Review Article

Human cloning, stem cell research

An Islamic perspective

Aida I. Al-Aqeel, *FRCP (Lond. & Edin.), FACMG.*

ABSTRACT

تظهر أبحاث التقنية الحيوية التي تخص الإنسان تداعيات أخلاقية، قانونية، و اجتماعية، ودينية كثيرة. وأن التقدم العلمي في مجال الاستنساخ وأبحاث الخلايا الجذعية أدى إلى أمل كبير في علاج الكثير من الإمراض، ولكن هذا التقدم أدى إلى الكثير من التحديات و الاختلافات بين العلماء، والفقهاء، والحكومات، والسياسيين حيث أنه ليس هنالك رأي محدد عن النواحي الأخلاقية للاستنساخ الإنساني. وفي الدول التي يؤثر الدين فيها بالقرار السياسي، فإن حقوق الجنين هي مركز الاختلاف، وبسبب النتائج السيئة للاستنساخ التكاثري فهو حرام في الإسلام، ولكن أبحاث الخلايا الجذعية التي تستخدم للعلاج هي حلال مع أخذ جميع المحاذير والاعتبارات في المرحلة التي تسبق نفخ الروح في الجنين، إذا كان مصدر هذه الخلايا حلال.

The rapidly changing technologies that involve human subjects raise complex ethical, legal, social, and religious issues. Recent advances in the field of cloning and stem cell research have introduced new hopes for the treatment of serious diseases. But this promise has raised many complex questions. This field causes debate and challenge, not only among scientists but also among ethicists, religious scholars, governments, and politicians. There is no consensus on the morality of human cloning, even within specific religious traditions. In countries in which religion has a strong influence on political decision making, the moral status of the human embryo is at the center of the debate. Because of the inevitable consequences of reproductive cloning, it is prohibited in Islam. However, stem cell research for therapeutic purposes is permissible with full consideration, and all possible precautions in the pre-ensoulment stages of early fetus development, if the source is legitimate.

Saudi Med J 2009; Vol. 30 (12): 1507-1514

From the Department of Pediatrics, Riyadh Military Hospital, and the Stem Cell Therapy Program, King Faisal Specialist Hospital and Research Centre, Riyadh, Kingdom of Saudi Arabia.

Address correspondence and reprint request to: Dr. Aida I. Al-Aqeel, Senior Consultant, Pediatrics Medical Genetics, Metabolic, & Endocrinology, Riyadh Military Hospital, Riyadh 11159, Kingdom of Saudi Arabia. Tel. +966 (1) 4791000 Ext. 25452. Fax. +966 (1) 4791000 Ext. 22682. E-mail: aalaqeel@rmh.med.sa / alaqeela1@hotmail.com

Cloning is the field of medical science that can both have an enormous potential impact on human health, and leads to new basic research and discoveries. Islam allows procreation between man and woman, only within marriage.[1-3] Human cloning is the production of a human being whose genetic make-up is nearly identical to that of a currently, or previously existent individual. There are 2 kinds of cloning: therapeutic, which may allow the generation of stem cells *in vitro*, with their potential ability to repair damaged tissues. Because of this potential, the European Society for Human Reproduction and Embryology (ESHRE) Ethics Task Force considers this technique acceptable.[4] The second is reproductive cloning, which can be achieved by embryo splitting, or by somatic cells nuclear transfer (SCNT). The SCNT, which can be used in either kind of cloning is achieved by injecting a nucleus from a somatic cell of an adult into an enucleated egg (whose nucleus had been removed). The cell would then grow into a fetus that would be a true genetic copy (clone) of the adult, from which the somatic cell nucleus was obtained.[2,3] The problem, however, is that therapeutic cloning requires embryonic stem cells (ESC), and to acquire these, early stage human embryos are needed. This raises serious ethical, moral, and religious concerns, for example, on the rights of the embryo, the timing of the onset of life, and the hazards to the woman. With the widespread and unchecked use of stem cell technology, there is also the risk that it could fall into the wrong hands and be used for human cloning, with unimaginable consequences.[5-9] All these issues will be discussed in this paper.

Islam has a moral code, as well as a civil law with a unifying ethical framework. A universal foundation of

practices and beliefs creates a monotheistic culture, the aim of which is to create peace in one's self, family, and society by actively submitting to, and implementing the will of God.[1] This culture is further refined by various local and regional cultures based on their inclinations and sensitivities. Muslims believe that Islam is the continuum and the culmination of, not an alternative to, the sister Abrahamic faiths of Judaism and Christianity. In the Qur'an, these faiths are links of the one chain of God's message to humanity. The Qur'an, which Muslims believe is God's very word, says: "the same religion He enjoined on you as the one He enjoined on Noah, and this we reveal unto you, and that we enjoined upon Abraham, Moses, and Jesus, that you should uphold the faith and break - not your unity therein" (Holy Qur'an 42:13). This is a commonality, we Muslims respect, although we are aware that on further comparison it is natural to find differences and distinct schools of thoughts between faiths, and even within one faith.

