Islamic Perspectives on CRISPR/Cas9-Mediated Human Germline Gene Editing: A Preliminary Discussion

Noor Munirah Isa, Nurul Atiqah Zulkifli & Saadan Man
Islamic Perspectives on CRISPR/Cas9-Mediated Human Germline Gene Editing: A Preliminary Discussion

Noor Munirah Isa1 · Nurul Atiqah Zulkifli1 · Saadan Man2

Received: 18 April 2018 / Accepted: 26 February 2019
© Springer Nature B.V. 2019

Abstract
The recent development of CRISPR/Cas9 technology has rekindled the ethical debate concerning human germline modification that has begun decades ago. This inexpensive technology shows tremendous promise in disease prevention strategies, while raising complex ethical concerns about safety and efficacy of the technology, human dignity, tampering with God’s creation, and human genetic enhancement. Germline gene editing may result in heritable changes in the human genome, therefore the question of whether it should be allowed requires deep and careful discussion from various perspectives. This paper explores Islamic perspectives on the concerns raised and highlights the ethical principles in Islam that should be taken into consideration when assessing the permissibility of CRISPR/ Cas9-mediated human germline gene editing. As argued in this paper, human germline gene editing would be considered lawful for medical purpose under certain conditions. It should not be applied on humans until the safety and efficacy issues are resolved. Robust ethical guidelines and strict regulations are necessary to preserve human dignity and to prevent premature and misuse of the technology. Maqasid al-shariah’s principles of preservation of human life, lineage, and dignity and ‘preventing harm takes precedence over securing benefit’ are among the guiding principles in assessing the permissibility of CRISPR/Cas9-mediated human germline editing from an Islamic perspective. Further discussions are important to address the controversies as well as to explore the related ethical principles.

Keywords Human germline gene editing · CRISPR/Cas9 · Ethical issues · Islam · Maqasid al-shariah · Fatwa
Introduction

The recent development of genome editing technologies has opened new avenues for basic research and treatment of a wide range of serious diseases including cancer, HIV, thalassemia, and muscular dystrophy (Wang et al. 2015; Maeder and Gersbach 2016). One core genome editing technology is clustered regularly interspaced short palindromic repeat (CRISPR), a rapidly advanced technology adapted from the bacterial immune system that uses RNA-guided nucleases, with the most frequently used being Cas9, to cleave foreign genetic elements. CRISPR/Cas9 has important advantages over other genome editing technologies, including higher targeting efficacy and the ability to target multiple genomic loci simultaneously (Ran et al. 2013; Doudna and Charpentier 2014). Scientists have begun applying CRISPR/Cas9 to correct disease-causing single-gene mutations in nonviable human embryos, which was previously unthinkable due to low efficacy (Tang et al. 2017). An early study by Liang et al. (2015) using human triploid zygotes concluded that the CRISPR/Cas9 could effectively correct mutated human β-globin gene (HBB), a gene that encodes a subunit of the adult hemoglobin.

CRISPR/Cas9 technology may soon be used to correct mutations and prevent transmission of genetic diseases from parents to offspring, perhaps providing better options, both scientifically and ethically, for existing treatments. For example, in treating mitochondrial diseases, CRISPR/Cas9-mediated germline gene editing is a less scientifically and ethically complex procedure than mitochondrial replacement therapy because it does not require cell donation (Wang et al. 2015; Craven et al. 2017). Only a healthy embryo would be transferred to the womb, and this, unlike prenatal diagnosis, avoids putting couples in an ethical dilemma of whether to abort a fetus that inherits their genetic disorder (Porteus and Dann 2015). CRISPR/Cas9 technology may also give couples afflicted by such disorder the chance to produce healthy offspring free from genetic defects (Savulescu et al. 2015).

