Can hIPS Cells Replace hES Cells: An Ethical Review

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Abstract

Invention of human inducing pluripotent stem (hIPS) cells have generated much confusion among the scientists, researchers, and health policy makers regarding the need to continue scientific research using human embryonic stem (hES) cells. Since the use of human embryonic stem cells seem to be ethically controversial some proponents of stem cell research advocate the use of embryo-independent inducing pluripotent stem cells to bypass the ethical controversy. In this paper we explore the both advantages and disadvantages of stem cell research and therapy. Aim of this article is to chalk out the ethical controversy of human embryonic stem(hES) cells and make sure whether human inducing pluripotent stem (hIPS) cells have the capacity to replace human embryonic stem cells.

Keywords: Stem cells, human embryonic stem cells, human inducing pluripotent stem cells, somatic cell nuclear transfer, genetically reprogrammed cells,factors, chimera, human cloning.

There is no disagreement among medical professionals all over the world that stem cell research and therapy are highly promising in medical field. The word 'stem' in connection to cell means root or origin. Every differentiated and specialized cell of the body descends from stem cells. Stem cells have the ability to cure incurable diseases like: Alzheimer , neurodegenerative diseases, heart disease, diabetes, specific types of cancers and many more. Apart from curing diseases stem cells have other beneficial attributes such as stem cells may provide comprehensive understanding of normal embryonic development, become good tools in drug testing, generate artificial limbs or organs and seem to be highly effective in therapeutic cloning and regenerative medicine. In spite of having so many beneficial attributes stem cell research and therapy seem to be controversial regarding the use of embryonic stem cells. Efficacy of stem cells depends on their potentiality. The undifferentiated and unspecialized stem cells have the highest

potentiality. For example a fertilized egg cell or zygote has the optimum potentiality and is recognized as totipotent stem cell. Having highest potentiality means having the highest beneficial features. Stem cells lose potentiality along with various beneficial capacity, with gradual differentiation over time. Hence differentiated stem cells are less potential than undifferentiated stem cells. Embryonic stem cells are undifferentiated cells and thus seem to be more promising than comparatively differentiated adult stem cells. Embryonic stem cells for research and therapies are pluripotent, which has been considered as the second highest degree of potentiality. These cells are obtained from the inner cell mass of six to eight days old embryo or blastocyst. However this process of harvesting embryonic stem cells involves destruction of the embryo, which has been pointed out as morally wrong action. Opponents of embryonic stem cell research and therapy holds that embryos are potential human being thus they have moral status as that of human the being. Hence killing of embryo is as derogatory as killing of human being. Now pluripotent stem cells are of two kinds embryo dependent stem cells or embryonic stem (ES) cells and embryo independent or genetically reprogrammed stem cells known as inducing pluripotent stem (IPS) cells. Since the use of pluripotent embryonic stem cells seem to be ethically controversial some proponents of stem cell research advocate the use of embryo-independent inducing pluripotent stem cells to bypass the ethical controversy. Aim of this article is to chalk out the ethical controversy of human embryonic stem(hES) cells and make sure whether human inducing pluripotent stem (hIPS) cells have the capacity to replace human embryonic stem cells.

Moral objection against hES cell research and therapy can be divided into three categories: 1. Objection from religious ground, 2. Objection from the ground of moral status and 3. Feminist objection against the method of collecting oocytes to create embryo in laboratories through somatic cell nuclear transfer (SCNT)[1].

[1] In genetics and developmental biology SCNT is a laboratory technique to create an embryo, inserting a nucleus of somatic cell into an enucleated egg cell.

The first objection against hES cell research and therapy is rooted in the religious belief that ensoulment occurs at conception. Roman Catholics as well as orthodox Christians and Protestants believe that human personhood begins with the zygotic stage after fertilization. Hence destroying an embryo is as sinful as killing a human being. Though a particular religious community hold that hES cell research is morally wrong, the other communities like Judaism, Islam, Hinduism, Buddhism and liberal Protestants go in favour of hES cell research. These religious groups tend to impose personhood on embryo after a certain period (at least fourteen days after fertilization). Thus destroying a six to eight days old blastocyst for the wellbeing of humanity is not morally impermissible.

