Derech HaTeva

A Journal of Torah and Science

Volume 23
2018-2019

A Publication of Yeshiva University, Stern College For Women

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Printing Advanced Copy Center, Brooklyn, NY 11230

Acknowledgements

Appreciation is expressed to Dr. Babich for developing and overseeing the publication, *Derech HaTeva. A Journal of Torah and Science,* to be a literary vehicle for students of Stern College for Women to utilize their dual strengths – *Torah UMadda*. Dr. Babich infuses his students with a passion for the *Torah Umadda* approach. This journal is a conduit to accomplishing just that, as throughout the research process, students feel confident to build bridges between Torah and science. Thank you, Dr. Babich, for your continuous support of us and the student body as a whole.

The publication of Volume 23 of this journal was made possible thanks to the generosity of the following donors:

Dr. Harvey and Mrs. Marsha Babich

Rabbi Joel and Dr. Miriam Grossman

Dr. Fred and Dr. Sheri (Rosenfeld) Grunseid

Dr. Richard and Mrs. Helen Schwimmer

Rabbi Baruch and Mrs. Rosette Solnica

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Dedication

On Motzei Shabbos, October 17th 2018, our community was left bewildered as we learned about the horrific massacre in the Tree of Life Or L'Simcha congregation, Pittsburgh, PA. When eleven precious souls of our own were ruthlessly torn from our nation, in an unprecedented act of antisemitism in the United States, we can only find some sense of solace in turning to God.

At the time of formatting this journal, the American Jewish community was made aware of yet another horrific shooting, this time in the Congregation Chabad synagogue, Poway, CA. On the first day of Passover, a radicalized terrorist entered the synagogue, armed with an assault-style rifle, and killed the founding member of that synagogue and wounded the rabbi of the synagogue, Yisroel Goldstein, and two congregants.

Therefore, we have chosen to dedicate the 23rd volume of Derech Hateva to the Tree of Life Or L'Simcha congregation and to the Congregation Chabad synagogue. Deepest condolences go out to the families who lost loved ones and heartfelt prayers are offered for a refuah shelemah - a complete and speedy recovery - to those injured. We hope that in the merit of the Torah learned in preparation for this Journal, the community should find comfort, and the memories of the victims should be blessed.

אֵלֶּה בָרֶכֶב וְאֵלֶּה בַסּוּסִים
וַאֲנַחְנוּ בְּשֵׁם-ה׳ אֱלֹקֵינוּ
נַזְכִּיר

תהילים כ:ח

"Some trust in chariots, and some in horses; but we will make mention of the name of the LORD our God."

(Psalms 20:8).

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Reading the Fine Print: Forensic Evidence in Jewish Courts

By **Elana Apfelbaum**

In the late 20th century, a rapist turned murderer terrorized Southern California. People were scared to leave their homes in fear they might be his next victim. The criminal was smart in the way that he carried out his crimes, staying informed of any media coverage and the overall progression of his case. He seemingly flaunted his power over the petrified citizens, as if he believed he would always be able to evade accountability. The police even suspected that he was a member of the law enforcement, but years went by and the case remained unsolved. When DNA evidence first surfaced, the police were able to ascertain that this perpetrator was the same murderer that was loose in Northern California. And, yet, they were still not able to identify him and completely solve the case. Only recently, through genealogical data from a family tree that his distant relative initiated, were the police able to identify the murderer as Joseph James DeAngelo and he was put on trial. They traced his DNA through the family pedigree tree and matched it to the DNA left at the crime scenes years ago [1].

As this case demonstrated, scientific evidence, such as DNA identification, has revolutionized the entire judicial system. When incriminating forensic information is presented, police are more likely to clear cases, lawyers are less likely to enter into plea bargains, and sentences are more severe [2]. This evidence is especially helpful in cases where the possibility of solution is otherwise minimal, for instance, if suspects are not identified immediately following a crime. In fact, police generally spend a considerable amount of time tracking down eyewitness testimony, and their hard work does not always lead to helpful evidence. James K. Stewart, a previous director of the National Institute of Justice, wrote:

> Some cases… cannot be proven without forensic testimony. Others cannot be solved without it, and even those cases where a suspect is quickly arrested are more likely to be solved when eyewitness testimony or confessions are supported by forensic findings [2].

Forensic technologies can identify a body, determine a cause of death, identify a suspect, prove or disprove a rape allegation, and provide information about gunfire, such as the gun that the bullet was shot from and the position in which the gunman was standing [3]. Because 'physical evidence is preferred over human testimony' [4], there has been a shift towards physical evidence in order to alleviate errors caused by witness testimony. This movement was further emphasized by the establishment of the Institute for Forensic Evidence.

DNA evidence is a powerful form of identification because the likelihood that two people match the same sample is minimal. Scientists look specifically at thirteen or more loci on the DNA strands where the human code is known to be diverse. These areas contain short-tandem repeats of genetic information, with the number of repeats varying between people. Because each person receives one chromosome from each parent, he has two numbers of repeats for that chromosome pair [5]. The likelihood of the pair of numbers matching at all the sites to another person is slim, and, therefore, this technology can be relied upon to accurately identify and prove involvement in illicit activities.

Because of the reliability of forensic evidence, it was incorporated into the judicial system. The Innocence Project, led by Dr. Barry Scheck, an American lawyer, utilized DNA evidence to exonerate those that were wrongfully incarcerated based on faulty eyewitness testimony and misidentification. This determination to incorporate forensic evidence into a verdict highlights the fact that DNA evidence is a crucial piece of evidence that must be considered when determining one's guilt or innocence [6].

Accordingly, scientific evidence is accepted, and even preferred, in secular court, but is it permissible to be used in a *beit din,* a religious court?

The Torah formulated specific guidelines to define that which is considered to be incriminating testimony, stating that the testimony of two witnesses is established as fact in the eyes of Jewish law (*halacha*). This legal criterion is dependent on the *pasuk*, "*Al pi shenayim eidim yakum davar,*" based on the word of two witnesses would a judgment be made

(Deuteronomy 19:15). There are cases, however, where two reliable witnesses are not present. In such situations, is the court not allowed to act? This cannot be true, as the court's jurisdiction would thus be limited to a select number of cases. This would diminish its authority and ultimately leave solvable cases without any arbiter; justice would not be properly served. Therefore, the courts must be permitted, if not obligated, to examine not only circumstantial evidence or non-legal witnesses who are undoubtedly telling the truth, but also evidence available through scientific discoveries and modern technology [7]. In certain situations, leniencies may be made to incorporate non-legal testimony in efforts to maintain the power of the judicial system. Perhaps these strict definitions of that which the court considers valid testimony is only applicable in a case of capital punishment, whereas in other types of cases, a judge would be permitted to incorporate alternative forms of evidence.

The rabbis of the Talmud (*Kiddushin* 73a) describe a situation in which three women give birth at the same time in the same place. Each is part of a different class of the Jewish society - *kohen* (a priest), Levite, and *mamzer* (an illegitimate child) - the latter of which has significant *halachic* ramifications, making the identification of the children crucial**.** The only person that had the ability to discern between the infants was a non-Jewish midwife, who, according to the strict definition above, would not qualify as a legal witness. In this situation, the *beit din* ruled that she can be believed, and, therefore, function as a witness. The Ran framed this story as the rabbinic pursuit for truth. Because the midwife was the only source to determine the facts, the rabbinical court accepted her testimony. Additionally, the Rama believed that if there are no legal witnesses available, judges should turn to reliable witnesses, regardless of whether the technical qualifications were met. He acknowledged that while there are rabbis who agreed with him, there are others, such as the Rambam, who did not (*Darchei Moshe, Choshen Mishpat* 35). Nonetheless, according to the Rama's reasoning, forensic evidence can be considered an acceptable form of testimony as it serves the same function as a "reliable witness."

A similar situation arose in an Israeli hospital under auspices of Rabbi Shlomo Zalman Auerbach. Two babies were mixed and the staff was unable to determine which baby belonged to which couple. When deciding whether DNA testing should be used to identify the correct babies, Dr. Abraham, a doctor in the hospital, consulted Rav Auerbach who ruled that it was permissible (*Nishmat Avraham* E.H. 4:6).

Rav Auerbach, a strong proponent of DNA technology, said:

> If this [DNA] test is well-known and accepted throughout the world as reliable as a result of a numerous and unambiguous tests, it is reasonable to say that the results of this testing constitutes admissible evidence by *halachic* standards [8].

Despite the potential for the results of a DNA test to be disproved in the future, Rav Auerbach believed that the current acceptance of the accuracy of a scientific procedure was sufficient to elevate it to the status of permissible evidence in a *beit din*.

Rav Auerbach's position was supported by additional prominent rabbinic figures. Rav Shlomo Dichovsky, a prominent modern judge who sits on the Israeli Rabbinate's Rabbinic Court of Appeals, noted that both the Rambam (*Moreh Nevuchim* 3:14) and the Tashbetz (1:163-165), a rabbi and practicing doctor during the middle ages in Spain, wrote that the medical assertions in the Talmud were based off of medical knowledge of the time. Therefore, conventionally accepted modern scientific evidence could be a valid factor in the *halachic* decision-making process. The Rivash disagreed with this notion, arguing that all the medical assertions in the Talmud were divinely inspired (Rivash 447).

Rav Kook supported the notion of incorporating scientific evidence in *halachic* decisions, however, he did not believe that it can be applied so simply. Rav Yosef Karo in his *Shulchan Aruch* noted that if a doctor determined that his patient can survive without eating on Yom Kippur, but the patient disagreed, then the patient was permitted to eat on Yom Kippur. On the other hand, if a doctor determined that the patient must eat on Yom Kippur in order to survive, but the patient disagreed, then the patient was still permitted to eat on Yom Kippur (*Orech Chaim* 618:1). Rav Kook used these rulings to demonstrate that scientific evidence was only relied upon to a certain degree. The Shulchan Aruch considered the important possibility that the doctor was both correct and incorrect, respectively, and, therefore, the patient was permitted to eat in both cases [16].

More specific rulings of the permissibility of DNA evidence in *halacha* can be seen when analyzing certain

cases in which the use of this evidence would be helpful. The role of DNA evidence comes into play frequently in the discussion of *agunot*. An *agunah*, literally translated as a "chained" woman, is a *halachic* status thrust upon a woman who is, for some reason, stuck in her marriage. A woman remains in this status until her husband gives her a *get*, a Jewish divorce document. If she is not given a *get*, whether because he refuses to give it to her or has gone missing, an *agunah* is still legally considered married and is prohibited from remarrying. When a woman's husband goes missing, even if he is presumed to be dead, she is "chained" to her marriage until definitive proof of his death is given. Without this proof, any relationship she engages in would be considered adultery and children born from it would be *mamzeirim*. Similarly, a man is prohibited from being married to sisters at the same time. In order to allow a man to marry his deceased wife's sister definitive proof of her death is necessary [4].

In order to verify a person's death in a *beit din,* either identification of the body or testimony about the death must be given. While the *beit din* certainly tries to be lenient in these cases, it cannot be so lenient as to allow the possibility of error; the *halachic* consequences are too significant. Therefore, there are specific standards for body identification. Unusual birthmarks or features can legitimize an identification. The Rama even formulated guidelines for that which was considered a "specific distinguishing mark." He believed that a short or long physical feature would not be enough to identify a body, but a missing or extra feature was sufficient [7]. Prior to the popularization of photography, the memory of these marks would fall into the realm of subjectivity.

The Israeli Police Rabbinate created a three-part test to determine the validity of identification - fingerprint, odontology, and DNA. Even according to stringent opinions, such as that of Rabbi Wosner, a prominent *Haredi* rabbi from Bnei Brak, an *agunah* is permitted to remarry as long as the DNA found at the scene matches that of her missing husband and a probable reason for the man's presence there is provided. More lenient opinions in the United States suggest that the DNA fingerprinting alone is sufficient evidence, as long as the testing is conducted under the provisions set by the New York City Office of Medical Examiner [9].

When the United Airlines Boeing 747 aircraft hit the World Trade Center in 2001, tragedy befell New York City. Among many problems facing the Jewish community, were the *halachic* questions that immediately arose, such as when does one start the mourning practices of sitting *shiva* and saying *kaddish*? Another major question that surfaced was regarding the status of the wives whose husbands had reportedly perished in the towers but whose bodies were not found in the rubble. Rabbi Yona Reiss, the *av beit din,* head of the court, of the Beth Din of America at the time, worked tirelessly with the Chief Medical Examiner's office and the widows to find *halachically* legitimate proof. The Medical Examiner's office worked to identify remains and issue death certificates and Rabbi Reiss consulted medical experts and civil authorities to determine whether the proof was valid to free the widows from their status as *agunot*. They managed to free all of the women, with the help of DNA analysis. However, it is important to note that the team ensured that the DNA evidence was not the sole proof of the deaths and there were multiple other factors permitting the women to remarry [6]. Whether this was because they believed that DNA evidence cannot be the sole testimony in *beit din,* or because they wanted to satisfy even the stringent opinions, is not clear.

In *agunah* cases, the *halacha* is lenient in terms of whom it considered to be legitimate witnesses. A single witness, women, and non-Jews, whose testimony ordinarily would not qualify as *halachically* valid, were accepted in order to relieve the woman of this status [9], and, likewise, so is the use of DNA evidence [16]. Rav Moshe Schreiber in his work, the *Chatam Sofer*, tried to extend these leniencies. He wanted to make civil divorce documents an extension of a *get* based on the rabbis' ruling in the Mishna in *Gittin* (10a) where they claimed that documents signed in a secular court could be accepted as evidence in a Jewish court, because a non-Jewish court was careful to preserve its integrity (*Chatam Sofer, Even HaEzer* 43). However, because this ruling was mentioned in the context of these divorce cases, there is ambiguity as to whether the forensic evidence was acceptable only because of these leniencies. The question remains as to whether DNA evidence can be employed in other types of cases in Jewish courts as well.

Forensic evidence for the purpose of victim identification is useful, not only in avoiding potential *agunah* scenarios, but also in serving other *halachic* purposes. For instance, post death, immediate burial is *halachically* required, therefore, identification of the

parts and reconstruction of the body must be done as soon as possible. DNA fingerprinting is a fast and definitive method to be used. Completed within 24 hours using phosphoglucomutase (PGM) genetic markers and DNA typing, this evidence can help identify victims after crises [10].

Israel decided to put government organizations in place that could monitor or facilitate these identifications. At first the Israeli Defense Forces (IDF) handled terrorist attacks and civilian incidents, but the rabbinate retained the supreme authority. In 1986, when a school bus with children was hit by a train, the IDF handled the identification of the victims. But three years later, the identification was delegated to the Division of Identification and Forensic Science (DIFS) or the Israel Police. Therefore, when a bus was pushed off of the Tel Aviv -Jerusalem highway, the Israel Police handled the identification. With the Israel Police in charge, a three membered board was created, consisting of a policeman, rabbi, and jurist, to oversee the identifications. As a result, civil considerations were infused into a field that had a rabbinic dominance. The police were able to handle most identifications and only submitted the more "problematic" cases to the rabbinic authorities. Since the cases that were deemed "problematic" were defined by the police, they assumed a 'quasi-judicial/rabbinic' role by determining which cases were sent to court [4].

The use of scientific evidence could prove harmful in the case of revealing a *mamzer*. While maternity is crucial to one's Jewish identity, paternity also plays an important role. A child that was born out of one of the three major illicit relationships - adultery, homosexuality, bestiality- is considered to be a *mamzer*. A *mamzer* is only able to marry another *mamzer* and cannot participate in some communal religious acts. Therefore, establishing paternity could reveal this status and shun a person from the community.

When the Beth Din of America began to use DNA evidence as an important, albeit not the sole piece of evidence for freeing *agunot*, they opened up a "proverbial Pandora's Box" [16]. Once the court was allowing DNA evidence as proof of a man's death, then the use of DNA to determine paternity should also be permissible. Popularizing the paternity test, however, would then lead to the investigation of many *mamzeirut* cases, which could be catastrophic to Jewish communities world-wide. *Halacha* relies on even remote possibilities to prevent exposing *mamzeirut* [16]. As the rabbis say in *Kiddushin* (71a), *mamzeirut* exists only when one has the knowledge; there is no obligation to reveal this status.

The Jewish sages, or *Chazal*, allude to the fact that blood tests are not a definitive marker of paternity. Rav Ben-Zion Chai Uziel, a former Sephardi chief rabbi of Israel, is the first to discuss this rule. He referred to the Talmud (*Niddah* 30a), which stated that there are three partners in the creation of a person - G -d, a mother, and a father. The rabbis of the Talmud elucidated the parts that each partner contributed, attributing the red material (*i.e.*, the blood) to the mother and the white material to the father. Regardless of the modern belief that the composition of the blood cells is influenced by both the maternal and paternal genes, *Chazal* formulated this ruling from Divine belief, and, therefore, blood is not a determining factor of paternal identification [16]. This might not exclude modern genetic testing, as long as blood is not sampled. Rav Mendel Senderovic, a contemporary rabbi who serves on the Beis Din of Milwaukee, noted the fact that *Chazal* thought that the father contributes the bones and fingernails, and, therefore, argues that a DNA sample could be taken from either of these areas to accomplish this determination [16]. Perhaps, blood samples could be used for paternity testing, provided that the white blood cells are being tested. According to the rabbis of the Talmud, the red blood cells were inherited from the mother, but the white blood cells, because of their lack of this red pigment, were inherited from the father. Therefore, the DNA from white blood cells would be permissible for determining the biological father.

The Rashash explained a passage in the Talmud (*Bava Batra* 58a) in which the rabbis opposed a blood test that would determine the legitimacy of a child. He believed that the rabbis of the Talmud did not want to expose the *mamzer* status of a person. This belief seemingly implied that blood tests would be a permissible way to determine paternity, but the rabbis refrained from doing so in order not to reveal a *mamzer*.

R' Saadia Gaon also did not think that blood tests for paternal identification was problematic. He is known to have performed a blood paternity test (*Sefer Chasidim* 232). A story is recorded of a man who was travelling with his pregnant wife and slave. When the man died, the slave presented himself as the man's son and was given the inheritance. The wife gave birth

and when the son came of age he approached R' Saadia Gaon for guidance. R' Saadia Gaon dug up the father's body and removed one of the bones. He took blood samples from both the son and the slave and placed them on the bone. When only the son's blood absorbed into the bone, R' Saadia Gaon took that as an indication of genetic similarity [15]. While this case did not include the possibility of exposing a *mamzer,* it did point to the permissibility of genetic information to aid in the identification of true paternity.

Rav Bena'ah in the Talmud (*Bava Batra* 58a) had a similar case come before him. A man with ten sons was on his deathbed when he revealed that only one of his sons was truly his. In order to determine which was the true son, Rav Benaah asked each son to hit their father's grave. The only one who did not have the audacity to hit the father's grave was revealed as the true son. The Eliyahu Rabba, a known *Acharon*, asked why Rav Benaah did not utilize the blood test developed by R' Saadia Gaon (chapter 568). The Rashash posited that Rav Benaah did not want to reveal which of the sons were *mamzeirim*, rather he wanted to single out the one that was most respectful of their father. While this test singled out the legitimate son, it did not necessarily delegitimize the status of the other sons [16].

Rav Mordechai Willig, one of the *roshei hayeshiva* of Yeshiva University, when determining whether DNA evidence should not be used in *agunah* cases because of the risk of exposing a *mamzer*, quoted the general principle, "*ein dochin nefesh mipnei nefesh*," we do not sacrifice one soul in order to save another (*Kol Tzvi* 4:12). This clarified his view that DNA evidence can, and should, be used to help *agunot*. Therefore, Rabbi Willig attempted to make various distinctions between *agunot* and *mamzeirim* so as to allow DNA evidence for the former but not the latter. He first pointed out that in general, there is no significance attached to that which is not visible to the naked eye. This could refer to microscopic insects in food, the spacing between letters of the *Sefer Torah*, blemishes on an etrog, *etc*. Accordingly, the ability to rely on DNA evidence is called into question, because the DNA molecules cannot be seen by the naked eye [16]. Because the rules of testimony are more relaxed with *agunah* cases, the microscopic DNA evidence would potentially be permissible. This is not necessarily the case with a *mamzer*.

Rabbi Willig also suggested that DNA evidence would not be problematic in the case of establishing paternity. While the test would confirm that the husband was not the father, it does not necessarily prove that the child was a *mamzer*. The child could possibly have been conceived through artificial insemination, which would not invoke *mamzer* status according to R' Yosef Dov Soloveitchik (*Nefesh HaRav* p.255) and Rav Moshe Feinstein (*Igrot Moshe E.H.* 1:10), among others. While this distinction does solve the problem and limit the exposure of *mamzerim*, it cannot be applied to every case. This approach has not been used by other *poskim,* or decisors [16].

On the other hand, Rav Ovadia Yosef, the former chief Sephardic Rabbi of Israel, argued that DNA evidence is not an accepted means of proving paternal identity. The Rabbinic Court of Appeals in Israel rejectw the ruling of a district Beit Din on a case regarding paternal identity and Rav Ovadia Yosef suspected that it was because DNA testing would also be prohibited to reveal the identity of the father. The rabbis in the Talmud did not provide any precedent for resolving issues regarding paternal identity using DNA testing as it did for other theoretical possibilities, such as transportation on a "flying camel" (*Makkot* 5a).

Similarly, Rav Wosner and Rav Karelitz, both prominent rabbis in Bnei Brak, believe that DNA evidence can be used to avoid cases of *agunot*, however, it is not acceptable evidence in the case of *mamzeirut*. These rabbis centered their position on the fact that there is precedent to use the physical features of the missing husband, such as dental records or fingerprints, to identify a body, but no such precedent exists for comparing features of a body to the missing husband's sons [16]. Therefore, this position alleviated the potential problems with the slippery slope associated with DNA evidence by ruling that it was just not acceptable evidence for a case of a *mamzer,* but it would be for an *agunah*.

While the rabbis were careful not to unnecessarily expose a *mamzer,* a case of a *safek mamzer*, or uncertain *mamzer,* was worse than of an actual *mamzer*. A *safek mamzer* is prohibited from marrying both a kosher person and a *mamzer*. A question came before Rav Eliashiv, a *Haredi* rabbi and *posek*, about whether a DNA test should be used to settle the uncertainty of a father who is skeptical of his child's relationship to him years after birth. He ruled against it, believing that in a case where the father is not sure, we are lenient and call the child kosher and do not allow for

DNA testing [11].

In 1982, there was a case brought before Rav Shlomo Dichovsky, a member of the Ashdod district of the Israeli Rabbinate Beit Din, involving a husband's accusation of adultery against his wife and denial of his genetic paternal relationship to his kids. A DNA test verified that the father of one child was not this woman's husband, but the wife vehemently argued that she never had an extramarital affair. Rav Dichovsky ruled that the child did not have a status of a *mamzer* and yet the father had no obligation to pay for child support because there was some truth to his denial. Because the DNA test was only 99.6% accurate, it was not sufficient as evidence to give someone the status of a *mamzer*. While the other two judges on the case disagreed with the decision regarding the monetary support, they agreed with the inability for DNA evidence to prove *mamzeirut* [16]. Therefore, according to Rav Shlomo Dichovsky, the problem with DNA evidence was not its inability to serve as testimony in court, but rather the inherent possibility of error that accompanies it.

As with all modern technology, error remains a possibility. The use of DNA identification can produce false positives. Whether it is because two people touched the same object, or two pieces of evidence touched each other, there is a possibility of incorrectly matching a suspect to a scene [17]. While police realize that the new identification technology that utilizes evidence collected at the scene makes their finding solutions to criminal investigations infinitely easier, they are aware of the universally acknowledged flaws with the technology. Such flaws could prove problematic. In Israel, a system was put in place between the rabbis and police in terms of victim identification using scientific evidence in order to ensure that the evidence being submitted is credible. Although the police depend upon these scientific findings, it is often the case that they rule more stringently than the rabbis because they are aware of the mistakes that can be made [4].

There have been numerous cases, where despite the use of DNA evidence, the wrong suspect was incriminated. False positives or careless analysis can create uncertainty regarding the reliability of the evidence. For example, a segment of KHOU 11, a CBS affiliate, delved into a case regarding John Sutton, a man wrongfully incarcerated on charges of rape in 1999, and the process of proving his innocence. The technician performing the test determined that Sutton's DNA matched the sample taken from the victim when it was clear that they did not match. The error was in the way that she had separated the complex mixture and reported the match. Errors such as this are unlikely, but are not uncommon, and substantiate concerns regarding the way that DNA evidence should be used in determining a verdict [17]. Similarly, when a building collapsed in Tyre during the Lebanese War, the fingerprint analysis used to identify the victims showed three mistakes [4]. Therefore, DNA evidence could prove problematic, because unreliable testimony cannot be used in court.

Rav Waldenberg, a rabbi, *posek*, and judge in Jerusalem, is wary of the problematic nature of the inaccuracy associated with DNA evidence. He notes that many medical advances are believed to be accurate, until they are disproved in the future. Because of the possibility of error, he is not inclined to accept conclusions from these technologies as evidence in court (*Tzitz Eliezer* 13:104).

However, these inaccuracies are anomalies. Rav Mendel was skeptical of Rav Waldenberg's opposition to scientific evidence. DNA evidence is based on the assumption that every person's DNA is unique, which has been previously proven. Most of the suspicions of the inaccuracy of DNA testing were disproved by 2001 [16]. Techniques have improved and the monitoring of accuracies has increased. Similarly, Rabbi Jachter, a modern Orthodox rabbi and Jewish judge, believes that Rav Shlomo Dichovsky's reasoning for the inability to use DNA evidence in court, that the tests are only 99.6% accurate, is obsolete. The current chance of error is ten billion to one [16]. Rambam also believed that despite the inevitable error of scientific research, the findings should be followed even if they are contrary to rabbinic opinion [15].

Another potential problem with DNA evidence is the presence of a rare genetic condition, chimerism. Chimerism occurs in an organism that has more than one genome, meaning it was derived from fusion of two or more zygotes. The concern is that the DNA found at the crime scene may not match the DNA known for a specific suspect, but still could be a match to the suspect if he/she was a chimera. In 2003 there was a documented case of this - Lydia Fairchild. When she was pregnant with one of her children, a paternity test determined that she was not the biological mother of her child. While the

government accused her of fraud and suggested that she was a surrogate, samples were taken of her hair, skin and cervix to determine that she was, in fact, a chimera and was the mother of that newborn child [13].

Microchimerism, a specific form of chimerism, occurs when there is a transfer of blood between the mother and the fetus or between twins, occurs at a high frequency. Although there is doubt whether the DNA testing could pick up on these extra alleles, even if they did, they would be present in all DNA testing that would be done. Blood transfusions could also present with temporary chimerism. But there would be a unique mixture of blood that would be noticeable in any test and is enough to incriminate a suspect. A complete bone marrow transplant would change the blood cells to have a different DNA type than the rest of the cells in the body. While this is problematic, it is unlikely. Additionally, if the patient receiving the transplant did not undergo chemotherapy, then there would be a unique mixture of blood cells that could be detected [13]. These cases are problematic and fundamentally question whether DNA evidence can truly be accurate.

