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Mesothelial cell transplantation

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The peritoneal membrane is normally formed by a monolayer of mesothelial cells which rest on a basement membrane composed mainly of type IV collagen. Underneath this layer there is connective tissue, rich in blood and lymphatic vessels.

Normal peritoneal anatomy is dramatically altered by several stimuli, one of which is the presence of peritoneal dialysis solutions in the abdomen. The distress induced by these commercial dialysis solutions manifests as rapid cell turnover, disappearance of microvilli, vacuole formation, mesothelial cell detachment, vascular alterations and finally mesothelial sclerosis. These alterations start with the initiation of dialysis treatment, and are accelerated by episodes of peritonitis, leading to the gradual replacement of mesothelium by fibrous tissue and to the progressive depletion of phospholipids normally produced by mesothelial cells. Efforts have been made to create more biocompatible dialysis solutions, but this required the use of mesothelial cell cultures.

We succeeded in culturing mesothelial cells first in rabbits and then in humans. Our technique consisted in obtaining a sample of omentum during insertion of a peritoneal catheter or washing the abdominal cavity to obtain mesothelial cells which were then cultured. Once we had succeeded in culturing these cells we decided to see whether autologous transplant of mesothelial cells was possible. We induced peritonitis in rabbits and the implanted autologous mesothelial cells, after 3-6 days the animals were sacrificed and we saw that the cells had been incorporated into the peritoneal surface. This same procedure was tried on four uremic patients on peritoneal dialysis after episodes of severe peritonitis and peritoneal biopsies performed after 3-6 days showed signs of peritoneal repair.

Unfortunately the high cost of the procedure and the lack of specialised staff prevented us from continuing these experiments and we have not been able to publish follow up data on these experiments. Many questions regarding autologous mesothelial cell transplant remain unanswered, such as why the cells dispose according to certain patterns and how they are attracted to the naked basement membrane. Our hypothesis on this last question is that the cells, being positively charged, are attracted to the negatively charged surface of the peritoneum.

Other authors have studied the potential of mesothelial cells in repopulating the peritoneum to prevent adhesions after abdominal surgery, and recent data has shown that mesothelial cells have the ability to transform into myofibroblasts and probably into smooth muscle cells. Some authors propose that the regenerated mesothelial cells may come from pluripotent mesenchymal cells, which can differentiate according to the biochemical and biophysical characteristics of the microenvironment in which they are immersed. Various authors have investigated the potential applications in several fields, such as the treatment of arthritis, myocardial infarction and bladder reconstruction.

In conclusion, mesothelial transplantation is now a fact, and mesothelial cells have unique properties which may have several applications, not only in nephrology and abdominal surgery, but also in cardiology, vascular surgery and many other fields.