The essential core of Islamic teachings is the perfection of the ethical conduct of a human being. The road to moral and spiritual perfection is described as the "quest for God" in Islam. The seekers after God must satisfy 2 conditions; their actions must be governed by the prescriptions or ordinances of the "divine law", and they must ensure God is constantly present in their hearts.[1] On the other hand, God gave humans life, and with that also gave humans the freedom and the authority to do good or evil. God also gave man the basic knowledge of "good" and "evil" at the time of his inception. The Holy Qur'an says (91: 7-10): "the human soul - the way He molded it and inspired it with knowledge of its evil and its good - bears witness to the fact that indeed he, who cleanses it (of all impiety), shall be successful while he, who corrupts it shall face down" (**Figure 1**).

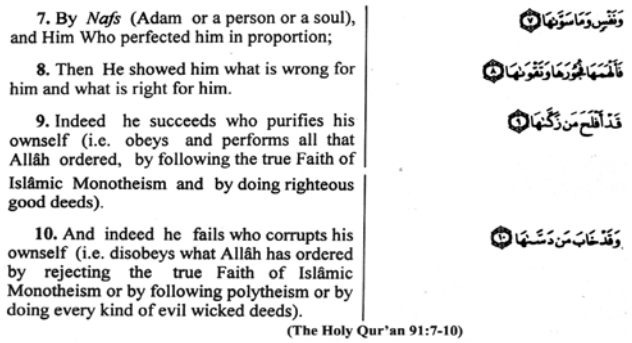

Figure 1 - The essential core of Islamic teachings is the perfection of ethical conduct of a human being. These verses from the Holy Qura'n 91:7-10 stresses that God (Allah) gave man life and with that also gave man the freedom and the authority to do good or evil.

Among the 57 Islamic countries that make up the Organization of the Islamic Conference (OIC), the specific religious and cultural values of each country's population have a significant impact on health, education, and social policies, which drives the health care, or models of care that patients receive. Islamic bioethics is derived from a combination of principles, duties and rights, and to a certain extent, a call to virtue.[2,3] Other laws are not Islamic but ethnic, and may even violate Islamic norms. Where appropriate, consideration is also given to "maslaha" (public interest) and "urf" (local customary precedent).[10] In the process of establishing a legal or ethical position namely, "Fatwa" (consensus edict), if the Qur'an or Sunna has a clear commandment, then the other sources do not need to be used. Ijmaa (consensus), qiyas (analogy), and so forth are supplemental sources.[5] However, these Fatwas are not binding by law, and every country has its own legislation.[3] In the opinion of Al-Ghazali, an Islamic scholar[3,5] "maslaha" consists of considerations, which secure a benefit, or prevent harm. Protection of life, religion, intellect, lineage, and property is "maslaha." The sources of Fiqh (jurisprudence in the Islamic tradition) - that is, Qur'an, Sunna (the statements "Hadiths," legal ways and traditions of the Prophet Mohammed), "ijmaa," "qiyas," and "maslaha" are not equal categories: there is a rank order in which these sources are used. The legal material of the Qur'an is contained in approximately 500 verses (out of over 6000 verses), according to various estimates.[5] The "Shiaha'a" (Ja'fari) branch of Islam has in some cases developed its own interpretations, methodology, and authority systems, but as the whole, its bioethical rulings do not differ fundamentally from the "Sunni" positions.[3,11]

In Islamic Shariai'ha law (Figh), there are juridical rules that encourage achieving ends, warding off corruption, and avoiding harm and evil: for example, when removing harm will result in another harm, a balance must be sought to achieve the least degree of the 2 harms.[3,12] Some of the Islamic Shariai'ha principles governing medicine, which are authoritative and agreed precedents are listed in **Table 1**.[3,13,14] In my opinion, applying these Islamic Shariai'ha principles to the field of cloning and stem cell research has the following implications.

Cloning. Issues in public policy concerning cloning overlap somewhat with general stem cell matters, but have additional dimensions. Prohibition of cloning for reproductive reasons is directed at the prevention of the birth of children who are genetic copies of already existing individuals.[15,16] Legislation on cloning for research, however, deals mainly with the development of stem cell lines through SCNT, thus raising issues on a specific type of stem cell research.[15,16]

Table 1 - Some Islamic Shariai'ha (Figh) principles governing medicine.[3,13,14]

• Necessities override prohibitions, "Al Drawrat Tabieh Al Mahdawrat."
• Preventing harm is preferable to procuring benefits, "Draa Al Mafasad Mukadam Ala Jalab Al Manafaa"
• The basic concept in useful matters is permissiveness, "Al Asal Fii Al Manafaa Al Abaha'a."
• The basic concept in harmful matters is prohibition, "Al Asal Fii Al Madar Al Tahreem."
• Human life protection is one of the main principles of Shariai'ha, "Al Mahafada'a Ala Al Nafas Al Bashariaha Ahda Al Maqasad Al Shariai'ha'a Al Raisayaha." God Almighty says: "If any one saved one life, it would be as if he saved the lives of all mankind" (Holy Qur'an 5:32)

In the Name of Allâh,
the Most Gracious, the Most Merciful.

1 O mankind! Be dutiful to your Lord, Who created you from a single person (Adam), and from him (Adam) He created his wife Hawwa (Eve)], and from them both He created many men and women; and fear Allâh through Whom you demand (your mutual rights), and (do not cut the relations of) the wombs (kinship) Surely Allâh is Ever an All-Watcher over you.

