Is robot assisted thoracic surgery better than video assisted?

Pavlos Papoulidis, Marco Nardini, Joel Dunning

Department of Cardiothoracic Surgery, James Cook University Hospital, Middlesbrough, UK

Correspondence to: Joel Dunning. Department of Cardiothoracic Surgery, James Cook Hospital, Marton Rd, Middlesbrough, TS4 3BW, UK. Email: joeldunning@doctors.org.uk.

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Introduction

Surgical approaches for thoracic surgery evolved over the years. Starting from the conventional thoracotomy, surgeons moved on to smaller incisions for video-assisted thoracoscopic surgery (VATS) (uniportal) and the introduction of evolving technology lead to the use of robotic surgery which emerges as more minimal invasive and with the same or even better therapeutic results and definitely promising faster recovery. First reports of robotic lobectomy appeared in literature in 2002 (1) and increasing numbers of pioneers in 2008 to 2009.

Robotic surgery has many technological advantages. Evidence has shown that thoracoscopic pulmonary resection for lung cancer has better perioperative outcomes and same oncologic results as open thoracotomy (2,3). Robotic surgery has technological advantages over conventional thoracoscopic surgery. High-quality imaging with ×10 magnification and three-dimensional vision, less fogging and therefore less camera manipulation are the most important ones. The safety of robotic anatomic lung resection has been shown in several case series, robot is gaining in popularity as high-quality video system, improved ergonomics, motion scaling, tremor filtering, and 7-degree endo-wrist capabilities allowing more simplifying operative procedure and excellent rate of lymph node dissection.

Experience

Since April of 2015 we performed 52 cases of robotic assisted thoracic procedures. The 46% of those were lobectomies (24 out of which 3 converted to open), sleeve resections 8% [3], 3 segmentectomies, 5 wedge resections, 4 thymectomies (1 conversion to open) and 12 diaphragm plications (23%). In all resections the nodal sampling was in more than 3 lymph node stations.

Also in one case which was excision of a bronchogenic cyst, the right main bronchus membranous portion was reinforced with a sutured bovine pericardial patch and in one lobectomy with a proximal tumour we performed suturing of the bronchial stump to ensure complete resection. In three cases we used the subxiphoid approach to remove the specimen. Median length of stay for lobectomies was 3 days, the same as for diaphragmatic plications. The median blood loss was 20 mL/s. The median length of stay for wedge resections and segmentectomies was 2 days. No mortality and negative surgical margins in all cases were noted. The median stay for the VATS lobectomies plications in our department is 3 days as well.

Discussion

Most surgeons who try both the VATS and robotic techniques agree that the robot provides clear advantages for mediastinal and esophageal procedures. Better dissection of enlarged or metastatic N1 lymph nodes off the pulmonary artery, more precise N2 lymph node dissection, and less operative blood loss are some of the best features of robotic surgery. The robot may be less painful than VATS and leads to fewer conversions. Unfortunately, all these are just observational studies and there are no reports that clearly support these features.

Cerfolio (4) compared the robotic with open thoracotomy and he noticed that in 106 patients that had robotic assisted lobectomy, there was reduced morbidity, a lower mortality, an improved mental health, and a shorter hospital stay compared to 318 patients who underwent lobectomy via nerve and rib-sparing thoracotomy.

A meta-analysis (5) of 9 retrospective observational studies of 3,379 patients from USA, Turkey and Korea, proved that the robotic surgery is safe and has the same results regarding the oncological outcome as the VATS. VATS is not widely adopted and is estimated that only 20–25% of patients receive VATS as treatment option versus open thoracotomy. The successful VATS is surgeon-dependent and requires patience and learning new surgical skills. The learning curve for VATS is steep, the position of surgeon is uncomfortable, the instruments lack in flexibility and finally the 2D view make VATS lobectomy more demanding, resulting in a long learning curve of approximately 40–50 cases, and for some surgeons, the use of VATS may compromise the oncological quality. Robotic surgery on the other hand showed less steep learning curve, demonstrating its better adaptability with less number of cases. Because of its advanced dexterity, accuracy and manoeuvrability is better in the robotic surgical system. This study was done using data of the old robotic system.

