Editorial

Robotic esophagectomy: a better way or just another way?

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The authors present a concise case report of their experience performing a three-field esophagectomy robotically (1). They have clearly developed a methodology for performing this operation that works well and their report demonstrates the profound forethought that they have given towards safely performing this operation minimally-invasively. Reading this article, we are reminded of the long-standing question of what the superior approach is for esophagectomy. Multiple authors and centers have offered their opinions as to which approach is better over the years, often citing conflicting data (2,3). Now with the application of robotic technology we have yet another entrant into the discussion of what represents the best technique.

Over the years, numerous articles have been published promoting the advantages of one approach over another. No large randomized trial has ever been done comparing Ivor-Lewis esophagectomy to either transhiatal or three-field, and it is unlikely that one will ever be done, as some estimate that it would take nearly 3,200 patients to adequately address the question (4). In terms of postoperative morbidity, it would appear that with a three-field esophagectomy or transhiatal approach, leak rate is higher and thus, so is the subsequent risk of stricture. Conversely, the risk of leak is less with an Ivor Lewis esophagectomy, but the morbidity of a leak in the chest has, traditionally, been higher (5). While these facts are, for the most part, agreed upon, there has been some dispute regarding which operation is oncologically superior, and this too is an unanswered question (2,3). In the end, robotic esophagectomy becomes part of a field that has no accepted standard of care and where institution and surgeon preferences predominate.

The morbidity associated with an esophagectomy, regardless of the approach, has been documented to be high, anywhere from 40–50%. Aside from the complexity of this operation, the candidates for it are often debilitated by their disease and of advanced age; a combination of factors that contribute to the high rate of complications that arise. Ultimately, among the myriad of potential complications perhaps none are more feared than pneumonia, anastomotic leak, or gastric tip necrosis. In theory, part of the appeal of minimally-invasive techniques is that they might reduce the rate of post-operative complications. Prior to the introduction of the Da Vinci robot, laparoscopic and VATS approaches were promoted as a way to reduce morbidity. The data to support that these techniques have accomplished this goal are not robust. Certainly, at high volume centers with vast experience, the results have been encouraging. The University of Pittsburgh group reported a rate of major morbidities of 32% in 222 minimally-invasive esophagectomies (6). Alternatively, in a recent review of the National Cancer Database (NCDB) that evaluated outcomes following over 4,000 esophagectomies (1,300 of which were completed "minimally-invasively"), the authors reported comparable readmission and length of stay numbers for open versus minimally-invasive esophagectomy. Admittedly, this study, due to the nature of the database, was limited by a lack of information regarding specific morbidities or conduct of the operation, but the

surrogates they reported would suggest that minimally-invasive techniques produce only modest improvements. Interestingly, in a subgroup analysis, comparing robot-assisted esophagectomy to standard minimally-invasive strategies, there was no difference in outcomes; either cancer related or otherwise (7).

With incontrovertible evidence still lacking that traditional minimally-invasive techniques are superior to open approaches, the onus is on our field to continue working towards establishing a clear advantage to the application of the robotic and non-robotic minimally invasive techniques. As a frame of reference, robotic technology has been uniformly accepted as advantageous to traditional methods in other disciplines such as gynecology and urology, where the robot's fine movements have particular advantages in procedures like a prostatectomy. The benefits of the robot include a 3D camera with 10× magnification, the ability to drive one's own camera, and wristed instruments. Technical limitations include the lack of haptic feedback and the need for qualified bedside assistance. More specifically to esophagectomy, the robot allows for superior visualization of the right gastroepiploic artery, which aids in its preservation. Plus, all robots are equipped with Spyware technology, which can serve as a valuable adjunct when assessing conduit perfusion. Thoracoscopically, the wristed instruments greatly facilitate the creation of the anastomosis. For example, at our institution, we routinely perform a robot-assisted esophagectomy with a stapled side-to-side anastomosis followed by suture closure of the front wall; a process that is greatly simplified by the robot.