However, the application of the CRISPR/Cas9 technology in editing the human embryo has revived the debate about germline modification that began decades ago. Previously, the debate was based on speculative assumptions, but the ethical issues raised are nonetheless similar (Baumann 2016; Hildt 2016). Human germline gene editing raises more complex issues than somatic gene editing because it would result in heritable changes to the human genome. The technology, which is cheap and easy to use, has also raised fear among the public about the harms it may inflict upon humanity if it is not strictly regulated. A long-standing public fear in altering the human genome is that it could be used for producing designer babies. This may result in inequality and discrimination in society, as portrayed in science fiction films such as GATTACA (Gross 2015).

There have been calls for moratorium on clinical research of human germline gene editing so that its potential risks can be thoroughly assessed. Its ethical implications may then be discussed from multiple perspectives. For example, the American Society for Gene and Cell Therapy (ASGCT) and the Japan Society
of Gene Therapy (JSGT) proposed a strong ban on human germline gene editing until its ‘technical and ethical problems can be solved, broadly and deeply discussed, and societal consensus reached’ (Friedmann et al. 2015). A summit of scholars with a broad range of expertise including science, ethics, law, and sociology was held in 2015 to discuss emerging ethical issues of genome editing. The summit’s conclusions about human germline gene editing emphasized the necessity of resolving the safety and efficacy issues as well as reaching broad societal consensus before proceeding with any clinical use of germline gene editing (LaBarbera 2016). Input from the public is therefore imperative so that local values can be integrated into the assessment of the technology and moral boundaries can be set (National Academies of Sciences, Engineering, and Medicine 2017).

Religious beliefs are among the predominant sources of societal values that enrich discussion and help to resolve ethical questions about human germline gene editing (Cole-Turner 2008). Given that the questions raised are modern and complex, deep and careful discussions from religious perspectives are necessary. In Islam, the process of deliberating such issues to derive rulings that have no direct reference in the Qur’an and Sunnah is called *ijtihad*. Muslim scholars, especially the Islamic jurists, will exert their best knowledge and decision-making capabilities to give religious opinion or fatwa about the issues. Issues in science and technology such as genome editing often require collective deliberation among the jurists, and scientists may be invited to explain the scientific aspects of a particular technology and give their opinions (Isa et al. 2015; Isa 2016).

There has been no specific fatwa about CRISPR/Cas9-mediated human germline gene editing thus far. Thus, this paper aims to discuss a few aspects that could contribute to the current global discussion about the Sunni Islamic view, which would elicit a more scholarly discourse from an Islamic perspective. This paper explores Islamic perspectives on the four major ethical concerns raised in the mainstream debate about CRISPR/Cas9-mediated human germline gene editing, namely safety and efficiency of the technology, human dignity, tampering with God’s creation, and human genetic enhancement. It also highlights the necessary ethical principles in Islam that should be considered when assessing the permissibility of germline editing. These guiding principles could be incorporated into the policies and ethical guidelines for responsible research and use of the CRISPR/Cas9 technology at the local and international level. The following subtopic briefly explains the Islamic ethical framework from which Islamic ethical principles are derived.

**Islamic Ethical Framework in Science and Technology**

Islam is a monotheistic religion based on a pronouncement that there is no God but Allah. This pronouncement of *tawhid* (oneness of God) has the greatest influence on the Muslims’ worldview and their way of life (al-Faruqi 1992). They firmly believe that Allah is the one who creates and governs the whole universe according to *sunnatullah* (Allah’s law). As guidance for humanity, He reveals the shariah (Islamic law) through the Quran and the Sunnah. The *tawhidi*c worldview prompts the Muslims to be diligent and strive for compliancy with shariah when making any ethical
decision in all aspects of their life because they will be held accountable for all their deeds in the Day of Judgement (Bakar 2008). Besides shariah, *fiqh*, which is based on the understanding and interpretation of scholars about shariah, serves as complementary reference for Muslims to determine whether an action is right or wrong (Kamali 1996).

