Stem cells- a cure for Cancer?

By

Dannielle Lam
Sana Faruq

Word Count: Approx 1600

Grade Awarded June 2006: PASS

Research paper
based on
Pathology lectures
At Medlink 2005
ABSTRACT

We stand at the open door of a field of medicine that could theoretically and potentially be a cure for Cancer. Stem cell technology and research is developing so fast that now almost every week there are new claims about embryonic stem cells and adult stem cells. Currently, we are on the edge of a major stem cell breakthrough. This paper explores the principles of stem cells and its applications in medicine, focusing particularly on its importance in treating Cancer.

INTRODUCTION

The potential of stem cells has been recognised for many years. Stem cells will, no doubt, one day provide effective treatment for health conditions like diabetes, heart attacks, spinal cord damages and some types of Cancer. In the 1800s in Germany, the pathologist, Rudolf Virchow found that diseases start at the cellular level, but embryonic stem cell research itself started in the U.S. when the scientist, James Thomson was the first to successfully remove cells from spare embryos. He also established the first human embryonic stem cell line. A stem cell line is composed of a population of cells that can replicate themselves for long periods of time in-vitro.

Stem cells are relatively primitive, unspecialised cells. The reason for the excitement over them is because they have the ability to develop into specialised cells and replicate themselves. They multiply, just like normal body cells, into a ball of millions of cells. Cells of a similar structure combine to form tissues and these then combine to make organs. Medical researchers are looking for a way in which they can send signals to a stem cell so that it will mature and develop into the required cells in order to treat a patient.

Stem cells in the embryo are capable of huge variation in the tissues that they make, this process is called pluripotency. However, embryonic stem cells are hard to control and grow in a reliable way as they are unstable and sometimes produce unexpected results as they divide or even make cancerous growths, so scientists have to keep the cells from maturing until they are needed to do so. Also, embryonic stem cells are difficult to obtain in humans, most come from embryos created during in-vitro fertilization.

A fertilized egg first divides into two cells, and continues to divide until a multicellular ball of cells called a blastocyst is formed. The inner cell mass of the blastocyst consists of about forty embryonic stem cells, which are picked up with a pipette and transferred onto a Petri dish for culturing. Under appropriate conditions, the embryonic stem cells divides and the cell mass grows. The cells develop with properties of different types of cells, and as they have the potential to become such as wide variety of specialised cells, embryonic stem cells can be described as pluripotent. Embryonic stem cells also have the ability to self-renew indefinitely whilst maintaining their unspecialised state. Small groups of cells are placed into Petri dishes to divide, the cycle continues so that unlimited numbers of pluripotent stem cells can be produced.
Adult stem cells, found in children and adults, were thought to be limited to becoming only the cell types of the original tissue. The primary role of adult stem cells in a living organism is to maintain and repair the tissue in which they are found where they are dormant until triggered by some change in the body such as illness or injury. Research on adult stem cells has recently created a great deal of excitement, as scientists have found adult stem cells in many more tissues than they previously thought possible. For the last couple of decades, stem cells forming blood from bone marrow has been used in transplants, but now this finding has led scientists to wonder whether adult stem cells could be used for more complex transplants. It was not until recently that scientists seriously considered the possibility that stem cells in adult tissues could generate the specialised cell types of another type of tissue. One study has shown that bone marrow stem cells from an adult human can form healthy brain tissue. This is because, adult stem cells contain all the genetic code needed to produce an entire clone of the adult and so in theory, produce whatever tissues or organs are needed. There are two ways in which this can be done. One way is to place the adult cell nucleus inside a human egg, but this would also raise the associated ethical problems. Another way is to create the exact right chemical bath needed in a test tube and to bathe the adult cells in it, so that they are deceived into acting more like embryo cells. This progress has been awe-inspiring.

Stem cell research continues to make rapid progress and the preliminary results are promising. So far, only adult stem cells have been tested on humans. In animal studies, these adult stem cells have been treated in the laboratory and injected into animals that have been given artificial strokes or heart attacks. The adult stem cells automatically identified the damaged tissues and produced almost perfect repairs.