The second objection against hES cell research is based on the moral status of the embryo. Some proponents of this argument hold that human embryo must enjoy the same moral status as that of a mature human being. Now moral status of a being requires a necessary and sufficient condition that is personhood. Only persons have moral status. However personhood depends on certain characteristics namely: self consciousness, autonomy and certain mental abilities. A being who is completely aware of her existence and has desire to continue existing as an individual entity is recognized as person. Now according to this definition being a member of human species is not the prerequisite of being a person. Any being for example chimpanzees and gorillas whose mental abilities have been proven in research are persons and human embryo, fetus, anencephalic children are not persons; though they belong to the human species. It can be said that though human embryos are not actual persons they might be considered as potential persons as they are potential human beings. Now having potentiality to become something means having the capacity to become that thing without any help from outside. For example, a caterpillar is a potential butterfly. However an embryo lacks such capacity because without the support of suitable environment in mother's womb it cannot be developed into a mature being. Thus potentiality principle fails to work in case of establishing morality of human embryo. Such perspectives towards embryo may lead towards a conclusion that human embryos have no moral status at all. Hence they might be considered as organic material or part of our body like hair, nail etc.

However this perspective is not right either. A human embryo is programmed to become a human being if it is allowed to develop in a suitable environment. Therefore we must treat it with some special care and respect. Thus it would be better concluding that moral status and protection of human embryo increases with gradual development. Now no one can definitely point out a particular phase during conception to birth, from when embryo owes moral protection. There is no such distinctive demarcation which determines embryo's morality. However it is anonymously decided that at around 14 to 15 days after fertilization, when monozygotic twinning[2] occurs and primitive steak[3] appears an embryo becomes eligible to pursue moral status. Before that it is just a cluster of homogeneous cells. Hence stem cell research which involves destruction of six to eight days old embryos may not seem morally wrong.

The above discussion may bypass the objection from the ground of moral status against hES cell research on the basis of appearance of primitive steak and chance of twinning , although it seems to face another barricade from feminists regarding the method of collecting huge amount of eggs to create embryos. In laboratories embryos for experiment are created through SCNT process which requires huge amount of eggs or oocytes. These eggs are collected from donors in exchange of ransom amount. Naturally every woman produces single egg in her monthly menstrual cycle. Thus to supply larger amount of eggs donors have to undergo certain hormonal treatment for producing multiple eggs. This process of multiple egg extraction seems to cause many health risk of the donor. The drugs used to hyperstimulate the ovary also have many negative effects. The egg donors may suffer from liver damage, kidney failure, chest pain, depression, vasodilation, burning sensation, itching, rashes, dizziness, migraine etc. Nevertheless ovulation stimulating drugs may cause ovarian cancer or may deprive them off from having their own baby in future. Another objection is about the coercion of poor and needy women. Since eggs are collected against lucrative amount, it is assumed that such offer may coerce poor women to donate their eggs for the sake of their family. Thus the process of collecting eggs for hES cell research is morally wrong because it exploits female donors. Hence feminists conclude that hES cell research should be banned.

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[2]Two offspring born from one fertilized ovum.

[3] A structure forms in blastula and considered as the forerunner of nervous system

In order to bypass the mind boggling ethical issues against hES cell research some proponents of stem cell research embrace the human inducing pluripotent stem (hIPS) cell research as an alternative of hES cell research. Induced pluripotent stem cells are adult cells that have been genetically reprogrammed to embryonic stem cell like state. Every cell in the body has the same genetic instructions. In spite of that specialized adult stem cells differ from each other. For an example heart cells differ from liver cells. This different identity of cells is determined by particular proteins. Different set of genes direct the cells to make particular proteins which are known as factors. Factors determine different identities of cells. In each stage of differentiation stem cells gradually lose their potentiality and different sets of genes get expressed in different specialized cells. Now, if a differentiated cell is genetically reprogrammed it would reverts back to the embryonic stem cell like state. This is what is done by doctor and scientist Shinya Yamanaka in the year 2007, which brought him noble prize in 2012. The four factors namely Oct-4, Sox-2, Klf-4 and C-Myc can transform an adult cell into pluripotent embryonic stem cell like cell. Many scientists and researchers believe that with the help of hIPS cells we may overcome the ethical hindrance against stem cell research. In this article we will focus on two things, first, we will consider whether hIPS cell research has been deemed as better alternative of hES cell research and second to explore whether hIPS cell research is morally safe or it conceives implicit moral threats.

