Editorial

Long-term outcomes and quality of life should be the future focus of research measuring effectiveness of lung cancer surgery approaches

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The manuscript by Cerfolio *et al.* begins to fill a gap in the robotic lung cancer surgery literature by demonstrating long term follow up data for patients. This group of 4 separate institutions has combined data from 1,339 patients to show 5 year stage-specific survival and to be able to use this as a potential future benchmark for robotics, thoracoscopic, and open lung cancer surgery. Their data is limited by the 30-month median follow up, but as they showed in Table 3, this is comparable to other large series comparing thoracoscopy and thoracotomy (range, 27–79 months). Table 4, while suggesting much better outcomes in this surgical population really should not compare patients from this series to those from the 6th and 7th IASLC staging system, as that group included patients with clinical stage IIIA, IIIB and stage IV, compared to this group of patients who were likely clinically staged at an earlier stage and were found to pathologically be at Stages IIIA and higher. Another limitation on this manuscript is that all four institutions are high volume robotic programs that likely reflect best practices, and not necessarily the average patient's data after robotic lobectomy, especially with regards to lymph node dissection and conversion rates. A key limitation, that is common gap in most similar studies, is the lack of documentation on quality of life and physical function after surgery. These limitations should not detract from the contribution that this makes to the literature though, and should highlight the gaps that future studies should address, including quality of life data, disease free survival, and overall survival.

Thoracoscopic lung cancer surgery has been described for over 2 decades (1). Robotic thoracoscopic lung surgery has been a more recent development (2), but shares many, if not all, of the same benefits as standard thoracoscopy with the potential for more benefits over open thoracotomy. Some of the greatest challenges in the minimally invasive surgery literature has been to demonstrate equivalency with regards to oncologic outcomes, and then has been reviewed across cancer types including lung (3-5) and colon (6). Even if the minimally invasive approaches are not the same oncologically, does the decreased morbidity from the alternative operation (robotic/thoracoscopy versus thoracotomy), make up for the sub-optimal cancer surgery? This question has been answered in the treatment in malignant pleural mesothelioma, as pleurectomy/decortication has been shown to have superior survival to extra-pleural pneumonectomy, despite being an "inferior" oncologic operation (7). The reduction is perioperative mortality (7% to 4%) offset the benefits from removing all tumors by pneumonectomy in this study. Even if minimally invasive lung cancer surgery demonstrates a lower lymph node harvest compared to open, the benefits in patients with limited functional status in quality of life improvement may offset the oncologic benefits. This has yet to be studied in lung cancer.

With regards to oncologic outcomes, they can be broken down into perioperative outcomes, including technical aspects like R0 resection rate, lymph node count, and lymph node station count, and longer term outcomes like disease free survival, overall survival, and 5-year survival rates. R0 resection is less applicable in lung cancer compared to other tumors, like esophageal or rectal cancer and most lung cancer studies, unless specialized around challenging cases, don't report this. Lymph node dissection has been compared between open and minimally invasive lung cancer surgery for many years with mixed results. Whereas a few single center studies have shown equivalence in thoracoscopic *vs.* open (8) or robotic *vs.* open (9) in lymph node dissection, a recent meta-analysis of 29 articles from Zhang *et al.* (10) comparing thoracoscopy versus thoracotomy suggested improved total lymph node and N2 lymph node numbers in the open surgery group. Another study (11) evaluating thoracoscopy *vs.* open patients from the National Cancer Data Base from 2010–2011 (16,983 patients) showed increased nodal upstaging in the open group over the thoracoscopy group. The difference was 12.8% over 10.3%, enough to be statistically significant, but not clear if this was clinically significant, and there was no long term survival data associated with this. A single institution study from Yang *et al.* (12) looking at stage I lung cancer patients compared robotic, thoracoscopy, and open approaches. In this study, there was a greater number of lymph node stations in the robotics arm, similar 5-year overall survival between all groups, and a slightly higher 5-year disease free survival in the robotic over thoracoscopy group. This data for the robotics arm reflects the work of a single surgeon. There is limited data yet comparing robotics to thoracoscopy, or robotics to open in any large, multi-institutional group or national database. Even if the lymph node dissection is less in the minimally invasive approach, this may not matter, as a recent meta-analysis from Han *et al.* has suggested the patients with selective lymph node dissection has equal survival to those with a more traditional lymph node dissection (13).

Survival has been studied, comparing minimally invasive (thoracoscopy) and open approaches. Ezer *et al.* (4) looked at stage I–II non-small cell lung cancer patients in the Surveillance, Epidemiology, and End Results (SEER) database and found similar long term survival between thoracoscopy and thoracotomy in the linked Medicare data. The thoracoscopy group had lower post-operative complications though. A separate NCDB study comparing thoracoscopy and open lobectomy showed no difference in 5-year survival between groups (5). There are no large studies comparing robotics to open surgery with regards to long term survival, although there is a growing body of literature showing similar, if not improved short term outcomes with robotics over thoracoscopy (14). If we presume that robotics offers similar lymph node dissection capability to thoracoscopy, we can extrapolate potential similar long term survival with the robotic lobectomy compared to the open lobectomy, but as stated earlier, this is a gap waiting to be studied.

The long term quality of life after robotic lung resection has not been compared to open or thoracoscopy. While some have suggested no significant difference in postoperative pulmonary function in thoracoscopy *vs.* open patients (15), a growing number of studies have suggested improved quality of life after thoracoscopy versus thoracotomy (16) and reduced short and long term pain with thoracoscopy and robotics having similar benefits over thoracotomy (17). As we design future studies to evaluate the long term survival, they should also include the long term quality of life. There are currently multi-institutional studies underway to compare robotics, thoracoscopic, and open lobectomy outcomes, both perioperative and long term.

In summary, the paper by Cerfolio *et al.* makes contributions to the current literature by highlighting the gaps in knowledge that exist in evaluating robotic lung resections. While it is important to look at short term outcomes, long term survival and outcomes must be studied to validate these approaches and not take for granted that improved short term outcomes equate with improved or equal long term ones. The quality of the lymph node dissection should be described, and sampling, or selective dissections, differentiated from traditional lymph node dissections. Also, the quality of life after thoracotomy or thoracoscopy should be rigorously monitored, as a reduction in chronic thoracotomy pain could offset minor differences in oncologic outcome, if any.

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Footnote

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