



Bioethical Issues of Tissue Engineering and Regenerative Medicine: A Preliminary Review from Islamic Perspective

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Abstract

Modern advances in biochemistry, cell and molecular biology, genetics, biomedical engineering and material sciences, have contributed to the development of tissue engineering and regenerative medicine (TERM). Although TERM is still in its initial phases, significant breakthrough in this cross-disciplinary area has clearly marked the way for the establishment of a promising new biomedicine technology which actively seeks to reconstruct tissues/organs or spare parts for the human body to repair, restore or replace damaged tissues. However, these breakthroughs have raised number of moral and legal questions, including among others, is it moral to genetically modify the human genes? What are the moral and legal implications of regenerative medicine? Does organ reconstruction or tissue replacement activity violate basic religious beliefs or legal status of the person? Through textual and analytical methods, this paper aims to explore relevant concerns from the Islamic perspective. Besides the texts of the Qur'an and the Prophetic narrations (*hadith*), both Muslim jurists (*fuqaha*) and ethicists' opinion on these matters would be unveiled.

Keywords: *bioethics, Islamic perspective, tissue engineering, regenerative medicine, ethical issues.*

Abstrak

Kemajuan moden dalam biokimia, sel dan biologi molekul, genetik, kejuruteraan dan bioperubatan dan sains bahan, telah menyumbang kepada pembangunan kejuruteraan tisu dan perubatan regeneratif (TERM). Walaupun TERM masih dalam fasa awal, kejayaan besar dalam menembusi rangkaian silang telah memberi penanda yang jelas bagi penubuhan sebuah teknologi bioperubatan baru menjanjikan keaktifan yang bertujuan untuk pembinaan semula tisu/organ atau alat ganti bagi tubuh manusia pembaikan, pemulihan atau menggantikan tisu-tisu yang telah rosak. Walau bagaimanapun, penemuan ini telah menimbulkan beberapa persoalan dari segi moral dan undang-undang, termasuk antara lain, adakah bermoral bagi pengubahsuaian genetik gen manusia? Apakah implikasi moral dan undang-undang terhadap perubatan regeneratif? Adakah pembinaan semula organ atau aktiviti penggantian tisu mencemari kepercayaan asas agama atau status undang-undang seseorang? Melalui penulisan dan kaedah analisis, kajian ini bertujuan untuk meneroka kebimbangan yang berkaitan dari perspektif Islam. Selain daripada ayat-ayat Al-Quran dan riwayat Nabi (*hadith*), pendapat kedua-dua ulama Islam (*fuqaha*) dan ahli etika berkaitan masalah ini dapat didedahkan.

Kata kunci: *bioetika, perspektif islam, kejuruteraan tisu, perubatan regeneratif, isu-isu etika.*

Introduction

Imagine a little child was born with a congenital kidney defect. Despite various ways to treat his illness, the kidneys were getting exhausted. Toxins

started to build up in the system, in such a way that the only solution is to go for kidney transplant. In this case, and perhaps some other similar problems organ transplantation is an option, but it comes with complications and risks, and too often there are not enough donated organs to meet the growing need. For instance, in January 2011, Global Industry Analysts, Inc. reported that, due to ascending increase of human population and growing incidences of organ failure, the global market for organ and tissue transplantation is estimated to reach 105,000 by 2015. Moreover, the

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company reported that advancements in technology, surgical techniques, and immunosuppressive drugs are also thrusting the market for organ transplants. However, this growing demand for organ and tissue for patient is faced by a number of challenges including growing shortage in the supply of organ or tissue transplants, and thus more patients die while waiting for a transplant. Similarly, another challenges raise from the risk of rejection of the transplanted organ by the body of the organ recipient, while other challenges arise from donor side morbidity, finite durability of the prosthetic devices, increased risk of infection and adverse effects. Due to these shortcomings, the multidisciplinary field of tissue engineering was born as an alternative to treat disease with new living tissue that is designed or constructed to meet the needs of each individual patient (Langer & Vacanti, 1993). Furthermore, though tissue engineering is set to improve certain difficulties of organ and tissue transplantation, nevertheless, the process of removing organs and tissues from given organ donors to the organ recipients has also raised certain moral and legal concerns among ethicists and jurists. Among many questions raised in this regard is can we treat parts of the human body as spare parts that can be removed and replaced according to the needs of given individuals? If yes, then does such process violate the sanctity of the body? If the answer to the above question is no, then on what grounds are these practices objected. Similarly, morality and legality of tissue engineering practices are also debated among ethicists and jurists across the globe.