Despite some of its potential advantages, the application of the robot has been less uniformly widespread in thoracic surgery. This reality is, of course, multifaceted and is not simply limited to the much-heralded "learning-curve", which cannot be diminished in its significance, and continues to limit the adoption of even VATS techniques for pulmonary disease. To begin with, simply consider the financial burden of the robot. At a cost, per machine of over $1.5 million dollars (with a second console costing another half million) and maintenance costs of over $100,000 dollars per year, it can be difficult for institutions to profit from procedures performed on the robot. For instance, in a single center retrospective cost analysis of VATS versus open versus robotic lobectomy, there was a significant difference in overall cost of $3,182 between robotic and VATS cases (8). Likewise, in another study based on the Nationwide Inpatient Sample, which is a large database maintained by the Agency for Healthcare Research Quality, total charges were again significantly higher in the cohort of patients undergoing a robotic lobectomy (9). However, it may be that systematic streamlining of operating room processes may lead to more cost-effective delivery of care in this area. For example, the group at the University of Alabama-Birmingham has published data demonstrating profitability from robotic techniques. While certainly impressive, this institution has achieved these margins by limiting expenditures on other routine elements of care. The early reports are very promising and hopefully longer-term studies will demonstrate cost savings without compromising quality of care (10).

Secondary to these challenges, robot-assisted thoracic procedures have been slow to attain widespread adoption. For example, a review of the NCDB for all lobectomies performed between the years of 2010 and 2012 demonstrated that only 20.9% of lobectomies are even being performed by VATS; with a paltry 5.9% being done robotically (11). However, the most recent report from 2016 indicated 40% of lobectomies in the U.S. were done using VATS techniques, and 20% were done robotically—a sharp increase in minimally invasive techniques. So what does this mean for robotic esophagectomy? Likely, the gradual acceptance of robotic lobectomy suggests a slow adoption for esophagectomy; again for a number of reasons. First, it is important to consider the disease itself. A still relatively rare disease in the U.S., with only 17,000 cases diagnosed per year (with the majority of those patients being non-operable), the number of esophagectomies being performed nationwide is relatively small in comparison to lobectomies (12). In addition, with the advances in endoscopic treatments (i.e., radiofrequency ablation, endoscopic mucosal resection and endoscopic submucosal resection) for Barrett's esophagus, high grade dysplasia (HGD) and T1a esophageal cancer, far fewer patients are being referred for esophagectomy. Thus, fewer esophagectomies are being done and far fewer surgeons nationwide have the level of surgical volume that enables them to develop the skill set required for robotic-assisted esophagectomy. In contrast, the disease is far more common in China and other countries in the Southeast Asia, where the number of esophagectomies that are performed at single hospitals

may eclipse the combined numbers across a geographic region in the U.S. Thus, when one takes all these variables into account, it seems likely that robot-assisted esophagectomy is going to remain, at least in the U.S., the domain of a very few centers.

The next question related to the robot is one of benefit. Any attempt to answer this question brings one back to the subject of superiority of approach. Clearly, there is no evidence yet that robotic-esophagectomy is better in terms of morbidity and mortality than traditional minimally-invasive techniques (7). In truth, the application of any new technology in medicine or surgery should at least meet, if not exceed, the traditional standard of care. No one would, for instance, dispute that a laparoscopic cholecystectomy was a vast improvement over the quite morbid way the operation was previously performed. More recently, transcatheter aortic valve replacement (TAVR) has repeatedly demonstrated outcomes that are either comparable or superior to surgical aortic valve repair while sparing these patients the morbidity associated with open heart surgery and cardiopulmonary bypass (13). But in reality and with these examples in mind, it is essential to remember that these transitions in surgical technique take time as the evidence mounts in one direction or another. The current manuscript provides support that the robotic approach can be systematically arranged and appears to be a safe and viable minimally invasive option. This importantly forms the basis to allow pioneers in this area to demonstrate superiority if and when it exists. We think few can deny that with continued engineering and technological advances, the future of robotic surgery will be intimately intertwined with the future of surgery in general.

In sum, robotic esophagectomy is yet another way of performing a difficult operation. In the future, it will undoubtedly become the preferred approach of certain surgeons and groups. Perhaps as the technology continue to improve, as it no doubt has across the various iterations of the Da Vinci system, more surgeons will begin to opt for its use. That has already been witnesses in the lung cancer arena. That said, we truly believe when it comes to esophagectomy, the best approach is the one that, for the individual surgeon, reliably produces consistently good outcomes for their patients in the least invasive manner possible. With that in mind, we commend the authors of this paper for achieving such an excellent outcome for their patient.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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