Living-Cell Dialysis Works on Dogs

For patients with kidney failure, dialysis machines can sustain life for a while but they can't save it. While these devices remove many toxins from the blood, their membranous filters don't catch the tiniest impurities. Nor do the machines produce hormones and enzymes, an essential task of normal kidneys. That's why a middle-age person with chronic renal failure has less than a 50-50 chance of living more than 5 years on dialysis.

Using a machine that sounds as if it belongs in a science fiction novel, researchers in Michigan have devised a blood-cleansing technique that incorporates living kidney tissue. Their study of the device's use on dogs, reported in the May NATURE BIOTECHNOLOGY, opens up the possibility that such machines might someday aid people.

To test the new dialysis machine, scientists removed the kidneys from 12 dogs. Six dogs then received traditional dialysis. The rest were treated with the new filtration system, which has live kidney cells from pigs growing in a chamber of the machine. Over a 24-hour period, blood tests showed the new method provided the dogs with higher-quality blood than did routine dialysis.

Kidneys filter out toxins and debris in the blood, a process that dialysis duplicates fairly well. Dialysis, however, isn't as adept at controlling electrolytes in the body, particularly calcium, phosphorus, and potassium ions. These ions can accumulate and alter a patient's electrolytic balance, says study coauthor William F. Weitzel, a nephrologist at the University of Michigan in Ann Arbor.

By taking up the ions, the living kidney cells in the new machine may help stabilize electrolytic balance and thus metabolism. In particular, the cells controlled potassium well, Weitzel says.

The pig cells in the new machine, which are nourished by the blood from the dogs' bodies, also yielded signs of restoring other kidney functions.

Vitamin D concentrations in the dogs on the new bio-artificial dialysis were significantly higher than in the other dogs, as were concentrations of glutathione, an antioxidant compound that plays a role in the immune system. The bio-artificial dialysis machine also removed ammonia from the blood more efficiently than did routine dialysis, but not quite as effectively as living kidneys, Weitzel says.

The results indicate that the pig cells are producing the hormones and enzymes that carry out these essential kidney activities.

"It's really pretty exciting that these cells . . . would maintain a complex function like that," Weitzel says. Some of the cells even multiplied.

These advances aren't great enough in themselves to change dialysis procedures in hospitals today, he notes. The ultimate goal is to do away with dialysis machines. "One can envision an implantable device," Weitzel says, "[but] we're a ways away from that."

Nonetheless, the work "is very exciting," says David M. Briscoe, a pediatric nephrologist at Harvard Medical School and Children's Hospital in Boston. This report is the first to suggest that a device using live kidney cells can replace renal function in an animal, he says. However, "it's likely that it will be some time before we will see a fully functional tissue-engineered kidney," he concludes.

"This work is a beautiful example of sophisticated targeted research," says Clark K. Colton of the Massachusetts Institute of Technology in the same issue of NATURE BIOTECHNOLOGY. "The system appears ready for human testing."

Indeed, Weitzel and his colleagues are now considering which patients might gain the most benefit from the new technology. Patients currently on dialysis whose other organs start to fail or who develop septic shock—an abundance of bacterial toxins in the blood—face a high risk of death. The Michigan researchers are currently testing the new dialysis treatment on dogs with septic shock to see if the living kidney cells can allay its effects more effectively than the standard techniques. —*N. Seppa*

Last drop squeezed from recycled tires

Old tires never die. Of more than 265 million discarded each year in the United States, some get shredded and recycled into products such as mulch, mats, and shoe soles. Most, however, end up as litter that clutters vacant lots and landfills indefinitely.

Borrowing from technology related to cotton ginning, scientists at the Department of Agriculture have developed a machine that may reduce the flow of old tires and their parts into landfills. The device will allow "a far greater fraction of the tires to be recycled into something useful," predicts inventor W. Stanley Anthony of USDA's Cotton Ginning Research Unit in Stoneville, Miss.

In a typical recycling plant, machines chop up tires into pieces that contain rubber, synthetic fibers, and steel. Then they grind up the pieces or freeze and pulverize them. Magnets extract the steel before vibrating wire-mesh filters separate rubber from fiber as best they can. Anthony says that about 15 to 50 percent by weight of an average 9-kilogram tire emerges from this process as a useless rubber-fiber blend, which gets buried in a landfill.

His group's prototype machine takes that waste, 80 percent of which is rubber, and turns out nearly pure, usable rubber and fiber, Anthony says. The machine mimics cotton-industry equipment that cleans raw cotton of leaves and other plant parts before the ginning separates fibers from seeds.

The new machine bites into the rubber-fiber waste with rotating, steel-toothed cylinders that push the material against gratings, forcing 97 percent of the rubber off the fiber. The recovered rubber contains only about 1 percent fiber, making it marketable for most uses.

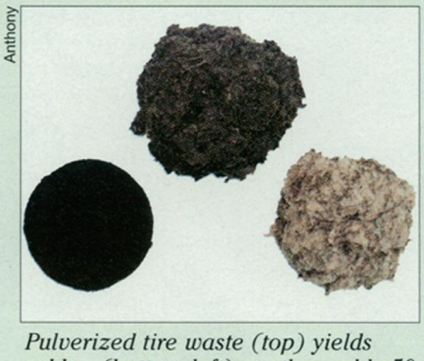
No market exists yet for the fiber, but a preliminary search for customers turned up a Korean textile firm that wanted to buy 36,000 kg, Anthony says.

The USDA group intends to install two demonstration machines in tire-recycling plants this year.

"If in any way, shape, or form, I can get that equipment in here, I'd love to," says Max Daughtrey, co-owner and vice president of operations of Four D Corp. in Duncan, Okla. The plant spends up to $8,000 per month to put rubber-fiber waste in landfills.

"I hate to landfill anything," Daughtrey says. "Why put sellable material in a landfill if you can find a use for it?" —*P. Weiss*

Anthony



Pulverized tire waste (top) yields rubber (bottom left) worth roughly 50 cents per kg when separated from fiber (bottom right) by the new device.