This paper explores in brief some of the moral concerns in tissues engineering and regenerative technology focusing on embryonic stem cell research, cloning, animal research and tissue/organ transplantation from an Islamic point of view. For human conducts (*af'al al-'ibad*), including healing and therapeutic practices, are guided by the *shari'ah* norms (*al-ahkam al-shar'iyyah*), in such a way that given conducts are evaluated and judged based on the principles of the *shari'ah*, this paper intends to address bioethical issues of regenerative medicine through and within the *shar'ah* norms of *halal* (permitted) and *haram* (prohibited). Since the intellectual debates on bioethical practices commenced in the Muslim world, Muslim jurists and ethicists have employed given *shari'ah* principles to judge the permissibility or otherwise on given biomedical practices. Generally speaking, Muslim jurists and ethicists have welcomed the scientific breakthroughs in biomedicine so that healing and therapeutic practices are improved, yet Muslim scholars have unanimously agreed that breakthroughs in biomedicine should be guided or

governed by the norms of morality (*al-qiyam al-akhlaqiyyah*), such as the protection of life, sanctity of the human body, protection of the intellect, good motives and good means of conduct, etc., as illustrated in the divine revelation (*al-wahy al-ilahiyyi*).

Tissue Engineering and Regenerative Medicine

The loss of organ or tissue is considered to be the most costly and frequent predicament in the human health care. The idea of tissue engineering and regenerative medicine is likely to revolutionize the way scientists and health professionals improve the wellness and the quality of life for people around the world. The field of tissue engineering, which aims to repair, regenerate, and/or improve injured or diseased tissue and/or functionality has evoked intense interest and holds great potential for improving the human life. Tissue engineering, which started in the late 1980's, is a field of research that envisages the use of both principles of engineering and life sciences towards the advancement of biological substitutes to restore, maintain, or improve tissue function (Langer and Vacanti 1993). The success in regenerative medicine appears to lie in the developments of tissue engineering. Generally, cell source, scaffolds, and signalling factors make up the tissue engineering chord (Pereira et al. 2011). Various naturally and synthetically derived biodegradable polymers have been used to construct scaffolds and using growth factors in tissue engineered cartilage. Novel biomaterials or scaffolds are being continuously developed and are leading to distinctive interactions with cells through controlled biomaterial chemistry, structure, and the addition of biological molecules (Leor et. al 2005).

It may sound like a science fiction, but to date, the effort to grow new organs from scratch has become a reality and this includes newly engineered skin, bone, cartilage, windpipes, arteries, bladders and corneas, to name a few. Scientific advances in biomaterials, stem cells, growth factors and biomimetic environment have created opportunities to reconstruct tissues from the combination of tissue engineering trio including the cell sources, scaffolds and biologically active signalling molecules. The term regenerative medicine is often used together with tissue engineering, although those involved in regenerative medicine place more emphasis on the use of stem cells to produce tissues. The establishment of tissue engineering and regenerative medicine technology is to eliminate and reduce the need of organ transplant among patients. Both potentially offer improvements in medical care for hundreds of thousands of

patients annually, and dramatic reductions in medical expenses. Although still in its infancy period, the prospect of tissue engineering and regenerative medicine holds a great promise of custom-made medical solutions for injured or diseased patients, with genetic re-engineering in the zygote or even earlier as one of the most promising and also most debatable aspects of this field. Transplantation raises a number of bioethical issues, including the definition of death, when and how consent should be given for an organ to be transplanted and payment of organs for transplantation. Some organs, such as the brain, cannot be transplanted. Here, both tissue engineering and regenerative medicine application are needed to solve this problem by treating the patients using their own cell or tissue (autologous), thus indirectly avoiding using organ transplant received from other patients or sources. There is no doubt that medical science has taken an enormous step forward in terms of creating a better health care to the world population during the past half-century.

