Nitinol-frame artificial trachea: Knight in shining armor or wolf in sheep's clothing

Jules Lin, MD

From the Section of Thoracic Surgery, Department of Surgery, University of Michigan Medical Center, Ann Arbor, Mich.

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Address for reprints: Jules Lin, MD, Section of Thoracic Surgery, 1500 E Medical Center Dr, 2120TC/5344, Ann Arbor, MI 48109-5344 (E-mail: juleslin@umich.edu).

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Sakaguchi and colleagues¹ describe an artificial nitinol-frame trachea and believe that this novel construct shares physical characteristics with the native trachea. However, it is unclear if the force measurements of the symmetric tubular nitinol construct—with equal forces in all directions—are comparable to asymmetric native trachea because the measurements were only taken in 1 dimension (ie, anterior cartilaginous to posterior membranous airway) and how that compares with forces in the other dimension (ie, cartilaginous to cartilaginous airway).

The authors¹ state that the nitinol construct reproduces the shape of the native trachea, although the nitinol stent is circular, whereas the native tracheal rings are C-shaped with a membranous portion posteriorly, allowing the trachea to deform when coughing to clear mucous. How well does the circular nitinol construct deform when coughing? Would a decellularized tracheal graft provide a more natural shape and better mucous clearance?² In addition, although the tracheal construct was re-epithelialized with a monolayer of epithelial cells, it is unclear if this monolayer is as effective at mucous clearance as the ciliated stratified epithelium of native trachea.

The preliminary results are interesting; however, only a short 2-cm portion of the trachea was resected, a length that is routinely resected with primary anastomosis. The technique described would be most useful for longer resections that cannot be performed with a primary anastomosis. How could differences in a longer construct influence epithelialization, angiogenesis, and mucous clearance?

Complete epithelialization is important in preventing granulation and stenoses. Epithelialization occurred from the native trachea over 3 months. Longer constructs could take a prolonged period to epithelialize, potentially leading to increased rates of ulceration and stenoses. In a previous article from this group,³ the atelocollagen layer was seeded with stem cells. Would seeding the collagen layer with epithelial cells and/or mesenchymal stem cells increase the rate of epithelialization?⁴ Growth factors may also be important, and decellularized grafts remain biologically active with extracellular matrix, chemotactic growth factors, and pro-angiogenic factors. The authors found that angiogenesis occurs 2 months after tracheal implantation with vessels extending from the native trachea and not from the omentum. With longer resections, it is unclear if the

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Central Message

Longer resections and follow-up are needed to confirm effects of this artificial trachea on mucous clearance, erosion into surrounding structures, and infections from foreign material.

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midportion of the tracheal construct will be relatively more ischemic and prone to stenoses.

Although the authors¹ provided intermediate-term results, it will be important to have longer-term follow-up to determine the effect of a nitinol-frame artificial trachea on surrounding structures because chronic metallic stent placement has been associated with erosion.⁵ Long-term follow-up will also be necessary to determine whether there is an increased risk of infectious complications with incorporation of foreign material into the tracheal wall.

The authors¹ describe a novel artificial tracheal construct in a canine model. Although the results are interesting, longer resections and follow-up are needed to confirm the effects of this artificial trachea on mucous clearance, erosion into surrounding structures, and infections from foreign material and to determine whether the nitinol-frame artificial trachea is truly a knight in shining armor or a wolf in sheep's clothing.

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