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Mini Review

A Brief Scientific and Catholic Viewpoint on Ethics of Stem Cell Research and Therapy

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Abstract

Stem cell therapy has gained widespread attention in recent years due to reports of miraculous healings after spinal injuries as well as cure from HIV or other improvements of injuries or chronic degenerative diseases. Ethical issues and public concerns surround stem cells and stem cell therapy, which is one of the most socially controversial area of modern science in our times [1]. Different viewpoint from scientists and theologians are briefly discussed regarding stem cell research and therapy based on three questions:

a. Question: Is stem cell research ethically of concern?

b. Question: Does the source matter?

c. Question: Is stem cell therapy ethically justifiable?

Introduction

James Thomson was among the first who isolated embryonic stem cells from human embryos in 1998 [2]. Stem cells are responsible for the development of an entire organism and play a major role in maintenance and repair mechanisms. Stem cells have the capability self-renewal (undergoing cell division to make more stem cells) and differentiation into mature cell types. Embryonic stem cells are considered pluripotent since they can develop into any cell types and tissue of all three germ layers, endoderm, mesoderm and ectoderm. Induced pluripotent stem cells are also considered pluripotent (as the name indicates) and thus, resemble embryonic stem cells. Mesenchymal stem cells are multipotent (or some are somewhat even pluripotent), as they can still give rise to multiple cell types within one germ layer, such as blood cells, bone cells, muscle cells et cetera.

The ethical issues are whether stem cell research is beneficial for the higher good of humanity by accepting ethical issues and risks. Some opponents of stem cell research argue that stem cells are like babies [3]. Neither technically nor biologically is that the case. Embryonic stem cells are derived from embryos, usually those considered as medical waste from IVF clinics that are no longer of any use but instead are actually thrown into the biologic waste bins. Embryonic cells are of special intertest for scientists since they contain the highest potential of all stem cells known so far. To retrieve and use embryonic stem cells requires the destruction of an embryo. So far, no alternative ways to retrieve embryonic stem cells are feasible. In order to avoid embryonic tissue for stem cell retrieval with its inherent religious, moral and ethical issues, many search for alternatives. Alternatives can be

a. The use of adult stem cells (autologous or allogenic) derived from different tissues and/or

b. Induced pluripotent stem cells (Ipsc).

Sources for autologous (retrieved from the same patient) stem cells could be adipose-tissue derived stem cells [4], muscle-tissue derived myoblasts [5], bone marrow derived stem cells for a variety

of conditions, from ovarian failure [6] to intrathecal administration to treat neurodegenerative diseases [7], heart tissue derived stem cells and cardio spheres for the management of chronic heart failure [8] or myocardial infarction [9], as described by our group [10], among other possible sources and indications. In contrast, allogenic stem cell materials come from donors other than the recipient. Umbilical cord and Wharton's jelly from donors represent a very promising source of mesenchymal stem cells. Wharton's Jelly is a gelatinous substance that represents a type of connective tissue located within the umbilical cord composed of hyaluronic acid and chondroitin sulfate to protect the umbilical blood vessels. It contains primitive mesenchymal stem cells that express lower levels of pluripotent markers than embryonic stem cells, suggesting they are highly multipotent rather than pluripotent [11] but also contains other ingredients including growth factors and cytokines that might exert clinically potential healing and regenerative potentials [12].

The potential therapeutic effects of stem cells on injured or degenerated damaged tissues are likely mostly mediated by factors secreted by stem cells rather than by differentiation of the injected stem cells. These factors secreted by paracrine signaling are extracellular vesicles called exosomes. The favorable biological properties of exosomes including biocompatibility, stability, low toxicity, and proficient exchange of molecular cargos make exosomes prime candidates for tissue engineering and regenerative medicine. Before a wider clinical usage can be implemented, several issues have to be addressed, including the development of globally accepted and implemented guidelines for adequate safe manufacturing procedures, appropriate donor testing as well as post-exposure monitoring of recipients [13] including post procedural HLA assessment [14]. None of these are currently in place.