The new advances in biomedical technology has created some debates; among these are the use of embryo for embryonic stem cell research, human cloning, the usage of animal research and tissue or cell transplantation on human. Hence, ethics seem to be an ideal resolution to regulate science from being harmful to all human beings. The combination between application of biological science and the implementation of ethics has brought out the existence of 'bioethics'. Bioethics has been widely discussed throughout the world, but there has been a lack of Islamic establishment not only in tissue engineering but also in many areas of biomedicine. The technology holds great promises and potential for all mankind. Although it involves highly controversial issues such as stem cell research, animal study and gene therapy, it also includes unsuspicious, low-risk research like basic cell culture experiment (Gelhaus 2009). There are ongoing disputes on certain aspects that may indicate man may be playing God. The debate on ethical and legal implications of biomedical breakthroughs resulted in the raise of bioethics as an independent field, which studies the ethical and moral implications of new biomedical advances (The American Heritage Dictionary of the English Language, 2000) as in the fields of genetic engineering, organ transplantation, clinical research on human subjects, artificial insemination, drug research, and etc.

Exploring the Bioethics of TERM from the Islamic Perspective

Based on the Qur'an and the Traditions (*sunnah*) of the Prophet (*s. a. w.*), Muslim jurists provided number of jurisprudential maxims (*qaw'id fiqhiyyah*), which function as normative guidelines that describe what man ought to do, in his or her daily life, including scientific researches. For instance, the Qur'anic verses like: "if any one saved a life, it would be as if he saved the lives of the whole people" (the Qur'an, 5:32) and "and make not your own hands contribute to (your) destruction" (the Qur'an, 2:195), teach Muslims including medical doctors, to prevent harm and thus save lives. Similarly, the Prophetic statements: *no harm is inflicted (la darara wala dirara)*, teaches us to prevent all kinds of harm, which implies to save life. Based on these and some other statements from the Qur'an and the Tradition (*sunnah*) of the Prophet (*s. a. w.*), Muslim jurists concluded that one of the basic objectives of the *shari'ah* is the protection of human life. Muslim scholars of jurisprudence, who wrote on the objectives of the Islamic *shari'ah* like Imam al-Shatibi and Ibn 'Ashur, state that, on one side, the *shari'ah* strives to foster human prosperity, while on the other side it aims to provide protection to humanity from all kinds of threats. Hence, the Islamic *shari'ah* ultimately aims to protect human life either through alleviation of hardship (*raf' al-haraj*) or realization of human interests (*tahqiq al-maslahah*). In this understanding, biomedical practices like tissue engineering and regenerative medicine are understood to be moral, as long as such practices are guided by the moral principles of life saving or preventing harm (*darar*).

Therefore, tissue engineering approaches are addressed within the principles of Islamic jurisprudence "*usul al-fiqh*", which are basically the foundations of Islamic ethical system. For instance, one of the principles of the Islamic jurisprudence states that 'harm must be eliminated (*ad-dararu yuzal*)', basically teaches that harm, regardless of its sources, is to be removed. Similarly, another principle of the Islamic jurisprudence states that 'hardship begets facility (*al-mashaqqatu tajlibu at-taysir*)'. Thus based on these and other principles of the Islamic jurisprudence, tissue engineering and regenerative medicine is in principle morally justified as long as such practices are not compromising with human rights and dignity. Hence, with the jurist principle of necessity begets facility (*al-daruru tubihu al-maxzur*), many *fatwas* have invoked the principle of priority of saving human life and have permitted the organ transplant and tissue engineering

as necessity (*darurah*) of saving live (Ebrahim, 2002; Howitt, 2009; Al-Qardawi, 1995).

Intention

The Prophetic statement: “*innama al-a'mal bi-l-niyyat*”, is a declaration that the voluntary actions of the moral agent are a consequence only of the moral agents' purpose to perform the act or bring it into existence; actions are indeed the result of one's intention. Hence, it is important to emphasize that intention (*niyyah*) plays a very essential role in Muslim thought. The Prophet (*s. a. w*) has stated: “*The reward of deeds depends upon the intention, and every person will get the reward according to what he has intended*”. (Umar bin Al- Khattab, Al-Bukhari). It is clear that every scientists and researchers should have a good intention (*niyyat*) when providing and improving the health quality of a patient, not just for the sake of doing researches or gaining popularity. A clear intention must be put in every action that involved when applying the engineered tissue, starting from the cell source selection up until to the last stage of implanting it back into the patient's body. It is important for the researchers to inform and explain to the patient their every intention or purpose of using the cell or tissue from the patient's body. Exceptions can only be made in emergency cases when one's life is at stake, and when there is no opportunity to get an informed consent. The consent form in both research and therapeutic contexts not only is viewed as an information and explanatory sheets to the subjects and patients, but also acts as a legal apparatus to protect researchers and physicians from liability that may arise later.

