Print me a heart and a set of arteries

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SITTING in a culture dish, a layer of chicken heart cells beats in synchrony. But this muscle layer was not sliced from an intact heart, nor even grown laboriously in the lab. Instead, it was "printed", using a technology that could be the future of tissue engineering.

Gabor Forgacs, a biophysicist at the University of Missouri in Columbia, described his "bioprinting" technique last week at the Experimental Biology 2006 meeting in San Francisco. It relies on droplets of "bioink", clumps of cells a few hundred micrometres in diameter, which Forgacs has found behave just like a liquid.

This means that droplets placed next to one another will flow together and fuse, forming layers, rings or other shapes, depending on how they were deposited. To print 3D structures, Forgacs and his colleagues alternate layers of supporting gel, dubbed "biopaper", with the bioink droplets. To build tubes that could serve as blood vessels, for instance, they lay down successive rings containing muscle and endothelial cells, which line our arteries and veins. "We can print any desired structure, in principle," Forgacs told the meeting.

Other tissue engineers have tried printing 3D structures, using modified ink-jet printers which spray cells suspended in liquid (*New Scientist*, 25 January 2003, p 16). Now Forgacs and a company called Sciperio have developed a device with printing heads that extrude clumps of cells mechanically so that they emerge one by one from a micropipette. This results in a higher density of cells in the final printed structure, meaning that an authentic tissue structure can be created faster.

Cells seem to survive the printing process well. When layers of chicken heart cells were printed they quickly begin behaving as they would in a real organ. "After 19 hours or so, the whole structure starts to beat in a synchronous manner," says Forgacs.

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Most tissue engineers trying to build 3D structures start with a scaffold of the desired shape, which they seed with cells and grow for weeks in the lab. This is how Anthony Atala of Wake Forest University in Winston-Salem, North Carolina, and his colleagues grew the bladders which he successfully implanted into seven people (*New Scientist*, 8 April 2006, p 10). But if tissue engineering goes mainstream, faster and cheaper methods will be a boon. "Bioprinting is the way to go," says Vladimir Mironov, a tissue engineer at the Medical University of South Carolina in Charleston.