This condition poses the questions of whether police should be wary of chimeras when they perform DNA matches for crime scenes and whether criminals incriminated with DNA evidence should be given retrials. However, they are rare and, therefore, should not be a major concern when determining its validity in court [13].

It is interesting to note a recent discovery that the Y chromosome of the Jewish priests, or *kohanim*, contain a unique marker, showing that the *kahuna*, has a genetic basis [12]. However, this cannot be used in court as evidence because only seventy percent of *kohanim* have this common marker [7]. While this genetic fingerprint cannot prove that someone is not a *kohen*, it can verify that someone is. Interestingly, there is a small tribe in Africa, in which the men also carry this genetic marker on their Y chromosome [7]. Similarly, mitochondrial DNA can be a source of determining lineage. The mitochondrial DNA is inherited solely from the mother, as only the head of the sperm cell, which contains the acrosome and nucleus, enters into the egg during fertilization. Therefore, a deep analysis of one's saliva using modern technology can possibly confirm whether one is Jewish [14]. However, this has been challenged, as recent studies have noted paternal mitochondrial DNA can be inherited as well [18].

As we move into the 21st century, with cutting-edge technology at our fingertips, ethical ramifications must be taken into consideration. While DNA information has positive uses that could transform both the secular and halachic judicial system, this technology can be used negatively. For example, is the collection of DNA to put into a large database a breach of privacy? Is having a criminal DNA database problematic? In the case of Joseph James DeAngelo, did the police take their investigation too far by using the genealogy data?

However, should we refrain from using these technologies for fear that the negative consequences overshadow the positive ones? At what point, if any, do we outweigh the benefits with the possible detriments? Dr. David Wasserman, an attorney and director at Yeshiva University's Center for Ethics, said:

> There is nothing inherently ethical or unethical in DNA typing or most other technologies. They can be used for good or bad purposes, to good or bad effect. We must guard against the abuse of genetic technologies to infringe out privacy or to debase our understanding of human beings, but we must also promote the use of these technologies to server our values. The work of the Innocence Project and the Beth Din of America are striking examples of how DNA identification has been used to further our ideals [6].

As the innovation of our generation exponentially grows, we are only at the tip of the iceberg with the scientific discoveries. These advances can lead us into the future and give us unsurmountable potential, we just need to be wary of the ethical ramifications and stay rooted in the values of the Torah.

Acknowledgements

I would like to thank my parents for infusing me with a love of and dedication to Torah. I also want to express tremendous gratitude to Dr. Babich for his constant encouragement and support both in and out of the classroom.

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A Halachic Perspective of Conception after Death

By **Nicole Aranoff**

For a few decades, researchers and physicians have expressed the possibility of posthumous sperm retrieval and conception after death. The first successful sperm retrieval took place in 1980 on a thirty-year-old man killed in a motorcycle accident and whose wife still wished to conceive by him. The woman conceived and gave birth to a healthy baby. The success of the procedure triggered numerous additional requests for postmortem sperm retrieval, which involved the extraction of living sperm from a man declared brain dead within the twenty-four-hour time frame of his prognosis [1]. Conception after death, like most medical advancements, has brought forth many ethical and halachic issues that must be addressed.

The leading concern surrounding the ethics of postmortem conception is the concept of fatherhood without prior consent. This ethical concern is a factor raised in many lawsuits regarding this issue, and, as a result, several countries established laws to prevent this procedure. In countries without established laws against this procedure, such as the United States, decisions of whether to perform postmortem sperm retrieval and conception was left to the good judgment of individual physicians and hospitals [2]. One factor that remains consistent is that there must be *some* indication of the father's consent, whether it be implied through prior actions or in a written form for a doctor or hospital to proceed with sperm retrieval and insemination.

This topic of discussion is particularly relevant in Israel today. With the abundance of terrorism impacting the country they are faced with the death of its citizens far too often. An increase in the mortality rate due to war and terrorism, increases the desire for post-mortem sperm retrieval and insemination. A prime example of this was seen in 2004 following the death of IDF reserve soldier, Shaked Meiri. After being married for just three months, Meiri was called into the IDF reserves and killed in a military operation leaving his new wife as a lonely widow. Upon his death, his sperm was extracted and frozen with the consent of both his wife and his parents, leaving the door open for post-mortem conception. Shortly after his death, however, his wife met someone, remarried, and gave birth to her own children from her new marriage. She no longer wanted to procreate from Meiri. After hearing this, Meiri's parents requested access to his sperm so that it could be used to impregnate another woman. The Family Court in Israel approved their request. However, following this approval, his widow appealed the court's decision and the case was brought before the Israeli Supreme Court.

This raised another ethical concern: Who has the right to use this sperm for procreation? Is the sperm within the exclusive right of the decedent's spouse? Or do the decedent's parents have equal rights to the retrieved sperm? In the case of Meiri, the court reasoned that the right to procreate is inextricably bound to the decedent's spouse and therefore, the court denied the parents' request. The court reasoned that there is an existing right to post-mortem conception, but with limitations, such that the clear understanding that the spouse, and only the spouse, has the right to decide about implementation [3].

In addition to the ethical issues raised by post-mortem sperm retrieval and conception, there are clearly relevant halachic issues. The most crucial and pressing is the *halachic* prohibition of *nivvul ha-met,* or insulting the dignity of the deceased [4], coupled with the *hana'a min ha-emet,* deriving benefit from the deceased [5]. When analyzing the concern of *nivvul ha-met* the Torah explains that this prohibition is under the category damaging one's fellow man. Such conduct is strictly prohibited as part of Torah *She-B'al Peh*. The primary source for this prohibition is that of *lo tigzol*, one may not steal, which includes theft from the living and from the dead [6]. As a result, if post-mortem sperm retrieval does indeed encompass *nivvul ha-met,* there would be a clear and sound *halachic* basis to prohibit it.

Interestingly, Rav Moshe Feinstein raised a compelling counter argument. He explained that taking a biopsy from a deceased man was not considered *nivvul ha-met,* as it is a procedure regularly performed on the living and therefore, if done carefully and respectfully, also can be performed on the deceased [7]. Based on this opinion, *halachic* authorities assert that there is an acceptable rationale

that *nivul ha-met* alone, is not enough to prohibit post-mortem sperm retrieval. *Hana'a min ha-emet,* however, is another concern under scrutiny. There is a clear Torah prohibition which prohibited one from deriving benefit from the deceased. As a result, it is logical to reason that utilizing sperm of the deceased for the purpose of conception is *halachically* problematic. Fortunately, here too, there is a compelling counter argument. Rabbi Issar Yehuda Unterman proposed an explanation and stated that for a corneal eye transplant, the cornea sustains its life in the body of the beneficiary and is not considered "dead tissue" [8]. Armed with that fact, Rabbi Shlomo Zalman Auerbach explained that perhaps the same logic can and should be applied to sperm. In doing so, the *halachic* issue of *Hana'a min ha-emet* can be eliminated because sperm, like the cornea, also can sustain its viability in the beneficiary [9].

In the event that *halachic* authorities determine these concerns to be non-issues, two *halachic* questions then follow: First, is this child, the product of post-mortem conception, entitled to his father's inheritance; and second has the decedent successfully fulfilled his *mitzvah* of *peru u-revu*? When analyzing the first question, the widely held *halachic* consensus is that a "paternal-filial" relationship existed and therefore, this child would clearly have the rights to inherit from his father [10]. The second question is more difficult. There is a clear debate among *halachic* authorities regarding this topic. Indeed, among the questions to consider is whether or not the essence of the *mitzvah* is the act itself, the *ma'aseh,* or the end result, the producing of progeny.

The *Taz* believed that the essence of the *mitzvah* lies within the action. Accordingly, one who is deceased cannot fulfill this *mitzvah* [11]. The *Beit Shmuel* [12] and the *Minhat Chinnukh* believed that the *mitzvah* was within the realm of having children. As a result, the deceased man would have fulfilled his *mitzvah* of *peru u-revu* [13]. With these *halachic* opinions on the table, if conception actually fell under the category of *peru u-revu,* and thereby enabled this the deceased childless man to fulfill the *mitzvah* of procreation, then the prohibitions regarding *Nivvul ha-met* and *Hana'a min ha-emet* would no longer apply [14].

Both these *halachic* issues, however, ultimately encompass the overarching ethical issue of creating a child without the father's consent. *Nivvul ha-met* is clearly implicated, as the man undergoes an invasive procedure and sperm is removed without his consent. Similarly, *Hana'a min ha-emet,* is implicated, as the retrieved sperm is used to benefit his surviving loved ones.

The default *halachic* consensus is to err on the side of permissibility as there is no concrete reason to prohibit sperm retrieval. However, *halachic* authorities carefully take into consideration the need for the consent from the deceased and, therefore, all rabbinic opinions firmly ruled against posthumous sperm retrieval where consent cannot be established. In the event that there is *clear* consent, then there is room to permit sperm retrieval. However, due to the markedly complex nature of this *halachic* question, one is urged to seek out the advice of a *halachic posek* [15].

Acknowledgments

I would like to thank my parents for their love and constant unconditional support in all of my ambitions and future endeavors. I would also like to give a special thank you to Dr. Babich for being such an incredible teacher and extremely resourceful in guiding me through this article.

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Editing Humanity: The Halachos of Germ-Line Engineering

By **Esther Butler**

Discussions of medical ethics precede the implementation of advances in genetic engineering. Genetic mutations occur in various ways, such as when a segment of DNA is repeated or deleted or one of the four nitrogenous base pairs is incorrectly matched. Scientific research is rapidly advancing in the area of gene-editing technology to repair deadly genetic defects and enable parents to select specific genes for their designer babies. Germ line therapy alters an embryo's DNA and affects the genetic code in all of the embryo's future descendants. Scientists have not yet refined the technique to safely alter the DNA of an embryo; however, Rabbanim already began discussing theoretical ethical issues that may arise by exploring the *halachos* (Jewish laws) pertaining to permissible, obligatory, and forbidden procedures.

Before delving into the *halachik* ramifications, it is important to have a preliminary understanding of the technology under discussion. There are assorted methods to genetically engineer an embryo's DNA. One method is based upon a bacterial defense system to destroy invasive viral DNA. This mechanism contains Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) which are identical segments of DNA separated by spacers. The spacers contain the history of previous viruses that have attacked this bacterium or one of its ancestors. If the same virus enters the bacterium or one of its descendents, then a CRISPR Associated (Cas) protein cleaves and inactivates the viral DNA. Researchers adapted this mechanism to gene-edit any organism's DNA. A common method uses the CRISPR system and the Cas9 protein. This mechanism contains guiding RNA (gRNA) which locates the specific target site on the DNA. Once the gRNA is in-line with the target site, the Cas9 protein unwinds and cleaves the double helix. At this point the scientist can alter the DNA by inserting or removing a gene or by repairing a mutation. However, the gRNA can mistakenly locate a different gene on the DNA, and as a result, a vital segment of DNA can be removed from or altered in the genome. Due to ethical concerns, the United States does not currently fund germ-line engineering [1].

This past November, He Jiankui, a Chinese researcher, claimed to have utilized CRISPR technology to edit the DNA of twin embryos. His goal was to lessen the possibility of these babies developing HIV later in life [2]. Currently, Dieter Egli, a developmental biologist at Columbia University, is researching the effects of CRISPR technology on embryos. Egli assures that the genetically modified embryos are only for research purposes and will not be implanted to develop into a baby [3].

Additionally, it is necessary to understand how *halacha* uses the following principles to determine one's obligations in medical care. There is a biblical commandment to heal one's body, "and he shall heal" (*Shemos*, 21:19). Rabbi Dr. Tatz, in his book, *Dangerous Disease*, discusses medical *halachos* and ethics. He explains that within *halacha* there are three categories that determine one's autonomy in medical care. The first category consists of medical situations that afford the patient the decision to undergo or refuse treatments. The second category includes conditions for which the patient is obligated by *halacha* to undergo treatment or therapy; however, if the illness is not life-threatening, a fellow Jew cannot force the patient to undergo the treatment or therapy. The final category consists of life-threatening emergencies where, despite a patient's refusal, one is required to perform the operation or administer the treatment. Rabbi Dr. Tatz showed how *halacha* considers the potential risk factors connected to any medical intervention; these are general guidelines based upon the principle that Judaism "sees life itself as the primary value" [4].

Dr. Loike and Rabbi Dr. Tendler discuss the life status of an embryo within the first forty days after conception. Some opinions in *halacha* hold that immediately upon conception the embryo has the status of a living human, while others hold that it is not considered a living being until it has developed in the womb for forty days. The results of the divergent opinions affect multiple rulings connected to the obligation of saving a life [5]. Whether an embryo has the full status of a living human or whether it is on a relatively lower level, the ethical discussion maintains its significance regarding the value of human life. Rabbinic leaders weigh a myriad of factors before

determining if a given act is permissible, obligatory, or forbidden. Dr. Loike and Rabbi Dr. Tendler assert, "Aside from as-yet undefined side effects, gene-editing procedures do not involve any prohibited acts" [6]. This ruling will be analyzed in the context of germ-line engineering.

Judaism emphasizes the importance of saving a life, even that of an embryo. Dr. Loike and Rabbi Dr. Tendler, citing the biblical commandment "to love your neighbor as yourself" (*Leviticus* 19:18), extend this to include parents' obligation to provide medical care for their children. Therefore, according to this approach, religiously observant Jewish parents can utilize gene-editing technology on an embryo to prevent a severe illness lacking an alternate cure. Dr. Loike and Rabbi Dr. Tendler broaden this ruling to include late-onset diseases, because Judaism follows the principle that a healthy person would take action to avert the illness. For instance, an embryo identified to develop Huntington's disease can be gene-edited even though the illness may not manifest for another forty years. However, *halacha* forbids gene-editing an embryo for non-medical purposes. Therefore, *halacha* prohibits creating designer babies [6].

The actual price to edit an embryo has not yet been established, but medical ethicists have already discussed the issue presuming it is an expensive procedure. *Halacha* requires individuals to expend all their money to save their own life, as well as the life of their spouse and children. There is a *halachik* dispute if individuals are required to spend all their money or up to 20 percent of their wealth to save another's life [4]. These rulings show that even one life is worth more than all of their possessions. Rabbi Taub, author of book, *The Laws of Tzedakah and Maaser,* explains that *halacha* recognizes that there are many people who need financial assistance, so there is a biblical commandment to give charity, *tzedakah*. The minimal *halachic* requirement, even for those who receive charity donations, is to give approximately two dollars and 50 cents to charity each year. However, one is generally expected to donate at least ten percent of his/her annual income to *tzedakah*. Charities that conform to *halacha* and focus on paying medical expenses will likely include financial assistance for germ-line engineering that is performed according to the *halachik* parameters. In addition to the obligation to give charity, *halacha* delineates a hierarchy to which organizations one should prioritize his/her donations. The top three categories are charities connected to saving lives, Torah study, and paying a poor person's medical needs [7].

Halacha prohibits editing the genome of an embryo that may produce an uncertain outcome; however, it is permissible to edit the genome for single gene mutations. Individual genes code for the synthesis of one or more proteins. Approximately 6,000 diseases may be controlled by a single gene. For example, a single mutation in DNA can result in Tay-Sachs disease. This fatal disease can be prevented by replacing the mutation with the correct nucleotide base. However, many genetic diseases, intelligence, and behavioral characteristics are controlled by the interaction of multiple genes. Current scientific knowledge cannot confidently predict the result of altering single genes that control several outcomes or behavioral characteristics and complex diseases which are determined by the interaction of multiple genes. Therefore, *halacha* does not allow editing a gene that will have multiple effects or altering a gene of a polygenic disease. *Halacha* considers potential risks connected to the procedure, such as the possibility to mistakenly alter the wrong segment of DNA or to activate a cancer-causing gene [6].

Another ethical question is in the arena of researchers altering DNA and "playing G-d." While some oppose genetic engineering because it negates the natural predetermination chosen by G-d, *halacha* recognizes that people are G-d's partners in creation. A story in the *Midrash Tanchuma* (*Tazriah* 19) relats that people are allowed to change nature. Rabbi Akiva explained to the Roman general, Turnus Rufus, that the permission of humans to grind wheat into flour to bake bread shows that people are meant to improve upon the natural world. Using this story, Dr. Loike and Rabbi Dr. Tendler conclude that there are occasions when one is allowed to alter the human genome to save a life. However, as discussed previously, one does not have exclusive permission to alter the genome for physical traits. Therefore, for medical purposes it is permissible to alter an embryo's DNA, without worrying that this medical procedure is outside of humankind's domain and "playing G-d" [6].

A final consideration is the ethical concern of human experimentation. *Halacha* outlines specific parameters that determine if one is allowed to partake in clinical trials. Two of the many requirements are whether the procedure has a low risk of causing harm to the

patient and whether there needs to be evidence that the treatment will yield the desired outcome [4]. Carriers of embryos with life-threatening diseases are encouraged to volunteer for these initial clinical trials. However, based upon the outlined parameters, one should only partake in studies in a licensed clinic [6].

As genetic engineering technology advances, the possibility to eradicate diseases may become a reality. CRISPR technology demonstrates the wisdom *Hashem* has granted to scientists to prevent fatal diseases. *Rabbanim* review and determine when it is permissible to utilize this wondrous technology. It is incumbent upon individuals to consider the *halachos* and ethical implications of any technology before it is incorporated into standard medical care.

Acknowledgements

I would like to express appreciation to my parents for encouraging my continued education in *Torah* and secular studies, Dr. Babich for research assistance, and Professor Miller for reviewing the development of these ideas.

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Should We Care? A Halachic Overview on Environmental Stewardship

By **Deborah Coopersmith**

Ralph Waldo Emerson, an American essayist, lecturer, philosopher, and poet, once said, "We do not inherit the Earth from our ancestors, we borrow it from our children" [1]. Today, that 'borrowed' world is faced with a multitude of ecological problems. There are ongoing crises of natural resource depletion such as air, soil and water pollution, as well as a loss of biodiversity and ocean acidification. According to the Intergovernmental Panel on Climate Change, sea levels will rise by at least two feet by 2100 because of global warming. This will lead to large expanses of Florida and other coastal areas becoming submerged under water by the end of the century [2]. The World Wide Fund for Nature reports that the rapid decline of biodiversity is between 1,000 and 10,000 times higher than the natural extinction rate [3]. The World Health Organization, an UN institution, study found that ninety percent of children breathe in toxic air [4]. This matter should be of concern because the world is being destroyed. The future of Earth is jeopardized by living recklessly. The great innovations of today save so much time, but people's health and futures pay for them. For example, being around technology around the clock leads to lead, mercury and arsenic exposure. These toxic chemicals can seep into the ground and enter the water supply or escape into the atmosphere, which affects the health of everyone nearby.

Humans should care about this issue, but should Jews from a halachic perspective? Is there a halachic commitment to ensure a world for the next generation?

The Torah, on multiple occasions, commanded Jews to protect the quality of their environment. When *Bene Yisrael* were building the *Mishkan,* a house for G-d, Moshe specifies that it must be built out of acacia-wood—a non-fruit bearing tree. In Shemot Rabbah, Chazal questioned why it had to be acacia-wood. They propose that "G-d taught us a lesson for subsequent generations, that if a man seeks to build his home of lumber from a fruit tree, say to him, if the King of Kings, the Lord blessed be He, who owns everything, when he commanded that His tabernacle be built He commanded that it be built from a non-fruit tree, you should certainly do the same!" Hashem and the Chachamim understood the importance of preserving the environment and conserving resources. In a similar vein, In Kohelet Rabbah it states, "when the Lord created Adam He showed him all the trees of the Garden of Eden and said to him, 'Pay attention to my creations -– see how beautiful and praiseworthy they are. All that I have created I have created for you. Take heed that you do not damage or destroy my world, for if you damage it there is no one who will repair the damage after you.'" There is a high degree of sensitivity towards conservation and waste that is present throughout Chazal's understanding of Torah.

The Torah also teaches the importance of not wasting natural resources. The *misvah* of *bal tashchit* is a perfect example of a prohibition against the misuse of resources. In Deuteronomy (20:19-20), God emphatically declares, "When you besiege a city for many days to wage war against it to capture it, you shall not destroy its trees by wielding an ax against them, for you may eat from them, but you shall not cut them down. Is the tree of the field a man, to go into the siege before you? However, a tree you know is not a food tree, you may destroy and cut down, etc." Despite the circumstances, it is forbidden to destroy fruit trees during wartime. Chazal take the prohibition a step further through the usage of a *kal ve'chomer* and understand that if a Jew is forbidden to cut down fruit trees in such an extreme situation, it can be presumed to apply readily to daily life. According to the Gemara, *bal tashchit* also includes the prohibition to waste burning oil or fuel [5]. Rabbi Yishmael, an *Amora*, infers that if the Torah warned against destroying fruit trees, then all must also be careful to not destroy the fruit itself [6].

Throughout the ages, many Rabbis maintained that being wasteful with any resources that benefit humans is a Torah prohibition. Rambam expounds on *bal tashchit* and writes that one is forbidden to "smash household goods, rip clothing, demolish a building, dam a spring, or destroy food." In regards to trees, Rambam writes:

> It is forbidden to cut down fruit trees outside the

> city and it is forbidden to dam their irrigation trenches in order that they wither, as it is written "thou shalt not destroy the tree"; anyone who so does is subject to lashes. This does not only refer to a siege; instead, anyone who cuts down a fruit tree in a wasteful manner is subject to lashes. However, the tree may be felled if it is damaging another tree, if it is damaging a field or if its financial value is great; the Torah only prohibited (felling in) a wasteful manner [7].

Rambam is very clear that any wanton destruction of resources is off limits and anyone who does this will be punished severely. He believes it's *asur me de'orayta*, a prohibition from the Torah and thus, is an infringement punishable by lashes. Rabbi Samson Raphael Hirsch interprets *bal tashchit* to be "the most comprehensive warning to human beings not to misuse the position which God has given them as masters of the world and its matter through capricious, passionate, or merely thoughtless wasteful destruction of anything on earth." He writes more of this in his book Horeb:

> Only if you use the things around you for wise human purposes, sanctified by the word of My teaching, only then are you a mensch and have the right over them which I have given you as a human . . . However, if you destroy, if you ruin, at that moment you are not a human . . . and have no right to the things around you. . . As soon as you use them unwisely, be it the greatest or the smallest, you commit treachery against My world . . . In truth, there is no one nearer to idolatry than one who can disregard the fact that all things are the creatures and property of G-d, and who then presumes to have the right, because he has the might, to destroy them according to a presumptuous act of will.

He explicitly states that one who is careless and takes advantage of what is around him is almost like he is committing *avodah zara,* idol worship. By comparing wastefulness to a cardinal sin, Rabbi Samson Raphael Hirsch is demonstrating the importance of conserving and being mindful of the effect of our actions.

There is also a *misvah* to take care of one's body—*venishmartem me'od lenafshotechem* [8]. In the Sefer Hachinuch it states that one may not cause danger to himself because Hashem gave him the nefesh which resides within his body. In efforts to protect one's nefesh, one is obligated to protect his or her body. Rabbi Moshe Aaron Poleyeff argues that overeating is a double transgression, as it violates both *bal tashchit* and *venishmartem me'od lenafshotechem,* through wasting food and causing harm to one's body. Rambam states, "keeping the body healthy and whole is part of the ways of Hashem, as one cannot understand the Will of Hashem if one is sick. Therefore, one must be careful to distance himself from things that ruin the body… and not do anything that cause harm to it [9]." Thus, one must be careful about spending too much time in ozone depleted areas, smoking, and breathing in toxic air. Nowadays, it is hard to avoid these situations because they are so prevalent in the world. There has been a tremendous loss of resources due to carelessness and that is causing Jews to be breaking, albeit not purposely, the commandment.

Most Rabbis and Talmudic scholars take a strong stance of preserving resources and protecting the environment. The author of the Sefer HaChinuch declared that *Tsadikim* "do not allow the loss of even a grain of mustard, being distressed at the sight of any loss or destruction. If they can help it, they prevent any destruction with all the means at their disposal."

Rabbi Moshe Yitzhak Forehand announced that all rabbinic authorities agree that it is forbidden from the Torah to destroy edible fruit [10].

Today we are living in age where there is a vast amount of waste. Food is thrown away to a despicable degree. According to a 2014 EPA study, the United States throws out more than thirty-eight million tons of food every year. Thirty-eight million tons is equivalent to 104 Empire State Buildings. When the food decomposes it produces methane, a greenhouse gas that is detrimental to the atmosphere. However, it is not just the food that is wasted. Water, land, nutrients and fossil fuels were all used to produce the food. A six-ounce steak requires 674 gallons of water and a salad costs twenty-one gallons [11]. By wasting food, we misuse an unconscionable amount of resources and squander time and money that could be directed towards more important objectives.

People have a responsibility to the environment. They must conserve it because it is not theirs to keep, but rather, to give to their children. We must prevent the misuse and overuse of natural resources, and

decimation of biodiversity. The *misvot of bal tashchit* and *venishmartem me'od lenafshotechem* clearly define our stance on protecting the environment. It is a human and Jewish duty to come up with solutions to ecological problems that are plaguing the world.

Acknowledgements

I would like to express a massive thank you to my high school environmental science teacher, Ms. Claudette Mikhli for introducing me to the beauty of the study of environmental science. Her constant enthusiasm and support for the subject is the reason why I am pursuing a career in environmental law. I would also like to thank my parents for their constant love and support for all my endeavours. Also, a big thank you to Dr. Babich for encouraging me to write an article for Derech Hateva.

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Bris and Hemophilia

By **Meira David**

With the medical advancements available at this point in time, fatal diseases are now almost completely eradicated. These medical innovations have contributed greatly to society, however, there are times at which these incredibly helpful tools may be at odds with our traditions. We must therefore take a deeper look into these practices to determine if such medical techniques are allowed to be used. A major situation in which this concern is raised is at the *bris* of a hemophiliac boy. In *Yevamot* (64b), a scenario is discussed in which a woman gives birth to a son that was circumcised after birth and died shortly thereafter. Subsequently, she had another son who died shortly after his circumcision as well. The Talmud cites Rabbi Yehudah *HaNasi,* who explains that she would not be required to circumcise a future third son, because of the ruling of *chazakah*. The assumption here is if all three sons have died from circumcision, any more sons she may have would die as well. Therefore, her future sons do not need a circumcision. Rabban Shimon ben Gamliel, however, disagrees and states that if the third future son will also die from circumcision, it would then be the fourth son who will not require a *bris*. Commentators add that this ruling specifically refers to three sons born to the same mother, regardless of the paternity. The Talmud continues with a similar story involving four sisters. Three of the sisters have sons, circumcise them, and the sons die shortly after. The fourth sister is then not permitted to circumcise her sons [1

Today, death of infants at their circumcisions, as noted in the Talmud, are associated with hemophilia, also known as "bleeder's disease." Hemophilia is due to mutations in the genes that encode for the proteins necessary for blood coagulation. The genes are X-linked and recessive and are therefore transmitted from mother to son, regardless if the father has this disease or not. This X-linked trait would explain the aforementioned irrelevance of the paternity in the determination of whether a bris would be necessary. The gene mutation originally arose through a *de novo* mutation, a mutation that spontaneously occurs in the germ cell of a parent that is heritable. This mutation altered the nitrogenous bases of the genes responsible for normal blood clotting [2].