The process of dealing with issues that have no direct reference in the Quran and Sunnah, such as ethical issues in science and technology, is called *ijtihad*. Muslim jurists usually review related evidences based on both sources. They also refer to other shariah sources, such as *ijma*’ (consensus of Muslim jurists), *qiya* (analogical reasoning), *isti*hab (presumption of continuity), and *sadd al-zara*i (blocking the means) (al-Qaradawi 2013).1 Issues may also be deliberated from the *maqasid al-shariah* (objectives of shariah) perspective, whereby any decision should be consistent with the objectives of shariah, which is to secure *maslahah* (benefit) to humankind and prevent harm (*mafsadah* or *darar*). In an Islamic perspective, benefits and harm are defined by shariah, whereby anything consistent with the shariah principles is considered beneficial to humankind and vice versa (al-Sulami 2010). Good actions or things are divided into three levels of importance, namely essentials (*daruriyyat*), exigencies (*hajiyyat*), and embellishments (*tahsiniyyat*). The essentials (*daruriyyat*) are about preservation of the five entities in shariah essential for human well-being, namely religion, life, intellect, lineage, and property. Without these entities, life in this world and the hereafter will be greatly corrupted (al-Raysuni 2006). Some scholars have also added human dignity as one of the essentials (al-Qaradawi 2013). The exigencies (*hajiyyat*) consist of fulfilling humans’ needs that are of lesser importance than the essentials but are needed to relieve hardships. The embellishments (*tahsiniyyat*) are about fulfilling humans’ interests of the least importance of all the three categories but that could enhance the quality of humans’ lives (al-Ray-suni 2006). For example, refraining from eating impermissible food is necessary to preserve one’s life, therefore such an action is considered *daruri* (essential) in Islam. Eating regular meals is considered *haji* (exigent), whereas washing hands before eating is considered *tahsini* (embellishing) (Attia 2010).

Furthermore, *qawaid fiqhiyyah* (Islamic legal maxims) are also important references for Muslims in making ethical decision. These general yet concise statements of principles have been developed by Muslim jurists throughout history based on the Quran and Sunnah. The five most comprehensive Islamic legal maxims are as follows (Kamali 2006):

(a) *al-ʿumur bi maqasidiha* (acts are judged by their goals and purposes)
(b) *al-yaqin la yazulu bi al-shakk* (certainty is not overruled by doubt)
(c) *al-darar yuzal* (harm must be eliminated)
(d) *al-mashaqqah tajlibu al-taysir* (hardship begets facility)
(e) *al-ʿadah muhakkamah* (custom is authoritative).

1 These sources are all derived from the Quran and Sunnah. Not all of them are agreed upon by all Muslim jurists (al-Qaradawi 2013).
Numerous submaxims can be found under each of the above maxims. Since deliberation of ethical issues in science and technology often involves evaluation of harm and benefit, it is worth mentioning that under the third maxim, some of the well-known sub-maxims are as follows (al-Hariri 1998):

(a) *la darar wa la dirar* (there shall be no harm inflicted or reciprocated)
(b) *al-darar yudfa’ bi qadar al-imkan* (harm should be prevented as much as possible)
(c) *al-darar la yuzal bi mithlih* (harm cannot be eliminated by causing another harm)
(d) *dar al-mafasid awla min jalb al-manafi’* (preventing harm takes precedence over securing benefit)
(e) *ihimal akhaff al-mafasadatayn li daf’i a’zamiha* (the lesser harm will be allowed to prevent greater harm)
(f) *yuhtamal al-darar al-khas li daf’i al-darar al-am* (inflicting harm on an individual is allowed to prevent harm from being inflicted on the society).

In addition to the abovementioned references, previous scholarly works and fatwas produced by Muslim scholars related to the issues discussed are very helpful as guidance for Muslims. For example, they refer to previous scholarly works and fatwas about the beginning of human life and abortion when deliberating ethical issues about human stem cell research (Ilkilic and Ertin 2010). Since CRISPR/Cas9-mediated human germline gene editing has been developed mainly for medical purposes, what follows is a review of previously known Islamic perspectives on the prevention of transmission of genetic diseases.