Embryonic Stem Cell (ESC)

Selection of cell source is very much essential before culturing the cell to become a functional tissue, which later will be used to restore, heal and improve body function without generating inflammation, rejection or adverse effects. However, there are different opinions regarding the use of cell source in this research even it is for the treatment purpose. For instant, Islam does not allow any treatment using forbidden (*haram*) ways. It shows that Islam has its own perspective in solving the issues that involved in tissue engineering and regenerative medicine pathway.

At present, the main bioethical issues associated with human stem cells involve their derivation (sources) and their usage in research. Because of its pluripotency, ESC has a remarkable potential in the field of tissue regeneration. Human ESC has the

capacity to differentiate into all types of tissue and therefore may be used to replace damaged organ tissues such as cardiac tissue following a heart attack or repair currently irreversible injuries such as spinal cord injuries. Some of the most promising tissue engineering projects require embryonic stem cell. According to Seip (2006), the embryonic stem cell research is considered ethically controversial because the idea of using, manipulating and destruction of human embryos. Gelhaus (2009) pointed out that the ethical evaluation of embryo is depending on its status and concept of beginning of human life.

The controversy in ESC research revolves around the various questions about when life becomes a human life, mainly; does the foetus have a soul? Can we say an ovum or sperm is a person? Or when do we consider the product of conception as a human being? Like many other religions, Islam has its own perspective on the status of embryo. Islam considers human life as valuable and as deserving of protection from conception onwards. According to *shari'ah*, we should make a distinction between the actual life and potential life. Also, we should make a clear distinction between the fertilized ovum in the dish and the fertilized ovum in the womb.

Before the embryonic stem cell is used in the ESC research, a few conditions must be met before making a decision. Muslims jurists have made a clear distinction between the early stages of pregnancy (first 40 days) and its later stages. As far as the usage of foetal stem cells is concerned, the age and the origin of the foetus must be known. One of the conditions is, if the foetus is the result of a spontaneous abortion (or miscarriage) there is no harm for using it, since it will be disposed of anyway. This statement was supported by The Ethics Committee of Islamic Medical Association of North America (IMANA), that “research using stem cell from product of miscarriages is permissible” (Atighetchi, 2007). But if it is the result of an induced abortion, then the age of the foetus should be known. Ensoulment timing based on a prophetic *hadith*: *Each one of you is collected in the womb of his mother for forty days then turns into a clot (alaqa) just like that (mithla dhalika), and turns into a lump (mudgha) just like that, and then Allah (God) sends an angel and orders him to write four things; his career, his provision, his life duration and whether he will be wretched or blessed (in the Hereafter), then the angel breathes the soul into him* (Sahih Muslim, *hadith* no.: 2645). This *hadith* mentioned on the three stages of embryonic development before ensoulment takes place. Many scholars believe that

ensoulment occurs 120 days after conception. However, there are some scholars infer the *mithla dhalika* stage signifies these three stages occur within the same period of the end of 40 days, at which the ensoulment occurs. Therefore, Muslim scholars have agreed that embryonic life deserve full right and entitle to respect before ensoulment and more so after ensoulment.

When it comes to treatment modalities, Muslim scholars hold that *halal* (permissible) practices should be used to heal given diseases, however, in the cases whereby the *halal* methods cannot help, then for the sake of life saving and based on the principles of necessity, it is permissible to adopt prohibited treatments, so that lives are saved or harms are alleviated. Hence, in the Islamic ethical system, extraordinary circumstances allow exceptional measures, based on the principle: necessity makes the unlawful lawful (*ad-daruratu tubeeh al-mahzurah*). The substance, which is the foetus, in the stem cell case, is considered *tahir* (clean; pure). In addition, the age and origin of the foetus should be known as far as the usage of ESC is concerned. The Qur'an has mentioned the development of foetus, which has to be a benchmark for us to refer to the age of foetus before conducting any research or procedures.