بسم الله الرحمن الرحيم

يَٰٓأَيُّهَا ٱلنَّاسُ ٱتَّقُوا۟ رَبَّكُمُ ٱلَّذِى خَلَقَكُم مِّن نَّفْسٍ
وَٰحِدَةٍ وَخَلَقَ مِنْهَا زَوْجَهَا وَبَثَّ مِنْهُمَا رِجَالًا كَثِيرًا
وَنِسَآءً ۚ وَٱتَّقُوا۟ ٱللَّهَ ٱلَّذِى تَسَآءَلُونَ بِهِۦ وَٱلْأَرْحَامَ
إِنَّ ٱللَّهَ كَانَ عَلَيْكُمْ رَقِيبًا ﴿١﴾

Holy Qur'an 4:1

Figure 2 - The importance of the concept of reproduction and family and preservation of kinship in Islam (Holy Qur'an 4:1).

36. Glory is to Him Who has created all pairs of that which the earth produces, as well as of their own (human) kind (male and female), and of that which they know not.

سُبْحَٰنَ ٱلَّذِى خَلَقَ ٱلْأَزْوَٰجَ كُلَّهَا مِمَّا تُنۢبِتُ
ٱلْأَرْضُ وَمِنْ أَنفُسِهِمْ وَمِمَّا لَا يَعْلَمُونَ ﴿٣٦﴾

(The Holy Qur'an 36:36)

Figure 3 - Creation of all beings in pairs; including human, animals, and plants (Holy Qur'an 36:36).

27. See you not that Allâh sends down water (rain) from the sky, and We produce therewith fruits of various colours, and among the mountains are streaks white and red, of varying colours and (others) very black.

28. And likewise of men and *Ad-Dawâbb* [moving (living) creatures, beasts], and cattle, are of various colours. It is only those who have knowledge among His slaves that fear Allâh. Verily, Allâh is All-Mighty, Oft-Forgiving.

أَلَمْ تَرَ أَنَّ ٱللَّهَ أَنزَلَ مِنَ ٱلسَّمَآءِ مَآءً فَأَخْرَجْنَا بِهِۦ
ثَمَرَٰتٍ مُّخْتَلِفًا أَلْوَٰنُهَا ۚ وَمِنَ ٱلْجِبَالِ جُدَدٌۢ بِيضٌ
وَحُمْرٌ مُّخْتَلِفٌ أَلْوَٰنُهَا وَغَرَابِيبُ سُودٌ ﴿٢٧﴾

وَمِنَ ٱلنَّاسِ وَٱلدَّوَآبِّ وَٱلْأَنْعَٰمِ
مُخْتَلِفٌ أَلْوَٰنُهُۥ كَذَٰلِكَ ۗ إِنَّمَا يَخْشَى ٱللَّهَ
مِنْ عِبَادِهِ ٱلْعُلَمَٰٓؤُا۟ ۗ إِنَّ ٱللَّهَ عَزِيزٌ غَفُورٌ ﴿٢٨﴾

(The Holy Qur'an 35:27-28)

Figure 4 - Diversity of creations of all beings; including human, animals and plants (Holy Qur'an 35:27-28).

In late 2003, 2 international bodies were unable to resolve disagreements that involved bioethical issues. First, the United Nations General Assembly failed to pass a treaty on reproductive cloning because of insistence by some countries that the treaty include a ban on cloning for research. Second, the European Union (EU) failed to agree on conditions for funding stem cell research, because of the diversity of views and policies of the countries of the EU.[15] A resolution on human cloning was passed, and declared on 8th March 2005, by a United Nation General Assembly Resolution 280/59.[6] Eighty-five nations voted in favor of the resolution, including 24 Muslim countries. The Declaration called on the member states to undertake necessary measures to prohibit all forms of human reproductive cloning to the extent that they are contradictory to human dignity, and the need to safeguard human life. The member states were also called on to take adequate measures to protect human life, and to prevent the exploitation of women in the application of life sciences, as well as, to adopt and implement national legislation for the purpose.[6]

Different religious groups have divergent moral conclusions on this subject. There is substantial debate regarding the start of life, and at which specific stage dignity is conferred on the individual during the course of development (conception, primitive streak development, implantation, ensoulment, or birth).[17] The Catholic Church considers the moral singularity of human to occur at conception, and Muslims at ensoulment,[18] but Judaism considers it at birth.[13] However, applying the Islamic Shariai'ha principle "preventing harm is preferable to procuring benefits," (which indicates that a balance has to be established between potential benefits and harms of any method of treatment or research in use, on the condition that such use does not cause further social damage)[3,12] to cloning, the real challenge is to find a balance between the need to preserve human dignity and the need for continued improvement in the quality of human life through research and development. Therefore, in addition to the fact that a resulting embryo from reproductive cloning would be severely deformed with developmental abnormalities and early aging,[19-21] the major problems of reproductive cloning are: 1) the loss of kinship and lineage due to the unnaturalness of reproduction (mixing of kinship or the loss of it, would be considered harram (unlawful in Islam), and undermining the concept of reproduction and family (**Figure 2**) (Holy Qur'an 4:1), unless if the ovum comes from the wife, and the nucleus to be cloned from the husband, 2) the social harms, problems of personal identity and the psychological development of a clone, and the disregard for human dignity, 3) the unjust eugenics (selecting genetic qualities by selective breeding), and trends towards

"designer babies" (superior or inferior, depending upon the motives of the creator), 4) the contradiction of the Islamic belief (God is the only and the best creator), as God Almighty says ("and He it is who originates the creation, then He will repeat it (after it has been perished) and this is easier for Him") (Holy Qur'an 30:27), 5) the contradiction of the principle of creation of all beings (human, animal, plants) in pairs (male and female) (**Figure 3**) (Holy Qur'an 36:36; 51: 49; 75: 39). However, as cloning produces the exact copy of the previously existent individual whether male or female, this leads to a disturbance of the natural existence of pairs, and finally, 6. the contradiction of the principle of diversity of creation of all beings, including human, animals, and plants in various colors and shapes (**Figure 4**) (Holy Qur'an 35:27-28).

