

## Very small embryonic-like (VSEL) stem cells An Overview

### Background

Dr. Mariusz Ratajczak, director of the stem cell biology program at the University of Louisville's James Graham Brown Cancer Center, and his colleagues published a paper in the January 2004 issue of the journal "Leukemia". The paper describes a strategy for identifying and isolating rare cells from adult human bone marrow, which have since been named VSEL (very small embryonic-like) stem cells. This research demonstrated that bone marrow contains more than one type of stem cell and that VSELS are different from hematopoietic stem cells (HSCs).

HSCs, blood-forming stem cells found in bone marrow, are routinely being used to treat disease. Doctors have been transferring these cells in bone marrow transplants for more than 40 years, and more advanced ways of collecting them are being used to treat leukemia, lymphoma, and several inherited blood disorders.

Early on, scientists assumed that HSCs could be used as precursors for other stem cells that could be used to regenerate various solid organs (e.g. heart, brain, liver or pancreas), but to date, researchers have obtained mixed results – some positive and some negative – in studies aimed at showing that this regeneration potential is present in HSCs.

The 2004 paper by Ratajczak et. al. has been highly cited in the scientific literature because it:

- Demonstrated that there is more than one kind of stem cell present in adult human bone marrow (VSELS with the potential to develop into liver, pancreas, neural tissue, skeletal muscles, or heart).
- Identified and isolated VSELS that are shown to have several characteristics (cell structure and protein markers) that are generally found in embryonic stem cells.
- Demonstrated that VSELS can mobilize into peripheral blood in situations of stress and are used by the body to contribute to tissue repair/regeneration of specific organs.
- Explains conflicting data as to whether cells derived from bone marrow have regeneration potential.
- Points out new directions for stem cell research, encouraging scientists to consider sources of stem cells other than human embryos for tissue repair and regeneration.

The results of this research have since been replicated by scientists in two additional locations, (*Leukemia 2005 Nov 3; epub ahead of print*) verifying that VSEL stem cells do exist in adult human bone marrow.

However, this research had a major drawback – VSELS are very rare and may not be present in adult bone marrow in sufficient quantity for use in new therapies. Stem cells are relatively difficult to culture in the laboratory, and without a demonstrated way to help VSELS grow and multiply, their usefulness in finding new treatments for diseases would be very limited.

### Current Research

The research announced on Dec. 12, 2005 by the University of Louisville appears to demonstrate that these rare cells not only have the physical characteristics of embryonic stem cells, but also can be cultured and grown in vitro (in the laboratory), multiplying into clusters of cells that then can differentiate into several different types of tissue cells.

If this work can be duplicated by other laboratories, it will be a very significant scientific discovery. Dr. Ratajczak's preliminary data suggests that the protocol for culturing these cells can supply stem cells that will develop into nerve cells, heart cells, and pancreatic cells under laboratory conditions.

If this process does indeed make it possible to develop these different types of cells, it would be a significant step toward resolving two major dilemmas facing scientists working on stem-cell therapies for treating disease:

1. The ethical dilemma that has given rise to the debate over using human embryonic stem cells for research;
2. The immunological problems potentially associated with using stem cells from a donor embryo or person to treat disease – instead, treatments could be developed using the individual patient's own bone marrow, eliminating the problem of donor tissue rejection.