**Islam and Prevention of Transmission of Genetic Diseases**

Preservation of lineage is one of the main thrusts of shariah that underlines prohibition of adultery and procreation without marital ties and the involvement of a third party in procreation. It also implies encouragement for Muslims to produce healthy offspring (Awadi 2015). The most essential aspiration of a Muslim is to have a healthy child by constantly praying to God to be granted with such blessings even before getting married. This is consistent with his belief that God creates humans, and everything happens according to His knowledge and will (al-Yabis 2012). It is among the prophetic traditions to ask God for ‘*al-zurriyyah al-tayyibah*’, which is often interpreted as offspring that would bring happiness to their parents here and in the afterlife (al-Qurtubi 1993). Nevertheless, the term may also be translated as healthy offspring that are free from diseases (al-Yabis 2012; Albar 2002).

Choosing a healthy spouse is encouraged in Islam. Nevertheless, Muslim scholars have differing opinions about whether Islam encourages marrying distant relatives or nonrelatives more than marrying close relatives. According to some scholars, in Islamic tradition the former is more encouraged as a strategy to prevent transmission of genetic diseases (Albar 2002). However, the preponderant opinion is that neither has advantages over the other. Apart from that, marrying someone afflicted with a...
disease is not prohibited but avoiding it is more favorable. This is compliant with the principle that ‘prevention of harm takes precedence over achieving benefits’ (al-Yabis 2012).

Ethical issues of genetic technologies that can prevent transmission of genetic diseases to offspring have become the subject of discussion among Muslim scholars. Questions typically revolve around whether such technologies are permissible from an Islamic perspective. Perhaps the technology that has caught their attention the most is human reproductive cloning. Although human reproductive cloning has great potential to produce disease-free children, a majority of Muslim scholars consider this technique as against the shariah principles and therefore impermissible (Ghaly 2010). Procreation in Islam is only allowed between couples in wedlock; however, human reproductive cloning requires no paternal contribution (no sperm required) and involves third parties as a cell donor or surrogate mother. This would consequently violate the foundation of parenthood and family in Islam and cause confusion in human lineage (International Islamic Fiqh Academy 1997). Islam dictates that preservation of human lineage as one of the human essentials (daruriyyat) and preservation of society’s interest takes precedence over individual interest. Therefore, the use of human reproductive cloning to fulfill one’s desire to have healthy offspring is not permissible in Islam.

In 2013, the International Islamic Fiqh Academy issued a fatwa about genetic engineering and the human genome that includes genetic counseling, premarital genetic screening, preimplantation genetic diagnosis (PGD), and prenatal diagnosis, as well as newborn screening. These procedures are considered permissible given that they are compliant with the shariah principles and would bring no harm or greater harm. PGD is allowed as long as the samples are handled properly so that they would not be wrongly mixed (International Islamic Fiqh Academy 2013). Even though PGD would result in discarding of diseased fertilized eggs, it is not considered unethical because according to Islam, the pre-embryo does not have a moral status (Fadel 2007). Prenatal diagnosis is also considered lawful, but permissibility of termination of pregnancy depends on the age of the fetus. Termination of pregnancy for the fetus aged less than 120 days is considered permissible if it is seriously deformed or diseased and can harm the mother’s life. Termination of pregnancy for the fetus aged more than 120 days, on the other hand, is unlawful because the fetus already has moral status at this age. Terminating pregnancy to save the mother’s life at this stage is, however, permissible (Majma’ al-Fiqhi al-Islami 2005).

The 2013 fatwa also touches upon the rulings of both somatic and germline gene therapy. Somatic gene therapy is considered permissible only if it has high possibility to treat or reduce disease and there is no alternative treatment available. The therapy is not allowed if it brings harm or greater harm to the patients, or it causes confusion concerning lineage. The use of this therapy to enhance human characteristics such as physical traits is also unlawful. Modifying a creation for non-medical purposes is unlawful in Islam because such a purpose is not valid according to shariah and can be considered a violation of human dignity (International Islamic Fiqh Academy 2013).

