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Commentary: The road less traveled! Do silk fibroin vascular grafts have a role in small vessel revascularization?

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Products from silkworms may provide vascular grafts to allow small vessel revascularization.

CENTRAL MESSAGE

Silk fibroin composite grafts may provide long-term patency for revascularization of small vessels, but much more work is needed to validate this technique.

Silk is a natural protein fiber typically derived from moths. Silk fibers are found in the cocoons of moth larvae. The moth larvae fashion cocoons in which to grow before they emerge as moths. Each cocoon is made of one long silk fiber that the larvae produce using their saliva. On average, a strand of silk from a cocoon ranges anywhere between 300 to 900 m long. Silk fibroin is produced by silkworms, and this natural product can be processed into various forms of scaffolds, such as films, fibers, porous sponges, and tubes (Figure 1). Investigations have shown that silk fibroin scaffolds can have multiple favorable biological effects. Silk fibroin scaffolds may prove useful to facilitate healing in various biological systems, including coverings for burn wounds,[1] promotion of neural progenitor cell proliferation for potential central nervous system injury repair,[2] and enhanced bone regeneration.[3]

Silk fibroin can be coated on the lumens of vascular grafts to provide a potentially biocompatible surface that resists natural processes that tend toward graft thrombosis. These features make this material a promising biomaterial for providing a biocompatible surface that prolongs small-diameter vascular graft patency. The silk fibroin biomaterial can be layered onto the intima of synthetic grafts, and this intimal layer has good biocompatibility and stability, allowing implantation into large animals in the form of composite vascular grafts with a silk fibroin inner layer. In this issue of the *Journal*, Tanaka and colleagues[4] describe the development of synthetic composite grafts whose intimal layer is coated with stable silk fibroin polymer. They present a small series of implantation of silk fibroin–coated synthetic grafts in 6 dog femoral arteries that measured ≤6 mm. They found that these synthetic grafts provide favorable biocompatibility at 3 months, with 5 of 6 grafts patent. Importantly, when grafts were excised, the lumen was seen to be covered with vascular endothelium without evidence of thrombosis or intimal hyperplasia.

These exciting experiments suggest a possible role for silk fibroin grafts in small artery revascularization. In reading this article, one can't help but wonder what's next. The experiments described in this article are very preliminary and really amount to proof of possibility, not proof of concept. Silk fibroin composite grafts can be implanted in small arteries with good cytocompatibility, with limited biodegradability, and encouraging graft patency for small arteries. All these features sound almost too good to be true. Much more work needs to be done before clinical use. There are multiple unanswered questions:

- Will silk fibroin intimal layers provide a stable biocompatible platform over time?
- What is the optimal means of delivery of these composite grafts?
- How will patients be identified as candidates for small vessel interventions?

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FIGURE 1. Products from silkworms may provide vascular grafts to allow small vessel revascularization.

- How can silk fibroin grafts be used in conjunction with large vessel revascularizations?
- Are silk fibroin grafts too prone to kinking or curvature? (One of 6 grafts occluded shortly after implantation, thought to be related to graft kinking.)
- Will other additions to the silk fibroin grafts (eg, vascular endothelial growth factor) be needed to improve long-term patency?
- Will silk fibroin grafts be able to be lengthened to provide suitable longer grafts?

Answers to these questions (and others) may be able to sustain the promising results presented in this article. I look forward to future reports on this novel form of small vessel revascularization.

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