"Man We did create from a quintessence (of clay); Then We placed him as (a drop of) sperm in a place of rest, firmly fixed; Then We made the sperm into a clot of congealed blood; then of that clot We made a (foetus) lump; then We made out of that lump bones and clothed the bones with flesh; then We developed out of it another creature. So blessed be Allah, the best to create".
The Qur'an (23:12–14)

It can be understood from these verses that, in order to receive the soul, i.e., to be considered a fully human individual person, the embryo must pass the stages of conception; zygote, implantation, somites occurrence and beginning of ossification and musculation. Siddiqi (n.d) considered the embryo in the fertilized ovum in the dish is not human because it is not in natural environment, which is the mother's womb. Hug (2006) also has concluded that, "All schools of thought in Islam accept that the foetus is accorded the status of a legal person only at the stages of its development, when perceptible form and voluntary movement appear." In the National Fatwa Malaysian Council, the jurists have agreed that after the blowing of the soul, which passed 120 days after, the embryo is perfectly content to be a man and it

can never be dropped or aborted. On the contrary, Al-Kasani has suggested that it is allowable to abort the pregnancy if the content is not yet considered to be a man because in such circumstances it is not human, but rather a blood clot. This statement has been made by referring to the *hadith Bada'i*, chapter 10, *hadith* no.4825. Based on the above words, the Hanafi scholars have belief that, the content has not been regarded as human beings before the soul has been blew into it. Therefore it can be dropped without any legal allegation. However, there is still on-going debate regarding when the exact time of life begins. The use of embryonic stem cell in the prospect of treatment is somewhat approvable but there are certain limitations (source and age of embryo) to it. Therefore, in this understanding given embryos can in principle be used in the ESC research, as long as principles of morality are observed, such as the consideration on the embryo's age and source, as well as the methods of receiving it. It is also important that the cells involved should and must be treated with respect even if it is not considered as human.

Cloning

Recent advances in the field of cloning and stem cell research have introduced new hopes for the treatment of serious diseases. This field causes debate and challenge, not only among scientists but also among ethicists, religious scholars, governments, and politicians. Every Islamic seminar, jurisprudence council or individual scholars have concluded that cloning procedures aimed at producing human clones is not permissible. Unfortunately the misconception at the prospect of cloning has affected the prospect of therapeutic cloning.

Unlike human reproductive cloning, the final product of therapeutic cloning does not produce a human being clone. The main purpose in producing human clonal embryos in therapeutic cloning is to gain harvesting stem-cells, tissues and organ. Therapeutic cloning has actually the potential of treating chronic and devastating diseases such as including diabetes mellitus, parkinsonism, myocardial infarction and spinal injuries (Musa, 2004). The Cloning of Man by David M. Rorvik in the late 1970s when cloning by nuclear transplantation became the hot topic of the day in North America. Following that, majority of the Muslim in North America have flashed the red light to human cloning. This situation have made Mufti of Egypt, Dr. Nasr Farid Wasil in Cairo to declare that the possibility of human copying as an act of disbelief and immoral conduct which must be controlled by the government (Sachedina,

n.d). Most of the Islamic scholars are against the cloning process related with human cloning but hands in the permit if cloning can improve human health and treat certain disease cases.

According to Sachedina (n.d), Al- Qardawi was against the cloning based on the Qur'anic notion about variation among peoples as a sign from God who created human beings in different forms and colours, just as He created them distinct from other animals and Al-Qardawi believed that cloning might lead to the errors of marital relationship. However, he also noted that this technology in fact can be used to overcome certain hereditary disease such as infertility. Musa (2004) quoted a remark on the issue of cloning by a highly respected and contemporary Muslim scholar, Al-Qardawi:

“If it becomes possible through research to clone organs such as the heart, liver, kidneys or others which may benefit those who are in dire need of them; then this is permitted by religion and the researcher or scientist will receive the reward from Allah. This is because the research will confer benefit on humanity without loss to others or infringing upon them. Therapeutic cloning with this noble research pursuit is permissible and it is encouraged. In fact, in some circumstances, it may become mandatory to enhance this research in accordance with the need and man's research capability and accountability.” (Al-Qardawi, 2002)

In accordance with Nasim (2004), human cloning is forbidden within the purpose of enhancement of physical appearance, increasing the population or making the state stronger. Likewise, Siddiqi (2002) was totally against cloning because he believed that it should not be used as an alternate way of human production, even at a small scale. In his opinion, a full-fledged use of cloning technology is prohibited (*haram*) because it may cause three major problems, which include danger to the human personality, danger to human dignity and honour as well as danger to human family and society.