Clearly, all creation takes place solely through God's will, and therefore the advancing knowledge and technology development that has made cloning possible was pre-ordained by God Almighty's will. Allah is the Creator of the universe, but He has established the system of cause and effect in this world. Sowing a seed in the ground is the cause, but only Allah produces the effect from it in the form of a plant. Similarly cloning is a cause, and only through Allah's will can it produce the effect.[5,7] So cloning would be only manipulating God's creation. Also in applying the Islamic Shariai'ha principle "the basic concept in harmful matters is prohibition" (which prohibits performing any medical procedure, where harm is absolute, or predominantly outweighs benefits),[3,12] as previously stated, the potential harms of reproductive cloning outweigh its potential benefits, therefore it is forbidden in Islam. Supporting this is the Decree # 100/2/D10 of the Islamic Jurisprudence (Figh) Council of the Organization of Islamic Countries (OIC) in Makkah Al-Mukarama in its 10th session (23-28.2.1418H / 28 June-3 July 1997)[2] (**Table 2**).

Therapeutic cloning and stem cells research. The ESC's have the remarkable ability to differentiate into any specialized cell type, except the placenta. Stem cells are cells from which all 210 different kinds of tissue in the human body originate.[5] Because many diseases result from the death or dysfunction of a single cell type, scientists believe that the introduction of healthy cells of this type into a patient may restore lost, or compromised function. The discovery of stem cells early in the 1980s had suggested therapeutic approaches to chronic, debilitating, and incurable disease such as Parkinson's disease, diabetes mellitus, stroke, arthritis, multiple sclerosis, heart failure, and spinal cord lesions.[22] The most important characteristics of ESC's are their pluripotency (the capacity to differentiate into many different cell types), and plasticity (the capacity to change from one type to another).[18] There are various ways in which human ESCs might be obtained (**Table 3**).[23,24]

The ESC research is morally controversial because it involves sometimes the deliberate production, use, and ultimate destruction of human embryos. The moral status of human embryo is a major ethical question in

Table 2 - The Islamic Jurisprudence (Figh) Council of the Organization of Islamic countries (Decree #100/2/D10) forbidding cloning.[2]

• Human cloning is forbidden in any method that leads to human reproduction.
• It is forbidden in all cases to introduce a third party into marriage, be it an egg donor, a surrogate womb, a sperm donor, or a cloned cell.
• It is permissible to use genetic engineering and cloning in the fields of germs, microorganisms, plants, and animals, following legitimate rules which lead to benefits and prevent harm.
• All Muslim countries are called upon to formulate the necessary legislation to prevent foreign research institutes, organizations and experts from directly or indirectly using Muslim countries for experimentation on human reproductive cloning or promoting it.
• Specialized committees should be set up to look into the ethics of biological research and adopt protocols for study and research in Muslim countries.
• Biological and bioengineering research institutions (other than cloning research) should be supported and established, according to the Islamic rulings, so that the Muslim world will not be dependent on others in this field.

Table 3 - Ways of obtaining human embryonic stem cells.[23,24]

• Pre-implantation embryos; these "pluripotent" cells are derived from the inner cell mass of a blastocyst, 5 or 6 days after fertilization. The embryo might be destroyed during the process of ESCs harvesting, except if a single blastomere is used to produce hESC lines without destroying the embryo. Stem cells retain the ability to differentiate into cells and tissues from all 3 germ layers (endoderm, mesoderm, and ectoderm). These cells cannot form the other "extra embryonic" tissues necessary for complete development, such as the placenta and membranes, so that they cannot give rise to a complete new individual.[22,24]
• Somatic cell nuclear transfer (SCNT), or Therapeutic cloning. Involves the creation of a cloned human embryo. These embryos contain the same genetic characteristics as the progenitor. Stem cells produced by this method have the advantage over those harvested from embryos resulting from IVF or aborted fetuses, in that these cells are genetically similar to the cells of the individual who donated the nucleus. They are immunologically matched to the patient and thus avoid problems of rejections.[25]
• Human embryonic germ (EG) cells; are derived from the gonadal ridges of aborted fetuses at around 6 weeks of gestation.[17]
• Stem cells have also been identified in adult tissues (multipotent adult progenitor cells [MAPC]), for example, the brain, skeletal muscle, bone marrow, and umbilical cord blood. Stem cells from one tissue can circulate to another and adopt the developmental fate of the second tissue (a process called transdifferentiation). However, these cells have restricted renewal potential.[26,27]
• Induced pluripotent Stem Cells (iPSC), as pluripotent state can be derived by some new modifications of adult cells, for example, from skin fibroblast, mesenchymal, liver, and other cells by mere transduction of 4 transcription factors, Oct4, Sox2, Klf4 and c-Myc.[27,28] However, iPS cell reprogramming remains slow and inefficient.[29] An important next step will be to identify ways of assessing which iPS cell lines are sufficiently reprogrammed and safe to use for therapeutic applications.[30]

conducting this research. To create new cell lines, it is necessary sometimes to destroy the preimplantation blastocyst. The question is whether the destruction of human embryos in stem cell research amounts to the killing of human beings. Considerable differences of opinion exist with regard to the ontological and moral status of the pre-implantation embryo. According to the "conceptionalist" view, the embryo is a "person" and because of the potential of the embryo to develop into a person, it ought to be considered as a person.[22]