There are numerous halachic questions that arise regarding hemophilia and the requirement for a *bris*. The *mitzvah* of *bris* is not one of the *mitzvot* that falls under the category of *yehareg val yaavor*, a law which requires one to die rather than violate a religious prohibition. Since this is not in the aforementioned category, the *halacha* rules that a hemophiliac baby should not have a *bris*. However, there is a future problem that results from the child not being circumcised. Through no fault of his own, this child is now considered an *"arel",* someone without a *bris,* and this title limits him from entering the *Beit Hamikdash* and eating from the *Karban Pesach*. Thus, it is a *g'nai,* or a disgrace, for someone to be an *arel,* and this category automatically extends to a hemophiliac baby. Rashi states that it was a *g'nai* for *Bnei Yisroel* that they did not give a *bris* to each child born throughout the forty years in the desert, even though they were exempt from this *mitzvah* because of their dangerous environment. Rashi feels so strongly about the importance of a *bris* that he labels it a *g'nai* when *Bnei Yisroel* refrained from doing it, even though they were exempt from this *mitzvah* at that time.

Clearly, circumcision is a very important *mitzvah* and the rabbinic authorities try to find a loophole that would allow hemophiliac babies to fulfill this mitzvah. Therefore, is it permissible to perform a circumcision in a nontraditional way in order to lessen the bleeding of the hemophilic baby? For example, would a hemophiliac be able to have laser surgery for the circumcision, thereby lessening the less risk, removing the label of an "*arel*," and removing the *g'nai* status? Many consider the blood, specifically, of the *bris* to be an essential component of the *mitzvah* and therefore an attempt at circumcision without the bleeding would not constitute an acceptable *bris*. Furthermore, Rav Waldenberg states that no other circumcision tools except from the traditional tools are allowed, as the instruments are a part of the *mitzvah* itself too [3]. Rav Moshe Feinstein agrees with Rav Waldenberg and states that no other tool aside from the traditional knife may be used. There are those that are lenient for a hemophiliac who cannot undergo the normal procedure. However, it is important to note that most *poskim* hold that we do not change our *minhagim*; this idea is showcased through the controversy associated with this issue [3].

Rabbi Dr. Richard Weiss poses a different question related to this same issue. He asks, "the question is

Clearly, circumcision is a very important *mitzvah* and the rabbinic authorities try to find a loophole that would allow hemophiliac babies to fulfill this mitzvah. Therefore, is it permissible to perform a circumcision in a nontraditional way in order to lessen the bleeding of the hemophilic baby? For example, would a hemophiliac be able to have laser surgery for the circumcision, thereby lessening the less risk, removing the label of an "*arel*," and removing the *g'nai* status? Many consider the blood, specifically, of the *bris* to be an essential component of the *mitzvah* and therefore an attempt at circumcision without the bleeding would not constitute an acceptable *bris*. Furthermore, Rav Waldenberg states that no other circumcision tools except from the traditional tools are allowed, as the instruments are a part of the *mitzvah* itself too [3]. Rav Moshe Feinstein agrees with Rav Waldenberg and states that no other tool aside from the traditional knife may be used. There are those that are lenient for a hemophiliac who cannot undergo the normal procedure. However, it is important to note that most *poskim* hold that we do not change our *minhagim*; this idea is showcased through the controversy associated with this issue [3].

Rabbi Dr. Richard Weiss poses a different question related to this same issue. He asks, "the question is whether a man who has hemophilia can properly convert due to the medical contraindication to circumcision." [4]. There are only two requirements for male converts to become a Jew: immersion and circumcision. Because of the dangerous nature of circumcising a person with hemophilia, Dr. Weiss questions regarding hemophilia converts, whether immersion alone can be enough to consider someone an acceptable convert? The Talmud (*Yevamot* 46a,b), notes that there must be both circumcision and immersion for an acceptable conversion by a hemophiliac non-Jew. There is, of course, the overall ruling that a hemophiliac child need not undergo a *bris* for it is life endangering. However, Rabbi Weinberg notes that this male wishing to convert is not yet Jewish and therefore the rules of exemption from a *mitzvah* are not applicable to him just yet. Rabbi Weinberg explains, "His requirement of circumcision is not simply a fulfillment of a *mitzvah* obligation, but a necessary procedure and prerequisite in a process leading to conversion" [4]. Therefore, the conclusion is that it is necessary for a male wanting to convert to undergo a *bris*. This necessity of *bris* is aided by today's medical advancements and the availability of protein clotting factors that can be administered to the hemophiliac prior to the circumcision in order to normalize bleeding [4]. These protein clotting factors are administered to the patient in order to increase the natural clotting factor in their blood which stops them from bleeding too much.

Rav Moshe Feinstein states that because in contemporary times the diagnosis of hemophilia is quickly determined, the instruments aiding a hemophiliac *bris* should be used if there is a history of the disease in the family [1]. If the measured levels of blood clotting factors are normal, then the infant is required to undergo a normal *bris* at the correct time, *i.e.* at eight days after birth. In order to get to this point, Rav Moshe supports the use of clotting factors for a child with hemophilia. He writes that use of these clotting factors can bring the child to a normal clotting factor level, thereby allowing for a *bris* at the proper time [1]. Rabbi Shlomo Zalman Auerbach also rules that if the missing clotting protein can be injected before and after the *bris*, then the infant should be circumcised. He adds that the clotting factors

can be administered intravenously even on *Shabbat* if that is the eighth day after birth, as long as the tubes are inserted before *Shabbat* or are put in by a non-Jew [1].

Despite the dangers associated with performing a hemophiliac bris, the major Rabbis of our time including Rav Moshe Feinstein and Rav Shlomo Zalman Auerbach, have concluded that if there is a way to temporarily control hemophilia for the *bris,* then those procedures should be utilized and the child should be circumcised [5].

Acknowledgements

I would like to thank my parents for supporting me in all of my endeavors and for allowing me to further my education in Stern College for Women. I would also like to express my appreciation to Dr. Babich for the opportunity to be published in Derech HaTeva.

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Mundane or Magical: Apples in the Torah and Medicine

By **Nechama Dembitzer**

From the beginning of time, the apple has been shrouded in mystery. Shortly after creation, Adam and Eve ate the "forbidden fruit" and were expelled from the Garden of Eden (Genesis 3:6-24). There is a dispute among both Jewish and Christian scholars regarding the identity of the "forbidden fruit." The Talmud (Brachot 40a) suggests that the "forbidden fruit" was either a grape, a fig or wheat. Additionally, the Midrash (Bereishit 15:6) suggests that the fruit was an etrog, a citron. However, a survey of Medieval art reveals that by the 12th century, Christian opinion defined the "forbidden fruit" as the apple. Later religious authorities have tried to explain this puzzling and sudden appearance of the apple as the "forbidden fruit" in Christianity. According to Rav J.B. Soloveitchik, the apple was chosen due to a mistake in Hebrew translation [1]. Based on the opinion that the "forbidden fruit" was an etrog, which is known as a "golden apple" in Hebrew, the word "golden" was lost in translation and only "apple" was left. Another explanation for the apple's portrayal as the forbidden fruit is based upon a hazy linguistic relationship; in Latin, an apple is called "malum," which is the word both for fruit and for evil [2].

However, before the apple attained its significance in the religious world, it was already popularized and domesticated in Europe many years earlier. Originating in the mountains of Kazakhstan, the apple was discovered by the Romans along the Silk Road and then brought to Europe [3]. The apple is scientifically classified as the *Malus pumilla mill* or *apple domestica* and is one of the most produced crops worldwide. In the United States alone, 10.4 trillion pounds of apples were produced in 2017 [4]. In addition to their importance as both the "forbidden fruit" and a domesticated crop, apples play a significant role in the Jewish religion. Apples are symbolic of the Jewish nation with abundant references throughout Jewish literature and law, which reveal the apple's medicinal properties and positive impact on lifelong health.

The apple is an important symbol in Jewish literature and law. In both Tanach (Shir HaShirim 2:3) and the Talmud (Shabbos 88a), the Jewish nation is compared to an apple tree. Apples are also relevant to the service in the Temple. The Talmud (Menachot 54a) states explicitly that one cannot use apple juices to leaven the sacrificial breads. However, the Talmud (Menachot 63a) indicates that there were apples in the Temple since there was a certain jug used to create sacrificial offerings in the shapes of apples. Apples are also mentioned in Jewish law regarding the prohibitions of the Sabbath. The Talmud (Eruvin 104a) states that the common practice of women playing with apples is forbidden on the Sabbath. Furthermore, apples are an important focus when discussing the rules of *kilayim*, grafting trees and creating hybrid fruits, in Jewish law. The Mishna (Kilayim 1:4) discusses the prohibition of grafting fruits of different species and specifies that, although domesticated apples are similar to crabapples, grafting them is still prohibited since they constitute different species. This statement by the Talmud is scientifically proven since the majority of the DNA of the domesticated apple arises from crabapple precursors [5]. Nevertheless, in accordance with Talmudic opinion, despite their shared DNA, the domesticated apple and the crabapple are classified in the same genus, *Malus,* but as different species.

Apples are not only a topic within Jewish law, but are also used to define Jewish law itself. The Talmud (Soferim 16:4) equates the pleasantness of learning Jewish law to enjoying the sweet aroma of apples. Research has shown that not only is an apple's aroma pleasant when smelled, but it is also a vital aspect of an apple's taste [6]. In fact, over 300 compounds have been identified as key contributors to the apple aroma and their relative distributions are characteristic of points in the ripening process. Additionally, while an apple's aroma is pleasant for the senses, it can also be beneficial for the mental health of its inhaler. Research has shown that inhaling the scent of green apples significantly relieves migraines and anxiety [7]. The apple appears frequently throughout Jewish works as both a subject and an allegory of Jewish law and an important emblem of the Jewish nation.

Beyond its role in Jewish legal code, the apple is also distinct in the birth of the Jewish nation. The Talmud (Sotah 11b) explains that during the Jewish nation's formative years in Egypt, the Jewish women gave

birth under apple trees in the fields. When analyzed more deeply, this seemingly trivial historical fact alludes to the health benefits of apples for a child's development both in the womb and beyond. Research has shown that maternal intake of apples during pregnancy significantly reduced the risks for asthma, eczema and allergies in subsequent offspring [8]. Interestingly, while these benefits have been attributed to the apple's contents of vitamin E, vitamin D and zinc, other fruits and vegetables that also contain these substances did not yield similar health gains.

In addition to the benefits of maternal intake during pregnancy, apple consumption can be beneficial for young children throughout their childhood. A study on fruit consumption in 8-year-old children found an inverse relationship between apple intake and the frequency of rhinitis, asthma and other allergic diseases [9]. Another study showed that the increased intake of apple-containing products led to lower risks of childhood obesity [10]. As the well-known adage states, "An Apple a Day Keeps the Doctor Away." Therefore, the role of the apple tree in the development of the Jewish nation in Egypt hints to the many health benefits that result from the prenatal intake and childhood consumption of apples.

Apple intake in adulthood provides medicinal benefits beyond those found in childhood consumption, including improved gastrointestinal health and anticarcinogenic properties. The Talmud (Avodah Zara 40b) introduces the story of a scholar who procured 70-year-old apple wine to cure himself of dysentery. Recent research has elucidated the above passage in the Talmud and has shown that apple products inactivated a common microbial-derived foodborne toxin, staphylococcal enterotoxin A (SEA), thus curing the diarrhea and other gastrointestinal diseases induced by ingestion of SEA [11]. Other studies have shown that apple consumption maintains the proper microbial balance in the large intestines, which improves gastrointestinal and cardiovascular health [12].

In addition to its positive effects on gastrointestinal health, apple extract displays anticarcinogenic properties. One study showed that apple extract is a potent antioxidant that can inhibit growth of liver and cancer cells *in vitro* [13]. Another study has shown that concentrations of an apple extract that were inhibitory to the *in vitro* growth of oral carcinoma cells did not interfere with the growth of normal cells [14]. However, unlike the first study mentioned, the second study indicated that the apple's antioxidant properties were not the source of its anticarcinogenic properties, rather the precise anticarcinogenic mechanism is yet to be identified. Apple consumption in adults improves overall health by maintaining proper gastrointestinal health, cardiovascular health and providing anticarcinogenic properties.

Apples are classic and ubiquitous. From the beginning of creation in the form of, the "forbidden fruit," our first fairy tale, "Snow White," and to the city we call our home, *i.e.,* "the Big Apple," apples are present all around us. Nevertheless, despite their ostensible simplicity and mundaneness, apples are, in fact, important parts of the worlds of Judaism and medicine. References to apples are replete throughout Jewish law and literature, in addition to their importance in medicine and scientific research. Ultimately, apple consumption provides promising benefits throughout one's lifetime, from the womb to the grave. In fact, in this digital age, it is not Apple's shiny iPhone and Macbook, but rather the inconspicuous apple hanging from a tree, that truly holds the benefits and promise of the apple of the future.

Acknowledgements

I would like to thank my family for all of their support and encouragement. I also would like to thank Dr. Babich for guiding me throughout the writing process and providing me with this incredible opportunity. Finally, I would like to express my appreciation to Dr. Schuck for introducing me to the world of research and teaching me so much along the way.

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Familial Mediterranean Fever: The Disease and the Need for Genetic Screening

By **Rachel Faiena**

Sephardic Jewry consists of people who originated from the Iberian Peninsula (Spain and Portugal). After their expulsion from Spain in 1492, the community migrated to Portugal and, soon thereafter, were expelled again and, as a result, migrated to the Middle East and North Africa. These communities were mainly isolated from European Jewry and married amongst themselves. There is a common misconception among Sephardim that hereditary diseases are solely an Ashkenazic health issue. Sephardim formed small and tight-knitted communities often isolated from one another, any hereditary diseases that may have developed were less numerous and varied much in their different communities. For example, a genetic disease common in Moroccan Jewry may be seldom seen in Syrian Jewry.

Until recently, little research and effort was directed towards discerning Sephardic genetic diseases, identifying the causative defective genes, and developing the molecular probes to screen for these disorders. Recently, extensive research was conducted to show that there is a broad spectrum of genetic diseases associated with Sephardim that are dependent on their country of origin. Amongst the various Sephardic conditions, Familial Mediterranean Fever (FMF) is one of the most common disorders found in most Sephardic populations [1].

FMF is an autosomal recessive disease that occurs in individuals who have multiple mutations in the MEFV gene located on chromosome number 16. When functioning normally, this gene is responsible for the presence of pyrin proteins which play a role in the immune system and regulating inflammation. Being homozygous is having two doses of the defective gene, thus an individual who possesses two copies on chromosome sixteen has the defective gene which causes an extended period of inflammation which reduces pyrin proteins in the body. Lack of treatment may lead to hazardous accumulation of proteins, termed amyloid fibrils in organs and tissues resulting in amyloidosis. In order to prevent amyloid formation, individuals take colchicine, an anti-inflammatory medication. People with amyloidosis experience fever along with recurrent attacks of painful inflammation of the serosal membranes in the abdomen, chest or joints. Additional symptoms include peritonitis, rashes and arthritis [2]. These painful episodes return in a variable pattern, and therefore occur often without warning [3].

The frequency of the FMF mutation has already been reported in several Arab countries, such as Lebanon, Saudi Arabia, and Jordan [4]. In Syria, specifically, there was a high percentage of people with FMF or at least who were carriers for the mutation. A study was conducted in which blood samples of 83 patients with FMF and 242 healthy individuals from different regions in Syria and were collected. Restriction fragment length polymorphism (RFLP) analysis was used to screen the FMF patients for the five most common MEFV gene mutations. Amongst the 83 FMF patients, 89% were positive for at least 1 to 3 of the more common mutations and the remaining 11% had none of the common mutations. The carrier rate in the population of the FMF individuals was 17.5%. E148Q was the most common FMF mutation with a carrier frequency amongst healthy subjects of 1 in 5.7 individuals. In 45.8% of the patients with FMF, M684V was the most common mutation. Additionally, 58.3% of the patients had a family history of FMF. It was also determined that the age of onset is extremely high and was estimated to about 14 years old. This study demonstrated that the carrier rate for this disease was is above average, with FMF rated as one of the highest frequent familial disorders in the Syrian population [4]. Similarly, the carrier rate amongst Sephardic Jews is 1 in 5 individuals, [5], thus there is a 1 in 25 chance of a Sephardic couple with both the husband and wife being carriers of FMF. For such a couple, there is a 25% (1:4) chance of producing any one child with FMF.

Because of their reproductive isolation from the population of their host country, non-Ashkenazi communities have developed a unique set of genetic disorders. In the 2001 survey of the World Sephardi Federation, non-Ashkenazim comprised only 26% of world Jewry. This may be one of the contributing factors as to why there was a lack of attention

towards involving Sephardim in screening programs for their unique genetic disorders. Through a collaborative effort between Dor Yeshorim, the largest Jewish genetic screening center, and the Syrian Jewish community in Brooklyn, NY, attention has focused to developing genetic screening for Sephardi Jewry. Dor Yeshorim, originally founded to prevent Tay-Sachs disease amongst Ashkenazim, has "spared 4,970 families from having children born with fatal or debilitating genetic diseases" [6].

According to Dor Yeshorim, 80% of children born with a genetic disease have no family history of the genetic issue. Thus, it is crucial to spread awareness and educate Sephardim on the severity and prevalence of those genetic diseases unique to their community in order to prevent the manifestation of these recessive genetic mutations. Many prominent rabbis such as Rabbi Ovadia Yosef, Rabbi Yitzchak Yosef, Rabbi Mordechai Eliyahu, .etc., have approved and encouraged Sephardic families to have genetic screening by Dor Yeshorim. These rabbis ensure that the testing is done under halachic rule and there is always strict supervision while maintaining total confidentiality [6].

It is written in the Torah in the book of Devarim , "וְנִשְׁמַרְתֶּם מְאֹד לְנַפְשֹׁתֵיכֶם"which means that one should guard themselves very carefully [7]. According to Mesilat Yesharim, one should not put him/herself in danger even if he/she is righteous with many merits. A person should not depend upon miracles, rather he or she should be proactive in maintaining good health for themself and their families [8]. According to the Peleh Yoetz, the pasuk in Devarim is instructing people that when it comes to health, a person should ensure to seek the best medical treatment. Failure to do so is a punishable transgression before G-d, as commanded, "ויהיה נספה בלא משפט;"that it will cause "death without judgment." Consequently, the person will be held accountable for his/her death [9]. In the Talmud a mashal about a man who is praying while he is walking is described. An officer stops to greet him and the man does not respond due to his concentration in prayer. After finishing prayer, the officer asked why the man would endanger himself, if in the Torah it says that one must guard himself. The officer wanted to know why the man did not respond to him, as the officer could have killed the man for impudence. The officer then asked who will be accountable for this man's death? Obviously, the man, not the officer [10]. This shows the extent to which a person should go in order to care for and prevent him/herself from facing danger, even if it may avert one from doing a mitzvah. Therefore, it can be understood that Sephardim have a responsibility to take control of their genes and be aware of genetic diseases present in their community.

FMF is a significant problem, yet we do not realize how common is it for people to inherit these diseases or become a carrier. FMF is but one of various genetic diseases in Sephardic communities. It is important to acknowledge the severe effects of some of these genetic disorders, because it will help educate people of the risks and to what extent they can prevent having children with these diseases.

Acknowledgments

I would like to thank my parents for their immense support in all my endeavors and ensuring that I get the best education which includes both Torah Umadda. I would also like to thank my brothers for their guidance through everything. Also, I would like to thank Dr. Babich for motivating me to write about something so important and helping me through the whole process of accomplishing something great.

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His Heart Skipped a Beat: The First Abnormal Heart Rhythm in Tanach

By **Miriyam Goldman**

The elderly man sitting on the veranda, rocks slowly in his chair, gazing into the distance. His eyes dimmed by years of exposure to the desert sand, glaring sunlight and years of crying over his lost son. Suddenly his serenity is broken as he sees from afar a dust trail from a caravan traveling towards him at breakneck speed. His heart rate quickens in anticipation and continues to race. The messenger alights from his camel, runs to the elderly man and blurts out the news- suddenly, the man faints.

The elderly patriarch is Yaakov Avinu, and the news is that his son Joseph is alive and well as second only to Pharaoh in Egypt and his reaction is "ויפג לבו" (בראשית מה:כז). This unusual term is never seen elsewhere in Torah and is uniformly interpreted as meaning a disturbance in his heart rhythm - the heart paused or stopped, leading to his fainting.

There are many different commentaries on these two words: Rashi (1040-1105, France) defined this as נחלף, his heart changed and ceased to believe - an emotional response. Ibn Ezra (1089-1167, Spain) stated "עמד לבו ודמם... וימת לבו" his heart stood still and it died - a physical response to the news.

Ramban (1194-1270, Spain) was a physician and, similar to Ibn Ezra, disagreed with Rashi. Ramban noted that the root פוג means his heart ceased and his breathing stopped as if he were dead. He continued, "this is a well-known phenomenon that occurs when joy comes suddenly upon a person. The medical books mention that older, frail people cannot tolerate sudden joy, and that many of them faint when happiness comes to them unexpectedly and suddenly". He quoted from the medical books that "the heart of a person told unexpected good tidings expands and opens suddenly causing the natural beat of the heart to escape and dissipate to the extremities of the body and the heart fails when it cools down. Thus Yaakov, the old man, felt nothingness as if dead. He remained motionless for the greater part of the day until revived physically and emotionally by the brothers shouting Joseph's words in his ears and the vision of the wagons". We presume that the wagons reminded him of the last topic he had learned with Joseph, עגלה ערופה, as quoted by Rashi.

Sforno (1475-1550, Italy), stated that the term meant that "his heart stopped beating briefly, something common when people have a fainting spell." This occurred the moment the brothers had uttered Joseph's name. Chizkuni (1250- 1310, France), noted that it meant that Yaakov's heart was standing still and stopped beating. He cited Lamentations 2:18, which uses the words "פוגת לך", meaning "no respite."

Rabbeinu Bahya (1255-1340, Spain) also stated that this was similar to Lamentations, but referenced a different pasuk, 3:49, "מאין הפוגות" without respite, and interpreted as his heart stopped beating and it was as though he was dead. Rashbam (1085-1158, France) also commented on this by saying that his heart skipped a beat. The heart is a four-chambered organ which sits in the middle of the chest behind the sternum.

The heart receives deoxygenated blood from the great veins which enter the right atrium, the blood then crosses the tricuspid valve, into the right ventricle, which pumps blood to the lungs where gaseous exchange takes place (carbon dioxide out, oxygen in). The blood re-enters the heart through left atrium from the four pulmonary (lung) veins, crosses the mitral valve into the left ventricle, which then pumps the blood out through the aorta to the entire body.

What controls the "heart beat"? The heart contracts in a rhythmic sequence between 60-100 beats per minute (known as the pulse) and can more than double its baseline (basal) rate when needed for exercise or in anticipatory reaction. The "fight or flight" response, the heart's ability to pump faster to circulate more blood through the "fighting" or "fleeing" muscles in times of need is found in many animal species. This basic response is under the control of the sympathetic nervous system which stimulates smooth muscles and the adrenal gland to release adrenaline and noradrenaline (epinephrine and norepinephrine) to increase the heart rate and blood pressure, and to send more blood to the working muscles. This is similar to the response we can imagine might have taken place in Yaakov when he fought the angel in the middle of the night (בראשית לב:כב).

Conversely, stimulation of the parasympathetic nervous system can slow or even stop the heart, lower the blood pressure and cause fainting known as "vasovagal syncope" or "neurocardiogenic syncope." This response is responsible for the fainting that may occur upon having blood drawn, seeing blood or hearing bad news. Yaakov's response to the sudden newsflash (CNN and Twitter were not around then) that his son was still alive may have triggered such a response.

An even more extreme response to sudden shocking news or an event is called the "Broken Heart Syndrome" or

"Takotsubo Syndrome" which can simulate a heart attack by all objective sophisticated tests. Yaakov's response upon hearing the news may have caused a profound slowing and stopping of his heart beat, causing fainting from which he was revived. The occurrence of "shock" or "fainting" or even "death" upon an elderly person's hearing a radically good or bad news report must have been well known. The Sefer HaYusher related that the brothers fearing the worst, send Serach, Asher's daughter, to play the harp and relay the news to Yaakov through music and song. Despite the mellifluous method to gently break the news to Yaakov, it was too much for his heart, and "ויפג לבו".

The real-life description of a natural response to sudden shocking new is further evidence that our Avot and Emahot were real people, responding emotionally and physically to events in their lives. They had to cope with joy, family feuds and tragedies. Whereas other religions deify their founders, we see all aspects of the human nature of our founders. But through their amazing life stories and perseverance they continue to serve as role models for our lives.

Acknowledgments

I would like to thank my parents for their constant unconditional support and help throughout my entire academic career. I would also like to thank my sister, Sarah, for all her assistance and revisions in writing this manuscript. I would also like to thank Dr. Babich for encouraging me and giving me the opportunity to write this journal article.

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A Land Flowing with Milk and Antibacterial Honey

By **Michelle Hoch**

Exodus 3:8 relates, "I have descended to rescue them from the hands of the Egyptians and to bring them up from that land... to a land flowing with milk and honey…" For many, this is the first passage that comes to mind following the mention of honey in the Bible. On this verse, scholars comment that the mention of honey was to foreshadow the abundance and prosperity in the land of Israel. To this day, scholars study the medicinal function of honey, with its healing powers rooted in both scriptural and scientific works alike.

The Babylonian Talmud discusses the subject of medicine more extensively than any other ancient text. Within Tractate Gittin, a span of pages from 68b to 70a presents an entire collection of medical therapeutics. Although this section is not demarcated from what comes before and after, it has a distinct style and tone which differs from the usual Talmudic discourse. In technical terms, Gittin refers to the get, or Jewish legal divorce document. The subject of health is introduced into the regulations of divorce when the Mishna states that a get would be invalid if, at the time of its preparation, the husband became "seized" by a "kordiakos". The accompanying Gemara asks what "kordiakos" is. Following this discussion, the Gemara begins on a stream of medical remedies. Many of the remedies are similar in structure, as all are recipes, but differ in the mode of preparation or application. Tractate Gittin (69a) relates:

For catarrh he should take about the size of a pistachio of gum-ammoniac and about the size of a nut of sweet galbanum and a spoonful of white honey and a Mahuzan natla of clear wine and boil them up together... [7].

