INNOVATION ARTICLES
THE IDEA SUBMISSION PORTAL FROM MEDTRONIC

KNITTED REMOVABLE AIRWAY STENT

Professor Erney Mattson

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It has long been recognised that leaving stents in place is not ideal, and to date several solutions exist, such as bioabsorbable stents. This is not enough according to Mattson. “Bioabsorbable stents do not have the same outward force as when you use a metal or alloy stent, and become weaker with time”, he says. Often the stents are not absorbed quickly enough, meaning that the scar tissue response starts before the stent has fully disappeared. “It’s better to have a stent where you can regulate the disappearance and have an optimal radial force.”

Mattson started pondering this problem when he was working in Seattle and Washington researching the biology behind restenosis, when scar tissues around stents re-narrows blood vessels. When he returned to Europe and settled in Norway, he started considering different ways to tackle the problem, and found the

production east to India and China. In an effort to revive the industry, Sweden was moving towards smart textiles. Mattson contacted a Swedish textile school, which has some of the longest experience worldwide of knitting with metal threads. “I went to them and asked - can we knit a stent?. We then played around and managed to do that,” says Mattson. “With knitting you can choose the thickness of the thread and the knitting pattern. By combining these two factors, you can vary the radial, or outward force of the stent and have a more individualised surgery directed at the stenosis you want to treat.” The stent is knitted using nitinol thread, a nickel and titanium mix called a shape memory alloy that holds its shape at a certain temperature. “You fix everything in a particular shape at a certain temperature and then pack it into a delivery sheath at lower temperature,” explains Mattson, “Then when you release the stent, it will flip out and take the same shape at the temperature at which it was fixed.” This space-saving packaging allows delivery of the stent into restricted spaces without the need for balloon dilation.

The knitted stent could also tackle one of the stenting world’s big challenges - how to deal with branches in the vessel to be stented. “Our stent is a loose loop with a thread which means the side holes of our stent are not fixed,” says Mattson. “This means you can go in through any of these side holes and widen the side holes to any size, which means that branching is no problem.” The real value of the knitted stent lies not in the ease of delivery, nor in sidestepping the branching issue. The headline innovation is the elegant solution to removing the stent once it has done its job. “You unravel it,” explains Mattson, “There’s an extension of the thread from which the stent is knitted and then you pull and that thread will unravel.”

Mattson and his team recently tested their stent in the airway, with the idea of using it in cancer patients, whose airways have been obstructed by tumors. Mattson explains that an easily removable stent is of particular value here, since non-removable stents interrupt mucus clearance in the airway - a vital mechanism in trapping and clearing infectious bacteria from the airway. “Doctors are reluctant to use a stent because they know that many tumors will shrink after radiation,” says Mattson. “If you have a stent, it will remain in place and will be a portion of the airway that cannot transport mucus, and you will get repeated pneumonias.” The team recently recently published a paper (1) describing the low-invasive insertion and removal of the device from the airway of two pigs. The stents were deployed into the airways using a flexible bronchoscope and flipped out into their pre-defined shape as planned. When it came to remove the stent, tiny forceps were sent down through a catheter to grasp the trailing thread and the stent was unravelled in one smooth movement, with no damage to the airway wall.

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This isn’t just good news for patients with airway narrowing, but for all patients who need stents. In the

become obstructed, such as in the gastrointestinal, respiratory, vascular, urinary and reproductive systems, explains Mattson. The next step is to move into human studies, which demands a new set of skills beyond medicine and engineering. "You must be prepared to eat, dream and think this idea around the clock," says Mattson, "and you must have at least some knowledge in each domain, such as IP strategy. It's not enough to be only a surgeon."

REFERENCES

[1] A new removable airway stent. Amundsen T, Sørhaug S, Leira HO, Tyvold SS, Langø T, Hammer T, Manstad-Hulaas F, Mattsson E. Eur Clin Respir J. 2016 Sep 6;3:30010