The Solution for Organ donation is Stem cells?

Stem Cell Project

By
Grace Hellier

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Abstract
At present the organ donation system is run by the NHS. In this paper I have looked at how the organs are procured and the difficulties in the current methods. This paper has looked at Stem cell therapies to establish where they are in their development, and what it may offer to this difficult clinical area. The study has been a fascinating insight into the advances of science but in reality we are trapped in an imperfect system where the opening statement is unlikely to change for the foreseeable future.

Introduction.
Three people die waiting for an organ transplant every day. (1)

“Today, we are on the brink of a new age in medicine, an age where we will be able to heal our bodies of any illness, all because of cell inside us......which have special powers. They are called stem cells. These microscopic miracle workers are, however, barely understood. Implanting them into our bodies could unleash biological mayhem. Are stem cells magic bullets or ticking time bombs?”
Professor Stephen Hawkings (2)

We are at the cusp of a new age of medicine and with wonderfully inspiring quotes such as the one above from a leading scientist of our time.

There is a tremendous demand for new organs and in this day and age of modern science and technology the impression would be we should be able to solve the problem of organ donation, nay disease.

The progress made by leading scientist in the field of Stem cell manipulation and clinical use is without doubt outstanding but is it a viable procedure now as the potential for its good is undeniably powerful.

Let us establish the current situation with organ donation as it is in UK and the NHS. The procedure is complicated and requires a multidisciplinary approach with teams of Medical professionals organising the logistics of identifying patient with greatest need and connecting those patients with the most suitable organs and concurrently obtaining consent from all parties involved(5). This is fraught with ethical social and logistical problems in order to bring about the transplant operation itself. Then there is the recovery of the patient and whilst the patient is a lot better than they were before the operation they are still Highly dependant upon medical support in terms of anti rejection medication and transplant counselling.

How does Stem cell science help this situation?

A situation where a patient requiring a new organ (a Kidney or Heart), where that patient could have a new organ grown from cells, from their body, would eliminate so many of the issue of the current model.

There is requirement for the identification of a suitable organ, the procedure can be planned well in advance at the convenience of the patient. In reality how close to this simplified scenario are we?
Stem cell science; the current situation:

Right now, scientists are in clinical trials to try to treat blindness using retinal cells that were generated from stem cells. They have been able to create entire tubes of red blood cells that transport oxygen just like normal, transfusable blood. Stem cells create not just body parts, but entire bodies. They do this for all of us when we start out as nothing more than a fertilized egg floating in the womb. Embryonic stem cells are blank cells. They have not yet become a specific type of tissue. But soon, they start transforming into specialized bone cells, muscle cells, and nerve cells. Nine months later, they form a complete person. Once we are born, however, these blank embryonic stem cells disappear. We lose the power that they alone possess to regenerate all of the tissues in our bodies.

The leading experts in the field of stem cell therapy are working on restoring that power. Cells, whether it's a skin cell, a heart cell, or a blood cell, carry out a very specific function. And it carries out that function for its entire life. So, the question is, what tells that cell what to do? And that's where DNA comes in. The way DNA is packed into the nucleus of each cell determines what function it's going to have. DNA's long double helix is wound around a huge number of tiny, molecular balls in a structure called chromatin. As we grow in the womb, certain proteins (ribosomes) interact with the chromatin of a blank embryonic cell causing parts of its DNA to become unspooled. The parts that are unspooled determine the type of cell this is going to be. A heart cell will have one DNA arrangement. A skin cell, another. This process of cell specialization appeared to be irreversible...

The Frog Experiment.

In 1962 scientists took an adult cell in the case of a frog, an intestinal cell, and they put it into an empty egg. The egg actually acted like a little time machine and brought the DNA back in time to a point where it could actually generate an entire tadpole and then, eventually, an entire frog. Biologists now believe key proteins in the egg undo all the specialized DNA arrangements in the adult cell. They return it to its original state... A blank embryonic cell awaiting instructions on what to become. This research shows that it is possible to generate embryonic stem cells that would grow forever, that were essentially immortal, and that could be turned into virtually all the cell types in the body.

A major drawback of using Human embryonic stem cells is ethical and it conflicts sharply with groups of people with particular belief sets i.e Jehovah Witnesses (9).

A group of stem cell researchers are currently working to make harvesting eggs or embryos obsolete. They use is a patient's skin cell. The traditional way that personalized stem cells were made, was to take the skin cell and take the DNA out of its nucleus, picking it up and carrying it over into an egg which doesn't have any DNA, and the egg can change the DNA and turn it into a stem cell that has our genome. A new way has emerged, by taking four specific genes into the nucleus of the skin cell and then wait. These genes reorganize the DNA so that it starts to look like stem cell DNA. Once this happens, it changes the cell around and the cell starts to shrink and not look like a skin cell anymore and loses its epidermis. Over the course of a week, it starts to look like an embryonic stem cell. The only difference now between this and an embryonic stem cell is that it has your DNA in it. The four genes inserted into the cell create four proteins that exist naturally in an egg. Those proteins appear to trigger skin cell DNA to arrange itself just the way it is in an embryonic stem cell. This is called induced pluripotent stem cells, or IPS cells.