As demonstrated above, the principles of preventing harm as well as preserving life and lineage were highlighted the most in fatwas on human genetic technologies.
Nevertheless, each technology might raise different concerns that should be carefully discussed. Therefore, what follows is an exploration of the ethical concerns raised in the debate of human germline gene editing using CRISPR/Cas9 technology from an Islamic perspective.

Ethical Concerns About Human Germline Gene Editing: An Islamic Perspective

Safety and Efficacy of the Technology

Concerns about safety and efficacy of the CRISPR/Cas9 technology in human germline gene editing are among the major concerns raised by both scientists and the public. Since the technology itself is new, several technical hurdles have yet to be fully overcome especially the issues of mosaicism and off-target mutation (Ishii 2015; Baker 2016; Le Page 2017). There are also uncertainties about the role of the targeted genes and the implications of the editing on the resulting child and subsequent generations (Guttinger 2017; Zaret 2015). The main ethical question raised is whether human germline gene editing using this technology should be allowed despite the concerns raised.

Safety and efficacy are among the main aspects considered by Muslim scholars when deliberating about the ethics of technology from an Islamic perspective. The risks and uncertainties of a technology could be the reason why it may be considered impermissible. Such a conclusion is often reached after considering the experts’ opinions and finding a balance between the potential risks and the benefits based on the Islamic ethical framework. Preventing the transmission of a potentially fatal genetic disease to the offspring is highly encouraged in Islam and is in line with the principles of preservation of human life and lineage. However, such a goal should not be achieved using a technology that is not compliant with the shariah principles such as similar harm or greater harm on patients, society, or future generations. This has been emphasized in the fatwas and scholarly writings of Muslim scholars examining germline modification (al-Qaradaghi and al-Muhammadi 2006; al-Lud‘ami 2011). Such technology may only be allowed if it is declared safe and efficacious (al-Qaradaghi and al-Muhammadi 2006). Although developing a technology that has zero risk is almost impossible, Islam teaches that a harm (the disease) cannot be eliminated with a harm of the same or higher degree (caused by the technology) (Isa and Man 2014). If parents were to choose among the various technologies, they should choose a technology that may inflict lesser harm.

Given that the safety and efficacy issues of CRISPR/Cas9-mediated human germline gene editing have not been resolved yet, it should not be applied on humans. This is based on the aforementioned principles and the principle that ‘preventing harm takes precedence over securing the benefits’. The use of technology that has yet to be proven as safe and efficacious on humans is also considered disrespecting humans as dignified beings (al-Lud‘ami 2011). Concerns about violating human dignity will now be examined.
Human Dignity

The research and practical implementation of human genetic engineering have raised concerns about violation of human dignity, especially when it involves modification of human germline genetic makeup (Heidari et al. 2017; National Academies of Sciences, Engineering, and Medicine 2017). Some view the human genome as fundamental for the dignity and integrity of the human species; every human is said to have the right to inherit a human genome that is not artificially changed, thus defining humanity and equality among humans (Knoppers 1991). Apart from that, concerns regarding the moral status of the human embryo used in human germline gene editing have also been raised. Embryos may be especially created for research, and the failed embryos would be discarded. This might be against the view that embryos have inherent dignity (Kirtley 2016).

As explained in the Islamic ethical framework of science and technology, human dignity is considered one of the human essentials that are preserved in shariah. It dictates that each human should be treated with respect even after death. One’s body is considered sacred; therefore, in a normal situation, the bodily integrity should remain intact because humans in Islam are regarded as honored creatures regardless of their race, religion, or social status (Padela and Qureshi 2017). Several hadiths of the Prophet Muhammad (peace be upon Him) have also explained about the dignity of a human. Among them is a hadith narrated by Muslim (may Allah have mercy on him) in which the Prophet (peace be upon Him) explained that a Muslim is strictly forbidden from taking away from another Muslim three things, namely his blood, his property, and his dignity [hadith no. 2564 in al-Nawawi (1996)].