Catarrh is excessive discharge or buildup of mucus in the nose or throat, associated with inflammation of the mucous membrane. Rashi here relates the possibility that catarrh is pleurisy, a condition in which the pleura, a membrane that lines the inner chest cavity and surrounds the lungs, becomes inflamed. This remedy for a respiratory infection is detailed in regard to quantities, but is deficient in discussing mode of application. As a respiratory infection, it is presumed that this concoction was made to be either ingested or inhaled. James M. Steckelberg, M.D. of Mayo Clinic, explained a study in which children age two and older with upper respiratory tract infections were given up to two teaspoons of honey at bedtime. The honey seemed to reduce nighttime coughing and improve sleep. In fact, in the study, honey appeared to be as effective as a common cough suppressant ingredient, dextromethorphan, found in typical over-the-counter medications. [1]

A 2012 study from physicians at the Sackler School of Medicine in Tel Aviv tested the effects of honey on nocturnal cough and sleep quality. They enrolled 150 children ages 1-5 years with coughs and difficulty sleeping due to upper respiratory tract infections. The experiment was conducted to compare the effects of a single nocturnal dose of three honey products to a placebo date extract. A survey was administered to parents on two consecutive days. On the first day, no medication had been administered the previous night, and on the second day, honey or placebo had been administered thirty minutes before bedtime. Outcomes were measured by cough frequency, severity and child sleep quality. In all children who were given honey, a significant improvement was shown in the night following administration of honey to the unmedicated, prior night. Parents also rated the honey product higher than the date extract for symptomatic relief of the children's nocturnal cough [4].

The land of Israel is characterized in the Bible as "a good land...a land of wheat and barley, of vines, figs and pomegranates, a land of oil producing olives and honey." (Deuteronomy 8:8) The honey mentioned here refers to date honey. Dates are among the most important fruits mentioned in the Talmud. Dates were considered a substantive source of nutrition. Tractate Ketubot (10b) states, "Dates [have the properties of] warming up, of satisfying the appetite, or purging, of strengthening, without any evil effect on the stomach." Moreover, it is stated that dates annihilate three things: evil thoughts, diseases of the

bowels, and hemorrhoids [5]. A study published by the Journal of College Physicians and Surgeons in Pakistan released an experiment proving this Talmud conjecture to be true. Their findings suggested that natural honey is equally as effective in healing of gastric ulcers as cimetidine, an antacid [2].

Tractate Bava Batra (3b) relates a story of Herod and his wife. "When she saw that he (Herod) wanted to marry her, she went up on the roof and cried out, 'I am throwing myself down from this roof.' He preserved her body in honey for several years…" [6]. To understand the scientific nature of this Talmudic proclamation, Dr. Shankargouda Patil studied the preservative powers of honey. Dr. Patil took a sample of fresh goat meat and submerged each piece into separate containers containing formalin, water, honey, and jaggery syrup, a coarse, unrefined brown sugar solution, respectively. After twenty-four hours, he then processed the tissues and stained them in traditional medical protocol. He noted that formalin, a commonplace preservative, is highly toxic. The tissues preserved in honey and in formalin showed almost identical results. Patil noted that honey's high osmolarity, low pH and presence of components like hydrogen peroxide and phenol all contribute to the antioxidative and antibacterial effects of honey. He theorized that in a low pH environment, the fructose present in jaggery and honey breaks down to aldehydes. These aldehydes cross-link with tissue amino acids, similar to the action of formaldehyde. This leads to tissue fixation. To bolster his findings, he published a second experiment regarding the usage of natural sweeteners as histopathological fixatives. This time, he studied the fixative properties of jaggery and honey over six months, using formalin as a control. After six months, his studies concluded that honey was just as good a fixative as formalin. In addition, the honey-fixed tissues left no pungent odor in relation to the formalin.

Since ancient times, honey was used successfully for treatment of infected wounds. Recently, honey has been introduced into clinical practice and has been efficacious in healing wounds including those of surgical, traumatic and even neonatal postoperative nature. Application of honey causes rapid clearance of infection, debridement of the wound and suppression of inflammation while also minimizing scarring and stimulating new epithelial growth. A review of human and animal data, including over 195 participants, provides evidence for the effectiveness of honey in wound healing. The conclusions of the study suggest that wound healing activity is not only due to honey's antimicrobial properties, but also to its high acidity, high viscosity and anti-inflammatory properties [3].

Honey has been widely accepted as a food and medicine by all generations and traditions, both ancient and modern alike. For thousands of years, honey has been used to treat a variety of ailments through topical application and ingestion. Only in recent years has research bolstered the Talmudic conjectures with scientific findings. Honey is not only antimicrobial, but also exhibits preservative qualities. Our Sages weren't wrong: honey is a sweet, sweet remedy.

Acknowledgements

I would like to express my gratitude to my family for their constant support as I pursue my education. I would like to thank Dr. Babich for providing me with resources on this topic. His passion for education and strong expression of Ahavat Yisrael has served to be a source of inspiration to me.

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Establishing Paternity and Maternity

By **Alexandra Huberfeld**

Increased reliance on assisted reproductive technology has raised many issues regarding the establishment of parenthood. Determining both maternity and paternity is of prime importance in Judaism since it has multiple implications for the status of the child. A child is only considered Jewish if his or her mother is Jewish, and a person's status within the Jewish people is determined by his or her father. For example, the tribe which an individual identifies with is based on that of the father, and whether a man is a *Kohen,* a member of the priestly class, also depends on the father. Therefore, it is essential for each individual to know his or her parents' identities. However, in the age of surrogacy and sperm donations, this information may not be readily available or clear.

The matter of establishing paternity is discussed in a variety of Jewish sources, which conclude that the man who donateIncreased reliance on assisted reproductive technology has raised many issues regarding the establishment of parenthood. Determining both maternity and paternity is of prime importance in Judaism since it has multiple implications for the status of the child. A child is only considered Jewish if his or her mother is Jewish, and a person's status within the Jewish people is determined by his or her father. For example, the tribe which an individual identifies with is based on that of the father, and whether a man is a Kohen, a member of the priestly class, also depends on the father. Therefore, it is essential for each individual to know his or her parents' identities. However, in the age of surrogacy and sperm donations, this information may not be readily available or clear.

The matter of establishing paternity is discussed in a variety of Jewish sources, which conclude that the man who donates genetic material to the child is considered the father. The Talmud (Megillah 13a), in a discussion of Esther's birth, explains that although Esther's father died before her birth, he is still considered her father. This teaches that paternity is established by conception, and not by birth. Furthermore, there is a discussion in another tractate (Chagigah 15a) about a pregnancy that lacks intimacy. There is a case brought up in the midrash of a child resulting from such a pregnancy, Ben Sira, who was considered to be the son of Jeremiah, despite his mother never having intercourse with the prophet. Jeremiah's sperm entered Ben Sira's mother when as she immersed in the bathhouse. This case emphasizes that whichever man donates the genetic material is considered the father, regardless of whether or not there was intercourse. This directly relates to sperm donations today. Most modern poskim, including Rav Ovadia Yosef, Rav Yitzchak Weiss, and Rav Zalman Nechemya Goldberg, conclude that the man who contributes sperm for fertilization is considered the halakhic father, even if he will not be involved in raising the child. Because of this, and other issues related to sperm donation, Rav Moshe Feinstein recommended that any sperm donor other than the father be non-Jewish to avoid uncertainties of the child's status within the Jewish nation. Since the child will have a Jewish mother, the child will be Jewish, and would not need conversion [1].

Every man has a responsibility of pru urevu, to be fruitful and multiply, in other words, to have children.There is debate about whether a man fulfills his obligation of pru urevu through artificial means. For example, there is a question if a man fulfills this obligation by providing sperm for in vitro fertilization. The Rabbis mentioned above, having concurred that the man which contributed genetic material is considered the halakhic father, argue that sperm donation is sufficient in fulfilling the obligation of having children. Others argue that a man can only fulfill the commandment of having children through conception in a natural manner [1].

The issue of maternity is far more complicated than that of paternity. In the case of intrauterine insemination, a woman's egg is fertilized outside the body, and inserted into the uterus. In this case, maternity is clear, because the genetic mother and gestational mother are the same person. Since the woman has no obligation in pru urevu, the debate of whether the commandment is fulfilled in the atypical matter is not a factor here.

Nevertheless, in a case where a surrogate mother is employed to carry the egg, maternity is quite unclear. According to Jewish law, is the mother the woman who contributed the genetic material (i.e., the egg donor), the woman in whom the fetus developed, or

both? In order to answer this question, one must explore the timing of motherhood determination. If maternity, like paternity, begins with conception, then the genetic mother alone would be considered the mother. However, if motherhood is determined at birth, then it would seem that the gestational mother could be considered the mother.

The Talmud (Yevamot 42a) seems to support the idea that the genetic mother is the sole mother of the child. It describes that when a married couple converts to Judaism, they must separate for 3 months to verify that the wife had not become pregnant prior to conversion. This implies that the status of the mother at the time of conception is important in determining the identity of the child, not the mother's status at birth of the child. If a woman is pregnant before her conversion, the religious status of the child would be put into question, suggesting that motherhood is determined by conception. This is similar to a situation described by the Rambam in which a Kohen marries a divorcee, an act which is prohibited by the Torah. Any child from this union is considered a chalal. However, if the woman is pregnant before marrying the Kohen, the child is not considered a chalal. This implies again that the child's status depends on the status of the mother at conception, not at the birth of the child, proving the importance of the initial genetic contribution of the mother.

On the other hand, there are many circumstances written in the Talmud in which the halacha seems to imply the opposite, that pregnancy and birth determine maternity. A different situation described in Yevamot (97b) explores a case in which a woman is pregnant with twins and converts while she is pregnant. The children are not considered paternal siblings since paternity is established at conception. But they are considered maternal siblings, which implies that maternity is established by birth. Once again, the discussion of Esther's birth provides insight on the topic. The pasuk describes that Esther was an orphan and that she "had neither father nor mother." The Talmud (Megillah 13b) notes that Esther did not have a mother since her mother died during childbirth. This indicates that maternity is established by birth. Rashi comments that the pasuk means that she had no father from the time in which paternity was established, ie., at conception. Rashi explains that Esther had no mother because her mother died before the time in which maternity was established, ie., at birth [2]. This view is supported by Rav Aaron Soloveitchik, who agrees that a child born from an egg implanted in a surrogate adopts the religious status of the mother at birth [3]. Because of the presence of seemingly contradictory sources, Rav Shlomo Zalman Auerbach favors the stringent side, that both mothers, the egg donor and the surrogate, are considered in maternity. Therefore, a child born through a non-Jewish surrogate must convert.

The discussion surrounding the use of a Jewish woman as a surrogate is complicated as well, and while Rav Zalman Nehamia Goldberg allows it, many Rabbanim disagree. They believe that implanting an egg in a woman with sperm from a man that is not her husband falls under the category of ervah, or improper behavior. Another issue is the prohibition from the Torah against self-harm. It is unclear whether surrogacy falls under this commandment, but it is a consideration. Finally, although unlikely, inappropriate behavior between the husband and surrogate has been a documented occurrence, leading many to strongly discourage or forbid the use of Jewish surrogates [2].

This matter of maternity is complicated by the concepts of bidirectional fetal-maternal cell exchange and epigenetics, which imply that a gestational mother's role is more than just an incubator. Bidirectional fetal-maternal cell exchange, or microchimerism, is when cells of the gestational mother travel across the placenta into the fetus. This means that there are cells in the child with DNA material from the gestational mother in addition to that of the genetic mother [4]. This process also works in reverse; cells with fetal DNA can be transmitted to the woman carrying the baby. The exchange occurs regardless if the woman carrying the child is the genetic mother or a surrogate. These stem cells are particularly identifiable when cells containing a Y chromosome are found in a woman, since Y chromosomes are found only in males [5]. Additionally, recent information about epigenetics establishes a connection between the gestational mother and fetus. The lifestyle of a gestational mother can affect the child, in addition to increasing the potential of autoimmune diseases. It has even been recorded that tumor cells from the gestational mother can enter the unborn fetus, resulting in an infant born with a tumor. These concepts of microchimerism and epigenetics complicate the issue of surrogacy since it becomes clear that the gestational mother has a far greater role in pregnancy than previously thought [4].

Acknowledgements

I would like to thank my parents for constantly motivating me to achieve my dreams and helping me reach them. I want to thank Dr. Babich for encouraging me to write this article and for assisting me with it, and Rav Apfel for his insights on the topic.

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Stem Cell Research in Jewish Law

By **Shani Kahan**

Medical ethics focuses greatly on the opposite ends of life. Regarding the beginning of life, there are debates over abortion, contraception, and conception, while the end of life raises questions pertaining to the management of death, the moment of death, autopsies, and the harvesting of organs after death. Over the past two decades, our generation has witnessed thriving applications of basic scientific advances in stem cell therapy. Therapeutic stem cell research has been the center of debate among doctors, politicians and philosophers. There are many different opinions regarding whether stem research is ethical and, therefore, whether it should be conducted. Jewish authorities examine this modern technology by turning to established halachic approaches and principles.

All cells of a living organism originate from stem cells. Mammalian development begins with the fusion of a sperm and egg, which ultimately results in the formation of a totipotent cell, the zygote. Within a few days, the zygote has divided multiple times to form the blastocyst, the structure from which every single cell type necessary for survival of the adult will originate. Included in the outer layer of the blastocyst are cells destined to form the umbilical cord and the placenta, both sources of nourishment for the developing fetus. At this point, the embryonic cells are no longer totipotent, but have restricted potential and are said to be pluripotent cells. Such pluripotent embryonic stem cells are found in the inner cell mass of the blastocyst; these pluripotent cells have the ability to give rise to all the tissue types in an adult, but are limited in that they cannot lead to the formation of an entire organism, since they lack placenta-forming trophoblasts. As the embryo grows, these pluripotent cells continue to divide and specialize into multipotent cells, which have more restricted potential and can rise to many, but not all, of the cell types necessary for fetal development. Soon thereafter, these individual populations of multipotent cells differentiate into specific cell types committed to form specific tissues [1].

Embryonic stem cells are commonly derived from human embryos initiated in a Petri dish in an in vitro fertilization (IVF) clinic. For a variety of reasons, a couple may be directed to an IVF clinic for assistance in the reproductive process. The woman is hormonally induced to hyper-ovulate and generate multiple immature eggs (more specifically, secondary oocytes arrested in metaphase of meiosis II) from her ovaries. These cells are transferred to a Petri dish supplied with a nutrient medium and sperm from a donor, usually the husband, is used to fertilize the eggs. After forty-eight to seventy-two hours, the growing "pre-embryo" is transplanted into the women's uterus. If this process is successful, the embryo implants in the uterus and pregnancy can be noted within ten to fourteen days. When a couple uses this assisted reproductive technology, more pre-embryos are created than can be used. They have many options for these surplus "pre-embryos", including cryopreservation for possible future use, donating them to infertile couples, discarding them, and permitting them for medical research [2]. The halachic debate regarding the permissibility of these options will be discussed later.

Pluripotent stem cells can be obtained in other ways. Aborted fetuses serve as a source of pluripotent stem cells, however, the use of fetuses ignites other ethical considerations that may not have been applicable to the use of stem cells obtained from a pre-implantation embryo. A less problematic source of stem cells can be found both in umbilical cord blood and in the adult human. As stem cells function in repair or replacement of damaged tissue, they occur in every organ in the adult body. For example, bone marrow stem cells primarily give rise to the various types of blood cells and can also develop into liver cells and cardiac muscle cells. However, these adult stem cells are more limited in potential, tending to be multipotent, not pluripotent. In addition, there are less hematopoietic stem cells than embryonic stem cells and they are more difficult to isolate. Because of their multipotent nature, adult stem cells do not seem to have equal potential for differentiation and proliferation as embryonic stem cells do [3, 4].

The following investigation is with regard to embryonic stem cells derived from pre-embryos from IVF clinics, obtained with permission from the egg donor and sperm donor. The extraction procedure for obtaining the stem cells from the pre-embryo essentially terminates the viability of that embryo from further development. As embryo-derived stem cells are not embryos in themselves and are unable to further develop to a human being, they are similar to cells from human tissues. Researchers are working on

using these embryonic stem cells to develop specific tissues which can be transplanted into patients. These tissues can potentially be used to generate entire organs for grafting into human recipients whose organs have unfortunately been destroyed or diseased. Embryonic stem cell research can bring about advancements in the treatment of many diseases, including diabetes, cancer, neural pathologies, immune disorders, bone and cartilage diseases, and heart infarctions [3]. According to some perspectives, the advantages of stem cell harvesting surpass any moral ambiguity regarding the procedure. However, since these organs were initially derived from preimplantation human embryos, this is potentially problematic. The question that arises is whether it is appropriate to use the human preimplantation embryos for developing biological therapeutics. Is it ethical to remove embryonic stem cells, albeit prior to implantation of the intact embryo into the uterus, knowing that extraction of such cells terminates the life of the human embryo?

Taking this into account, halachic authorities attempt to resolve this dilemma. Many considerations must be made to better understand the field. Some Jewish authorities permit the use of embryonic stem cells, provided the technology is done according to halacha [3]. First, the commandment to save lives overrides most statues in Judaism. This approach serves as a possible justification for the therapeutic use of embryos, such as for tissue or organ transplantation. Given that the biological materials necessary for stem cell research is acquired with donor consent, it would seem that the technology is morally neutral. In other words, it may seem that stem cell research earns its ethical value on the basis of its therapeutic accomplishments, as such technology can make an enormous difference in the lives of individuals [3].

Another potential issue regarding the pre-implanted embryo is whether it falls under the category of hashchat zera, wastage of semen. The Torah forbids the destruction of living sperm cells (Bereshit 38: 7-10) and some opinions hold that the destruction of a fertilized egg within forty days of conception is considered as the destruction of seed as well [5]. Moreover, its destruction may be violating the command of "pru u'revu,", to be fruitful and multiply [3]. On the other hand, many authorities, including Rabbi Yitzchok Breitowitz, author of "the Preembyo in Halacha", hold that the restriction of hashchat zera levata does not apply after an ovum has been fertilized and that destruction of the zygote is not equivalent to the destruction of the male seed [2]. Based on this idea, many follow that the use of the pre-implantation embryo is allowed if there is potential for a future child to be born as a result of this research [5].

The Talmud (Yevamot 69b) teaches that "the embryo is considered to be mere water until the fortieth day" [6]. This serves as support for the minimization of the embryo's status prior to forty days gestation, suggesting that this aged fetus lacked the status of being a human [7], so that there is no violation of destroying a potential human life [3]. This is relevant in the context of the laws of female impurity. A Mishna in Niddah (30a) presents a case in which a woman miscarries within forty days of conception. She does not have tumat layda, ritual impurity, which would apply to a woman who miscarried after forty days. Furthermore, hilchot tumat met teaches that coming in contact with a fetus delivered within forty days of conception does not result in a tamei met status, which is the ritually impure status acquired upon coming into contact with a dead body [7]. However, some authorities hold a more stringent position in regards to embryos prior to forty days of gestation. Their approach stems from the idea that Shabbat may be violated to save an embryo, even in its earliest phase of development (Yoma 85b) [2].

Generally, halacha does not distinguish between the destruction of a pre-implanted embryo and its use in scientific research. Unless performed with the purpose of saving life, both are considered to be forbidden as long as the potential for the implantation of the embryo exists. Moreover, an IVF-derived pre-embryo with lost implantation potential is allowed to be used for scientific research, but it is forbidden to use an implanted embryo for such purposes. A pre-embryo with lost implantation potential may even be used if the research encompasses stem cell extraction [3].

The course of life has a beginning and an end. A general agreement about when exactly human life begins has not been reached among rabbis, scholars, scientists, philosophers and ethicists and as a result, stem cell use for therapeutic use becomes a topic of debate. As technology advances, improvements in adult-derived stem cell research can serve as an alternative to embryonic stem cell research and contribute to the resolution of this scientific debate.

Acknowledgements

I would like to express my gratitude to Hashem for giving us a world filled with incredible creations to explore and discover. I would like to extend my sincere appreciation to Dr. Maya Mikami and the Department of Anesthesiology at Columbia University College of Physicians and Surgeons for their exciting mentorship and for energizing me with their dedication to research and respectful patient care. I would also like to thank Mr. Allen Sachs, my first science research mentor and greatest inspiration, for believing in me from the start and sparking my love for and enthusiasm towards science research and the incredible potential it entails. Thank you as well to Dr. H. Babich and Dr. B. Lowey for motivating me to further discover the links between Torah U'Madda with their devotion to biology and guidance. Finally, I want to acknowledge my family for their unconditional love and for supporting me in all my endeavors.

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A *Halachic* Perspective on Dental Implants

By **Tamara Kahn**

The Science of Dental Implants

Dental implants are a rapidly advancing solution to replace missing teeth. Implants provide a restoration of full-functionality to teeth, in addition to realistic aesthetic benefits. They are the strongest, most reliable mechanisms for replacement teeth, and the implant procedure is safe and predictable [1]. In order to place an implant into the jawbone and ensure its permanence, the bone must be healthy, and without atrophy or breakdown. However, when a tooth is missing from the jaw, the necessary bone tissue that holds an implant is often absent or lacking in quality, preventing permanent anchoring and, therefore, rendering the dental implant ineffective. To stimulate bone growth, known as osteogenesis, or to input a more stable base of bone, bone grafts are helpful tools that offer a way to properly anchor implants into the jaw site of implantation [2-3].

Bone Graft Implants

A bone graft is a surgical procedure performed to replace missing or broken bones by transplanting healthy or synthetic bones into the affected site. The bone graft is an implant itself that binds with the natural bone after treated chemically and formed into a sterile, congealed compound to reconfigure the jawbone. Once the jawbone can act as a solid base, the implantation of the new tooth can occur.

There are various types of bone grafts. An autograft is the traditional method of bone grafting, in which a sample is taken from elsewhere within the patient's own body and is used to rebuild the deteriorating part of the jawbone. Recently, other methods of bone grafting have risen in prominence and are achieved without injuring the patient: allografts and xenografts. Allografts use cadaver bones, and xenografts use bovine species bones. Synthetic grafts are another option, but they come with more complications. Since most people prefer an alternative to an autograft, which entails a second surgical procedure, unnecessary pain and an extended healing process, allografts from the cadaveric bone tissue have been found to possess the most benefits for the bone. [2-4].

***Halachic* issues with Cadaveric Bone Grafts**

Rabbi Bleich listed three major *halachic* issues with cadaveric bone grafts. The first two issues arise in the context of how a dead body should be treated. A dead body must be buried with all of its limbs and constituent parts; all the remains of a body must be buried together, and in a timely manner (*Sanhedrin* 46a -b, citing *Devarim* 21:23). Additionally, no benefit may be received from a cadaver (*Avodah Zarah* 29b, and based on a comparison in *Psalms* 106:28) [3]. Rabbi Dr. David J. Katz also listed the prohibition of denigrating a dead body as another issue that arises with cadaveric bone (*Sanhedrin* 47a, *Chullin* 11b) [5].

The third central issue brought by Rabbi Bleich that arises with cadaveric bone grafts relates to the possibility of either the dentist or the patient possessing the status of *kahuna* (priestly holiness). A *kohen* is forbidden to come into contact with a dead body, and therefore risks defilement by either placing or receiving a piece of cadaver bone, in the case of a dentist or patient, respectively. Furthermore, a *kohen* also may not be in the presence of a dead body, so someone possessing a bone graft or a dental office with cadaveric bone graft material may cause the defilement of *kohanim*, as well [3, 5-6].

Resolutions

According to Rabbi Bleich, the rabbinic consensus is unanimous in approving the use of cadaveric bone grafts for dental implants; Rabbi Dr. David Shabtai is the original contemporary figure who addressed the *halachic* issues specific to these dental implants [3]. Rabbi Bleich and Rabbi Dr. David J. Katz each wrote comprehensively and presented various positions in rabbinic law regarding these issues and ways to resolve them.

Burying a dead body in its entirety does not extend to the small sample of bone used in the dental bone graft, assuming that burial applies only to a substance equal to a *ke-zayit,* the general measure of *halachic* significance for eating, commonly held as about 28 - 33 mL. However, this assumption is not universally held. Furthermore, the statutory obligation of burial only applies to Jewish bodies, so the implant can be derived from a non-Jewish cadaver; since the majority of people in our country are not Jewish, the assumption based on *rov* (majority) is that the cadaver

is a non-Jewish body, and therefore does not *halachically* require burial. Rav Unterman views a transplanted organ or tissue as losing the status of a dead body and by extent, losing the requirement of burial. Rav Meir Sternberg reasons that the transplanted specimen will eventually be buried when its new owner dies. Another alternative is applying the notion of honoring a deceased donor to the teaching from the Mishnah in *Sanhedrin* (46a), which stated that burial may be delayed in order to offer honor to the dead [3, 5].

Since a dead body must be treated with respect, there are prohibitions against denigrating and benefiting from the dead body. Different *poskim* have alternate approaches to the prohibition of disgracing the body, some prohibiting autopsies and organ transplants and some allowing them in certain circumstances. Rav Ovadia Yosef stated the opinion that denigrating the dead by removing part of it only violates the prohibition if the intent is to mutilate; however, if the intent is for a different purpose altogether, then extracting the body part is permitted (*Sho'el U-Meshiv* and *Maharil*) [5].

The prohibition of benefitting from a cadaver has disputed origins. It is clearly forbidden on either a rabbinic or a biblical level to benefit from the body of a Jew, but not all *poskim* recognize benefitting from the body of a non-Jew as problematic, and some allow for it in a case of significant need. On the topic of a Jewish body, Rabbi Dr. David Shabtai maintained that the *Shach* provided a ruling that allowed for bone transplant donations from Jewish cadavers and that explained that benefitting from a cadaver was not an explicit Scriptural negative commandment, thus creating room for leniency [3, 5-6].

The parameters of violating the biblical prohibition of benefitting from a cadaver are also debated in *halacha*. Benefit received *ke-derech hana'ah*, using it for its natural, usual use, is forbidden, but some *poskim* permitted unusual benefit from cadavers. Using cadaver bones for bone grafting is certainly unusual, as a dead body's bones were not meant for grafting. According to Rav Moshe Feinstein, cadavers were not usually used at all. He also teaches that non-Jewish body may be used for benefit. *Nishmat Avraham* quoted Rav Shlomo Zalman Aurbach's position that no benefit, usual or unusual, may be derived from a Jewish body, which requires burial, but unusual benefit may be derived from a non-Jewish body in certain necessary cases [3, 5].

Moreover, benefitting from a dead body is forbidden, but benefiting from something that was once dead but regained life or function is completely permissible. This is the argument of Rav Unterman, also suggested by Rabbi Weiss, regarding the bone becoming alive again, and receiving benefit from a live tissue is permissible. According to Rav Moshe Feinstein, cadaveric tissue lost its "death status" when taken for a utilitarian purpose, so when the bone is taken from the cadaver, it immediately attains a new status and was no longer considered dead. However, while bone grafts for dental implants inseparably bind to the jawbone in osseointegration, it did not become living bone itself, thus reinforcing Rav Moshe's argument but failing to support Rav Unterman's [3].