This poses the question whether pluripotent stem cells really are the same a human embryonic stem cells? An ideal IPS cell or embryonic stem cell should be able to make all the cell types that you want equally well and at the same time, not make unwanted cell types... In particular, cancer. But some of the cells actually fail to make cell types that you'd like and others can actually cause cancer. Research has been carried out to identify the stable stem cells and eradicate the unstable cells that produce cancer.
This has been achieved in Part identifying the stable IPS cells which brings the next question can we now influence the specific type of tissue they grow into; those which are useful in medicine.

Not only have they been able to create heart cells. It is possible to create, brain cells, and neurons.

Cell types are impressive but what about entire organisms? . . . the answer to this is yes and they have been able to produce “A Mouse”! They were able to show that the IPS cells worked as well as embryonic stem cells, however, there is still a risk involved due to uncertainty still about reliable identification of IPS cells. This does however circumnavigate the opposition to embryonic stem cell use by certain belief groups within society.

Before the stem cell revolution can begin, we need a safe and uncontroversial source of embryonic cells.

One leading scientist believes he has identified a potential source of multitalented cells that can produce the stable risk free IPS cells He believes the answer lies within the precursor cell of the gonads which go on to produce eggs and sperm however he is still not quite there and unsurprisingly he is super optimistic that we are within decades of finding this holy grail of cells.

Furthermore groups of Scientists are looking at ways round this deficiency at present. One group regrow Hearts by removing diseased hearts from an organism i.e. a Rat taking the heart decellularising the tissue to leave the Extracellular matrix (ECM) a “Ghost Heart”. The ECM is the repopulated with IPS cells and nourished in a controlled environment and a new healthy heart is formed. The fascinating aspect of this is the organisation of how the IPS cells differentiate into all the different tissue types that produce the functional organ appear to be managed by proteins already present on the ECM. Similarly Scientist have been able to regrow spinal nerves and there are applications in Oncology and without any irony at all Cosmetic surgeons lead the research into the science of epigenetics (Thought to be the key to ‘Eternal Youth’) which is the technical detail of what happens when the 4 specific genes are places into the skin cell. This brings us up to date with Stem cell therapies to date.

Discussion:

96% of the population agree with organ donation but only 30% have donor cards.

The reason for this could be belief groups and their religious doctrines forbidding it For instance Jehovah Witnesses, however, they do not represent 96% of the population.

We have an ageing population and older organs that have seen some use are not preferred by the medical professional. Again it cannot explain the 96%.

Poor marketing and awareness has been suggested as a reason the researchers carried out a very small internal study and it represented only 18% that really had no idea about how to register to donate.

General public apathy and possibly not very keen to sign up for organ donation due to negative perceptions of the current process, they simply do not like the idea of sharing their organs or the alternate of pig heart valves transplanted?

There has been an announcement in the press as this paper is written about the Donation of Kidneys and heart valves from an Infant, his name Teddy Houlston; he was born with a life limiting condition and his parents agreed that at his death the medics could harvest his Kidneys and heart valves which were transplanted into an Adult man in Leeds. Teddy’s parents were very proud that their son of under a year old was able to donate it has given someone else a new chance at life and given meaning to a short young life.

In the event of all the multi-factorial constraints coming together there are still enormous costs involved with the present system of organ donation. The economic cost £55,000 for a single organ transplantation. The cost to the Clinicians faced with the choice: we have one Kidney and six patients that need that kidney now so who gets it? judged on clinical need and a queuing system.
Another solution to the current system is to vote for an “Opt out Policy”(7) ie everyone is considered to agree to donate their organs unless they carry a card which is indication that they do not want their organs donated. This could be a useful exercise as it would further identify if non registered donators are resistant or just not organised enough which help the transplantation planners know better what they do need to supply.

Stem cell therapy really solves all of the current issues with the current system. It is unlikely the religious groups would object to using your own body to heal itself. The reticent of the general public can be bypassed due to their not being any other person involved and therefore no economic incentive created by a supply and demand curve.

There is no need for grand donor awareness schemes as the ability to grow your new organs from your own cells negates the requirement of a Donor.

The economics could be the sticking point for stem cell therapies, depending on how well governments legislate so as to make the therapy available to all as opposed to the few. There are some worrying signs that the commercial potential of these new therapies will draw out the worst desires of greed. There is no irony that the last piece of the Documentary Stem cell Universe was presented by a West Coast of America Cosmetic surgeion specialising in epigenetics and apoptosis(2).

The technology is not excessively complex and is not unlike Labs run by giant super stores growing the perfect strawberry so it would be conceivable the model of mass supply could easily be applied to organ donation which would provide and economy of scale and maximise the access which would be very beneficial to society so as not to generate one more differentiation between the” haves and have not”s and the bottom line is good health is for all.

**Conclusion.**

The conclusions that can be drawn from the research is that the present organ donation system does not work. Evidenced by the opening statement of this Paper.(1) It is hamstrung by the requirement of Donors. A solution is very close but unfortunately right now it is still some time off maybe a decade and a half away. In the short term possibly the most helpful route would be to change to a policy of ‘Opt Out’ to help identify just how many people actually do not want to participate in organ donation.

The biggest obstruction to the progression of Stem cell theory will be at first testing the science to establish constant predictable stable result each time an organ id grown. The next hurdle will be the political and commercial wrangle. Possibly the world needs a more mature altruistic geo economic and political model to emerge in order to do justice to this, medical revolution which is about to befall Humanity.
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