The deliberation of ethical issues in biological applications from the Islamic perspective has been often considered a principle of preservation of human dignity, but it does not always become the deciding principle for the rulings about the applications. When the principle of preservation of human dignity is in conflict with the principle of preservation of life, then the latter often takes precedence over the former. For example, even though medical interventions such as organ transplantation may involve mutilation of both dead and living bodies, it is considered permissible because it is necessary to save a patient’s life (al-Ludʿami 2011). Nevertheless, such an intervention should be proven as safe and efficient and patients should be given the full respect and rights to choose or refuse the treatment (al-Qaradaghi and al-Muhammad 2006).

Having said that, it could be argued that to comply with the principle of preservation of human dignity, due consideration should be given to the aim and the procedure involved in the research and the use of human germline gene editing. If the research has a medical purpose such as to prevent the transmission of genetic disease to the offspring while giving full respect to the participants, then human dignity would not be an issue from an Islamic perspective. Concerns about the violation of human dignity could be mitigated through the establishment of strict regulations to prevent premature use and abuse of the technology.

In the Islamic perspective, only surplus human embryos are allowed to be used in research. This reflects the opinion of a majority of the Muslim scholars as found in the fatwas and scholarly writings regarding embryonic stem cell research.
life is described as to begin after ensoulment. Thus, a human embryo at the earlier stage is deemed as having no moral status of an actual human being (Saniei 2012). Therefore, spare embryos can be simply discarded or used for research purposes such as stem cell and genetic research, provided that consent is obtained from the parents (IMANA Ethics Committee 2005; Jabatan Kemajuan Islam Malaysia 2015). Such research is limited to therapeutic purposes and the researchers involved should be skillful and trustworthy (Jabatan Kemajuan Islam Malaysia 2015).

Tampering with God’s Creation

Some religious beliefs may not support human germline editing because it may be perceived that such editing would enable scientists to play God and take control of humanity (Carroll and Charo 2015; Peters 2017). Muslims, however, do not share the same view. They believe that God and humans belong to two different orders of being (al-Faruqi 1992). God is the Creator of the universe, whereas humans are the creatures who no matter how hard they try would not be able to be God. Modifying a human germline is not considered as playing God because scientists are not creating a human from nothing; instead, scientists are just harnessing the process and the creatures (Bouzenita 2010). Nevertheless, the ethical question raised is whether humans can tamper with God’s creation.

To solve this question, Muslim scholars often refer to the following verses in the Quran that literally mention the prohibition of changing God’s creation:

(a) Chapter al-Nisa’ verse 119 which may be translated as follows: “I will mislead them, and I will create in them false desires; I will order them to slit the ears of cattle, and to deface the (fair) nature created by Allah.” Whoever, forsaking Allah, takes Satan for a friend, has of a surety suffered a loss that is manifest.” (Ali 2007). The meaning of the phrase ‘khalq Allah’ (nature created by Allah) in this verse can be twofold. First, it refers to the natural disposition (fitrah) of the creatures, such as the sun and stars created for human use. Second, it refers to the physical nature of the creatures such as castrating cattle and tattooing (Ibn Atiyah 2001).

(b) Chapter al-Rum verse 30 which may be translated as follows: “So set your face steadily and truly to the Faith; (establish) Allah’s handiwork according to the pattern on which He has made mankind; no change (let there be) in the work (wrought) by Allah; that is the standard Religion; but most among mankind understand not.” (Ali 2007). The preponderant meaning of the phrase ‘khalq Allah’ in this verse is the religion which God has made humans naturally disposed to (al-Qaradaghi and al-Muhammadi 2006).