As mentioned previously regarding burial, the quantity of cadaver bone must be considered in terms of allowed benefit. Since the pulverized bone, merely a minimal quantity of tissue, is much less than a *ke-zayit* and cannot be combined with more tissue without risking marring the procedure, using this small amount was legitimate for benefit [3].

Concerning the issue of a dentist or patient being a *kohen*, there are many reasons to support the view that cadaveric bone grafts for dental implants do not cause defilement of a *kohen*'s elevated level purity. First, the opinions of Rav Unterman and Rav Moshe Feinstein on the transplanted bone losing its death status apply to it also losing its ability to cause defilement. Defilement comes in the form of touching, carrying, and being under the same roof as a cadaver, and most *poskim* agree that a *kohen* is defiled with the dead body of either a Jew or a non-Jew through touching and carrying, and with a dead body of a Jew through close proximity. *Poskim* are divided on whether a dead non-Jewish body can defile from being in the same location as a *kohen,* but according to the Rambam, the amount of cadaver bone required to defile a *kohen* located nearby is one-fourth of a *kav* (measuring to 0.3-0.6 L), which highly exceeds the amount of bone used in the bone graft, as well as the amount likely to reside in a dental office at a certain time. Therefore, *kohanim* who do not touch or carry the bone graft should not be concerned. However, there is a difference in the quantity that causes defilement from bone that was pulverized and bone that was not pulverized, because

pulverized bone is unrecognizable as bone. A particle of pulverized bone, as used in dental implants, is much smaller than a grain of barley, which is the size of bone fragment that causes defilement through touching, so no defilement is attained through touching the pulverized bone tissue for the implant. In terms of defilement through carrying, only a quantity of half a *kav* (measuring to 0.6-1.2 L) qualifies (*Nazir* 13b), and this amount is much more substantial than the cadaveric tissue used in the graft. The Rambam presented a minority opposition to the leniencies of carrying pulverized bone, but there are various reasons to permit it; the implant is concealed inside of body tissue (*Niddah* 42a) and might prevent defilement, and the pulverized bone may be considered *rekev* (decomposed bone turned to dust) and does not constitute a large enough quantity for defilement. Additionally, when the tissue is chemically treated, it completely dries out and is reduced to powder, so it may no longer defile. If chemical treatment is considered similar to burning the bone tissue, then it would remove the concern of defilement. Reduced bone that is derived from a single cadaver continues to cause defilement when reconstructed to a size larger than a grain of barley, but the likelihood of the material deriving from multiple cadavers, and not exclusively from a single cadaver, is high, and therefore *kohanim* do not need to worry about defilement when coming into contact with the bone graft [3, 5].

Acknowledgements

I would like to thank my parents for their constant support and encouragement, Dr. Babich for supplying me with the major sources and introducing me to Derech Hateva, and Rabbi Dr. David Shabtai, an expert in the topic, for assisting and reviewing the information from both a scientific and *halachic* standpoint.

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Genetic Determinism and Free Will

By **Rina Krautwirth**

Introduction

Behavioral genetics, a concept that dates back to ancient times, but emerged as a distinct scientific discipline in the 1960s, examines the extent to which a particular gene or set of genes determines a person's behavior and in its more modern iteration, evaluates the gene-environment interaction (G x E) on a particular behavioral phenotype [1,2]. Based on this concept, some research has implicated specific genes in aggression and criminal behavior and, as such, a debate has arisen over whether criminals could use, as a defense, the assertion that they have a genetic predisposition for criminal behavior. More recent research has moved away from attributing direct causality to genes, but some research still does suggest that genes can, at least to some extent, impact behavior in that they can influence whether or not someone becomes aggressive as a result of an abusive environment. Yet, sources within Judaism teach that all people have free choice. Rambam, for instance, in very strong language writes:

> Every man was endowed with a free will; if he desires to bend himself toward the good path and to be just, it is within the power of his hand to reach out for it, and if he desires to bend himself to a bad path and to be wicked it is within the power of his hand to reach out for it...Permit not your thought to dwell upon that which ridiculous fools of other peoples and a majority of asinine individuals among the children of Israel say, that the Holy One, blessed is He! decrees at the very embryonic state of every man whether he should be just or wicked. The matter is not so. Every man is capable of being as just as Moses our Master or as wicked as Jeroboam, wise or incony, merciful or human, miser or philanthropist, and so in all other tendencies [3].

How then would Jewish thought approach the idea of a genetic predilection, such as for crime? Although early Jewish sources do not mention genetics as we understand it now, sources that discuss parallels of genetic determinism, such as Rambam's use of the phrase "at the very embryonic state," can potentially shed light on our modern concept of genetic predisposition and give us a better understanding of how Jewish thought might view this idea.

Genes and Behavior

As an example of a gene implicated in criminal tendencies, some studies have suggested that a gene variant that lowers monoamine oxidase A enzyme levels (MAOA-L), the so-called "warrior gene," could increase aggression and, therefore, could increase criminal behavior. The enzyme monoamine oxidase A (MAOA), localized on the outer mitochondrial membrane, breaks down the neurotransmitters serotonin, dopamine, norepinephrine, epinephrine, melatonin, tyramine, and tryptamine, [4] called monoamines because they have one amine (NH_2) functional group [5]. Low levels of this enzyme cause elevated levels of the target neurotransmitters to accumulate in the synapses, while extra high levels of the enzyme would decrease target neurotransmitter levels. Altered neurotransmitter levels in turn could impact brain function, which could potentially influence behavior [6,7]. The gene variant type at work here [8] is a variable number of tandem repeats (VNTR), meaning that a short nucleotide sequence repeats a number of times in tandem within a gene and the number of repeats can vary among individuals [9]. The *MAOA* gene has variants of two, three, three and a half, four, and five repeats of a thirty nucleotide sequence; the two and three repeat variants (MAOA-L) cause monoamine oxidase A production to decrease [6]. The fact that the *MAOA* gene resides on the X chromosome (short arm), such that males only have one copy, might render males more susceptible to its inactivity [4,6]. For women, in contrast, a study showed that *high* monoamine oxidase A expression (MAOA-H), with VNTRs of 3.5 or 4, in combination with childhood trauma or adverse environment, might lead to aggression, though the study did have limitations [10].

The history of a perceived association between MAOA-L and aggression traces back to a 1993 study by Brunner of a family in which the males had functionally no MAOA enzyme due to a C to T point mutation that created an early stop codon [11] and in which these males displayed "impulsive aggression" [12]. In 1997, Sabol *et al.* found that the number of VNTRs impacted levels of MAOA expression and mentioned possible implications for behavior [13]. In 2004, a study that compared the gene in monkeys to that in humans used the label

"warrior" [14]. In 2006, the media in New Zealand reported on a study that found an increased presence of the MAOA-L variant in the Maori people as compared to the general population and, as previously discovered, this variant had been associated with aggression. The study was taken to attribute genetic aggressiveness to the Maori people [15]. Researchers and commentators quickly took this attribution to task and the study generated a lot of backlash, with the main objection that a single gene alone does not contribute to something as complex as behavior [16,17,18]. According to Hunter, forty percent of the general population has the MAOA-L variant and yet, not all forty percent exhibit criminal behavior: "the *MAOA-L* variant is extremely common and occurs in about 40% of the population. Clearly, most of these people are peaceable and have never committed a crime..." [19]. Moreover, an earlier 2002 study by Caspi had shown that the link to aggression occurred only when genetically susceptible individuals experienced childhood abuse [20]. Though the Caspi study and other similar research modifies the underlying deterministic factor from just genes to genes plus environment, the research does still raise the question of free choice: considering that a gene variant can influence a person's response to an abusive environment, if a person with the gene variant does experience that environment, would he or she then have free choice?

Additionally, some studies also have suggested a link between the XYY karyotype and problematic behavior, as these findings have shown increased risk for behavioral difficulties and "increased risk of impulsivity," though the link between XYY and criminality "must be viewed with extreme caution, given their reliance on small sample sizes and selected rather than broader-based sampling approaches" [21,22]. Similarly, genetic polymorphisms in the genes that code for the serotonin and dopamine transporters have been linked to behavioral disorders, once again taking the role of environmental factors into account [23,24]. Though the research of the 1970s sought to find a direct connection between these genes and criminal behavior, the more current research remains more cautious about definitively linking genes to behavior without including environmental influences. However, current research does leave open the possibility that genetic polymorphisms could play a role in certain traits such as impulsivity, which, without intervention, could become a risk factor for behavioral problems and again raises the question of free choice in a situation in which the person did not grow up in an environment that provided intervention.

Rabbinic Sources on Determinism

Chazal in the *gemara* address the idea that someone could be born with murderous tendencies. Chazal do not discuss genetics, but they do discuss whether the constellations predetermine this trait and other aspects of a person's life. *Gemara* Shabbat (156a) delineates the outcome for someone based on the day of the week and planetary influence of their birth. The *gemara* explains, according to astrology, each zodiac sign falls under either a ruling planet, the sun, or the moon. One born under the influence of the planet Mars, possibly because of its red color, will become "one who spills blood." Rav Ashi responds that they can become a blood-letter, a thief (according to Rashi, this refers to a thief who kills), a *shochet,* or a *mohel.* Rabba questions the concept of astrological determinism by saying that he in fact born under the influence of Mars and does not do any of these activities. Abaye responds with: you punish and kill. (Rashi explains this statement to refer to people who go against his word, presumably people who get the death sentence for going against his rulings). Rav Ashi's comment seems to suggest that if one is born with an inclination for blood, one can channel this natural predetermined birth trait into a profession that involves blood, in fact, even into a profession that helps people. One born to "spill blood" does not have to do so via murder but could do so in these other ways.

Along similar lines, on the issue of inborn traits, Chazal also discuss how everything which is prohibited has a permitted equivalent. In Chullin (109b), Yalta states this idea and lists several examples, including a fish called *shibuta*, whose brains taste like pork. This *gemara* suggests that even in a situation of inclination for something non-permissible, other options exist to prevent someone with a negative inclination from doing the wrong thing. Even if someone were to have the predetermined inclination to eat pork, they instead could eat the *shibuta* fish.

In Moed Katan (28a), Rava states that three things are determined by *mazal* rather than by merit: length of life, children, and sustenance [25]. Perhaps of note, the first two of these three items potentially have a genetic component. Tosafot on this *gemara* inquire that the subsequent statement in Shabbat (156a) that "there is no *mazal* for the Jewish people" seemingly contradicts this *gemara* in Moed Katan. Tosafot, in their comments on Shabbat (156a), note that sometimes, with great

merit, *mazal* can change whereas, sometimes, it does not. The *gemara* in Moed Katan resolves the contradiction by saying that while sometimes *mazal* changes, like in these cases, at times it may not [26]. The Tosafists seem to take the view that sometimes something predetermined changes while sometimes it does not, at times depending on great merit. Whereas for the *gemara* and for Tosafot, determinism takes the form of "*mazal*", fate, our later understanding of genetics might also inform our reading of their discussion on this topic, as *mazal* could include genotype.

Rabbi Dessler in his book *Michtav me-Eliyahu* discusses the question of environmental influences counteracting free will—the same question of environmental determinism raised by Caspi's research—and writes, "...no one is held responsible for the evil to which he is accustomed from birth and as a result of his environment...he has the *halachic* status of 'a child taken captive and brought up among idolaters'"[27]. Rabbi Dessler also establishes the idea of a *bechira*, choice, a point at which everyone has free choice, though potentially in different circumstances for different people. For someone raised in a righteous environment, his/her *bechira* point might be to observe a commandment more scrupulously, whereas for someone born to thieves, the *bechira* point might be to behave honorably while they steal [28]. This idea asserts that people have free choice within the confines of their surrounding environment.

Legal Context

When Appelbaum *et al.* surveyed cases in WestLaw and LexisNexis (now called NexisUni) as well as in Ovid MEDLINE, PsychINFO and Embase from 1995 to 2016, they found that so far, only in eleven cases, nine in the United States and two in Italy, did MAOA-L genetic evidence get admitted as evidence for the defense [29]. Of the eleven cases, only in one case did it change the guilt phase of the case and only in two cases did it change the sentencing or appeal phase, when the defendants had both the genotype and an abusive upbringing [29]. The authors opine that "[e] ven when charges or sentences are reduced, it is difficult to gauge the effect of evidence of the MAOA-L genotype. Genotype evidence may lack persuasive effect because the impact of the allele on a particular accused is difficult to establish" [29]. The authors point to their limited access to court documents and the fact that they only looked at English-language cases as limitations to the study.

Conclusion

The topic of genetic determinism has never been clear-cut. Though genes exert their influence, environment also plays a significant role in their outcome. The scientific literature reflects this ambiguity in that no one study conclusively shows that genes alone can alter behavior, although simultaneously, some research does suggest the idea of a genetic disposition. Studies also have shown that temperament, which emerges in early childhood and shows distinctiveness between different children, has a "strong genetic component", while at the same time, "the family environment moderates the heritability of temperament" [30,31]. Similarly, Jewish sources point to the idea of temperament and the need to shape the environment in accordance with the phrase "train a lad *in the way he should go*; he will not swerve from it even in old age" in Sefer Mishlei (22:6).

In discussing ways by which one can improve one's character, Rambam writes:

> Pertaining to tendencies in general, there are such tendencies that a man acquires at his birth, in keeping with the nature of his body; and there are particular tendencies to which a particular person is by nature prepared to acquire them more aptly than other tendencies; there are among them such which do not come naturally to a person at his birth, but which he learns from others, or by leaning towards them as a result of a thought invented by his heart, or by having heard that this particular tendency is good for him and proper to follow it, and he did follow it until it was set in his heart [32].

Perhaps the "tendencies that a man acquires at his birth" seem reminiscent of genetic traits and "in keeping with the nature of his body", their corresponding physical genes as known to us today, while "which he learns from others" speak to environmental influences. This statement does not contradict Rambam's view on free will, as he explains that one can cultivate a trait at the opposite extreme of an undesirable trait, which would pull one's natural tendency toward the middle and thereby enable one to achieve the golden mean [33].

In 1962, Marian Diamond *et al.* published their groundbreaking research on brain plasticity and in doing so, turned around the firmly established notion that the brain remains static and genetically

predetermined [34,35]. Their research showed that the cerebral cortex size increased in rats who lived in an enriched environment, in contrast to those of rats raised in an impoverished environment, an experiment that showed for the first time that environment can actually alter the physical anatomy of the brain [35]. Their research has many implications for activities or conditions that impact the brain. Positive influences include reading aloud to children, running, meditation, bilingualism, playing a musical instrument, and staying socially connected [34]. Negative influences include childhood poverty, fear, trauma, isolation, sleep deprivation, low socioeconomic status, and protein deficiency [34]. Perhaps one can liken the gene to environment interaction to a pinball machine, where if one flips one or the other of the two flippers, the ball might propel slightly, but if one flips both in unison, it creates a much higher chance that the ball will propel with force. As scientific research progresses in the area of behavioral genetics, it likely will continue to discover new insights into genetic and environmental influences on behavior. Analyzing these findings along Jewish sources can allow us to gain an added perspective on how Judaism might view this new information.

Acknowledgements

I would like to thank Dr. Babich for suggesting that I write this article and for offering advice on its content. I also would like to thank my family for their continued support.

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[25] In support of Rava's statement, the gemara describes two Rabbis, Rabba (the same who questions Rav Ashi's statement) and Rabbi Chisda, who were so equally righteous that when each prayed for rain, it rained, yet Rabbi Chisda lived an amazing and long life--sixty wedding feasts in his family and until age 92--whereas Rabba lived in poverty and died young--sixty calamities and at age 40.

[26] To show that sometimes mazal does not change, Tosafot on Moed Katan 28a quote the gemara in Taanit 25a, in which Rabbi Elazar ben Pedat has a vision that G-d tells him that in order for him not to be poor, G-d would need to recreate the world so that Rabbi Elazar ben Pedat could be born during a time of sustenance. In this case, it would take re-creation of the world would change this mazal.

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The Miracle of Being Barren: Insight Into the Prominent Barren Women of Tanach

By **Talia Kupferman**

*"Sarah was barren and had no child" (*Gen. 11:30).

"And Isaac prayed to the Lord opposite his wife because she was barren" (Gen. 25:21).

*"But Rachel was barren [akarah]" (*Gen. 29:31).

"But Chana had no children…For the Lord had shut her womb" (Samuel 1: 1:2-6).

There is an undeniable recurring theme of infertility amongst many prominent women in in *Tanach*. Some *Tanach* scholars suggest that this theme teaches important lessons from these women's struggles. Others treat the mentioning of their barrenness as merely descriptive, holding no deeper meaning. Regardless of why the *Tanach* mentions their barrenness, one cannot help but wonder what precise physiological abnormalities caused their fertility issues. Was their infertility due to biological or prior congenital issues? Stress? Obesity? Many commentators, Rabbis, and scientists explore this area to gain insight.

The first barren women described in *Tanach,* and therefore, the most commentated on, is Sarah. The verse, *"Sarah was barren and had no child"* (Gen. 11:30), contains a redundancy regarding her infertility. After stating that Sarah was barren, the verse did not need to specify her lack of children. Dr. Joshua Bacon stated that since this is the first time the word *akarah,* barren, appears in the Biblical text, the *Tanach* is simply defining the word [1]. In order to understand her barrenness, a closer look needs to be taken at the text. The literal definition of *akarah* is "not attached." Could there be a connection between Sarah, and the infertility issues of other barren female personalities? [1]. Resh Lakish, an Amoraic scholar, explains that Sarah did not have ovaries, a possible interpretation for something "not attached" in her body. Ultimately, when God blessed Sarah (Genesis 17:16), Resh Lakish suggested that God fashioned her ovaries, which allowed her to conceive [2].

Interestingly, a passage in the Talmud *Yevamot* (64b) indicates that Sarah was an *aylonit*, a woman without secondary sexual characteristics. It should be understood, according to the Talmud, that a woman categorized as an *aylonit* is biologically a woman, and not a hermaphrodite. An *aylonit* is a woman with an imbalance of female sex hormones. The Talmudic sages describe four qualifications of an *aylonit:*

> No breasts;
>
> She has difficulty during sexual intercourse; she derives no pleasure;
>
> She lacks elevation of fat over her abdomen: and
>
> Her voice is deep and cannot be distinguished from that of a man.

Today, many scientists and medical professionals use this Talmudic explanation to draw the conclusion that Sarah had polycystic ovarian syndrome (PCOS) [1]. Alternatively, the term '*aylonit'* is often used in the Talmud to describe a woman who is barren due to a defect in her reproductive system, making it difficult to get pregnant. Such a defect is found in women with Turner Syndrome (females born with only one X chromosome) or other hormonal abnormalities. Since Sarah was described as an *aylonit,* she may have had one of these syndromes that prevented her from bearing children. Additionally, Sarah is the only woman in *Tanach* referred to as an *aylonit*. Therefore, we have no other barren women to compare her symptoms to, making it more difficult to identify the biological issues of Sarah's infertility.

Another reason why her eventual conception of Isaac was so miraculous was due to her advanced maternal age (AMA). Research has shown that beginning at the age of 35, the risk of having a child with chromosomal issues becomes higher as a woman continues to age. As women age, their eggs age as well. It is recorded in Genesis (21:5), that Sarah was ninety when she had Isaac, which is notably above the thirty-five year AMA limit used today. Thus, Radak, a medieval Biblical commentator, noted that there must have been Divine intervention for Sarah to conceive. There was no natural explanation for her to have been able to get pregnant with Isaac, considering the previously mentioned conditions. Even a scientific method could not have explained this odd phenomenon [3].

About 10 percent of women in the United States, ages 15-44, have difficulty getting pregnant or staying pregnant, according to the Centers for Disease Control and Prevention (CDC). It is common for both women and men to have fertility issues. While one third of infertility cases are due to physiological issues in the male [4], these cases are often not discussed. This applied to the case of the next matriarch and patriarch: Isaac and Rebecca. After struggling with infertility for 20 years, Isaac prayed for Rebecca to conceive. God accepted the prayer and Rebecca became pregnant (Genesis 25:21). Rabbi Yitzhak, a Talmudic Rabbi, presented the interpretation that Isaac was also infertile [5]. The *Tanach* described the scene of Isaac's prayer, "*And Isaac prayed to the Lord opposite his wife….*" It did not relate that Isaac prayed specifically for his wife, simply opposite her. Perhaps they were both infertile and Isaac and Rebecca were praying for their own fertility as individuals and for the fertility of the other. This urgent and powerful prayer led to the conception of their two children, Jacob and Esau.

Isaac and Rebecca's fertility journey can be compared to the story of Chana and Elkanah. Unlike Isaac and Rebecca's situation, in which it was unclear which of them was infertile, it is obvious that Chana was the infertile spouse, as Elkanah, her husband, had children with Penina, his other wife. Penina tormented and mocked Chana for not being able to have a child. Due to this mocking and lack of sensitivity, Chana stopped eating [6]. Dr. Isaac Schiff and Professor Morty Schiff explained that perhaps this constant taunting led Chana into a deep state of depression and anorexia which caused her infertility struggles to worsen [7]. Chana

traveled to pray at the Temple in Shiloh, pouring out her heart to God. At the Temple, Eli

the Cohen told Chana that God heard her request and as a result, will open her womb, in other words, give her a child. Upon hearing this positive news, she left the Temple, and returned home. She ate and her overall appearance brightened (Samuel 1: 1:18). Chana had been in a state of depression, perhaps developing anorexia, but after eating, her strength returned, and she conceived. Possibly, it was this combination of prayer and eating that allowed her to conceive.

Another matriarch who struggled with infertility was Rachel, Jacob's most beloved wife. When Rachel saw that she could not bear children, she stated the famous quotation to Jacob, *"Give me children, and if not, I am dead"* (Genesis: 30:1). This reveals how imperative having a child was to Rachel, so much so, that she would rather die.

When comparing the stories of Sarah, Rachel and Chana, a pattern can be seen in their approaches to coping with infertility. Sarah told Abraham to conceive a child with Hagar, Abraham's other wife, in order to procreate. Rachel told Jacob to be intimate with Bilhah, Rachel's handmaid, in order to conceive. The sacrifice these women made could have caused emotional embarrassment and strain. Rabbi Levi ben Gershon, a medieval commentator, philosopher and physician, offered a different explanation for both Sarah and Rachel's situations, postulating that excess fat led to their infertility. Overweight and obese women are at a high risk for reproductive health issues due to the higher incidence of menstrual dysfunction and inabilities to ovulate. The risk of infertility, conception rates, and pregnancy complications are increased in these women. Thus, weight loss would have tremendously beneficial effects on the reproductive systems in these patients [8]. Henceforth, if the reason why Sarah and Rachel could not conceive was due to their obesity, then the utter sadness and extreme emotions they felt after offering their husbands to their maidservants, could have caused them to stop eating and lose weight. Perhaps this weight loss allowed them to finally conceive [3].

Overall, there is no definitive reason or explanation as to why or how these women were barren. However, these women serve as a reminder that the ability to conceive a child is not simple. This reality is apparent even in today's society and dates back to Judaism's first matriarchs. To help cope with the struggles of barrenness, these women turned to prayer and emphasized its importance. These women revealed the value, sacredness and true miracles of conception, pregnancy, and childbirth. They are the epitome of perseverance, as they did not allow their realities to stop them from yearning and praying for the children they dreamed of having.

Acknowledgments

I would like to thank my parents, and the entire KupferFam for always encouraging me to be my best self and for teaching me to reach my highest potential. I would also like to thank Dr. Babich for supporting me in writing for *Derech HaTeva* and for being my pillar of support while on my journey to become a genetic counselor. Thank you to my teacher and mentor from Midreshet Harova, Rav Jonathan Bailey, and Professor Smadar Rosensweig of Stern College for Women, for giving me guidance on this topic. Lastly, I would like to dedicate this paper to the strong, brave and steadfast women in *Tanach* who understood the importance of continuity and took the difficult steps necessary in order to have a child; because of them, I am here today.

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The Past and Future of Dental Health

By **Lily Madeb**

The field of dentistry has been constantly revolutionizing in the past twenty years. There has been a significant decrease in periodontal disease in modern Western countries. In light of this, a new branch of dentistry has developed and flourished which aims to improve the aesthetics of our smiles. This also initiated the modernization of prosthodontics. The concepts upon which these improvements were made rest on foundations dating back to Talmudic times. Tracing back the developments of these fields help better understand the strides dental medicine has taken through history and see the similarities of human nature throughout history.

Even in the time of the Mishnah, esthetics were given much consideration. In the field of dentistry, esthetics refers to any dental work that improves the appearance (though not necessarily the functionality) of teeth, gums, and bite. As mentioned in the tractate Nedarim, "Rabbi Ishmael beautified the daughters of Israel: 'And Rabbi Ishmael made a tooth in the same place as a false one to make them more beautiful'... he replaced the false one to make them more beautiful [1]." Jews were not alone in recognizing the need for facial esthetics. The Central American Mayans, who lived between the years 2500 BCE and 1500 CE placed semi-precious stones in the oral cavity to enhance personal appearance. Though not the esthetic dentistry to which we are accustomed, appearance played a vital role in society and laid the foundation for esthetic dentistry.

Esthetic dentistry also had played a role in some laws pertaining to the Temple service, as noted in Maimonides' Mishnah Torah, defects in esthetic appearance can disqualify a priest in serving, as "those without teeth are prohibited because of their seemingly poor appearance [1]."

This has relevance to Jewish law regarding breaking religious engagements, also known as "Kiddushin", when the groom unexpectedly discovered that his bride-to-be was missing two teeth. The question was asked if he can break the engagement without having to pay damages. The famous sage, known as the Ohr Somayach, answered that he can break the engagement without paying damages as missing teeth were considered a blemish that disqualified a kohen or priest from serving in the Temple. This was distinctly noted in the Talmud (Ketovot 72a) where it stated that, "any flaw that disqualifies a kohen also applies to women" [2].

Artificial teeth used in Talmudic times were crafted from either gold, silver, or wood. In the Talmud, a case was noted in which a woman who replaced a tooth with a wooden one "was ashamed to say the nagra [carpenter], 'I have lost a tooth'" [3]. The woman's dead or infected tooth was described as discolored. Evidently, it was a nonvital tooth that lost its color due to degraded blood cells and hemorrhaging in the pulp. This caused a red color within the crown of the tooth. In order to remedy the situation, the tooth was replaced by a false gold tooth.

Whether or not these gold, silver, or wooden crowns were used for esthetic reasons or for dental health, a religious problem was posed. There is a Talmudic discussion of what items a woman may bring from a private domain to a public domain on the Sabbath, despite the law that carrying from a private to a public domain or vice versa is prohibited on the Sabbath. The Sages discussed whether a woman with a gold crown can come into in a public domain on the Sabbath. As noted in the Talmud, "a woman may go out with... a peppercorn, with a globule of salt and anything that is placed in her mouth...as for an artificial tooth [or] gold tooth, the Rabbi permits, but sages forbid it" [4]. The debate distinguished a gold tooth from a silver or wooden tooth, as the gold tooth had more value. On the Sabbath a woman should not go into a public domain wearing a gold tooth because if it fell out of her mouth she would not be permitted to retrieve it and put it back. Another reason presented was that of her pride, as "those who forbid it feel that the woman might be tempted to remove the gold tooth and show it to her friends in a prideful manner...and a silver tooth does not entail the same consideration as it is indistinguishable from other teeth" [5]. While this scenario described a woman sinning from a swelling pride, the next explanation proposed the opposite reaction. There was a fear that a woman who walked out on the Sabbath with a gold tooth would be embarrassed, as her friends would mock her for her need of a false tooth. To prevent embarrassment, she would remove it from her mouth, thereby incurring a sin of carrying on the Sabbath.

