One-off treatment to stop back pain -- Using patients' own stem cells

November 30 2006

A University of Manchester researcher has developed a treatment for lower back pain using the patient's own stem cells, which could replace the use of strong painkillers or surgery that can cause debilitation, neither of which addresses the underlying cause.

Dr Stephen Richardson, of the University's Division of Regenerative Medicine in the School of Medicine (FMHS), has developed the treatment; and in collaboration with German biotechnology company Arthrokinetics and internationally-renowned spinal surgeons Spinal Foundation are hoping to enter pre-clinical trials next year. It is expected to rapidly yield a marketable product which will revolutionise treatment of long-term low back pain.

As a result Dr Richardson has been named Northwest Young Biotechnologist of the Year (sponsored by Nature) at the North West Development Agency/Bionow awards.

Low back pain (LBP) affects a large proportion of the adult population at some point in their lives and in many of these cases it is persistent, eventually leading to debilitating pain. The majority of the cases of LBP are due to degeneration of the intervertebral disc (IVD), the soft tissue which separates the vertebrae in the spine and protects them from damage; it is the flexibility of this tissue that allows movement of the spine (bending, twisting etc). The IVD is comprised of a central gel-like tissue (nucleus pulposus or NP), surrounded by a fibrous ring of tissue (annulus fibrosus or AF). Over time the NP becomes dry and fibrous and

cannot support the weight of the body, which means the disc becomes damaged and painful and this is the source of the LBP in many people.

Currently, treatments address the symptoms – mainly pain – using a combination of painkillers, physiotherapy or surgery, removing tissue to relieve the pain or fusing the vertebrae above and below the painful disc level together to remove the pain, although this also stops movement at that disc level. None of these options is ideal as they only treat the symptoms, not the cause, and are of limited long-term success.

The treatment Dr Richardson is developing uses a cell-based tissue engineering approach to regenerate the IVD at the affected level. This is achieved through the combination of the patients' own mesenchymal stem cells (MSCs) and a naturally occurring collagen gel that can be implanted through a minimally-invasive surgical technique.

MSCs are a population of progenitor cells found in the bone marrow of adults which can differentiate into many different cell types in the body, including bone, cartilage, fat and muscle cells. Dr Richardson found that for several reasons he could not use cells from the IVD itself and thus spent a number of years developing a method of producing NP cells from MSCs. He, together with colleagues, now has an international patent on this method. It was the development of this method, combined with the establishment of collaborative links with a company to supply the gel and a surgeon to develop the implantation technique, which won Dr Richardson the award.

Dr Richardson explained: "Once we have extracted the bone marrow from the patient and have purified the MSCs, they will be grown in culture and our patented method of differentiation will be applied. They will then be embedded within a gel which can be implanted back into the patient through an arthroscope.

"The gel used, produced by Arthrokinetics, is based on a collagen that is a component of many tissues within the body, a totally natural product that is similar to the gel already used clinically for the treatment of articular cartilage defects. The ability to reimplant this within the body with an arthroscopic procedure – similar to an endoscopy, in which a camera is inserted through a narrow tube into the body – means that there is only a very small scar on the back and the patient could hopefully return home on the same day or the day after the surgery. Once implanted the differentiated MSCs would produce a new NP tissue with the same properties as the original and would both treat the underlying cause of the disease and remove the painful symptoms."

The treatment has massive implications for the future of LBP treatment – with substantial NHS cost savings as patients could be treated quickly and effectively without any need for extended hospitalisation. In addition, as both the cause and the symptoms are treated, only one treatment should be needed in a lifetime and there would be no need for continuous treatments with painkillers and physiotherapy. The patient would therefore benefit and there are also implications for productivity in the workplace as a large number of work hours are lost every year due to sickness leave for low back pain. In the UK alone the combined figures for lost productivity and health-care costs due to low back pain run in the tens of millions of pounds a year and this will only increase as the population ages.

Dr Richardson said: "I am delighted to have won the award. The judges acknowledged the importance of the work and the advances we had made in the treatment strategy. In particular they noted that with all the hype surrounding MSC-based treatments of many diseases, the fact that we were hoping to start pre-clinical trials next year was a massive step towards finally realising the potential of MSCs in a clinical environment.

"They also commented on the difficulties I had overcome in finding an

appropriate gel to complement the MSC differentiation work and in drawing in both commercial interest from the company which produces the gel and clinical interest from spinal surgeons who saw the potential of the treatment."

Dr Judith Hoyland, head of the Intervertebral Disc Regeneration and Spinal Disease research group, said: "Dr Richardson has strived hard to overcome the numerous hurdles involved in such a complex process. As a result of his tireless dedication to the development of a clinically-viable tissue engineering strategy for treatment of low back pain, he was the ideal candidate to receive the young biotechnologist of the year award. I hope that it will spur him on to develop his full potential as a biotechnologist and become a credit to the burgeoning Northwest biotechnology sector."

Source: University of Manchester