From the above verses, it can be understood that changing the spiritual aspect of God’s creation is prohibited in Islam. This includes adhering to any religion other than Islam and prostrating to creatures such as the sun which was originally created to benefit humans (al-Fawzan 2008). Ibn Atiyah, a prominent Muslim scholar who lived during the Islamic Golden Age in Andalusia, had explained the
prohibition of changing physical aspects of creation mentioned in the Chapter al-Nisa’ verse 119. According to him, some Muslim scholars such as Ibn Abbas and Anas (may Allah be pleased with them) regard castrating cattle and the like as changing God’s creation. Nevertheless, other scholars including Umar bin Abdul Aziz (may Allah have mercy on him) allow cattle castration if it could bring benefit such as making the cattle meatier than usual. Therefore, Ibn Atiyah argued that any physical change that would bring harm is prohibited, whereas a change that would bring benefit is lawful (Ibn Atiyah 2001).

In addition to the above, Muslim scholars also review hadiths of the Prophet Muhammad (peace be upon Him) regarding changing the physical aspect of a human body. One of the famous hadiths is the hadith narrated by Bukhari and Muslim (may Allah have mercy on them) which can be translated as follows: “Allah has cursed those women who practice tattooing or get it done for themselves, those who remove facial hair, and those who artificially create spaces between their teeth to look beautiful…” [see hadith no. 2125 in al-Nawawi (1996)]. This hadith shows that the listed actions are prohibited in Islam. Nevertheless, another hadith explains the exception of the prohibition of wearing fake hair, trimming eyebrows, and tattooing for medical reasons [see hadith no. 4170 in al-Sijistani (n.d)]. Based on this hadith, Muslim scholars concluded that changing the physical nature of humans for medical treatment is allowed (al-Fawzan 2008). There are also hadiths allowing several changes considered as fitrah (things that humans will do innately) and hence are allowed, such as circumcision and trimming nails [(see hadith 507 in al-Nawawi (1996), al-Fawzan 2008)].

The question of whether changing God’s creation is allowed has been widely discussed by Muslim scholars when dealing with the ethical issues of plastic surgery, organ transplantation and genetic engineering. From the discussion, it can be understood that the ruling of changing God’s creation is different according to its level of importance, whether it is an essential (taghyir daruri), exigent (taghyir haji) or embellishing change (taghyir tahsini) (Hamdan and Ramli 2018). Any changes made for a medical purpose usually fall under the category of essential and exigent changes and hence are allowed. For example, it is permissible for a Muslim to undergo plastic surgery to restore the normal function of an organ, fix defects or disfigurement or remove ugliness that cause physical and physiological harm. Undergoing surgery for a non-medical purpose such as to enhance the nose’s shape or enlarge lips merely to look more beautiful, however, is not permissible from the Islamic perspective. This kind of surgery falls under the category of embellishing change (taghyir tahsini) (International Islamic Fiqh Academy 2007).

It can be concluded that if the human germline gene editing is conducted for a medical purpose, it falls under the lawful category of changing God’s creation and is therefore permissible. The Islamic Fiqh Academy of the Muslim World League and International Islamic Fiqh Academy, the two prominent fatwa institutions in the Muslim world, shared a similar opinion (Islamic Fiqh Academy 1998; International Islamic Fiqh Academy 2013). Since great concern has been raised about the potential use of the gene editing technology for human genetic enhancement, the following is devoted to its discussion.
Human Genetic Enhancement

The advent of the CRISPR/Cas9 technology has intensified concerns about the possibilities of improving human traits beyond the normal capacities. It may lead the society to strive for genetic perfectionism and select desirable genetic traits or remove unwanted traits for the sake of the common good (Knoppers 1991; Frankel and Chapman 2000; Melillo 2017). Several difficult questions have been raised regarding this, such as whether this technology should be allowed to proceed even if it may lead to human genetic enhancement.

On the question of whether Islam allows genetic enhancement, according to a minority opinion such as Tammam Muhammad al-Ludʻami (2011), it is permissible to enhance genetic traits of the offspring since Islam encourages producing good descendants. He refers to a hadith that states that a strong believer is better and preferable by Allah than a weak believer. His argument can be considered weak because the preponderant translation of word al-qawi (strong) in the hadith is strong disposition and motivation that drives a Muslim to do good deeds [see hadith no. 2664 in al-Nawawi (1996)].