In the "classical" normative debate on embryo research, 2 perspectives can be distinguished: a "fetalist" perspective (focusing on the moral value of the embryo), and a "feminist" perspective (with the interests of women, particularly candidate oocyte donors, playing a central role). From a feminist perspective, the creation of embryos for research should be evaluated critically in as far as it may require that women themselves become objects of instrumental use.[22] The creation of human embryos for research purposes requires the harvesting of eggs.[8] Hundreds of unfertilized eggs prove necessary to produce one human clone embryo, so how will those eggs be provided? Hormone treatment of a woman to obtain oocytes for research purposes, and obtaining eggs from her body is invasive, and so it could lead to exploitation of women and commercialization of human eggs.[8] Women might conceive specifically to abort so as to obtain ESCs, or these processes might be commodified.[19]

Therefore, the central objective of therapeutic cloning is to cure disease, improve health, and hence, strive for a better quality of life for humans. This calls for research and development in therapeutic cloning to improve the knowledge, skills, expertise, and techniques for achieving the stated objective. The problem, however, is that therapeutic cloning requires ESC's, and to acquire these, early stage human embryos are needed.[5-9]

To address the ethical, moral, and religious concerns associated with therapeutic cloning, we must understand the timing of the onset of life and the rights of the embryo, therefore we must know when the ensoulment (inspiration of the soul) in Islam is: from an Islamic perspective, man is the vicegerent of Allah (God) on earth. "Behold thy Lord said to angels: I will create a vicegerent on earth" (Holy Qur'an 2:30). The creation of human individuality and fetal development are referred to in several dozen verses of the Qur'an in various contexts, and also in Hadiths.[5] Human life begins at the time of ensoulment (inspiration of the soul) "Nafkh Al Rouh," prior to this moment, the embryo has sanctity, but does not reach the status of a full human being, therefore its eradication is a sin but its punishment (blood money) will be less than that after ensoulment.[2,3,5,9,31-33] The Holy Qur'an describes stages of the human creation in Surat 23 (Al-Muminun Sur'ah verses 12-14). "And indeed we created man from a quintessence of clay. Then we placed him as a small quantity of liquid (nutfa) in a safe lodging firmly established. Then, we have fashioned the nutfa into something which clings ('alaqa), then we made 'alaqa into a chewed lump of flesh (mudgha), and we made out of that chewed lump of flesh into bones, and clothed the bones with flesh. And then we brought it forth as another creation. So blessed be God, the Best of creators."

The role of Hadith in Islamic teaching is to help us better understand and interpret the verses of the Qur'an, since Prophet Mohammad is the ultimate interpreter of the Qur'an. Prophet Mohammad was not only a religious or political leader for his nation, but also a guide who would teach Muslims how to understand the Qur'anic verses. He was reported to have said 2 Hadiths, which will help us greatly to better understand the Qur'anic verse above, especially as they relate to the physical development of the embryo and the time of ensoulment.[5] The Prophet Mohammad has said; verily your creation is on this wise. The constituents of one of you are collected for 40 days in his mother's womb; it becomes something that clings ('alaqa) in the same period (mithla dhalik), then it becomes a chewed lump of flesh (mudgha) in the same period. And the angel is sent to him with instructions concerning 4 things, so the angel writes down his provision (sustenance), his death, his deeds, and whether he will be wretched, or fortunate. Then the soul is breathed into him.[5,32,34] And, after the zygote (nutfa) has been established in the womb for 40 or 45 nights, the angel comes and says: "my Lord, will he be wretched or fortunate?" And both these things would be written. Then the angel says: "my Lord, would he be male or female?" And both these things are written. And his deeds and actions, his death, his livelihood; these are also recorded. Then his document of destiny is rolled, and there is no addition to, or subtraction from it.[5,32]

Many Hadith scholars, referring to the first Hadith only, and understanding the expression "mithla dhalik" as "time equal to this period" rather than "in the same period," have suggested that the angel comes to the prenate, and breathes in the soul 120 days after conception. Some ancient scholars, as well as some contemporary researchers have disagreed on this interpretation, and concluded from both Hadiths that, if one understands the expression "mithla dhalik" to mean "in the same period," then the completion of certain physical forms and ensoulment take place after the fortieth day of conception. However, to interpret the expression "mithla dhalik" to mean "in the same period" is more accurate in this context from both an embryological and a theological perspective.[5,35] If it is

accepted that ensoulment takes place at 120 days of gestation, the embryo should look like a nutfa (a drop of liquid: the zygote) between days 0 and 40; it should be something like 'alaqa (something which clings: the implantation stage) between days 40 and 80, and it should be similar to mudgha (a chewed lump of flesh: the occurrence of somites - the appearance of the primitive streak) between 80 and 120 days. As we know from modern embryology, these stages occur well before these times.[36] It can be understood from the above verse and Hadiths that in order to receive the soul, that means to be a full human individual person, a prenate must pass through the various stages of conception: zygote (nutfa); implantation ('alaqa); formation of somites - the appearance of the primitive streak - (mudgha), and the beginning of the formation of bone and muscles. According to the embryological information given above, ensoulment cannot take place before 7 weeks after conception, since these embryological stages are not completed before this time.[5,36] The embryo was classically referred to as the early stages of development, after formation of the embryonic disc in the second week (primitive streak), until the end of the eighth week. However, the ESHRE Task Force decided to use the generic term "embryo," which refers to the stages from fertilization to the formation of the embryonic disc, therefore, the moral status of embryos gradually increases with their development.[4,8,22]

