The plastic pancreas

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A bio-artificial pancreas could benefit 200 million people world-wide

The BARP (Bio-Artificial Pancreas) project has brought together five high-tech SMEs and five research labs to find a replacement for daily insulin injections in the management of insulin-dependent diabetes. Transplants of complete pancreases are impractical, so the researchers have developed a semi-artificial system in which pancreatic cells from pigs or cows are enclosed in a synthetic polymer membrane that prevents rejection. Progress has been excellent, though a commercial product is still some years in the future. The implant will significantly improve the quality of life for many people with Type 1 diabetes, which affects up to 5 million in Europe and some 30 million world-wide. European Commission support has been essential for such an ambitious project, say the researchers.

Because of its world-wide progression, the World Health Organisation has likened diabetes to an epidemic," says Alain Belcourt, research director at the European Centre for Diabetes Study (Centre Européen d'Etude du Diabète – CEED) in Strasbourg. The condition affects 200 million people world-wide, and the number of new cases is doubling every ten years. For people with Type 1 (insulin-dependent) diabetes, insulin injections several times daily are a poor substitute for a healthy pancreas. Even with the latest insulin pumps and blood glucose monitors, injected insulin lacks the precision and speed of response needed to control glucose levels properly. Problems of rejection, and the usual shortage of donors, mean that pancreas transplants are unlikely to solve the problem.

A more promising technique is to transplant just the insulin-producing cells. The BARP project, co-ordinated by CEED, is using this approach to make good progress towards an implantable 'bio-artificial' pancreas. The CRAFT project brought together five high-tech SMEs – two French medical device manufacturers, and cell culture specialists from Belgium, Germany and Sweden – and five research laboratories. They aimed to produce a device roughly the size of a cigarette packet that can be implanted in the peritoneal cavity within the abdomen and will function for several years before it needs to be replaced.

"When the project finished in May 2000 there was still plenty of work ahead," stresses Dr Belcourt. Human trials will not begin for another two or three years, and a commercial product will take up to ten years. But he is confident that Type 1 diabetes sufferers will eventually be spared the hassle and psychological pressure of insulin injections. "It's a question of when, not if, we succeed," he claims.

An ideal home for pancreatic cells

Pancreatic cells taken from pigs or cattle will solve the problem of donor shortage, Dr Belcourt explains. At present it is not feasible to transplant just the insulin-producing cells, so the researchers work with the so-called islets of Langerhans – microscopic structures within the pancreas that carry the insulin cells. Each human pancreas has around a million islets, and the researchers aim to get at least half this number into the bio-artificial pancreas.

To transplant successfully without the danger of rejection, however, the cells must be 'hidden' behind a membrane that lets through cell nutrients, glucose, oxygen and insulin but blocks the body's immune cells and other products. Choosing the right materials for the membrane and the supporting structure that carries the cells is the project's biggest scientific challenge.

Taking the lead in this area have been French medical device manufacturers Laboratoire Perouse Implant and Statice Santé and Swedish biomaterial specialist Percell Biolytica. Having experimented with a range of different materials for the support and the enclosing membrane, they have come up with a promising combina-

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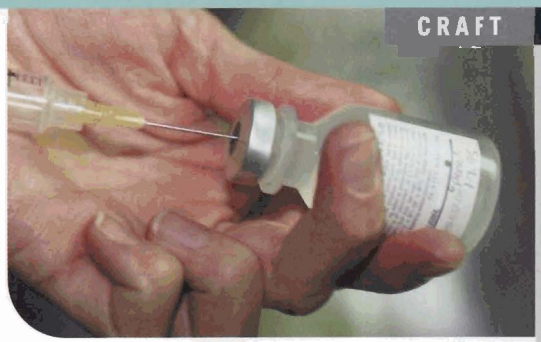

Insulin injections could become a thing of the past for diabetics

tion that keeps 80% of the cells alive over a five-month period. Details are sketchy, because this is at the core of the project's intellectual property and some of the discoveries are still to be patented.

"This cell survival rate is a breakthrough," says Dr Belcourt, "but we are continuing to develop even better materials. For the implant to be practical, we need the cells to survive for at least a year and preferably much longer." There is no way to accelerate the ageing process, so checking long-term survival rates involves a lot of waiting.

Success on the horizon

There will be a lot of waiting, too, before the bio-artificial pancreas comes onto the market. But while BARP is just one of several new approaches to the treatment of diabetes, the researchers are confident that they will succeed. The implants have been tested in 'mini-pigs' weighing around 30 kg, and large animal studies are now beginning. "Human trials will take another two or three years, and we should have a commercial product in five to ten years," says Dr Belcourt.

With 300 implants needed for the small-animal trials, the team feels it has demonstrated that the devices can be made in quantity. That's just as well, since Europe alone has almost five million Type 1 diabetics, most of whom would be candidates for the implant. Cost is also a driving force. Although no-one yet knows the cost of treatment by implants, it may well be less than the estimated total of €7,500 every year that each patient needs for insulin, syringes and medical supervision.

"The commercial device will probably be manufactured either directly by Laboratoire Perouse Implant, or by a third party under licence from another partner, Statice Santé," says Dr Belcourt. Laboratoire Perouse Implant, Percell, Statice and the Université Catholique de Louvain, one of the project's many research providers, form a core group responsible for the project's intellectual property.

"Such a large and complex project would not have been possible without financial support from the European Commission," says Dr Belcourt. The project has also led to valuable networking and spin-offs, he says. Statice, for instance, did not join the project until part-way through and was previously unaware of Laboratoire Perouse Implant. Now, though, the two companies have a close working relationship and have embarked on other projects together.

Full Title:
Bioartificial pancreas

Industrial sector:
NACE 73.I Research and experimental development on natural sciences and engineering

Supporting Technologies:
0074 Biomedical Sciences; 0075 Biomolecules, Bioplastics, Biopolymers; 0385 Membrane Technology

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- Computer Cell Culture SA (B)
- CellConcept (D)
- Statice Santé (F)
- Percell Biolytica AB (S)

RTD Performers:
Centre Européen d'Etude du Diabète (F)
Centre de Transfert de Technologie du Mans (F)
Université Catholique de Louvain (B)
Université Libre de Bruxelles (B)
Istituto di Endocrinologia, Metodologia Clinica e Medicina del Lavoro, University of Pisa (I)

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References:
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€70,000 – €120,000

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€450,000

PROMOTION OF INNOVATION AND ENCOURAGEMENT OF PARTICIPATION OF SMEs