A meta-analysis by Räsänen *et al.* (6) using data from STS database, showed that robotic thoracic surgery wasn't inferior to conventional VATS, even though a slightly higher rate of conversion (25.5% *vs.* 23.1%) was noted compared to VATS. But it is understandable as high conversion rates were noted during the adaptation process of the VATS as well. In this study of 52,505 cases from 140 reporting centres (1,220 robotic lobectomies and 12,378 VATS lobectomies), showed median operative times for robotic lobectomy were longer (186 min) compared to VATS (173 min, P<0.001), but patients undergoing robotic lobectomy were slightly older, less active, and had a higher BMI and worse performance status. Patients undergoing robotic lobectomy were also more likely to have coronary heart disease or hypertension. Bleeding was the most common reason for a re-exploration in both groups (29.6% of returns in the VATS group and 14.8% of returns in the robotic group), but proportionately more patients in the VATS group returned for bleeding than did patients in the robotic group. The use of blood products was minimal (1%) in both groups either intra- or post- operatively. Median length of stay was 4 days in both groups, but most of the patients underwent robotic lobectomy were discharged sooner.

A recent retrospective study from university of Texas (7) compared 432 lung resections where almost 50% underwent robotic assisted procedures and robotics significantly lowered skin-to-skin time, blood loss, inpatient stay, and ICU days after surgery. There was also significant reduction in post-operative morbidity compared to open, but no difference compared to VATS. Exceptional, high negative surgical margin and nodal dissection rates in favour of robotics were noted.

Mungo *et al.* (8) using a newer system, noted in their study an increased number of segmentectomies in the robotic group, mainly due to worse pulmonary function in patients of this group. Anatomic segmentectomy for early stage lung cancer is gaining as the population ages, with a consequent decrease in cardiopulmonary reserve. As it offers comparable oncologic outcomes for early stage cancer to the gold standard (lobectomy), while preserving more lung tissue and function it becomes more favourable as an alternative to the traditional lobectomy. The general perception that this procedure is more challenging than lobar resection adds to the minimally invasive techniques approach with a further layer of complexity. But the advantages in dexterity and depth of visualization delivered by the robot facilitate execution of such complex procedures in safer environment (9).

Another procedure that robotic has advantages is the robotic assisted thymectomy as it was shown by Ye *et al.* in their study. It was less invasive, with significant decrease in the mean or median postoperative stay, no serious postoperative complications, zero conversion rates to open surgery and no recurrences. The use of ultrasonic devises gives an extra advantage in order to avoid postoperative bleeding.

There are papers questioning the transition from VATS to robotics. One of those evaluates the learning curve in robotic lobectomy program and shows that for an established VATS surgeon there is only small advantage in the transition to robotic, with the upper lobectomy to be the most difficult to be performed (10,11).

We believe though that the use of advanced technology brings superior health care. Strong statistical support may not be available, but the trend is to involve more technology in health care. Also the standardization of surgical education tends to move towards computer based systems, as robotic simulators, and even recognized or certified as surgeons in next years through simulators. As the trainees gain practice during the training protocols, their results can be measured by the robot, and more objective evaluation can be done. Under this prism, patients may be operated on in a standard way around the world. Another advantage could be tele-surgery or assistance to those surgeons who need mentorship during a particular surgery.

Conclusions

VATS continues to evolve with the rapid development of new technology and acquired experience, but robot-assisted surgery is the most promising for the future. Better and enhanced visualization and dexterity gives to the surgeon the opportunity to perform more complex procedures (microlobectomy, segmentectomy) and nodal dissection than VATS, with the same treatment outcomes.

Some recent studies compared the cost for robotic surgery and started having doubts for overall benefit if the steep learning curve is added to the equation (9,10). But if we think about the advantages in future from using the robots, the overall benefit/gain will be in favour of robotic surgery. Reducing instrument use in theatre and shortening operative times, will probably make robotic surgery more cost effective. Also courses will help the new surgeons to get more involved and actually reduce the learning curve.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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