As pointed out previously, some of the judgments and decrees of Islamic jurisprudence regarding human therapeutic cloning and stem cell research originate from the interpretations of the above verse of the Holy Qur'an and other similar verses, and Hadiths. Muslim jurists have made a clear distinction between the stages before and after ensoulment (when God says, "then, We (Allaha) brought it forth as another creation.") By applying the rule "the basic concept in useful matters is permissiveness" (which indicates that everything is lawful (Halal), as long as it is useful to people, unless otherwise stipulated in a religious provision, or could be judged by analogy (Qiyas) with unlawful things (Harram),[3,12] it is quite clear that Muslims consider an embryo to acquire human status at the time when the soul is breathed into it. So it can be argued at least that Islam does not totally prohibit early embryonic stage research, especially if it is justified and deemed necessary.[2,3,5,9,31,33] However, the manner in which the early embryos may be obtained and the inherent risks to women who would be the source of such embryos pose serious ethical and social problems. Also applying the first and last Islamic Shariai'ha principles (necessities override prohibitions; human life protection is one of the main principles of Shariai'ha), the use of embryo for therapeutic or research purposes may be acceptable under necessity, if it takes place before the point, at which the embryo is ensouled in its early stages of development (before 40-45 days of gestation).[5] The source has to be legitimate; as such cells could be used to save lives. The Islamic Jurisprudence Council of the OIC in Makkah Al-Mukarama on its 17th session (19-23.10.1424 H/13-17 December 2003G) declared Decree #3, setting the guidelines for SCT (**Table 4**).[2]

Although the collection and storage of cord blood has prompted ethical considerations, mainly dealing with the issues of autonomy regarding decisions on the donation of cord blood, and regarding the privacy and confidentiality in the tests required before use of these cord blood cells for transplantation.[37,38] Cord blood transplantation is encouraged in Islam, supported by the above Fatwa and the previous 2 Islamic Figh principles.

Due to these clarifying decrees (Fatwa), the Islamic Republic of Iran was one of the first countries to have produced human ESC's.[2,3,9] In 2003, Iran became the tenth country in the world to produce culture and freeze embryonic human stem cell lines, and 2 years later the Iranian Ministry of Health and Medical Ethics and the History of Medicine Research Center at Tehran University (Tehran, Iran) developed related special guidelines.[39-41]

In our experience, practical application of the use of stem cells in therapy is the use of bone marrow transplant to treat blood disorders like thalassemia, and leukemia, and it is used to treat storage disorders like Niemann Pick's disease and Morquio's disease. Umbilical cord blood banks are available in the Kingdom of Saudi Arabia and the United Arab Emirates.

"Allah created man in the most perfect form" (Holy Qur'an 95:4). This citation from the Holy Qur'an is

Table 4 - The Islamic Jurisprudence (Figh) Council of the Organization of Islamic countries Decree # 3 on stem cell therapy.[2]

It is permissible to obtain stem cells, to be grown and used for therapy, or for permissible scientific research, if its source is legitimate. For example:

- Adults, if they give permission, without inflicting, or experiencing physical or emotional harm.
- Children provided that their guardians allow it, for a legitimate benefit and without inflicting or experiencing physical or emotional harm on the children.
- The placenta or the umbilical cord, with the parents' permission.
- A fetus if spontaneously aborted, or when aborted for a therapeutic reason permitted by Sharia'ha, with the parents' permission.
- Left-over zygotes remaining from *in vitro* fertilization, if donated by the parents, when it is ascertained that they will not be used in an illegitimate pregnancy (outside marriage).

It is forbidden to use stem cells, if their source is illegitimate. For example:

- Intentionally aborted fetuses (that is, abortion without a legitimate medical reason).
- Intentional fertilization between a donated ovum and sperm.
- Therapeutic human cloning by somatic cells nuclear transfer.

often used to explain that each human life has its own inherent value and goodness. Although cloning and stem cell research may have positive uses in serving to restore health (and in the process integrity), care must be taken to ensure that other Islamic principles are not violated. Applying the same principle, an accurate and complete knowledge of one's pedigree is a fundamental human right. Therefore, human cloning is forbidden in any method that leads to human reproduction. The SCNT is currently not permitted by the Islamic Jurisprudence (Figh) Council of the OIC, although it is urged to be allowed by some Islamic scholars.[7,9] However, stem cell therapy is allowed if the source of the cells is legitimate; including left-over zygotes, or excess embryos (from *in vitro* fertilization laboratories) - in the early stages of development (before 40-45 days of gestation),[5] and if the parents have consented to its use.[2,3,5,7,9,13]

