



Mobile stroke units, such as this one run by Saarland University in Germany, contain all the tools needed to diagnose and start treating a stroke.

FIRST RESPONSE

Race against time

Mobile stroke units can save lives by treating people before any damage starts to take hold.

BY ED YONG

Somewhere in your bloodstream, a clot loosens. It travels to your brain and blocks one of the blood vessels there, depriving the surrounding neurons of oxygen and glucose. Your face suddenly drops on one side, one of your arms weakens and your speech becomes slurred. You are having a stroke. The hourglass turns — your time is running out.

Neurologists have a saying: ‘time is brain’. The brain guzzles so much energy, and is so dependent on oxygen and glucose, that it is extremely vulnerable to any shortfall in these substances. For every minute a stroke goes untreated, a patient loses 1.9 million neurons and 14 billion nerve-cell junctions, known as synapses. For every hour without treatment, the brain effectively ages by 3.6 years¹.

Doctors can use an enzyme called tissue plasminogen activator (tPA) to dissolve a clot, but patients are most likely to avoid disability if they receive the drug within a few hours of their first symptoms. Ideally, they would be treated within the first ‘golden’ hour. This rarely happens: fewer than 5% of patients in the developed world receive tPA, because most arrive at the hospital too late.

Neurologist James Grotta from the University of Texas Health Science Center at Houston has a solution: rather than waiting for patients to arrive at hospital, he is bringing the hospital to them. Earlier this year, he unveiled the first

mobile stroke unit in the United States — an ambulance fitted with a computed tomography (CT) scanner and a telemedicine system that sends data from the scanner to the hospital.

When an emergency call fits the profile, Grotta’s team rushes to the scene in the ambulance alongside the usual emergency services. If the CT scan reveals a clot, the team injects tPA right away. The scanner also tells the crew whether the stroke is ischaemic, caused by a clot, or haemorrhagic, caused by a burst blood vessel. About 85% of strokes are ischaemic, but the distinction is crucial — tPA can break up a clot, but make things worse for a bleed.

NO TIME FOR DELAY

Mobile units have a long history. In the First World War, Marie Curie fitted 20 vans with X-ray scanners, then learned to drive so that she could take them to the front line herself. In 2003, Klaus Fassbender at Saarland University in Saarbrücken, Germany, resurrected the idea for people having a stroke². The first ambulance rolled out in 2008, and dealt with more than 300 patients before an accident put it out of commission 18 months ago (a replacement vehicle will start running on 1 July). In 2012, the team showed that the unit could halve the median time from emergency call to treatment, to just 35 minutes³.

Grotta was paying attention. “Our door-to-needle times were around 60 minutes, and no matter how hard we tried, they remained there,”

he says. “I read Fassbender’s paper, visited him and thought: we should do that here.” Two years later, and with US\$1.1 million in funding from local businesses and philanthropists, the unit saw its first patient on 4 June. A Norwegian team has adopted a similar approach by adding CT scanners to its air ambulances. The fleet of light aircraft and helicopters can reach most of the population within 30 minutes.

Mobile units are an expensive and labour-intensive approach. In Houston, the ambulance and scanner cost around \$600,000, and supplies, drugs and personnel further inflate the costs. But Grotta says that every case of stroke costs the US health-care system around \$140,000, largely because of lengthy hospital stays and long-lasting disability. “We’re talking about people who are facing paralysis, but who return to normal if the treatment works,” he says. “The pay-off is immediate and dramatic.” If the mobile unit can deliver tPA to just four patients early enough to avoid long-term consequences, the health-care savings downstream would pay for the initial financial outlay.

But the biggest lingering question is whether early treatment actually saves lives — a crucial issue that Fassbender’s trial³ was not designed to address. It is hard to say, says Grotta. Shortening the time to treatment from 3 hours to around 90 minutes is known to improve the chances of complete recovery⁴, but no one knows what an even smaller delay could accomplish, because so few patients are treated within that window. “That’s what we intend to find out,” he says.

Fassbender is optimistic. “Every solution is better than the current situation,” he says. “We can only win.” ■

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1. Saver, J. L. *Stroke* **37**, 263–266 (2006).
2. Fassbender, K. et al. *Stroke* **34**, e44 (2003).
3. Silke, W. et al. *Lancet Neurol.* **11**, 397–404 (2012).
4. Fassbender, K. et al. *Lancet Neurol.* **12**, 585–596 (2013).