Induced pluripotent stem cells (Ipsc) are not of embryonic origin and were firstly described by Yamanaka in 2006 in mouse cells [15] and later in human cells [15]. Induced pluripotent stem cells are thought to be a source for the regeneration of different tissue cells and thereby, are meant to be able to repair damage in degenerated organs, essentially the brain and the heart. Recent preclinical studies showed potentials benefits of IPS for the regeneration of neurons in patients with Parkinsons' disease [16,17], or Alzheimer's dementia [18]. IPS could be created autologous (Ips from the patient's own adult tissue such as from skin cells) [19] or allogenic, i.e., created from donor cells [20]. The procedure, however, is costly and several risks such as the potential induction of immune responses or mutagenesis are unresolved. The International Society for Stem Cell Research (ISSCR) was formed in 2002 and published its first guidelines in 2006 entitled "Guidelines for the Conduct of Human Embryonic Stem Cell Research" [21], with the addition of "Guidelines for the Clinical Translation of Stem Cells" in December 2008 [22]. The ISSCR Guideline Updates Task Force published a revised guideline in May 2016 ("Guidelines for Stem Cell Research and Clinical Translation" [23]), followed by a subsequent revision in 2021 [24]. An Embryo Research Oversight process was suggested in the 2016 guidelines. The updated 2021 guidelines included the culture of human embryos and stem cell-derived models of embryo development, embryo-like entities and more robust clinical translation guidance. There are categories that are considered unsafe or ethically questionable or even unethical, such as genome editing for reproductive reasons (category 3A, "unsafe"), or human reproductive cloning (category 3B, "not allowed").

Even though almost all published studies using stem cell products for different illnesses such as neuro-degenerative diseases, heart disease, erectile dysfunction, renal failure, diabetes, arthritis, HIV among many others, showed significant benefits for the treated patients with improvement of symptoms and functioning (even though no cure), there is no FDA approval for any stem cell product for any disease at the current time (with the exception of stem cell transplantation for certain forms of blood cancer) [25]. Therefore, the FDA in general warns against unapproved therapies using stem cell products, as in a published consumer warning in 2020. The Catholic Church does not oppose stem cell research and therapy, which is oftentimes confusedly stated. A recent report from the United States Conference of Catholic bishops stated the any research using stem cells if supported except for using embryonic derived stem cells (if this means the destruction of a human embryo) since life begins with conception in a traditional Christian view [26].

Of interest, the Catholic Church has supported stem cell research in several instances, such as Catholic bishops of South Korea raise and donated $10 million in 2005 to advance adult stem cell research, the Archdiocese of Sydney/Australia $50,000 in 2005 for stem cell research, a major Catholic teaching hospital in Boston, Caritas St. Elizabeth's Medical Center, announced in 2005 that it had "identified adult stem cells that may have the capacity to repair and regenerate all tissue types in the body", and the U.S. Conference of Catholic Bishops has supported a nationwide public bank for umbilical cord blood stem cells, for research and treatment. A position paper from 2006 by Prieur et al. and later in 2017 by Beltrame described how stem cell research could be conducted legitimately in Catholic institutions by using an ethical analysis involving a narrative context, the nature of the moral act, and the principle of material cooperation, along with references to significant ethical assessments [27,28].

Is Stem Cell Research Ethical?

In my opinion, yes, it is not only ethical, but obligatory to provide research opportunities that have the potential to heal diseases and help to alleviate sufferings form incurable chronic diseases, especially those of degeneration with advanced age.

Does the Source Matter?

Yes, the source matters, in particular for Catholics, for many Christians and the pro-life movement since embryonic stem cell research at the current time does require the destruction of an

embryo, which is not permissible, even if the embryos are no longer meant for uterine implantation. Instead, the use of umbilical cord tissue is permitted, as argued by Thompson that "garbage can be turned into gold", which does not require the destruction of unborn life.

Is Stem Cell Therapy Ethical?

In my opinion, absolutely, yes. That does not mean that one should support false marketing of cash clinics that lack any clinical or scientific reputation, but in general, as in evidence-based medicine, whatever helps someone in need - helps. Stem cell therapy represents the future of modern medicine and thus, should be widely supported. Despite warnings of the FDA against unapproved therapies, the business is booming without having large scale major clinical trials underway. Therefore, clinical research needs more financial support to conduct more clinical studies to evaluate the safety, tolerability and efficacy of stem cells and their derived products in a systematic manner for different conditions, from heart and neurodegenerative diseases to age-related joint disorders.

Disclosures

The author has no conflict of interest.

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