Today, dental crowns and false teeth are replaced by tooth implants. Yet, a more innovative approach is being directed to the usage of stem cells to potentially grow teeth that were removed due to periodontal infection. Embryonic stem cells, derived from human embryos at the preimplantation stage, are grown in cell culture. Rounds of subculturing keep the cells from differentiating until they can be directed to differentiate into the desired cell types. This is often accompanied by insertion of specific genes [6].

According to the American Academy of Implant Dentistry, more than three million Americans have dental implants. Despite their widespread use, dental implants come with a potential host of problems, such as rejection of an implant due to a incorrect implantation. More risk could arise from the required injections of bone materials, which can lead to further surgery and a possibility of having to re-implant again. This includes wrong placement of injections leading to irregular growths which would then require further surgery.

Research at the University of Pennsylvania by Dr. Songtao Shi was focused on extracting stem cells from children's teeth for use to help renew sensation in injured teeth that were considered "dead teeth" in those same patients. Stem cells, injected into the site of injury, differentiated into dental tissue. This study included a control group was treated using apexification, which is a process that encourages root development in injured children when blood does not correctly flow to the tooth. However, unlike the stem cell procedure apexification does not replace lost tissue. After analyzing the experimental and control groups, there were more signs of thicker dentin and healthy root development in the experimental group treated with stem cells. In addition, there was increased blood flow and, after a year, there was some regain of sensation. Dr. Shi described the results as, "this treatment gives patients sensation back in their teeth. If you give them a warm or cold stimulation, they can feel it; they have living teeth again" [7].

There have also been breakthroughs in research at the University of Nottingham by David Mooney. He developed synthetic biomaterials that when placed in direct contact with dental pulp tissues stimulated native stem cell population to repair and regenerate the tissue and surrounding dentin. Instead of filling decaying teeth with inorganic restorative material, stem cells grow natural bony tissue instead. In other words, this stem cell procedure is preferred over the restorative biomaterials procedure and may soon replace it when it is confirmed to be done in the United States. Research with laboratory animals at the Wyss Institute at Harvard University modified this technique with the use of low power lasers to activate the growth of dental tissue. These procedures have not yet been approved to be performed on humans.

Lastly, studies at Tufts School of Dental Medicine have used stem cells to grow new teeth and jaw bone. The procedure included the differentiation of stem cells to tooth buds, which were used with cellular matrix to allow successful implantation of a tooth bud into a pig's jaw. Transfer to a human would require a significant advancement in biotechnology, which has yet to come [8].

Overall there is an extensive history that comes behind the branch of prosthodontics and esthetics that have been the foundation of the procedures we use now and are continuing to develop to keep our dental health at its finest. These advancements may also change the way we deal with these Talmudic texts. Stem cells work to regrow the natural tissue, thus there would be no question of bringing this new tooth into a public domain the way we might have with the restorative biomaterial replacements. It would also eliminate the debate of a woman showing off a new tooth, or perhaps being embarrassed of one, a naturally formed tooth would not ignite this type of debate anymore. This is an accurate example of the Torah's flexibility because it of course still applies even as we continue to advance. Moreover, we often can look to our past to inspire the innovations that push us forward in society, more specifically the world of medicine.

Acknowledgments

I would firstly like to thank my parents and sisters for always supporting me in every direction I go. They continuously push me to learn more and support my education in order to reach my fullest potential. I would also like to thank Meir Bozaglo for being my biggest support and inspiring me to achieve all that I can with grace and confidence. I will never be able to thank any of you enough.

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Halachic OCD

By **Miriam Radinsky**

Obsessive compulsive disorder, OCD, is a chronic anxiety disorder in which a person becomes trapped in a cycle of unwanted and uncontrollable thoughts- obsessions- that lead to repeated behaviors- compulsions. Obsessions can be characterized by a variety of irrational and stressful thoughts. Some obsessions include obsessive doubts, where a person is unwilling to accept that a task has been competed in a satisfactory way, and obsessive thinking, where a person becomes distraught about potential negative future events in an almost infinite chain of thoughts. Compulsions are fixed, ritualized behaviors that a individual develops in order to prevent the occurrence a future event. Although one deems it necessary to succumb to these actions in order to release tension, the act itself does not give pleasure to the individual with OCD and is often harmful. Some compulsive acts include overly cleaning, checking, counting, hoarding and being overly superstitious [1].

OCD is a common disorder, affecting over 2% of the American population. While many people affected by OCD can control their compulsive behaviors and function normally for certain periods of time, in severe cases, OCD can interfere with occupational and social functioning [2].

Due to the rituals and stringencies that accompany religious observance, OCD can manifest in extreme ways within the context of religion. This idea dates back to the 1600s in the Catholic Church when monks were accused of being involved in excessive prayers, antithetical to what was believed to be a positive expression of devotion to God. The term scrupulosity was coined to define the obsessive God pleasing and the extreme fear of falling short. Characteristics of scrupulosity include excessive prayer and constant fear of sin. Today, this phenomenon is known as religious OCD [3]. Studies show that youths and adults with symptoms of religious OCD have significantly higher symptom severity and a poorer treatment response than those affected by other types of OCD [4].

The issue of religious OCD is particularly challenging in Judaism because of the major emphasis that *halacha* puts on specific details of required rituals. Jews are expected to conform to high standards and preciseness regarding everything they do. As noted in *Avot* (2:1),"Be as careful with a light commandment as with a weighty one, for you do not know the reward given [for the fulfillment] of [the respective] commandments." No matter how simple a commandment may seem, Jews are always meticulous with the details because the effects of our actions can never truly be known. However, the priority given to the details of *halacha* leaves a lot of room for OCD expression in Judaism [6]. How does Judaism handle this issue of *halachic* OCD?

As noted by Rav Mordechai Willig [5], this issue was addressed by the Ramban in *Hilchot Nida*. A case is presented in which a woman was afraid to go through the *tevila* (spiritual cleaning) process because of concern about the preciseness and details of the *halachot*. The Ramban urged this woman to go through with the *tevila* anyway because " - "אין לדבר סוף"this matter has no end." She will never be able to function normally if she is over-concerned about the tiny details of the *halacha* [5].

Rav A. Lebowitz noted a similar situation presented in tractate *Pesachim*, which addressed an individual who was concerned that a rat brought leavened bread *(chametz)* into a room that was already checked before Passover. The conclusion was that "this matter has no end." There would be no end to the search for leavened bread before Passover if a person was constantly thinking about the possibility that something unlikely would happen. It is our responsibility to have normal concerns, not to be stressed over infinite possibilities that may go wrong [6].

Rabbi M. Willig, while presenting a *shiur* that addressed the topic of *halachic* OCD, quoted from tractate *Brachot*: "The Torah was not given to angels." Rabbi Willig quoted the Kotzker Rebbe who has been known to say that *Hashem* has enough angels, He just wants us. *Hashem* did not choose to give the Torah to angels who cannot sin. Rather, the Torah was given to human beings and we do our best to live by it, even though we are imperfect. *Hashem* wanted us to be "" - "אנשי קודש*people* of holiness," which inherently includes our human and physical limitations [5].

Rav Willig further explained that *halacha* is fully dependent on the *mesorah*, the chain of Jewish thinkers and Rabbis before us, without which we would be completely off base in our religious observance. The *mesorah* allows us to connect with the great scholars and Jewish communities that preceded us in order to guide us in our service of *Hashem*. Without such a connection to the past generations, there is no way we would be able to determine the appropriate pathway in life. The *mesorah* is important because in addition to teaching us the technicalities of *halacha*, it also teaches us how to behave and interact with others. The *mesorah* teaches us the extent to which we should be meticulous and exact about *halacha*. Although it is imperative to do our best and to be as fastidious as possible, it is clear from the actions of those who preceded us that it is not proper to be obsessive about *halacha*. All we can do is our best; the rest is in the hands of Hashem [5].

Rav Willig cited a passage in tractate *Brachot* (60a), "Fortunate is someone who is always afraid," noting that Rashi explained that this referred to a man concerned about forgetting his Torah knowledge. Rabbi Willig pointed out that Rashi specifically did not say, as one might have thought, that this referred to someone afraid of performing the commandments improperly. Someone who is afraid of following the *halacha* correctly to such a great extent will not be able to accomplish anything. A person must not be so nervous about one detail of *halacha* going incorrectly so that he misses performing the *mitzvah* entirely. Rabbi Willig further explained that someone should also not be overly fearful of forgetting his Torah. In regard to Torah knowledge, "we do the best we can" [5].

Rav Asher Weiss published a *teshuva* on the topic of *halachic* OCD in his book *Minchas Asher*. A man suffering from OCD was told by his doctor that in order to treat his OCD he could never repeat words in his *brachot*. However, according to the *halacha*, if a person is sure he said a word incorrectly, he must go back and repeat it. He asked Rav Weiss if he should follow the treatment or the *halacha [*6]. The recommended treatment for this man was exposure and response prevention therapy (E/RP), which is the most effective treatment for controlling OCD known today. E/RP forces subjects to confront their anxiety-producing stimuli and to actively abstain from the compulsive behaviors that usually accompany them. Slowly, anxiety decreases and the person becomes less sensitive to the stimulus through a process called habituation. After a strict adherence to E/RP, the stimulus may have little to no effect on the person [1].

In this situation, Rav Asher Weiss answered that this man should follow the E/RP treatment rather than the *halacha*. He supported his claim with three major sources. Firstly, a person need not spend more than twenty percent of his income on any given *mitzvah*. Rav Weiss argued that if this is the case, surely a man's money cannot be more important than his mental health. A man should not have to sacrifice his mental health for a *mitzvah* [6]. Secondly, tractate *Shabbos,* presents the reason why one can break the laws of *Shabbos* in order to save a life: "One is permitted to desecrate one *Shabbos* so that the person can observe many [future] *Shabboses*." Rav Weiss used this Talmudic source to show that *halacha* fosters sacrificing one *mitzvah* in order to be able to fulfill many *mitzvot* in the future. If this man did not follow through with the E/RP treatment, he would be unable to function normally and this would prevent him from performing future *mitzvot*. Rav Weiss cited a *teshuva* from the *Chasam Sofer* who ruled that it would be permissible to institutionalize a man in a facility with non-kosher food if that was the only available option. Better to violate one *halacha* now and to be able to keep many *halachot* in the future, than not violate the *halacha*, remain incapable of functioning, and as a result, not be obligated in *mitzvot* at all (Orach Chayim, 83). Violating a single *halacha* for the long run pursuit of performing many *mitzvot* can often be a preferable option [6]. Finally, as noted in tractate *Nazir* (23b), "Great is a sin for His name," which means that it is praiseworthy if a person violated *halacha* for *Hashem*'s sake. The specific parameters of this concept are unclear and therefore, this is generally a tricky concept to implement. However, Rav Weiss held that this concept can be applied "in a place where there is nothing else," meaning, if there is really no other option, then this principle can be used. Rav Weiss argued that in the case of OCD, the situation is dire enough to rely on this concept [6].

It is clear that Judaism does not encourage *halachic* OCD and any person with OCD, whether or not it is expressed through *halacha*, is encouraged to seek help. Although the details of Judaism are of the utmost importance, there is also value in realizing that no one is perfect. Nevertheless, we must strive to do our best.

Acknowledgements

I would like to thank my parents for their continued support in all my endeavours and specifically for supporting my education at Stern College. I would also like to express my gratitude to Dr. Babich for his encouragement and resources, which greatly contributed to this article.

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Born from a Bag: The Halachic Challenges of Ectogenesis & the Artificial Womb

By **Tamar Schwartz**

In today's ever-changing world, scientists constantly progress further in facilitating pregnancy and childbirth for the large population of women who have difficulty with fertility. While *in-vitro* fertilization (IVF) has become a popular route since its 1978 inception, having produced 5 million births by 2013 [1], some cases of infertility involve complications in the mother's ability to gestate a child whether conceived traditionally or not. Women suffering from uterine-factor infertility, by the absence or dysfunction of the uterus [2], as well as many survivors of ovarian or cervical cancer, are unable to gestate a child on their own, even if an embryo is implanted. Thus, surrogacy has remained a more viable option for these cases, and with it, halakhists have investigated the complications arising when two potential mothers contribute to the future child; does the motherhood rest in the egg donor or in the birth-mother, some combination of both, or neither?

As a recent 2017 study published, an extra-uterine "bio bag" has been successfully tested on premature lambs as an effective incubator for continued fetal growth[3]. Scientists project to use such technology to further synthesize the perfect artificial maternal environment, equipped with simulated organs of the mother and an artificial placenta. Therefore, such innovations predict the near development of an entire artificial womb capable of growing, carrying and gestating a child. This issue somewhat facilitates but also complicates our halachic argument; while the external womb obviates the potential dual motherhood presented in the case of surrogacy, the fetus's missing birthmother generates its own questions and challenges. If the gestational birth-mother is considered the halachic birthmother of a child, then how do we treat a child is born from an inanimate object? If maternity generally determines the Jewish status of a child, and the child has no mother, would it even be possible for a child produced in an artificial womb to be considered Jewish?

Parenthood Status

There are two classical approaches to assign motherhood within Jewish law. The first implies "genetic motherhood" as the woman who contributes the egg, and the second, "gestational motherhood"- the woman who carries and gives birth to the child. Genetic motherhood seems logical according to both Talmudic legends as well as *halakhically* binding rules. On a theoretical level, Rebbi and Antinonus are quoted in *Sanhedrin* (91b) for saying that the soul enters a child at conception, and the Talmud in *Nida* (31a) is quoted classically to state that three partners are involved in the creation of human being: mother, father and G-d, thereby conceptually proving a mother is defined by her egg in the formation of the fetus. Furthermore, the Ramban (*Vayikra* 12:2) explains that the mother transfers "*odem*", or redness, a term for flesh to her child at the time of fertilization. This approach is additionally proven by the rule that a woman who remarries after her husband's death or after conversion must abstain from marital relations for three months so as to avoid questionable paternity from previous relationships. This would indicate that the status of a Jewish child originates at conception (*Yevamot 42a)*.

A somewhat strange source comes from Talmud (*Brachot* 60a*)* which described that Leah prayed for her fetus to become a girl, after which she gave birth to Dina. According to the Tur, this source proposed that Dina was in fact conceived originally by Rachel and subsequently transferred and gestated through Leah, thus allowing her to be eligible to marry Shimon, also a son of Leah. However, Targum Yonatan understands the case differently, explaining that since Yosef switched with Dina in the womb, he was ultimately considered the son of Rachel as he was gestated by her, thereby proving that gestation defines motherhood. Rabbi Yaakov Emden used the phrase *ubar yerekh imo* to define the fetus as a limb of the mother, or a physical entity of her, hence an outgrowth of her body. The Talmud (*Yevamot* 97b*)* stated that twin boys born to a woman who converted during pregnancy are related maternally, but not paternally [4].

Alternative perspectives in this argument include the *Tzitz Eliezer*'s denial of any kind of motherhood in the case of IVF. Among his arguments, he claimed that

the Petri dish involved in fertilization is a third-party parent that interrupts the other relevant progenitors. He adds that the ovum is not fertilized naturally in the mother's body but was fertilized outside and thus severed the mother-child bond. Rabbi Zalman Nechemiah Goldberg, a modern *posek* in Israel and the son-in-law of Rabbi Shlomo Zalman Auerbach, posited that both egg donor and birthmother can simultaneously experience mother status [5]. He explains that we must consider both possibilities since one or the other cannot be confirmed, as also noted by R' Shlomo Zalman (Nishmat Avraham 4:186). This theory may be further bolstered by more recent scientific discoveries including the theories of maternal -fetal exchange and epigenetics which imply a biological link between the birth-mother and the fetus, thereby supporting the gestational motherhood view alongside the biological point of proof for genetic motherhood.

Uterine transplants present a more complicated case from simple IVF or surrogacy assisted IVF, yet avoid the epigenetic factors of a surrogate mother. A transplant, in fact, according to Rabbi Binyamin Aryeh Weiss in his *sefer, Even Yekara,* was *halakhically* like a branch of an *orlah* tree (less than 3 years old with fruit that are *halakhically* inedible) grafted onto an older tree is considered an entity of the larger tree. Therefore, a new uterus within a woman becomes part of her body and retains one's maternal status [6].

Unlike the previously researched cases of surrogacy, ectogenesis, or the development of a baby outside of the womb eliminates the debate between genetic and gestational birthmother. Yet, this process presents a child who may have a clear halakhic mother, according to the genetic motherhood approach, which would qualify egg donation for IVF and subsequent incubating in an artificial womb. Conversely, ectogenesis may disqualify motherhood according to the gestational motherhood perspective, as an actual mother is lacking. The unique, unilateral approach of the *Tzitz Eliezer* prohibits the use of IVF altogether as a mode of conception before artificial womb even enters the equation as a mode of gestation.

Defining Human Status

Whether we assume that motherhood is ascribed to the egg donor or not, the reality of ectogenesis presents a child who grows in a laboratory-manufactured bag. Rav Hershel Schachter noted the response of the *Chacham Tzvi,* Rabbi Tzvi Hirsch ben Yaakov Ashkenazi, a 17th century *posek*. He cited the Talmud (*Sanhedrin* 65b*)* which explained that Rabbi Zeira killed the *golem,* an artificial life-like creation that Rava made for him. In reference to that case, the Chacham Tzvi (*Chacham Tzvi* 93*)* points out that in his time as well, his grandfather built a *golem* which similarly was treated as a non-human, and was allowed to be murdered without consequence. Whatever the status of the *golem*, the *Chacham Tzvi* concludes that he is defined by having not been gestated by a mother. According to Rav Schachter, this source, further emphasized by the *Cheshek Shlomo* on Yoreh Deah, worked under the same theory that laboratory-produced meat from animal stem cells was considered *pareve*. In both cases, a living organism that is not produced naturally was not treated like the actual organism [7].

However, in a 2003 article in *Tradition*, Rabbi Moshe D. Tendler and Dr. John D. Loike defined a human as someone possessing a number of traits including physiological normalcy, *daat*, or basic knowledge, even with certain mental impairments, and reproductive capacity. Apparently, there are minimal requirements to be considered a human being. When addressing the case of the artificial incubator, they propose that such a child will assume human status according to these qualifications. As long as the child produced is physiologically normal, even developmental abnormalities would not skew his status. They posit that there are in fact rabbinic authorities that have treated *golems* as human despite not being born from a human[8].

Ethical Considerations

According to philosophers Peter Singer and Deane Wells [9], there are five general claims that support the usage of artificial wombs: assisting infertile couples, mitigating abortions [10], allowing for equality between man in woman in reproduction, producing better adjusted children, and producing "spare parts" for organ donation.

These reasons are challenged by the authors through corresponding arguments against ectogenesis and are questioned by Jewish ethics as well.

The first claim, while most innocuous, must be seriously evaluated by *halakha* as a valid reason to take certain measures when playing around with human life. Although American law considers infertility a

disability, it is not clear that halakha does the same. A lack of a reproductive capacity does not constitute a level of *choleh she'yesh lo sakana* of which we allow violation of Shabbat. However, the psychological and social pressures that arise from the experience of infertility are weighed by many *poskim* as valid reason to permit IVF treatments on Shabbat [11].

The arguments toward abortion, while complicated may be in line with halakha's tendency to prioritize saving human life and the greater attitude of halakha toward the equating the roles of man and woman in reproduction as well as organ donation (and the seeming immorality of reproducing for such purpose) are beyond the scope of this article. Nevertheless, the issue of producing "better adjusted children" requires further discussion.

Singer and Wells cite Shulamith Firestone's argument for "better adjusted children" as a beneficial measure of the detachment of the fetus from mother at early stages of development. However, this view appears remarkably challenged by research in "skin-to-skin" interactions as well as maternal-fetal stem cell trafficking, both proven to improve the health and adjustment of both mother and child. Yet, the concept of producing supremely healthy children through artificial womb technology seems critically relevant in this discussion. Dr. James Fritzell Jr., clinical director of the Small Baby Program at Miller Hospital in Long Beach, California explained that by growing a fetus in a controlled environment, the artificial womb can actually mitigate birth complications [12]. Variations of artificial womb technology are apparent here as well, as neonatal specialists are using similar research and technology to develop "artificial suppliers" such as the artificial placenta to provide proper nutrients to premature birth infants. The thought is that such technology will avoid maternal diseases and maternal exposures to drugs and pollutants and instead developing the ideal resources for a fetus within a simulated womb. The scientists building the first artificial wombs are creating artificial lungs, kidneys and hearts in effort to replicate the maternal environment to wholly support the fetus outside of the human body [13].

Nevertheless, many other research studies have proved the importance of numerous hormones and mainstays of the mother's internal environment that naturally assist in many aspects of fetal development and that would be difficult to simulate in the artificial womb.

Although researchers are still in the developing stages of building the perfect incubator environment for the human fetus, after successfully growing a lamb to gestation, we are nearing the reality of a human-like artificial womb. Given the numerous questions presented, the issue is in need for further discussion to distill its *halakhic* parameters. After finding surprisingly positive results in favor of potentially making use of the artificial womb among a sample of 216 people in Israel, Frida Simonstein and Michal Mashiach-Eizenberg noted that at one time, IVF treatment seemed radical, unsafe and out of reach until its safety was confirmed and it developed into a modern norm [14]. In a matter of time, once the biochemical and technological intricacies of the artificial womb are inevitably addressed, it will become necessary to weigh the importance of this novel advance in infertility treatment with the applied relevant halakhot any impact on family structures that will ensue with the development of a child from an artificial incubator.

Acknowledgements

I would like to thank my parents for their constant guide and support in pursuing my love of Torah and my fascination with science. Thank you Dr. Babich for providing valuable materials for research and support in writing and editing for this wonderful publication. I would like to thank Rabbi Dr. Eddie Reichman as well for his additional insights on the topic.

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The Unknown Perks of Meat and Wine

By **Leah Shulman**

A ritual Jewish meal is always accompanied by wine and meat. It is written, "On every joyous occasion or Festival, wine is imbibed (*Ecclesiastes* 9:7, *Psalms* 104:15) and, "Meat should be consumed on joyous occasions and on *shabbat* and festivals" (*Pesachim* 109a). Cases that require wine, preferably red wine, include evening *kiddush* for *shabbat* and *yom tov*, *havdalah*, the *pesach seder*, a *brit milah*, and a wedding (*Berachot* 34b). In fact, wine is so vital for evening *kiddush* that when wine is not available, *kiddush* must be made over *challah*, not a substitute liquid. Furthermore, a special blessing is made specifically on wine, but not made on other liquids. The Hebrew word for a feast, *mishteh*, is derived from the word *shoteh*, which means drink; this indicates how important wine is at a meal [1]. Rabbi Yehuda was said to only drink wine for his *pesach seder*, *kiddush*, and *havdalah* [2], which emphasizes the special status given to wine. It is up for debate whether it is a *mitzvah* to have meat at a *yom tov* meal, but regardless, it is the ideal food. Wine and meat are commonly perceived negatively by contemporary diet plans in regards to maintenance of a healthy lifestyle. While the health benefits of the two may not necessarily be the reason for the *mitzvah*, wine and meat provide nutritional benefits.

Wine plays an important role in a meal due to its ability to "cheer a man's heart" (*Psalms* 104:15). It has the ability to bring happiness and bring people together for celebration. It is customary for a *l'chaim* to be made when drinking wine, which serves as an acknowledgement to its power of enhancing life. Wine is used as a means of blessing and joy, but the Talmud also discusses the various health benefits of wine and meat.

While wine and meat consumption can be healthy, the most concerning health risk of red wine is from its ethanol content, which can be poisonous in high doses. However, the recommended dosage, two cups of red wine per day, does not result in significant health risks. In fact, a study showed that, "platelet aggression is decreased by low or moderate doses of alcohol. However, after heavy ingestion of alcohol, a rebound effect on platelet response can be observed, causing sudden death." In moderation, wine has numerous health benefits. Only when it is over consumed, is it harmful. One study of American alcohol consumption showed that those identified as low consumption drinkers had a reduced mortality rate than abstainers. However, the death rate for heavy drinkers increased tremendously.

These recent studies have elucidated truth to the Talmudic position on the health benefits of wine and meat. The talmudic *Amora* Abaye had a mother who maintained that diluted wine helps for weakness of the heart (*Eruvin* 29b), and protects against cardiovascular disease. Aged wine is helpful for the intestines, whereas fresh wine can be harmful (*Nedarim* 66b). New liquor increases excretion, bends the body, and dims the eyes (*Pesachim* 42a, *Eruvin* 55b-56a). The Talmud also explains that wine has healing abilities as potent as modern medicine, "Wine is the greatest of all medicines. Where there is no wine, drugs are necessary" (*Baba Batra* 58b). Studies show major benefits of wine, such as improvement of the bioavailability of polyphenols (natural antioxidants) in the food bolus and the lowering of blood pressure. Wine is thought to protect against cardiovascular disease and to prevent some types of cancer. It prevents the oxidation of low density lipoproteins (LDL), a process which negatively affects cholesterol. One study showed that consumption of 200 mL of red wine during a meal lowered total cholesterol and LDL cholesterol in just one week. Wine reduces High Density Lipoprotein tissue factor which in turn reduces ischemic heart disease. Wine contains omega-3 polyphenols and antioxidants, each playing its own important role. An interesting study showed that one glass of wine per day lowers the risk of cancer, sudden deaths, all causes of mortality, and myocardial infarction (heart attack). It should be noted that more than four cups of wine a day increases these risks [3]. In addition, moderate alcohol consumption causes an improvement of mood and quality of life for older men and women [3].

These benefits of wine hold true mainly when wine is consumed as part of a meal. For example, there is a direct relationship between antioxidant effects when wine is consumed during the meal. For example, red wine consumption during meals decreases the oxidation of LDL. In this light, the French paradox. i.e., the seeming contradiction that despite French

people consuming foods high in saturated fats (similar to Americans), they appear to have a lower incidence of cardiovascular disease, can be understood by studying wine consumption. The French are the highest consumers of wine in the world. The average daily meal time for Americans is sixty minutes while the French average ninety-three minute meals excluding longer meal preparation. The French population drinks more wine at meals and mealtime is more focused. Therefore, they reap the aforementioned benefits of wine consumption. A longer meal benefits metabolism of fats and the peak level of insulin secretion, which is an important factor of food metabolism [3]. Wine is a vital contributing factor to digestion at meals, as it improves cardiovascular health and enhances life expectancy.