Islam embraces scientific progress and research and that at no time during the Islamic history has there ever been a conflict between Islam and science. The first verse from the Holy Qur'an which was revealed to Prophet Mohammed, says "Read" (Akra). God Almighty also says (He has taught man that which He knew not) (**Figure 5**, Holy Qur'an 96:1-5). Therefore, if cloning creates a human being, it is a violation of Islamic beliefs, but if it is to be used for the purpose of treatment, this is not only permitted, but recommended and rewarded by God. In the opinion of most Muslim jurists, stem cell and cloning research, as scientific advancement, would have advantages and limitations. Because of the inevitable consequences of reproductive cloning, it is prohibited by the majority of Muslim reference decrees.[2,3,5,7,9,13] However, stem cell research for therapeutic purposes is permissible with full consideration, and all possible precautions in the pre-ensoulment stages of early fetus development.[2,3,5,7,9,13]

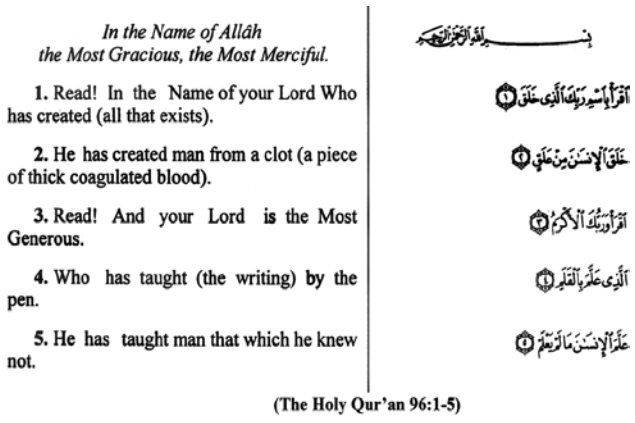

Figure 5 - Islam embraces knowledge and science, as God Almighty says (He has taught man that which He knew not). (Holy Qur'an 96: 1-5).

The field of stem cell therapy is still in its infancy, with researchers incrementally improving safety, efficacy, and applicability to a wider spectrum of diseases. The scientific community has a responsibility to engage the public in their efforts to gain public understanding and support. Policy makers should take into account public opinion. Only in this way we can realize the great potential of stem cell research.[22] Public education and information on the ethical and policy issues raised by stem cell research and its application is necessary. Given the promise of stem cell research, special efforts should be made by the international bodies to promote equitable access to the benefits derived from stem cell research. Cooperation of scientists, ethicists, jurisprudents, and lawyers is essential for establishing national well-controlled systems with appropriate ethical guidelines and so is the scientific supervision of the research program in all countries.[3]

Research and science drive innovation for human development.[7] It is important that when creative science and technology begin to impact on deeply rooted concepts of theology and culture, science and religion should engage in constructive dialogue, and come to an informed consensus for the good of the public at large. Developing science and technology for better health is a religious and moral obligation. Therefore, there is a need for a dialogue on health care ethics and human cloning at all levels, including interfaith dialogue as a means for enhancing dialogue among the world's people on challenges that are common to us all.[3] Finally, persons considering donating their excess embryos for research purposes should be afforded the highest standards of protection for the informed consent and voluntariness of their decision.

Acknowledgment. *The author gratefully acknowledges Dr. Mohammed A. Al-Bar, (Kingdom of Saudi Arabia), for providing the Arabic version of the Islamic Fatwa and for his expert advice, and special thanks to Dr. Judith G. Hall, Canada, for her valuable comments and support.*

References

1. Fakhry M. Ethics in Islamic philosophy. In: Craig E, editor. Routledge Encyclopedia of Philosophy. London (UK): Routledge Publishing; 2000. (updated 2002. accessed 1 October 2009. Available from URL: http://www. muslimphilosophy.com/ip/rep/H018.html
2. Al-Aqeel AI. Ethical guidelines in genetics and genomics. An Islamic perspective. ***Saudi Med J*** 2005; 26: 1862-1870.
3. Al Aqeel AI. Islamic ethical framework for research into and prevention of genetic diseases. ***Nat Genet*** 2007; 39: 1293-1298.
4. Shenfield F, Pennings G, Sureau C, Cohen J, Devroey P, Tarlatzis B, et al. I. The moral status of the pre-implantation embryo. ***Hum Reprod*** 2001; 16: 1046-1048.