**DISCUSSION**

Now that the potential of stem cells has been recognised, medical researchers are continuously trying to discover how to instruct the stem cells on what to become, by trying to uncover the required conditions.

Our paper is about how in the future stem cells found in human breasts can be grown to firstly produce breast cells and then breast tissue, which could be used to reconstruct the breasts of cancer patients who have had a mastectomy, or even to grow implants for augmentation operations. In Australia, mammary stem cells from the breast pads of female mice were isolated for the first time. These cells were then transplanted into the mammary fat pad of a living female mouse from which all breast tissue had been removed. The cell divided and eventually gave rise to all the normal types of cell found in the mouse breast, and the gland worked normally to produce milk.

This procedure could be done in humans to produce drugs that effectively kill a tumour, and researchers will be able to provide a cure for breast cancer.
The same procedure would have to be carried out. Stem cells that cause cancers carry genetic errors; if these were allowed to develop they would start producing cancerous breast cells and in effect become a “tumour factory”. This is why some breast cancers return after apparently being eliminated by chemotherapy. Stem cells would have to be taken from the patient and checked for errors. The stem cells would have signals sent to them so that they will start developing into breast cells and only those that are genetically correct will develop into cells that do not carry the tumour. These stem cells can then be placed inside a human female breast, where they will continue to produce non-cancerous breast cells. This means that a patient suffering from breast cancer will produce normal breast cells but a problem is that they will still also produce cancerous ones. In order to cure a patient permanently of breast cancer a drug can be developed to target the abnormal breast stem cells to eliminate not only tumours but also the source tissue from which they arise.

The cloning of embryos for research is sometimes referred to as ‘therapeutic cloning’; this involves combining an adult human cell with a human egg from which the nucleus has been removed. The result is a human embryo which divides rapidly to become an identical twin of the cloned adult. Theoretically, this could allow scientists to take embryonic stem cells from the embryo to generate tissue that is genetically identical to the person cloned. Alternatively tissue banks holding thousands of stem cell lines could be set up. There are a total of 155 embryonic stem cell lines today. Stem cells would have to be extracted from many different human embryos that whoever needs treatment can be closely matched with the tissue type of an existing cell line. This would raise controversies and ethical dilemmas, which is why so many countries have banned this work, and many governments have refused to fund any stem cell research.

Stem cells can be obtained from three different sources,
- Tissues within an aborted foetus
- Embryos donated through in-vitro fertilisation programs
- From tissues in adults.

There is as much controversy surrounding the use of stem cells from aborted foetuses and from the in-vitro fertilisation, as there is surrounding abortion. This is because they both involve the production of embryos which are destroyed, and according to many religious groups this is unnatural; therefore an ethical dilemma is bound to arise.

Research on one kind of stem cell, human embryonic stem cells, has generated a great deal of interest and public dispute. Pluripotent stem cells (cells that can develop into numerous different cell types of the body) are isolated from human embryos that are only a few days old. Pluripotent stem cell lines have also been developed from foetal tissue (older than 8 weeks of development). This raises controversy as the argument of the sanctity of human life arises. There are many conflicting ideas about whether a fertilised egg is counted as a life or not?
Stem cell researchers argue that the majority of the surplus fertilised eggs produced during in-vitro fertilisation will be destroyed, and this is a waste as they could be used for stem cell research. They accept that the fertilised eggs will be destroyed during stem cell research, but this is the same as destroying them, apart from in this way they contribute to a major medical discovery.

CONCLUSION

Stem cells are a branch of medicine that holds a lot of potential and importance for the future. Currently, we stand on the edge of a stem cell breakthrough. Stem cells could, theoretically, be a cure for breast Cancer. Now all we need is more time and research to be carried out. There are several ethical objections, but these are outweighed by the potential benefits. Stem cells could be the end of diseases, but there are still many medical uncertainties and hurdles to jump over, as well as many financial implications to be considered by the government and private companies. We need to do it for the sufferers of breast Cancer and other health conditions. It’s a small step for research but a giant leap for Cancer victims.
REFERENCES

Mark Henderson. (2006) Scientists discover clue to growing new breast tissue. The Times Newspaper

National Institute of Health  http://www.nih.gov/

Sumamas Inc. Multimedia Development Services  www.sumanasinc.com