Improving clinical use of stem cells to repair heart damage

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Presenting at the UK National Stem Cell Network annual science conference today
(13 July), Professor Michael Schneider describes a new approach to treating heart attack and cardiomyopathy using stem cells.

Professor Schneider, British Heart Foundation Professor at Imperial College London, said "Recent clinical trials using stem cells to treat heart damage have been successful in terms of safety but unfortunately the bone marrow stem cells used tend to give only a small improvement in how well the heart is pumping.

"We really want to use stem cells from the patients themselves that we know can give rise to beating heart cells and these are not found in bone marrow. The good news is that we're now finding ways to identify and purify such cells."

Around 1000 patients have been treated in approximately 20 trials worldwide, mostly using bone marrow stem cells or derivatives of bone marrow cells to repair damage caused by heart attack. There has also been a significant body of work looking at ways of producing beating heart cells from stem cells. The best proven approaches to creating new beating heart cells are using embryonic stem cells, induced pluripotent cells and heart-derived stem cells.

Professor Schneider continued: "Using heart-derived stem cells to treat heart attack and cardiomyopathy has some advantages over embryonic

and induced pluripotent cells as they are potentially safer. It's also notable that of these three cell types, it's only heart-derived cells that are in current human clinical trials for this sort of treatment.

"The biggest challenge is to make an ideal product for transplant, which would be either a mixture of heart muscle- and blood vessel-forming cells or a pure population of some sort of precursor that could give rise to both muscle and blood vessel cells."

Professor Schneider's team have discovered a way to identify heart stem cells so as to purify them for transplant. They first developed the method in mice and although the identifying markers are quite different in human cells, they have been able to successfully map their knowledge from mice onto humans. This research is funded by the British Heart Foundation, the European Research Council, the European Union (through the EU FP7 CardioCell consortium), the Leducq Foundation and the Medical Research Council.

Professor Schneider said "We've developed a method to identify cells that have three important characteristics: They are definitely stem cells; they have the right molecular machinery turned on in order to become heart muscle or blood vessel; and they don't yet have any of the full characteristics of heart muscle or blood vessel cells such as producing cardiac myosin - an important protein in heart muscle cells."

The next stage of the research is to develop this technique into a method for extracting, purifying and multiplying heart stem cells in the clinic to be used to repair heart damage arising from heart attack or cardiomyopathy. Professor Schneider's laboratory uses advanced robotics, automated microscopy and other high-throughput methods to screen many thousands of experimental conditions in order to devise the best ways to grow the cells and instruct them to go down the route of becoming heart muscle.