Many Muslim scholars, however, view human genetic enhancement as inconsistent with the shariah principles. This can be seen in their fatwas about genetic engineering and stem cell therapy (Islamic Fiqh Academy 1998; International Islamic Fiqh Academy 2013; Jabatan Kemajuan Islam Malaysia 2015).

These arguments are twofold. First, God has created humans in their best form as explained in Chapter al-Tin verse 4 (Awadi 2015). They are endowed with various traits and capacities that reflect the omnipotence and omniscience of the Creator. Such variety is important to have a balanced human population (al-Qaradaghi and al-Muhammadi 2006). Each human is born with strengths and weaknesses, which are not to make one arrogant or otherwise, but to be utilized to achieve success in life. For a Muslim, striving for taqwa (righteousness) and spiritual rather than physical perfection is of priority, because these are what make one honorable in the sight of God (see Chapter al-Hujurat verse 13). Even when choosing a spouse, one is encouraged to choose based on the religiosity of the potential partner more than on looks, lineage or wealth [see hadith no. 1466 in al-Nawawi (1996)].

Second, as earlier noted, Islam draws a firm line between therapy and enhancement. Genetic enhancement whether to increase the capability of a human or to improve the quality of a race is strictly prohibited. This is because it falls under the category of embellishing change (taghyir tahsini). It is also against the principle of preservation of human lineage as it may bring great harm to the human lineage, especially when there is no proper regulation to restrict enhancement (Awadi 2015).

The mainstream debate about human genetic enhancement has also involved the issue of rights, namely the right of the parent to have a healthy child versus the right of the unborn child to have an open future (Agar 2008; Mintz et al. 2018). The Islamic perspective on this matter can be explained based on the Islamic view on parental and unborn child’s rights and obligations. An unborn child in Islam has no obligations and possesses very limited rights, namely rights to several matters that do not require his qabul (consent) such as wealth inheritance (al-Zuhaili 1986), whereas the parents as adults have full obligations and rights as dictated by shariah
to raise and protect the child from harm (Kabir and az-Zubair 2007). Therefore, it could be argued that the parents are free to decide in the best interest of their child. However, such a freedom is not absolute and is subjected to what has been allowed in shariah. Given that human genetic enhancement is considered unlawful by a majority of Muslim scholars, the parents should abstain from genetically enhancing their child.

Conclusion

Based on this study, it can be concluded that CRISPR/Cas9-mediated human germline gene editing would be considered lawful in Islam if it met the following conditions:

(a) It is only used for medical purposes particularly to prevent or treat diseases. Such a modification is not considered tampering with God’s creation.
(b) It is allowed only after safety and efficacy issues are resolved. The technology used should not bring more harm to the parents, the resulting child, the society, and the future generation.
(c) Strict regulation is established to ensure respect for the persons involved, prevent premature use, and abuse of the technology as well as to strictly prevent human genetic enhancement.

This paper demonstrates applications of several Islamic ethical principles that could be considered when assessing the permissibility of CRISPR/Cas9-mediated human germline gene editing. Among the main guiding principles are the three principles of *maqasid al-shariah*, namely principles of preservation of human life, lineage, and dignity. Islamic legal maxims or principles of ‘prevention of harm takes precedence over securing benefit’ and ‘harm cannot be eliminated with harm of the same or higher degree’ could also be considered. Nevertheless, further discussions and research are necessary to address the controversies as well as to explore the related ethical principles from Islamic perspectives.

Acknowledgements This work was supported by the Fundamental Research Grant Scheme under Ministry of Higher Education Malaysia (Grant Number: FP032-2016).

References


Springer


Islamic Perspectives on CRISPR/Cas9-Mediated Human Germline…


**Publisher’s Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.