As reported by Singh (2002), from Associated Press in Kuala Lumpur, Malaysia's highest religious decision-making body also has banned human cloning, saying that the procedure is “unnatural and totally against Islam”. Islam forbids human cloning since it goes against the law of natural reproduction. A verse in The Qur'an (4:1) mentioned that: “*O mankind! Reverence your Guardian-Lord, Who created you from a single person, created, of like nature, his mate, and from them twain scattered (like seeds) countless men and women.*” This verse indicates that the creation of human being is brought through the reproduction seeds of a husband and wife.

Thus, any procedure that does not meet this criteria is unnatural and totally against Islam.

The Council on American-Islamic Relations (CAIR) (2001) has reported that 81 percent of 1008 Muslim respondents were opposed to human cloning. However, Nawash (n.d) and majority of council members permit cloning in the case of plant except human being. Practically every Islamic jurisprudence council or individual scholar have concluded that cloning procedure aimed at producing human clones is not permissible, in other word majority considered it as *Haram* (Mishal, 2002). The rationales for prohibition were mainly because human cloning is against the natural process of human relationship of marriage and reproduction and there is a possibility of interfering with the male-female population dynamics. From the ethics side, human reproductive cloning is unproven safe and compromises the gene pool, which reduces genetic variability and one virulent pathogen maybe sufficient to wipe out the whole clone population like Dolly (a sheep in lamb's clothing). Therefore, it is believed that advanced knowledge and application in tissue engineering and regenerative medicine such as cloning of cell or tissue is permissible from the eyeglass of Islam as long as it is not for the human cloning purposes.

Animal Research

There have been numerous pharmaceutical breakthroughs in the medical field that could have possibly remained undiscovered were it not for the animal testing. Animal trials are generally considered to be an essential link in the preclinical research leading up to a clinical trial. Even though this trial involves the animal ethics issue but animal experimentation remains essential for the evaluation of the safety and efficacy of therapeutic compounds and is furthermore still a legislative requirement. Some scholars agree that since animal tissue engineering is an alternative approach to biomedical problems, then this method is allowed as long as it obeys the conditions outlined by the prominent Islamic scholars and renowned jurists. But subsequently comes the question of exactly where do we draw the line?

Hamblin (2007) agreed that animal study should only be performed when there are no other options available and when the benefits from doing the research outweigh the loss of animals. This is true since there are some animal researches done around the world, which do not even give benefit to the society. Furthermore, Gomes and Reis (2004) highlighted the importance of reducing the number of animals involved as much as possible in the pre-

clinical phase. The Prophet (s.a.w) declared: *“There is no man who kills (even) a sparrow or anything smaller, without its deserving it, but God will question him about it.”* (Narrated by Ibn ‘Umar and by Abdallah bin Amar bin al-Nas). In another hadith no.4808 as narrated by al-Bukhari and Muslim, which stated that *“Allah has cursed the one who inflicts pain upon animals”*. These hadith clearly signify to us that in Islam, every living entity has a right of protection, preservation and a right to live.

According to Al-Hafiz Masri (n.d), killing animals to satisfy the human thirst for inessential is a contradiction in terms within the Islamic tradition. In Islam, we have no right to use animal in any way that suits us just because we are members of a higher species. We should take into account their feelings and their capacity for pain, stress and suffer. Other species should be treated in a justly manner and never should we oppress them. As mentioned in a hadith; *“Verily Allah has enjoined goodness to everything; so when you kill, kill in a good way and when you slaughter, slaughter in a good way”* (Sahih Muslim, hadith no. 4810). Tissue engineering and regenerative medicine is an available option to help minimize the usage of animal by only using cell/tissue from the patient’s body itself (autologous). In this field, certain animal species is necessary to be used as subject due to its functional similarity with the human body physiology. It is ethically unacceptable to perform tests directly on human being because it is against the human morality and law. Animal research is a requirement in clinical research in order to lessen the risks of new therapies in human beings. Islamic ethics rejects extravagant (*israf*) and maltreatment of natural researches including animal. For that reason, the Muslim researcher should always pay their respect towards all God’s creation and should only perform experiments that can significantly contribute to new important knowledge.

