

Stem cells

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Project summary

We will be discussing stem cells and their various applications (cell therapy, adult cells, current research). We will also identify different types of stem cells.

Project report

INTRODUCTION

In the past few months, stem cells have been making the headlines. We know that they are the source of much controversy and that they have something to do with cloning. But what are they really? Do they represent a bright hope for the future or are they a potential danger for the natural order of things?

DEVELOPMENTS

We know that all living things are made up of a complex system of cells. Each cell has a specific role to play, otherwise the system fails.

A cell is made up of a plasma membrane (envelope), cytoplasm and a nucleus, which contains genes that carry a genetic code.

A stem cell is an immature capable of producing several types of more highly specialized cells. To do so, it reproduces and divides. When a stem cell divides, one part becomes specialized while another remains intact so as not to exhaust the reserve of cells in its category.

There are various types of stem cells. First, there are multipotent stem cells and unipotent stem cells. Multipotent stem cells can give rise to several types of cells, while unipotent stem cells can produce only one type. The most interesting from a research standpoint are the pluripotent stem cells. These embryonic stem cells, taken from the internal part of the blastocyst—the evolutionary stage of the embryo during which it begins to take shape—have the ability to produce nearly two hundred types of cells, that is, all the tissues of an organism, only five days after conception. They do not, however, have the potential to become an entire human being. That is the role of totipotent cells. These cells make it possible for an embryo to become a fully formed organism. Without them, human tissues could not come together to create an organism.

The fusion of egg and sperm creates an initial totipotent cell, which begins to divide and multiply. All cells at this stage are totipotent. If they divide into two distinct parts, twins will result. The embryo has this potential until the eight-cell stage is reached. After this, the cells are pluripotent, which means that an isolated cell will no longer be able to give rise to an entire human being, although it will still have the ability to form all of its tissues. During the course of embryonic development, cells become increasingly specialized.

Why is there so much interest in stem cells? The secret is in cell therapy.

This approach involves removing a damaged cell and replacing it with a healthy one. In order to obtain healthy cells, embryonic (pluripotent) stem cells are used and allowed to divide under specific culture conditions that make it possible to obtain the desired specialized cells. This type of cell therapy provides hope for people with neurodegenerative diseases or cerebral lesions.

These practices, however, raise a number of ethical issues. Should an embryo be considered a person with rights on whom experiments should not be conducted because of a lack of consent? If so, at what stage of development should an embryo be considered a human being?

Researchers thought about using therapeutic cloning to avoid rejection. This method has the advantage of using the principle of the autologous donor, which involves cloning a patient's cells so that they can be readministered at a later date.

The idea is not to clone a child or a several-week-old embryo, but a blastocyst whose pluripotent cells will be placed in a culture medium for approximately three weeks to obtain cells that are identical to those of the patient. The embryo will not be allowed to develop beyond that stage.

The main concern is that the research will go too far and the cloning technique will be used for reproductive purposes. For this reason, it is critical to establish clear and precise guidelines as soon as possible.

These various ethical questions led researchers to consider the possible use of adult stem cells. Several sources of stem cells were discovered in adult bodies. Until very recently, it was thought that they were not easily malleable and had only limited applications. Researchers were, however, surprised to discover that these cells were not as specialized as they had at first thought. It was believed, for example, that bone marrow stem cells gave rise exclusively to blood constituents. It was recently revealed, however, that they can become other types of cells (muscle, tendon, fat) depending on the conditions.

This year, Freda Miller of the Montreal Neurological Institute discovered a source of stem cells beneath the skin. This is an important discovery, since these cells are much more malleable than those from other known sources and can remain in culture for a long time. They also seem to be quite versatile.

Another Quebec researcher, Dr. Marc-André Sirard of Université Laval, may have discovered the future fountain of youth.

CONCLUSION

The fountain of youth? A cure for cerebral lesions? Human embryos? An end to neurodegenerative disease? Although stem cell research provides tremendous hope, it also leads to a multitude of unanswered questions.