The first and foremost advantage of hIPS cell research is that this research does not require human embryo to harvest stem cells. Thus hIPS cell research avoids two inevitable moral objections raised against hES cell research. Unlike hES cell research hIPS cell research is free from the black patch of killing a very nascent form of human life. In spite of providing lots of argument in favor of hES cell research it is undeniable that this research involves destruction of early embryos which could have formed human beings if they were allowed to develop. Besides, hIPS cell research also bypass the feminist objection of exploiting female egg donors as it does not require eggs to create embryo. Second advantage of hIPS cell based therapy is that this therapy is patient specific. Direct reprogramming of adult cells of the patient precludes the fear of immune rejection. On the other hand the fear of immune rejection persists in hES cell based therapy if non-autologous

hES cells are used for therapeutic purposes. Hence from the point of immune rejection hIPS cell based therapy seems to be safer than the hES cell therapy. Like hES cells, hIPS cells have many advantages in the field of modern medical research. hIPS cell model may contribute to understand developmental biology, may use as important tools for drug testing , drug discovery and disease research such as psychiatric diseases, nurological disorders, genetic disorders and critical infertility treatment. Since IPS cells have been successfully used in mice chimeras,[4] following that method scientists are now trying to preserve the life of some extinct animals. For example Ian Wilmut from the university of Edin Burgh who became famous for cloning Dolly the ship, is now working with IPS cells to preserve the species of northern white rhinoceros who are about to extinct. These above mentioned advantages of hIPS cells show that these reprogrammed cells are equal potential to hES cells. Thus to bypass the ethical dilemma some scientists and researchers opt for the promotion of hIPS cell research as an alternative of hES cell research.

Science and technologies are invented for the welfare of mankind. However use of scientific knowledge and technologies depends on the good will of the user. Any science or technology is not intrinsically valuable, they are valuable in respect of their impact on mankind and that is determined by the motive of the agent. Science and technologies are means to achieve wellbeing for humanity. If being controlled by good will, science and technologies produce good end then they make the world a better place to live. But if they are exploited they will produce gruesome result. Though hIPS cell technology has several noble features, like any other technologies it has the chance of being exploited too. Since the scope, nature and efficacy of IPS cells are not fully explored, advanced studies are going on and most of its promising attributes are not proven yet now, we need to be very cautious about its application. Easy accessibility of the resources of IPS cells may become a cause of their exploitation. As stem cell based therapies are highly expensive some clinics may offer unproven therapies using hIPS cells for making money. Such attempts should be prohibited from the very beginning. As IPS cells are genetically altered cells, they may lead towards other health hazards after

[4] An organism composed of two distinct type of cells that originate from two (or more) different species.

therapy. The C-Myc gene required in reprogramming of IPS cell is commonly associated with tumor formation and prone to cause cancer. Thus deep and continuous ramification is needed before therapy. It has been discussed earlier that mice chimeras are successfully formed using IPS cells in laboratories. hIPS cells are also likely to be used to form human-animal chimeras[5] for experiment. Though apparently these efforts are considered as high leap of medical science there remains the fear of creating an organism admixtures of human and animal which may be purposefully trained to meet up certain goals. However that will degrade human dignity. Nevertheless it is not logically impossible to conceive of that advanced research on IPS cells in future may be able to convert its potentiality into totipotent stage, that is embryo. If that happens then natural mode of procreation will lose its significance because any cell of the body would have been capable to initiate new life. That means human cloning will become inevitable with all its moral threats.

In fine it is understood that one must not blindly cling onto hIPS cell research as it also has many underlying moral threats. Basically efficacy and attributes of stem cells, both in hES cells and hIPS cells, are not fully discovered yet. Thus before application extensive ramification is desired. Besides, unlike hIPS cells hES cells are not genetically manipulated and therefore they are considered as the pure resources for developing any stem cell based research and therapy. Hence we must carry forward both hES cell research and hIPS cell research.

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[5] Human animal hybrids.

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