The Talmud discusses the many health benefits of meat, for example, its rich nutrient content. Meat is more nourishing than vegetables or grains (*Nedarim* 49b). Moreover, a pregnant woman who eats meat and drinks wine has robust children (*Ketubot* 60b). Red meat contains substantial amounts of vitamin D, potassium, heme-iron, which is especially beneficial for cognitive development in children, and sodium, all of which are included in the seven required nutrients essential for every person, according to the U.S. DGA (Dietary Guidelines for Americans) [4]. The Talmud recommends eating roasted meat to treat weakness of the heart (*Eruvin* 29b) and eating fat meat to strengthen the body and lighten up the eyes (*Pesachim* 42a). In one scientific study, increased red meat consumption was linked to greater zinc levels, which is an important factor for cell growth, as well as higher riboflavin and vitamin C levels. Meat also contains vitamin B12, and important vitamin for various neurological functions and one which reduces the risk of megaloblastic anemia, a blood disease otherwise fatal. It also has important nutrients such as phosphorus, selenium, niacin, and vitamin B6 [4]. Furthermore, beef's high energy content is associated with good muscle mass [5], which is especially crucial for the elderly.

Similar to wine, over-consumption of meat is detrimental to health. Excessive ingestion of processed meat is linked to colorectal cancer. This processing includes salting, curing, fermentation, smoking, or preservatives. Many of the risks associated with meat are delineated only in studies of processed meat, but not unprocessed red meat [5]. For example, one study showed no association between consumption of unprocessed meat and chronic obstructive pulmonary disease, however, an association was observed for processed meat [6]. One major risk factor of red meat is its high fat content, which is why it may be substituted for other high protein foods, like chicken or fish. However, grilling or roasting red meat, instead of frying it, can help lower this risk. Cooked properly and eaten cautiously, meat can be extremely healthy. In fact, meat consumption in moderation is advised in Tanach (*Proverbs* 27:27). Both wine and meat are stigmatized for their health risks, but there are extremely important benefits to both, and only in excess are they harmful.

Wine and meat can be savored knowing they are *halachically* ideal and healthful. The Torah recommends to have both wine and meat at a meal, "One should drink wine only as part of the meal, otherwise it intoxicates" (*Pesachim* 10:37). The pros of wine consumption are enhanced during a meal, and the risks are tremendously reduced. As shown by the French paradox study, having wine at a meal was shown to be very beneficial for digestion, and reduction of the intoxicating effects of ethanol. Similarly, risks of meat consumption may be reduced when eaten with wine. One study showed the absorption rate of malonaldehyde, which is responsible for peroxidation of LDL and increased cholesterol, was caused by high fat meals like red meat. However, when consumed with red wine, the absorption rate of malonaldehyde decreased by 75% and this rate was eliminated altogether when the meat was marinated in red wine prior to cooking. Essentially, regular and moderate consumption of red wine actually counteracted the "initiating factors of the atheromatous plaque" of high fat foods and had protective properties against cardiovascular diseases [3]. The benefits of both wine and meat are complemented when consumed together, just how it was commanded to be. *L'chaim*.

Acknowledgements

I would like to thank Dr. Babich for encouraging me to write for Derech Hateva, helping me gather necessary sources, and being there for constant support. Thank you to Rabbi Itamar Rosensweig for reviewing the Talmudic sources and discussing the

subject matter with me. I would also like to acknowledge the editors of Derech Hateva, without whom this publication would not be possible. Lastly, I would like to thank my parents for their constant love and inspiration.

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New Findings in Psychopharmacology May Impact Smoking on Yom Tov

By **Esther Stern**

The list of smoking withdrawal symptoms is quite lengthy, including both physiological and psychological effects. Psychological reactions include depression, insomnia, irritability, frustration, anxiety, difficulty in concentrating, and restlessness. Decreased heart rate, and increased appetite or weight gain are examples of physiological effects of smoking withdrawal [1]. Craving to smoke typically increases in response to smoking deprivation.

A study was conducted to understand the relationship between Sabbath abstinence of smoking and withdrawal symptoms amongst smokers [2]. Sabbath-observant Jewish men were surveyed on their urge to smoke and on their withdrawal symptoms that were experienced on the Sabbath as compared to non-Saturday weekdays. Findings from the study suggested that Sabbath-observant Jews were able to abstain from smoking during the Sabbath with significantly fewer withdrawal symptoms as compared to weekdays. Apparently, the Sabbath-observant smokers had lower levels of nicotine craving and fewer withdrawal symptoms on the Sabbath as compared to other days of the week.

The accounts of withdrawal symptoms were evaluated in an experiment that sought to understand the effects of abstaining to smoke on the Sabbath as compared to baseline [3]. A forced smoking-abstinence workday was introduced, which allowed for comparison both to baseline smoking on a weekday and to Sabbath abstinence. The results showed that craving to smoke, as well as irritability, were lower during the Sabbath than during the other two days tested. Difficulty in abstaining was also lower on the Sabbath than it was on the workday. The resulting lowering of craving and irritability, suggested that the participants were more affected by habits, cues, and expectations than by smoking deprivation.

These findings could possibly impact on the *halakhic* approach taken to those smoking on *Yom Tov*. Insofar as preventing oneself from smoking caused great anguish, anyone who routinely smoked was permitted to smoke on *Yom Tov* [4]. Even those authorities who ruled that smoking should not be allowed on *Yom Tov* were lenient when it came to those who experienced painful withdrawal symptoms on *Yom Tov* [5]. The *halakhic* assumption maintained that smoking deprivation caused craving and irritability. However, the recent findings noted above, suggested that habits, cues, and expectations had more of a bearing on withdrawal symptoms than did smoking deprivation. Carried one step further, the experimental results implied that *Yom Tov* is like *Shabbat* in routine and in expectation, and thus, one should be able to accustom him/ herself to habitual abstinence instead of resorting to quenching the deprivation by smoking on *Yom Tov*.

Before the discussion of accommodating nicotine addicts on *Yom Tov* if they were in dire need, cigarette smoking was *halachically* permitted to the extent that it belonged to the *halakhic* category of *Davar Hashaveh L'chol Nefesh,* something unilaterally necessitated for everyone [6]. Others supported smoking, even on *Yom Tov*, because it strengthened the health of the smoker [7]. With scientific advancement in understanding the hazardous health effects of smoking, an updated reality and a changed *halakhic* reality was triggered, causing a shift in the strictness of the rulings with regards to smoking.

As for *halakhic* implications of the experimental research, many of the current Rabbinic authorities [8] have outlawed smoking under any circumstances. There are those who go so far as banning smoking in public areas, with the idea that it is damaging both to oneself and to one's neighbors [9]. The studies cited above on the psychological effects of smoking withdrawal on the Sabbath by Sabbath-observing Jewish men are fascinating in their own right, but also add to our understanding of nicotine addiction and the effect habits, cues, and expectations have on smoking withdrawal.

Acknowledgments
Thank you to my parents for supporting my education and to my brothers who aided me in completing this manuscript.

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Halachic Ramifications of Head Transplants

By **Sara Verschleisser**

During the Reign of Terror (1793-1794), in which the guillotine was the primary method for capital punishment, Charlotte Corday was executed publicly for the assassination of a representative of the people. After her decapitation, the carpenter that built the guillotine picked up her head and slapped it. To quote Albert Camus's *Reflections on the Guillotine*, "Charlotte Corday's severed head blushed, it is said, under the executioner's slap" [1]. Witnesses are reported to have seen her face twist in indignation [2]. This lead to the realization that the head remains conscious and aware for a short time after its removal from the body.

People were fascinated by this idea. For thousands of years, scientists, who at the time of the discovery were mostly philosophers, had been arguing about where a soul resides in a person. According to many, the soul was in the liver, to others, the heart, and to a few, the brain. Scientists were in awe to have found an answer: the soul is in the brain.

Researchers began to experiment. After decapitation, unconsciousness generally occurs within 10 seconds, as the brain lacks oxygenated blood. Irreversible brain damage occurs only six to ten minutes after decapitation [2]. This leaves a short window for action, in which the head can be saved through a transplant. If the head and body are kept at cold temperatures, scientists have more time to restore blood flow to the head, which can be done through anastomosis, the surgical connection of blood vessels. If one can provide the head with a blood supply fast enough, full consciousness may be preserved. Charles Guthrie, one of the developers of anastomosis, was the first to successfully transplant a head onto another body. He grafted the arteries of one dog's head to another dog's body, so that the heads were facing, chin to chin. However, too much time had elapsed before the attachment, and the brain of the attached head did not regain much function [3]. In the 1950s, a Russian scientist, Vladimir Demikhov, transplanted 20 puppy heads (including the forelimbs- shoulders, lungs and front paws) onto the backs of fully grown dogs, and they retained full brain function. The doctors fed and played with the attached heads, and they acted like normal puppies. They lived between 2 to 29 days before dying, generally because of the rejection of the new head by the original dog's immune system, which had a lack of immunosuppressive drugs [4]. In the 1970s, Dr. Robert J. White was the first to successfully switch animals' heads, a "cephalic exchange," not just adding a head, but replacing one. He switched the heads of two chimpanzees, who reportedly were aware enough post-surgery to chew, focus their eyes and bite the researchers. He could not, however, attach their spinal cords and chose not to attach their esophagi. They died within 3 days, from either immune rejection or internal bleeding [4].

While these experiments seem grotesque, pointless, and ethically controversial, they have very practical applications. A countless number of diseases and accidents can permanently ruin the body and cause it to deteriorate until death. Therefore, head transplants could save many lives. Doctors are still incapable of performing spinal fusion, the process of reattaching the spinal cord, however, if it can be developed, endless human conditions could be remedied by giving one a whole new body. Other than spinal fusion, the medical technologies needed for a head transplant already exist. So a quadriplegic, already paralyzed from the neck down, whose body is failing, could possibly have a new body and an extended life span. As of now, no head transplants have been attempted on humans, and research on animal subjects continues [4].

A head transplant raises a myriad of *halachic* hypotheticals. This medical innovation raises many issues regarding *Aiver Min Hachai*, *Retzicha*, the location of the soul, gender identity, *Giloi Arayot*, and more. Due to the fact that a human head transplant still lies in the realm of hypothetical, no major *posek* has discussed the matter. There are, however, some Jewish ethicists who have taken an interest in the topic, providing *halachic* insights, perspectives, and suggestions about possible rulings. Many of the sources used are not necessarily *halachic* sources, but

philosophical and ethical sources. In modern hypotheticals, this usage of *hashkafa* (religious perspective) is often necessary to draw out the *halacha*.

The simplest questions involve head transplants with animals, such as those pertaining to the possibility of post-*shechita* head transplants. If an animal, who shall be called Bob, has been *shechted halachically*, but the head is then attached to another animal, John, similar to Demikhov's dogs, is the rest of Bob's body *halachically* considered *Aiver Min Hachai*?

The *Simla Chadasha* discussed laws that are more stringent to a non-Jew than a Jew, such as the Seven Noahide Laws. Among these is the sin of *Aiver Min HaChai,* eating from a live animal. For a Jew, an animal is kosher once it has been *shechted halachically*, whether there is still movement or not. If a chicken's head has been cut off and the body is still moving, *halachically* called *pirkus*, a Jew can eat the head immediately. A non-Jew, however, must wait until the body has ceased moving before eating it. Applying this to a Bob-and-John situation, Bob's body would be kosher for a Jew, but *Aiver Min HaChai* for a non-Jew, because the head is still moving.

Another hypothetical situation is the potential for doing a Robert J. White experiment after *shechita,* which invovles *shechting* both Bob and John and switching their heads. The question is whether one has effectively created a *Ben Pikua*, the offspring of a *shechted* animal that has been born after the mother was *shechted*. Because it was considered part of the mother when it was *shechted*, it does not need its own *shechita*, and eating from it while living is not considered *Aiver Min HaChai* (*Chullin 74a, Shulchan Orech Yoreh Deah* 64:2). Theoretically, because Bob and John have already been *shechted*, they should be considered *Bnei Pikua* and not need another *shechita*. It would also be possible to create these *Bnei Pikua* by *shechting* Bob and John and reattaching their own heads to themselves.

The *halachic* issues involving people are much more complex. The first question to be asked about head transplants with people is whether one is really performing a head transplant or performing a body transplant. In essence, is the identity of the person in the head or in the body?

The *Mishna* in *Sotah* (45b) speaks about the *Egla Arufah*, when a body is found between two cities and the closest city must bring the *Egla Arufah* as a special *karban*. It poses two questions: what if the body is equidistant between the cities? Or, what if the head and body are found separately? Is the city closest to the head or the city closest to the body obligated in the *karban*? Although Rabbi Eliezer said to measure from the body, we hold, in both cases, like Rabbi Akiva and measure from the head.

Interestingly, in *Yalkut Shmoni* (*Mishlei* 929), when the question was raised about where the seat of wisdom is, Rabbi Eliezer replied that it was located in the head, and Rabbi Yehoshua said that it was found in the heart, as all of the limbs depend on it. These two views imply *halachic* differences: either one is considered living only as long as his head is viable, or only as long as his heart continues pumping. Rav Yosef Karo, when listing what would make an animal a *treif* versus a *nevelah*, noted both the removal of the heart and the brain create the status of *nevelah*, being considered already dead.

Rabbi Aryeh Kaplan explained that for *Egla Arufah* the reason one measures from the head is not because the brain is the real 'you,' but because that's where the real 'you' is contained. He referenced the philosophical Kabbalists who believed "that the spiritual world is a realm whose substance is information" [5]. This is what the human soul really is, and what it will be like after death. A person really is, in essence, just his memories, thought patterns, and personality traits. All of this is stored in the brain, and all of this is what would remain intact after a head transplant. If what is in the head is what makes up a person, then the head is the deciding factor of a person's identity.

On the other hand, if one goes by the beliefs implied by the first Rabbi Eliezer and Rabbi Yehoshua, the identity of an individual, post-head transplant, would be that of the body. The body, having been previously part of a brain-dead person, is *halachically* considered dead. Potentially then, one has created a *halachically* 'dead-but-living' person. Possibly, this person would have no *halachic* status and would have no *mitzvah* obligations. The idea of such a person existing, of someone being outside the realm of Torah altogether, is so heretical to Jewish ideology that it's hard to believe that anyone could hold by this opinion without finding or creating a *halachic* status for this person that sets him or her within the realm of the Torah and *mitzvot*.

Another issue that arises is the doctor's role. To do a head transplant, can doctors cut off the quadriplegic's

head or is that action considered *retzicha*, murder, even if one planned to reattach it?

The *Tzitz Eliezer*, when discussing cardiac death, held that stopping the heart in a surgery setting is not really death, because it is intentional and reversible [6]. The heart has not really stopped, but only paused. The same, possibly, could be said for head transplants. The head has not been permanently cut off or removed, but temporarily disconnected. This seemingly is not *retzicha*. This may pose a problem. If it is not always murder to cut off a head, then, as it is sometimes reversible, decapitation does not equal death. If it is reversible, can one actually rely on the *halachic* sources that say 'decapitation equals death' to support post-brain stem death organ donation?

Brain stem death, when one is on a ventilator and the brain stem ceases to function, is considered death based on the assumption that, when the brain stem stops working, one is effectively internally decapitated. One of the main sources for brain stem death is the *Mishna* (Ohalot 1:6), which states that once someone is decapitated, even if there is still bodily movement, they are considered *Tameh Meit*. The earlier part of this source, however, stated that '*Afilu Miguyid, Afilu Goseis'*, if one is cut up or in the throes of certain death they are not considered *Tameh Meit* or dead. This means that the ruling that decapitation is considered death is because it is certain that the person is already dead. We now know, however, that post-decapitation there is still a short period of time that the head is still aware. Would this not mean the decapitated person has the status of someone who is *Miguyid* or *Goseis*? Even more so, if it is possible to do head transplants, and if a person can continue living a full life post-decapitation, would it no longer be possible to consider brain stem death to be actual death?

This concern can be dismissed for two possible reasons. First, the reason why decapitation is equivalent to death, according to Rav Dovid Feinstein's interpretation of Rav Moshe Feinstein, is because decapitation is a clear sign of cessation of spontaneous breathing [7]. The real sign of death according to the *Gemara* in *Yoma* (85a) is cessation of either the heartbeat or breathing (*poskim* argue this, with most leaning towards breathing). The reason why brain stem death would be considered death is because the person can no longer breath on his/her own, and the brain stem being 'decapitated' is proof it is irreversible. Even if it eventually were possible for doctors to perform head transplants, and therefore for decapitation to not necessarily equal death, the irreversible cessation of a brain-dead person's ability to breathe on his/her own could still potentially allow us to hold by brain stem death.

Secondly, As of now, head transplants are still in the realm of the hypothetical. As Dr. Ari Schick, a fellow at the Edmond J. Safra Center for Ethics, pointed out, currently, at least, the arguments to support brain death have not changed, and therefore the hypothetical head transplant does not affect the *halacha*. This, of course, holds true for any *halacha* that comes under question because of science. The future does not change the current *halacha* [8]. Only once medicine and technology are no longer hypothetical can the *halachic psak* be re-discussed.

Many more questions involve the newly created person's identity. If a Jew's head is transplanted onto the body of a non-Jew, is the person still Jewish? According to Rabbi Dr. Azriel Rosenfeld, in "The Heart, the Head, and the *Halacha*," the person is unquestionably Jewish [9]. The Jewish identity of a person is part of one's ingrained personality, and would remain with the head, and therefore, although the new body may require circumcision and *mikvah*, the person would still be Jewish. Conversely, if a non-Jew received the body of a Jew, he would not suddenly become Jewish, because he has not accepted the Jewish faith, nor was his head, his identity, born into Judaism.

Just like general Jewish identity, the discussion of *Kohanim* getting head transplants raises, in addition to the question of whether *Kohen* status is stored in the personality, discussing *Kohanim* brings up a related topic: who are the *Arayot* (people forbidden to have relations with) of a person who received a head transplant? Are the *Arayot* those of the head, or those of the body? Rabbi Dr. Rosenfeld posits:

> The case of a *kohen's* brain in the body of a non-*kohen*, or vice versa, is perhaps less straightforward. However, we may note that in general, a transplanted donor would presumably still be forbidden to marry his relatives, even though genetically his new body is unrelated to them. True, he would almost certainly be prohibited from marrying his new body's relatives, but even artificial insemination of a relative is surely prohibited. Problems of a comparable nature would also arise if transplantation of reproductive organs were

feasible. Conceivably, even in matters of heredity we may follow the personality rather than the body; a *kohen* remains a *kohen* even if he occupies the body of a non-*kohen*, and vice versa [9].

Another question is raised regarding the possibility of a man receiving the body of a woman or vice versa. Gender in *halacha* is identified not by the personality but by the body. Much of the discussion on the *halachic* status of a person who received this type of transplant is the same as the discussion about transgender and gender dysphoria. This is a vastly complex topic that will not be covered completely here, just an exceedingly simplified explanation of the discussion. There are multiple discussions in the *Gemara* about people who are *tumtum* or *androgynous*. These people have undetermined gender because they either have or lack both male and female genitalia. Their gender *halachically* is decided from this, and the gender which they identify with is irrelevant. However, if one type of genital organ is malformed and dysfunctional, according to Rabbi Yaakov Emden, the other is the clear identifying gender [9]. Therefore, if fully functional genitalia are created or transplanted, it could potentially impact one's status, and a transplanted body would be the epitome of this. There are still many arguments to deal with though, including the discussion on whether gender identity is permanent from birth, whether there is a possible issue of *Beged Ish,* a law about wearing clothing of the opposite gender, and more.

Head transplants could impact extremely diverse *halachot*. Rabbi Shlomy Raiskin raised a question about the status of *Kibud Av V'Aim*, both for the person who was transplanted, and for the children of one who is transplanted. Do the children of the head or the body have obligations of *Kibud*? Do the children of the head receive an inheritance after their parent's 'death', as the person may have been considered dead during the surgery? [10]. Are they orphans with both living parents? Although he did not answer these questions, it could possibly be answered using the approach of Rabbi Dr. Rosenfeld: if we assume the parental identity is ingrained in one's identity and personality, the children of the head would be obligated in *Kibud Av V'Aim*, and the children of the body would be orphans. If the parental identity is decided like gender, by physical existence, then the children of the head and body may both have obligations of *Kibud Av V'Aim*.

As all of these questions are raised, there is a basic assumption that the new body is considered a body, a part of the person. However, it is possible that the new body does not necessarily become *halachically* the quadriplegic's body. Perhaps, the new body is considered not part of the body, but like a piece of medical technology, a biological version of a ventilator or LVAD (left ventricular assist device). This would mean that the body would have no effect on the head's status, related to its Judaism, *kohanic* inheritance, gender, or otherwise.

As can be seen by the lack of conclusions about these questions, this entire problem remains in the hypothetical realm. It is possible and probable that it will never become an issue in reality. However, with the speedy advance of technology, like many hypotheticals, this issue may need to be addressed in the next few years.

Acknowledgements

A big thank you goes to my parents for supporting my learning. I would like to thank the rabbis of MMY who helped with the research for this paper: Rabbi Yosef Bronstein, Rabbi Eliezer Lerner, Rabbi Yonaton Emmet, Rabbi Yedidya Berzon, and Rabbi David Katz. I would also like to express gratitude to Rabbi Dr. Eddie Reichman, Dr. Ari Schick, and Avi Verschleisser for their input and suggestions.

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Searching for Patrilineally Transmitted Genetic Markers in Cohanim

By **Temima Kanarfogel**

At the return of Jews from *Galut Bavel* to *Eretz Yisrael*, there was a need to re-establish familial descent lines in order to resume proper *Halakhic* marriage restrictions, and to re-enact certain privileges that were afforded in the *Beit HaMikdash* before exile. For *Cohanim* this especially mattered since they could only perform services in the *Beit HaMikdash* and receive priestly gifts if they were proven patrilineal descendents of legitimate *Cohanim*, and not *chalalim*, offspring of forbidden relationships between *Cohanim* and women whom they were prohibited from marrying. The *Gemara* in Kiddushin 89b records the issue that arose in distinguishing between the *Cohanim* who could not provide legal documentation of their *Cohanic* status and the *chalalim* whose emergence saw an uptick during exile. Ezra *HaSofer*, a *Cohen* himself, decided to allow these *Cohanim* who lacked substantial proof to partake in certain privileges (though not all) given to *Cohanim*. This decision formed the basis for two different statuses a *Cohen* could assume; a *Cohen meyuchas*, one who could provide physical evidence of his lineage through documentation, or corroborated testimony of two witnesses, and a *Cohen muchzak*, a status-quo *Cohen* who is presumed to be a *Cohen* because he was told this by his father.

Halakhic restrictions of whom a *Cohen* can marry are still in effect today, one such example being divorcées. Most contemporary self-identifying *Cohanim* are considered to be *Cohanim muchzakim*, relying on oral transmission from their fathers as reliable evidence. There have been several attempts to discover genetic markers on *Cohanic* chromosomes to help corroborate claims of *Cohanic* status.

The Y chromosome has been the subject of special interest to researchers looking for genetic trends in *Cohanim*. Human cells contain 46 chromosomes made up of 23 pairs. Each pair has one chromosome from the father and one chromosome from the mother. These chromosomes that make up each pair are said to be homologous to each other. During reproduction, each parent forms a gamete, a haploid cell with only 23 chromosomes that will combine with the other parent's gamete to produce one diploid cell with 46 chromosomes. Gamete formation, achieved through a division known as meiosis, also includes a process called crossing over, the trading of some genetic material between homologous chromosomes. Crossing over occurs between all homologous chromosomes, including the 22 autosomal pairs and the one pair of sex chromosomes. Females have two X chromosomes, while males have one X chromosome and one Y chromosome. Every male offspring inherits his Y chromosome his father. Some, but very little, crossing over occurs between the X and Y sex chromosomes in meiosis, resulting in a nearly completely preserved Y chromosome transmitted through male descent. Since a *Cohen's* status is a patrilineal inheritance, transmission of the Y chromosome could potentially trace the line of descent of *Cohanim*. [1]

Another unique aspect of the Y chromosome is its ability to measure the passing of time. The Y chromosome experiences naturally-occurring random spontaneous mutations when it replicates; also, environmentally induced mutations may occur. It is possible to calculate the rate of random mutations that accumulate over time. By analyzing the differences in Y chromosomes of two populations with a shared ancestor, researchers can calculate the approximate number of years that the two populations had been separated. [1]

The Lemba are a tribe native to Zimbabwe, Africa, whose oral traditions claim they are a "lost tribe" of Israel. Several of their cultural practices overlap with Jewish *Halachic* observances, such as abstention from eating pork, following guidelines for animal slaughter, and male circumcision. Though other African tribes make similar claims of genealogical descent from ancient Jews, the Lemba are among the only people whose genetic markers show significant signs of originating from ancient Jews. [2]

Genetic proof of the Lemba's descent from ancient Jews surfaced in a study led by historian Tudor Parfitt. The non-recombining region on the Y chromosome contains both microsatellites, which are short repeating DNA sequences with relatively high mutation rates, and biallelic polymorphisms, mutations that arise in both alleles of a single gene.

Because they occur so infrequently, biallelic polymorphisms are categorized as unique event polymorphisms (UEP), which are genetic markers that generally occur once in evolution. Therefore individuals who share the same UEP are considered extremely likely to be descendents from a common ancestor. [2]

Samples were collected from males of several subject groups, which included Lemba, Bantu, and Yemeni, Ashkenazic and Sephardic Jews. The six populations were classified into four UEP groups. Results showed 67.6% of Lemba Y chromosomes in the study were found to be of Semitic origin, with the remaining 32.4% of chromosomes to be of Bantu descent. Additionally, the presence of the Cohen Modal Haplotype (CMH) at a high rate in the Lemba group suggested that the Lemba tribe originated from ancient *Cohanim*. A haplotype is a group of alleles that are passed down together from a parent organism to its offspring. It may refer either to clustered alleles found closely grouped together on a chromosome that are inherited simultaneously, or to a group of single nucleotide polymorphism (SNP) alleles that show tendencies of simultaneous inheritance. In the late 1990s, research led by Dr. Karl Skorecki found a Y chromosome genetic link in both Ashkenazic and Sephardic *Cohanim*, and later on, six Y-linked short tandem repeats (STR) in 50% of *Cohanim*. These STRs now compose what is known as the Cohen Modal Haplotype. [3]

Although the CMH was discovered at high rates in Ashkenazic and Sephardic *Cohanim*, some researchers questioned whether this haplogroup was unique to this specific group and could be used to identify only those of ancient Jewish *Cohanic* descent. Researchers M.F. Hammer and D.M. Cehar conducted additional research to address this issue. Self-identifying *Cohanim* chromosomes fell into 21 different haplogroups. While most of these haplogroups occur extremely infrequently, this new study discovered a subclass of haplogroup J (J-P58) that appears in Ashkenazi and non-Ashkenazi Cohanim at significantly higher rates (51.6% and 38.7% respectively) of those *Cohanim* in the sample sets, respectively). The sample set of 99 *Cohanim* contained 87 *Cohanim* with identical haplotypes to the original CMH (determined by 6 Y chromosome markers), while 10 had haplotypes one-step removed from the original, and 2 were more than 2 steps removed. When the number of markers was increased from 6 to 12, 43 of 99 subjects who had the original CMH also had this "extended CMH." The extended CMH and two associated haplotypes made up 64.6% of the chromosomes among the J-P58 *Cohanim*. [4]The presence of the CMH at a high frequency in Lemba tribe members neither disproved nor confirmed their claims of Jewish descent. It is possible these shared genes resulted from gene flow, the passing of genes from one population to another. This would have led Lemba tribe members to share some genetic markers with ancient Jews. No genetic marker has been designated as a universal *Cohanic* gene. As genetic testing advances researchers may discover more genes that are present specifically in Jewish populations.