Tissue/Organ Transplantation

Advances in the modern surgical world have made it possible for patients with diseased or damaged organs or tissues to be replaced with healthy and functional organs or tissues from a living or dead donor. Some destructive diseases are devastating and can only be treated and cured by giving the patients an entirely new organ. Therefore, scientific research is thriving hard to deliver treatment modalities that are suitable for clinical use. Currently the demand for organ or tissue transplantation exceeds the available supply, thus raises the issue as to how the organ shortage can be efficiently managed. Because of the

critical need to overcome these shortages, some scientists have gone on board using animal parts such as extracting insulin from animal pancreases (Groth et al. 1994). However, these cross-species transplantation (xenotransplantation) using organs and cells from animal species into the human being, such as using baboon’s heart, chimpanzee’s heart or pig’s liver are still debatable (Cooper 2012).

There are two schools of thought in the Muslim community when it comes to deciding the need for an organ or tissue transplantation. The majority of Muslim scholars legalized organ donation with clear notions as means of preserving life. In cases when the life of a person is in threatened, certain prohibitions are waived. It is mentioned in the Qur’an: *“He (Allah) has only forbidden you dead meat, and blood, and the flesh of swine, and that on which any other name has been invoked besides that of Allah. But if one is forced by necessity, without wilful disobedience, nor transgressing due limits, then he is guiltless. For Allah is Most Forgiving and Most Merciful”* (2:173).

In view of this, it is permissible to transplant and donate organs in order to save another person’s life but it is subject to certain terms and condition. On a contrary, some other scholars rejected the idea and claimed that the human body belongs to God and that no one has the right to fiddle, interfere or donate what he/she clearly does not possess. It is thought that the human body is considered a trust (*amanah*) from God the Almighty and it is unacceptable for one to sell, give or donate any organs from his body. The principle of Islamic jurisprudence states that *“when the evidenced of prohibition conflict with the evidences of permissibility, preference is given to prohibition”* (Ibn Nujaym, al-Ashbah wa al-Naza’ir). For this reason, there is no clear-cut as to who is right or wrong as the issue of organ transplant merely subjected to the *ijtihad*.

Conclusion

Ethical assessment of tissue engineering and regenerative medicine is a complex matter, depending on the applied techniques, the type of subjects and the intended goals as well as the social context. Although many researchers indicated that the development and scientific progress in tissue engineering and regenerative medicine research is not entirely ethically deviated from societal approved values but in certain aspect, there are several contradictions from the Islamic viewpoint.

Though tissue engineering and regenerative medicine have gained a remarkable achievement of modern medical science in the treatment of diseases,

bioethical issues that still linger and shrouded within the field may have a huge impact on the scientific integrity, behaviour and awareness of the researchers and health professionals. Bioethics should not be seen as a reason to restrict or retard a scientific progress, but it is crucial to substantiate what is permissible and what is not, preferably from Islamic perspective.

Despite the widely ranging bio-religio-ethical problems and dilemmas posed by these emerging biotechnologies, Islamic bioethics have provided a “middle of the road” approach moderating between the extremes of conservatism and contemporaries. Instead of going into a depth and comprehensive discussion, this paper is meant to prompt awareness amongst Muslim scholars and scientists on the need to incorporate Islamic element into tissue engineering application. Of course there are still so much work that needs to be done but it is hoped that in the near future, more allowable experimentations from a standpoint of Islamic teaching will be made possible for the betterment of human health. It seems that, from Islamic perspective, scientific researches in all fields, including tissue engineering and regenerative medicine are permitted, as long as scientific advances in respective scientific fields are guided by ethical values, which are derived from the Divine Revelations (*al-wahy al-Ilahiy*). In this understanding, scientific research conducts in tissue engineering and regenerative medicine is permissible as long as such advances are not a threat to human life and dignity. Allah says in the Quran (2:143):

“Thus, have We made of you an Ummat justly balanced, that ye might be witnesses over the nations, and the Messenger a witness over yourselves; and We appointed the Qibla to which thou wast used, only to test those who followed the Messenger from those who would turn on their heels (From the Faith). Indeed it was (A change) momentous, except to those guided by Allah. And never would Allah Make your faith of no effect. For Allah is to all people Most surely full of kindness, Most Merciful”.

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