5. Aksoy S. Making regulations and drawing up legislation in Islamic countries under conditions of uncertainty, with special reference to embryonic stem cell research. ***J Med Ethics*** 2005; 31: 399-403.
6. United Nations General Assembly. International convention against the reproductive cloning of human beings. Fifty-ninth session. Sixth Committee. Belgium: United Nations Office of Legal Affairs; 2005. Updated 6 October 2004, accessed 1 October 2009. Available from URL: http://www.un.org/law/cloning/
7. Abdur Rab M, Khayat MH. Human cloning: Eastern Mediterranean Region perspective. ***East Mediterr Health J*** 2006; 12 (Suppl 2): S29-S37.
8. United Nations Educational, Scientific and Cultural Organization. Human cloning: ethical issues. Paris (France): UNESCO; 2004. (Updated 2005. Accessed 1 October 2009. Available from URL: http://www.unesco.org/bioethics)
9. Larijani B, Zahedi F. Islamic perspective on human cloning and stem cell research. ***Transplant Proc*** 2004; 36: 3188-3189.
10. Kamali MH. Urf (custom). Principles of Islamic Jurisprudence. Cambridge (UK): Islamic Texts Society; 1991. p. 283-296.
11. Daar AS, al Khitamy AB. Bioethics for clinicians: 21. Islamic bioethics. ***CMAJ*** 2001; 164: 60-63.
12. Al Sayyad IA. Legal Directives for Medical Practice Procedures: An Islamic approach to medicine. Accesssed 10 January 2009. Available from URL: http://www.islamicmedicine.org/SayadBook2.htm
13. Ajlouni Kamal MS/ Cloning Between Science and Religion. Amman (Jordan): Ajial Press; 2004. Arabic.
14. Al Othiamian MS. Fundamentals of Islamic Jurisprudence "Isul Al Fagih." Dammam (KSA): Abn Al Jawzi Press; 2006. Arabic.
15. Tauer CA. International policy failures: cloning and stem-cell research. ***Lancet*** 2004; 364: 209-214.
16. Wakayama T. On the road to therapeutic cloning. ***Nat Biotechnol*** 2004; 22: 399-400.
17. Cogle CR, Guthrie SM, Sanders RC, Allen WL, Scott EW, Petersen BE. An overview of stem cell research and regulatory issues. ***Mayo Clin Proc*** 2003; 78: 993-1003.
18. Daar AS, Bhatt A, Court E, Singer PA. Stem cell research and transplantation: science leading ethics. ***Transplant Proc*** 2004; 36: 2504-2506.
19. Bowring F. Therapeutic and reproductive cloning: a critique. ***Soc Sci Med*** 2004; 58: 401-409.
20. Solter D. Mammalian cloning: advances and limitations. ***Nat Rev Genet*** 2000; 1: 199-207.
21. Janisch R , Wilmut J. Don't clone humans. ***Science*** 2001; 291: 2552.
22. de Wert G, Mummery C. Human embryonic stem cells: research, ethics and policy. ***Hum Reprod*** 2003; 18: 672-682.
23. Reiss MJ. Ethical dimensions of therapeutic human cloning. ***J Biotechnol*** 2002; 98: 61-70.
24. Lo KC, Chuang WW, Lamb DJ. Stem cell research: the facts, the myths and the promises. ***J Urol*** 2003; 170: 2453-2458.
25. Cheshire WP Jr, Pellegrino ED, Bevington LK, Mitchell CB, Jones NL, FitzGerald KT, et al. Stem cell research: why medicine should reject human cloning. ***Mayo Clin Proc*** 2003; 78: 1010-1018.
26. Beltrami AP, Cesselli D, Bergamin N, Marcon P, Rigo S, Puppato E, et al. Multipotent cells can be generated in vitro from several adult human organs (heart, liver, and bone marrow). ***Blood*** 2007; 110: 3438-3446.
27. Fischbach GD, Fischbach RL. Stem cells: science, policy, and ethics. ***J Clin Invest*** 2004; 14: 1364-1370.
28. Wernig M, Zhao JP, Pruszak J, Hedlund E, Fu D, Soldner F, et al. Neurons derived from reprogrammed fibroblasts functionally integrate into the fetal brain and improve symptoms of rats with Parkinson's disease. ***Proc Natl Acad Sci U S A*** 2008; 105: 5856-5861.
29. Zhao XY, Li W, Lv Z, Liu L, Tong M, Hai T, et al. iPS cells produce viable mice through tetraploid complementation. ***Nature*** 2009; 461: 86-90.
30. Amabile G, Meissner A. Induced pluripotent stem cells: current progress and potential for regenerative medicine. ***Trends Mol Med*** 2009; 15: 59-68.
31. Albar MA. Ethical considerations in the prevention and management of genetic disorders with special emphasis on religious considerations. ***Saudi Med J*** 2002; 23: 627-632.
32. Imam Al-Bukhari. Sahih Al-Bukhari. ***Matabi Asshab*** 1958; 4: 135. Arabic.
33. el-Hashemite N. The Islamic view in genetic preventive procedures. ***Lancet*** 1997; 350: 223.
34. Gatrad AR, Sheikh A. Medical ethics and Islam: principles and practice. ***Arch Dis Child*** 2001; 84: 72-75.
35. Aksoy S. A critical approach to the current understanding of Islamic scholars on using cadaver organs without prior permission. ***Bioethics*** 2001; 15: 461-472.
36. England MA. A colour atlas of life before birth. Aylesbury (UK): Wolfe Medical Publications; 1990.
37. Burgio GR, Gluckman E, Locatelli F. Ethical reappraisal of 15 years of cord-blood transplantation. ***Lancet*** 2003; 361: 250-252.
38. Marshall E. Clinical promise, ethical quandary. ***Science*** 1996; 271: 586-588.
39. Aramesh K, Dabbagh S. An Islamic view to stem cell research and cloning: Iran's experience. ***Am J Bioeth*** 2007; 7: 62-63.
40. Saniei M, De Vries R. Embryonic stem cell research in Iran: status and ethics. ***Indian J Med Ethics*** 2008; 5: 181-184.
41. Zahedi F, Larijani B. National bioethical legislation and guidelines for biomedical research in the Islamic Republic of Iran. ***Bull World Health Organ*** 2008; 86: 630-634.