A question to consider is the effect that a universal *Cohanic* gene would have in the realm of *Halakha*. Genetic testing could potentially identify anyone with *Cohanic* genes, and possibly identify even those who are unaware of their *Cohanic* status. However, due to the restrictions that genetic testing has today, and because of the indistinguishable genes of descendents of *chalalim* from valid *Cohanim*, the oral transmission of *mesorah* is likely to remain the predominant mechanism of *Cohanic* identification.

Acknowledgments

I would like to express my deep appreciation for my parents' unwavering support in aspects of my life. Thank you also to Dr. Babich for his assistance in this paper.

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Scientific thoughts on specific Talmudic passages

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Introduction

As part of a *daf yomi*, each day the group studies one complete page of a specific tractate of the Talmud. The Talmud contains much science, including medicine, biology, chemistry, physics, earth science, and cosmology. At times, it is difficult to comprehend the science of a Talmudic passage. This has lead to much debate and many suggestions in the Torah-science literature, trying to elucidate the passage. This article is an attempt to explain some of such Talmud-science passages. However, it should be clearly understood that these explanations are not an attempt to second-guess the explanations offered by *Chazal*, but rather an attempt to satisfy the questions in my mind.

Freckles

In the Talmud (Berachos 58b), there is a discussion on the blessings recited upon seeing unusual creatures, including humans that appear different from the norm. Rabbi Yehoshua ben Levi said that upon seeing "spotted" people one was obligated to recite the blessing, "Blessed are You …. Who diversifies the creatures." Rashi explained that "spotted" referred to "freckles." The Mishnah Berurah (225:24) described these spots as of a light red hue with glistening white skin between them. Rabbi Yehoshua ben Levi's opinion was challenged by a Baraisa which enumerated examples of people with various deformities for whom, upon seeing, one was required to recite the blessing of, "Blessed are you … the true Judge." Included in this enumeration, were leg and hand amputees, the blind, a person covered with boils, and "spotted" people. Thus, there was disagreement upon the appropriate blessing to recite upon seeing a person with freckles. The apparent contradiction was resolved, as Rabbi Yehoshua ben Levi referred to freckles present at birth, whereas the Baraisa referred to freckles acquired in later life. The Mishnah Berurah (225:26) noted that the commonality among the people enumerated in the Baraisa was that their deformities and infirmities were acquired later in life.

What bothered me was the difference in the nature of the two blessings. The blessing, "Blessed are You …. Who diversifies the creatures," has positive connotations, as it extols the power of *HaShem* to add phenotypic variations within His creations. However, the blessing, "Blessed are you … the true Judge," is recited during times of emotional distress (see note 44, Artscroll edition of Berachos 58b). For example, this blessing is recited by mourners when they rip the outer garments prior to the eulogy; it is recited upon hearing unusual bad news; and it is recited upon seeing a destroyed synagogue. Apparently, there is something different about the nature of freckles that trigger the recitation of "Blessed are You …. Who diversifies the creatures" from freckles that trigger the recitation of Blessed are You … the true Judge"

The Baraisa included "spotted" people with those individuals with infirmities and deformities, suggesting that these "spots" were symptomatic of a medical condition. While, the "spots" referred to by Rabbi Yehoshua ben Levi, apparently, referred to a normal, nonpathological condition. Normal freckles are clusters of skin melanocytes that overproduce the pigment, melanin, thereby causing a change in skin color. Freckles although rare in infants, occur more usually in prepubertal children. As freckles are not a skin disorder, the blessing, "Blessed are You …. Who diversifies the creatures," would be the appropriate blessing upon seeing a freckled individual.

The Baraisa, however, may be referring to a pathological case of freckling. A freckle-based pathology that would be a potential candidate for reciting the blessing, "Blessed are You … the true Judge," is xeroderma pigmentosum (XP; Figure 1), an autosomal recessive genetic disorder in which the XP individual lacks the ability to repair DNA damage caused by exposure to ultraviolet solar light. This genetic disease has a frequency of about 1 case per a population of 250,000. In XP people, development of freckles occurs at an early age, usually in infancy or early childhood. At birth, the skin appears healthy, but after 6 months of age, the skin is characterized by diffuse erythema, scaling, and a freckle-like area of increased pigmentation. By two years of age, in response to sunlight, XP children develop freckling of

the face and arms and are at a heightened risk for skin cancer and, perhaps, for brain cancer. About 30% of XP people develop progressive neurological disorders, *e.g.*, hearing loss, difficulty in walking, loss of intellectual function, and seizures, which tend to worsen with time [1, 2]. The recitation of the blessing, "Blessed are You … the true Judge," upon seeing "spotted" people is appropriate if the freckles are symptomatic of a pathology, such as XP, and even more so if the observer feels pain on seeing a fellow human in such distress.

Figure 1. Boy with xeroderma pigmentosum.

Liver

An animal with one of a specific list of fatal defects would prohibit it from being eaten, even if it was properly slaughtered. Such an animal or bird is a *tereifah* whether it was born with or acquired one of these life-threatening defects which led to death within a year. Conversely, if the animal would live for 12 months, it is not a *tereifah* and can be consumed. The sages of the Talmud (Chulin 57b) compiled a list of various defects which rendered an animal as a *tereifah*. The liver is an essential organ for viability and an animal completely lacking the liver is a *tereifah*. What about an animal with a partial liver? The Talmud (Chulin 45a,b, 46a, 54a) recorded a dispute to the status of an animal if the remaining liver was less than a *k'zayis* (*i,e.*, the size of an olive). The accepted opinion is that for the animal to be considered viable (*i.e.,* not a *tereifah*) its liver must be at least the size of olive. As explained by Rashi, this amount of liver is sufficient for the remaining liver "to produce healing" and thereby to continue to perform its life sustaining functions. A defect in the liver was considered non-fatal, whereas defects in other organs were deemed life-threatening. Why?

Current thought is that the Talmud was referring to the regenerative nature of the liver [3], as the liver is the only internal mammalian organ capable of natural regeneration of lost tissue. In the research laboratory, liver regeneration was studied by surgically removing 2/3 of the liver mass of rodents (mice and rats), a technique known as 2/3 partial hepatectomy. The researchers followed the regrowth of the liver. The regenerative process in mice and rats was rapid, with complete restoration of the liver within 5 to 7 days post-surgery [4]. How did Chazal know of the regenerative nature of the liver? Katznelson, in his book on Talmudic medicine, *Hatalmud Vechochmas Harefuah* (1928), theorized that the rabbis of the Talmud carried out experimental hepatic resections on animals to prove liver regeneration from an olive-sized liver. Westreich [5] countered that "this seems highly unlikely, and the theory is based solely on semantic evidence." If so, how did *Chazal* know of the regenerative nature of the liver? Apparently, this information must have been transmitted as *mesorah* down through the generations.

Oculocardiac reflex

A section in tractate Avodah Zarah (28b) discusses the seriousness of eye ailments and the permissibility of applying ocular ointments on Shabbos. Examples of ocular ailments that can be treated on Shabbos include excessive discharge, a stabbing pain in the eye, blood in the eye, excess tearing of the eye, and an inflammation of the eye. Mar Shmuel explained that permission to apply ocular ointments on Shabbos was that "eye sight is connected to the muscles of the heart." *Tosafos* cited a version of Rashi that implied a physical connection of some sort between the eyes and the heart. Although this association may seem strange, Rashi was on target and the physical connection may refer to the nervous system, with a nervous reflex arc triggered from the eye may lead to slowing of the heartbeat and even death. This reflex, termed the oculocardiac reflex, as a possible explanation of this Talmudic passage, was brought to my attention by Mordechai Shedrowitzky, P.T. and Natan Tracer, M.D. The stimuli associated with this reflex include traction applied to the extraocular muscles and compression of the eyeball. Upon stimulation, afferent nervous impulses are transmitted via the trigeminal nerve to the brain stem in which they transmit the nervous impulse to the

parasympathetic nervous system via the vagus nerve, which innervates the sinoatrial node of the heart. The result is a decrease in the heart rate (sinus bradycardia), junctional rhythm and asystole, all of which may be life-threatening [6].

Sperm viability

Following cohabitation, sperm can survive in the vagina for up to several hours. The lifespan of sperm in a woman's body is largely dependent of the cervical fluid, which provides the nutrients for sperm survival in their journey to the ovum in the fallopian tube. Once sperm enter the female fertile genital tract, *i.e.*, the cervix and uterus, most sperm die within 1-2 days. Sperm cells exposed to room air on clothing or bed linens lose motility rapidly; once the semen dries, the sperm cells are dead [7].

Viability of sperm obtained from the female genital tract has been studied both microscopically and with a variety of metabolic assays. Wallace-Haagens *et al.* [8] studied sperm survival, in terms of numbers, motility, viability, and metabolic activity, in vaginal washings obtained daily from 22 healthy, fertile, married women during one complete menstrual cycle. The numbers of sperm were never large compared to the number of sperm in a single ejaculate. Forty-eight hours after intercourse, only 6% of the specimens showed any evidence of sperm. Motile sperm were observed in only six of 94 postcoital specimens examined within 12 hours after intercourse. Fluorochromatic studies of recovered sperm treated with acridine orange were used to indicate sperm viability and phase contrast studies of sperm treated with tetrazolium salts were used to study metabolic activity. Their data on sperm motility, numbers, and staining reactions supported the conclusion that the small number of sperm that remain in the vagina after intercourse quickly inactivated. The study cited above is one of the early studies to evaluate sperm viability in the fertile female genital tract. Sophisticated laboratory techniques, both microscopic and chemical, were used to evaluate sperm viability. The key finding in this study, and in all subsequent studies, is that sperm remain viable in the female fertile genital tract for 1-2 days, with most dead by day 3. Interestingly, the three-day viability of sperm in the female reproductive was the basis for the prohibition of a husband and wife having intimate relations during the three-day period prior to the giving of the Torah at Mt. Sinai (Shemos 19:15).

To understand the Torah aspect, a little background information is needed. After intimate relations, a woman may discharge some viable sperm cells. Regarding the laws of *tumah* and *taharah* (not, the laws of *nidda*), such a discharge of viable sperm cells would make the woman unclean (*tamei*) until the night after immersion in a *mikvah*. However, the discharge of non-viable sperm cells from the female reproductive tract, *e.g.*, such as that >3 days after intimacy, does not make the woman *tamei*. On the sentence, "He (*i.e.*, Moshe) said to the people, "Be prepared after a three-day period: do not draw near a woman"" (Shemos 19:15), Rashi commented, "For this entire 3-day period, so that the women should be able to immerse themselves by the 3rd day and thereby be *tahor* to receive the Torah. For if they were to have relations within the 3-day period prior to the giving of the Torah, perhaps a woman would discharge (*living*) sperm after her immersion and would become impure again. But once she waited 3 days after having relations, the semen has already become putrid (*i.e.*, *was not viable*) and is not fit to fertilize and is pure regarding contaminating the woman who discharges it." Thus, the 3-day separation between husband and wife was necessary to ensure that the woman would be *tahor* for the giving of the Torah (Shabbos 86a). What is unusual is that *Chazal,* without the use of a microscope to visualize sperm cell motility and without the knowledge of metabolic chemical assays to assess sperm viability, understood that sperm viability in the female reproductive tract lasted for a three-day period. Apparently, this information must have been transmitted as *mesorah* down through the generations.

Food cravings of a fetus

A Mishnah in tractate Yoma (82a) states, "If a pregnant woman smelled food or drink and craved it on Yom Kippur, we feed her until she feels relieved." Rashi noted that the fetus smells the food and craves it and if the mother does not eat it, both she and the fetus will be in danger. A fetus is fed through the gestation umbilical cord and flavor perception is experienced through the sensations of taste (tongue) and smell (nose), with smell the larger factor in the perception of flavor (*e.g.*, for a person with an upper respiratory infection who cannot smell, food has no flavor). Logically, it would seem that food

preferences and cravings should begin after birth, not *in utero*. Yet, Rashi implied that a fetus, albeit fed through the umbilical cord, experiences tastes and smells *in utero*, thereby developing cravings for pleasurable foods. Current research shows Rashi was correct, as (a) the ability to perceive flavor begins *in utero* with the development and the early functioning of the olfactory and gustatory systems and (b) amniotic fluid contains molecules derived from the mother's diet [9].

Taste sensations result from activation of the gustatory system and are directed to the sensations of salty, sour, bitter, sweet, and umani (savory). Regarding the perception of odor, thousands of different odors stimulate the olfactory system to create smell sensations. The perception of food flavor results from the integration of the odor and taste sensory systems.

Morphological and functional development of taste cells on the tongue and the olfactory receptors in the nasal passages begin in the first trimester of fetal development. Taste buds are mature and functional *in utero* by the beginning of the second trimester. Olfactory receptor cells are evident by 11 weeks and fetal olfactory receptor cells are stimulated by odor compounds by at least 26 to 28 weeks gestation. The nasal plugs, which the block the openings of the nasal passages, dissolve in the third trimester, thereby allowing the nasal passages to be bathed by amniotic fluid. The fetus both inhales and swallows significant amounts of amniotic fluid by late gestation. The amniotic fluid contains many constituents, ranging from nutrients (such as glucose and amino acids) to the flavors of the mother's dietary and environmental exposures [9, 10]. For example, Mennella *et al.* [10] obtained amniotic fluid from women in their second trimester of pregnancy after ingestion of garlic capsules or a placebo. The odor of garlic on pads containing amniotic fluid was discernible from those women who ingested the garlic capsules.

The main determinant of what an individual selects to consume is whether he/she likes the flavor of the food or beverage. Flavor is dependent upon the perception of smell and taste. The fetus swallows and inhales significant amounts of amniotic fluid by late gestation. Although the chemical senses of taste and smell are operational *in utero*, what evidence is there that the fetus experiences these sensations? It was shown that injection of a sweet-tasting stimulus into amniotic fluid stimulated fetal swallowing, whereas injection of a bitter stimulus inhibited fetal swallowing [9]. What evidence is there that an infant develops cravings for pleasurable food items experienced prenatally? Mennella *et al.* [12] studied pregnant women who consumed either carrot juice or water for 4 days/week for 3 consecutive weeks during the last trimester of pregnancy. Subsequently, their infants, at about 6 months of age, were fed plain cereal and cereal amended with carrot juice flavor. The infants were videotaped as they were fed cereal with/without carrot juice flavor. Videotape analyses were directed on the frequency of negative facial responses (*e.g.*, gaping, head turning, nose wrinkling, upper lip raising, brow lowering) in response to each spoonful of ingested cereal. In addition, immediately after each videotape session, the mothers rated their infants' enjoyment of the food. As evaluated by their mothers, infants exposed prenatally to carrot juice appeared to enjoy the carrot juice flavored cereal more than the plain cereal and exhibited less negative facial responses to the carrot juice flavored cereal than did the control group not prenatally exposed to carrot juice. Prenatal experiences with food flavors transmitted from the diet of the mother into the amniotic fluid lead to greater acceptance and enjoyment of these foods during weaning. Hepper *et al.* [13] evaluated whether prenatal experience influenced dietary preference in two groups of children (8 to 9 years old). One group of children was from mothers who consumed garlic during pregnancy, whereas the other group, the control, was from mothers who had not consumed garlic during pregnancy. The dietary test consisted of meals which included garlic-flavored potatoes. Children prenatally experiencing garlic ate more garlic-flavored potatoes than did the control group. Apparently, Rashi (Yoma 82a) was correct, in that *in utero* the fetus experiences flavors sensations, which, if pleasurable, can lead to cravings for specific food items.

Snake gestation

After mating, some female animals store sperm. For example, in Genetics (BIOL 3513) the class works with fruit flies (*Drosophila melanogaster*). Suppose an assignment was to mate wild-type red-eyed male flies to mutant white-eyed female flies. Students are provided with vials of both strains; each vial contains populations of adult male and female flies, pupae (cocoons), larvae, and eggs. All adult flies in the vial

of white-eyed flies cannot be used in the study: the white-eyed males are not needed for the mating and it can be assumed that the white-eyed females have already mated with white-eyed males in that vial. Isolating these white-eyed female flies for use in the mating is pointless, as female *Drosophila* store sperm. The technique calls for removing all adult male and female white-eyed flies from the vial and then waiting for newly hatched adult flies to emerge from their cocoons; newly hatched adult flies do not mate for the initial 8 to 10 hours of adult life. The procedure then requires the isolation of virgin white-eyed female flies which are mated with red-eyed male flies. This concept of sperm storage by females also applies to snakes [14] and may explain the Talmudic passage (*Bechoros* 8a) that the gestational period of a snake is 7 years. A different version of this passage is presented in the *Yalkut Shimoni* (*Bereishis* 3, os 30), in which a gentile philosopher viewed snakes mating, captured females, placed them in a vessel, and fed them. After 7 years of captivity he noted that the female gave birth. As a 7-year gestational period for a snake is highly improbable, this incident may refer to the ability of female snakes to store sperm, thus, explaining the current observation that some female snakes give birth several years after mating [15].

An article in the Science Section of the N.Y. Times [16] described an annual mating evident that occurs between male and female red-sided garter snakes in Narcisse, Mantiboa. Around April/May of every year thousands of these snakes "awaken from an 8-month nap in their subterranean limestone lairs. They tumble about the craggy landscape in tangled knots with a singular focus: reproduction. The males pour out of the dens first and wait for the females to slowly trickle out of the course of a few weeks." The female secretes pheromones that attract dozens to hundreds of males that try to mate with the lone female. One selected male mates and leaves a stinky plug inside the female which serves to ward off other males. "A female can store sperm until she's healthy enough to reproduce." The researcher, Robert Mason, "documented a female snake that gave birth seven years after mating." Apparently, this female stored sperm for several years, eventually resulting in birth of offspring seven years after mating. In addition, Magnusson [17] observed a captive Australian file snake (*Achrochordus javanicus*) that gave birth to a single young after seven years of isolation, suggesting that this species of snake was capable either of prolonged storage of sperm or of parthenogenesis (in which the female gamete develops into a new individual without fertilization by a sperm).

As the society in the era of the Talmud was basically agriculturally-based, *Chazal* obviously were cognizant of the botany and zoology relevant to their environments. From every day observations, they were aware of various species of snakes, noting that some gave birth by laying eggs and others by live birth. It would be incorrect to assume that *Chazal* meant the seven year gestational period to be applicable to all species of snakes. Rather, apparently, they noted an unusual event, a snake which appeared to have a gestational period of 7 years. This seemingly impossible event may have been due to prolonged sperm storage by the female snake, as suggested in the *Yalkut Shimoni*.

Bishul on *Shabbos*

Bishul, the 11th of the 39 *melachos*, is loosely defined as "cooking." As related to Shabbos, *bishul* is the use of the heat of fire to alter the quality of an item, and includes activities as cooking, boiling, frying, baking, and roasting. In the *Mishkan, bishul* was the activity employed to cook ingredients to produce the dyes used to color the wool curtains and tapestries [18]. Fuels for *bishul* were logs and wood-derived coal; during the era of the *Bais HaMikdash*, wood from the fig tree, a nut tree, or an oil tree was preferred (Zevachim 58a). The logs were used in the pyre of the Alter (*Miz'ba'ch*) for burning the sacrifices and the hot coals were used for the incense pyre (Tamid 29a). In the *Mishkan* and *Bais HaMikdash, bishul* was accomplished by fire, scientifically defined as the rapid oxidation of a material in the chemical exothermic process of combustion, releasing heat, light, and various reaction products. The source of the fire in the *Mishkan* and *Bais HaMikdash* was organic matter.

Several passages in the Talmud (*e.g.*, Shabbos 39a, 146b; Pesachim 39a) note that *bishul* on Shabbos was permissible with direct radiant heat from the sun. Rashi (Shabbos 39a) explained that the use of solar radiation is an unusual mode of *bishul* and, thus, was not included in the Biblical prohibition of cooking on Shabbos. Furthermore, the Rabbis saw no reason to prohibit this type of cooking using solar radiation, as nobody would confuse cooking directly in the sun with cooking on a fire. Only the ordinary methods of cooking used in the *Mishkan* were defined as *bishul*;

any other mode of cooking that was not similar to the method employed in the *Mishkan* was not considered to be *bishul* [18].

It is interesting to note a basic difference between *bishul* considered to be a *melacha* and forbidden on Shabbos and *bishul* utilizing solar radiation which is permitted on Shabbos. *Bishul,* as derived from the work in the *Mishkan*, involved the usage of heat released from combustion of organic fuels (logs), whereas *bishul* utilizing solar radiation involves the usage of heat generated from nuclear fusion reactions. The sun, like most stars, is composed of the elements, hydrogen and helium, occurring as plasma (*i.e.*, a hot, ionized gaseous state); by mass, 75% of the sun is hydrogen and 25% is helium. Solar energy is generated by nuclear fusion reactions, in which hydrogen nuclei separate from their electrons and fuse to form helium atoms. During the fusion process, radiant energy is released. Solar energy is a combination of infrared, visible, and ultraviolet light and heat [19].

Between the Earth and the sun, there is a vast vacuum expanse, with no molecules present, which means that solar heat has to be transferred without a medium. Of the three forms of heat transfer, conduction, convection and radiation, conduction and convection require the presence of a medium to transfer heat. Only radiation does not require the presence of molecules to transfer heat and, hence, it serves as the mode of heat transfer from the sun. Of the various wavelengths within the electromagnetic spectrum, it is infrared radiation that can transmit the most heat. This heat warms the planet Earth [19] and it is this heat that can be used for *bishul* on Shabbos.

Ancient civilizations viewed the sun as a giant ball of fire lacking a solid surface [19]. *Chazal*, apparently, were knowledgeable of the difference in the source of heat derived from the sun versus that derived from fire combustion, thereby allowing cooking on Shabbos by heat derived from solar nuclear fusion reactions and prohibiting cooking by heat from the combustion of wood.

Soil volatiles and *kilayim*

A passage in tractate Pesachim (25a) discusses the laws of *kilayim*, loosely defined as "forbidden mixtures," which includes cross-breeding or side-by-side planting of certain food crops and mixtures of the vineyard. "Rav Shemayah cited the Mishnah (Kilayim 7:8) regarding one who transports a perforated pot containing a blooming plant through a vineyard. If it increased a two-hundredth part during the passage, it is forbidden." This is explained as follows: "If the perforated flowerpot has a hole large enough to permit the passage of a small root, the plant inside the perforated obtains nourishment through the air from the ground below and is regarded as having been planted in that ground. Accordingly, if one carried such a perforated pot through a vineyard, it is as if he planted it directly into the ground, thereby creating *kilayim* of the vineyard" [20].

The obvious question concerns how roots emerging from a perforated flowerpot can obtain nutrients from the underlying soil when the flowerpot is carried over a vineyard. The answer may be through gaseous absorption of biogenic volatile organic compounds (VOCs) emanating from the above-ground soil and the grape plants. Apparently, there is an invisible wall (*i.e.*, the atmosphere) of volatile chemicals that connects the ground soil with the soil in the perforated flowerpot. Soil microbes, both bacteria and fungi, and plants, including their roots, stems, leaves, and flowers, undergo many biochemical pathways to produce intracellular chemicals that are released as organic gases, or volatiles. The majority of biogenic VOCs are lipophilic, have a small molecular weight, and a high vapor pressure - all physicochemical features that support evaporation. Biogenic VOCs are released directly into the above-ground atmosphere and within the soil, in which case the gases permeate through air-filled spaces. The most well-known scent emitted by soil bacteria, primarily species of *Streptomyces* is geosmin, which emanates from forest soil to produce the typical earthy odor after a rain. Biogenic VOCs serve many biological functions, including acting as repellants, stimulants, and nutrient sources. For example, root-derived VOCs may (a) serve as carbon and energy sources for neighboring soil microbes; (b) play a role in insect and nematode interactions; and (c) inhibit root growth of competing plant species [21-23]. It would seem that this Talmudic passage is referring to biogenic VOCs released from the above ground soil and grape plants that diffuse into the atmosphere to provide nourishment to the roots of the potted blooming plant being transported over a vineyard.

Concluding remarks

The scientific explanations for the various Talmudic passages cited above are intended to satisfy the curiosity of a *daf yomi* student with a science background. These explanations are neither intended to challenge a specific Talmudic passage nor to contradict a statement of *Chazal*. Rather, these scientific explanations are presented to provide some limited insight into the materials presented in the Talmud. In fact, these observations draw us to a conclusion that *Chazal* had an extraordinary level of scientific knowledge beyond the general science knowledge of the time.

Acknowledgment

Appreciation is expressed to Rabbi Yisrael Reisman, *Rav*, Agudath Yisrael of Madison, Brooklyn, NY, for reviewing the Torah content of this article.

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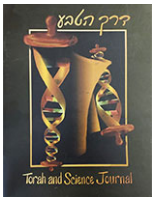
Volume 1, Spring 1997  • Yeast and the *Yeizer Hara*: The Biology Beneath the Symbolism (P. 15)	**Volume 4, 1999-2000**  • Was Moshe Left-Handed? (P. 14)	**Volume 5, 2000-2001**  • Chicken Soup: Jewish Penicillin? (P. 21)
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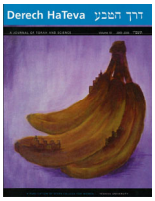
Volume 9, 2004-2005  • Jewish Genes: References to Genetics in the Torah (P. 35)	**Volume 10, 2005-2006**  • An Orthopedic Analysis of Jacob's Injury (P. 41)	**Volume 11, 2006-2007**  • Siamese Twins: Together Forever? (P. 54)

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		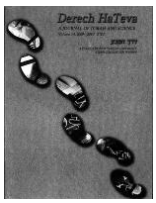
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		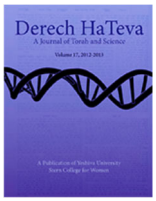
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	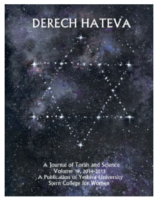	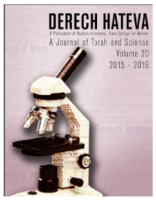
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	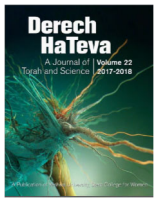	**This is it:** **You're Reading it...**
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