

in experienced hands. Because the learning curve for robotic surgery seems gentler than the learning curve for VATS, surgeons might choose to transition from open techniques to robotic surgery without doing VATS. It will be interesting to see how the current generation of surgical trainees chooses to adopt minimally invasive approaches. Although the evidence is weak supporting robotic surgery over other approaches and the cost of the robotic platform is a limitation, the use of robotic surgery is growing exponentially. One way or another, minimally invasive thoracic surgery is here to stay and is rapidly evolving.

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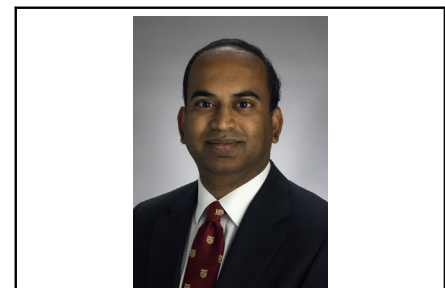
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## Commentary: Minimally invasive sleeve lobectomy—from case report curiosity to standard of care?

Nirmal K. Veeramachaneni, MD



Nirmal K. Veeramachaneni, MD

In this issue of the *Journal*, Qiu and colleagues<sup>1</sup> report on their experience with 188 patients undergoing sleeve lobectomy from 2012 to 2017. What is remarkable is the volume of procedures and their ability to transition from thoracotomy, to video-assisted thoracoscopic surgery (VATS), to a robotic platform in a short time frame. For this complex operation, the authors noted a mortality

**CENTRAL MESSAGE**

Robotic and VATS sleeve lobectomy is feasible. Surgeons who have reported excellent results have considerable experience with minimally invasive techniques.

rate of 2.1%, with no conversions to open surgery in either the VATS or robotic groups, and no difference in complications. Their latest technique used the robot—length of stay, operative time, and blood loss were all least within this group. Given the inherent selection bias and

From the Department of Cardiovascular and Thoracic Surgery, University of Kansas Health System, Kansas City, Kan.

Disclosures: Author has nothing to disclose with regard to commercial support. Received for publication Nov 4, 2019; revisions received Nov 4, 2019; accepted for publication Nov 4, 2019; available ahead of print Nov 27, 2019.

Address for reprints: Nirmal K. Veeramachaneni, MD, Department of Cardiovascular and Thoracic Surgery, University of Kansas Health System, 4000 Cambridge St, Kansas City, KS 66160 (E-mail: [nveeramachaneni@kumc.edu](mailto:nveeramachaneni@kumc.edu)).

*J Thorac Cardiovasc Surg* 2020;160:852-3  
0022-5223/\$36.00

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<http://dx.doi.org/10.1016/j.jtcvs.2019.11.020>

differences in training and experience, we cannot conclude that one technique is superior to another. The authors are able to clearly demonstrate the feasibility of a minimally invasive technique for sleeve lobectomy, with excellent outcomes.

The history of sleeve lobectomy is one of continuous technologic innovation. Pioneers in thoracic surgery reported on the concept of parenchymal-sparing lung resection, with anastomosis of the airway to avoid pneumonectomy back to the 1950s.<sup>2</sup> Sleeve resection could have oncologic results similar to pneumonectomy, without the deleterious effects of pneumonectomy.<sup>3,4</sup>

In a review of the literature in 1992, Tedder and colleagues<sup>3</sup> reported a bronchopleural fistula rate of 3%, stenosis rate approaching 5%, and operative mortality rate of slightly more than 5% in their review of more than 1900 cases. These operations were performed using an open technique and meticulous attention to the airway anastomosis, as this was the leading source of complications. The principles of reconstruction center on avoiding devascularization of the bronchus or tension on the suture line. These principles have not changed with the advent of minimally invasive techniques.

With the first report of VATS lobectomy in the 1990s, we have seen a revolution in technical innovation. By 2008,<sup>5</sup> we had reports of sleeve resection by the VATS technique (n = 13), followed by single-incision VATS in 2013<sup>6</sup> (n = 1), soon to be followed by large series of patients undergoing uniportal complex airway resection.<sup>7</sup> In 2016, Cerfolio and colleagues<sup>8</sup> published their experience with 8 patients undergoing robotic sleeve resection, soon to be eclipsed in the same year by Pan and colleagues<sup>9</sup> with a report of 21 patients including double-sleeve resections. The current manuscript rivals all of these publications in number of cases. What is common in all of these publications is excellent outcomes, predicated on vast experience.

The report by Mahtabifard and colleagues<sup>5</sup> of 13 patients was based on experience with more than 1500 VATS lobectomies, and Gonzalez-Rivas and colleagues<sup>6</sup> performed a single-incision sleeve lobectomy after having performed more than 170 uniportal resections. Qiu and colleagues<sup>10</sup> honed their skills by performing 4695 lung resections in their study period and reported their own experience with double-sleeve resections. Technologic innovation may be difficult to replicate without rigorous practice and high volume. In an era of rapid dissemination of surgical experience by digital media, the rush to try the next surgical technologic innovation should be tempered by one's own experience and meticulous attention to detail and long-term outcomes.

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