Open, Video-Assisted Thoracic Surgery (VATS), and Robotic Lobectomy: Review of a National Database

Kent M, Wang T, Whyte R, Curran T, Flores R, Gangadharan S.

This paper includes a discussion of "Robotic Lobectomy" performed using robotic-assisted *da Vinci*® technology.

Many comparative studies have demonstrated benefits of VATS lobectomy compared to open thoracotomy. The learning curve for VATS lobectomy is steep and recent studies have indicated penetration of 15% to 30% in the US. Robotic-assisted lobectomy has been proposed as an alternative to VATS, offering the additional benefit of three-dimensional visualization and wristed instrumentation.

This study presents a comparison of 33,095 patients in the State Inpatient Databases (SID) who underwent an open, VATS, or robotic-assisted lobectomy or segmentectomy from 2008 to 2010. Primary outcomes compared were mortality and overall complication rate. Secondary outcomes compared were proportion of patients with prolonged length of stay (>14 days) and non-routine discharge.

Key Takeaways

- Robotics group had significantly lower mortality, length of stay, overall complication rate, and rate of prolonged LOS compared to the open group
- Robotics group had lower mortality, length of stay, and rate of prolonged LOS compared to the VATS group, however, these differences did not reach statistical significance
- Robotics group had significantly lower mortality compared to VATS in a subgroup analysis of high-volume surgeons (>20 lobectomies per year)
- Robotics grew from 0.2% to 3.4% of resections during the study period and was performed in all states captured in the SID during the study period
- Outcomes observed above were achieved in both academic and community hospital and were not limited to specialized centers

Study Limitations

Retrospective database evaluation with a potential for coding errors applicable across all cohorts; conversion rate from robotic-assisted or VATS lobectomy could not be obtained from this data set; overall experience and board certification of surgeons is unknown; possible for individual surgeon experience to account for observed differences in outcomes between robotic-assisted and VATS cases; State Inpatient Database (SID) does not capture data after discharge.

Data

Propensity-Matched Analysis

Propensity-Matched Analysis of Patients Undergoing Open, Video-Assisted Thoracic Surgery (VATS) or Robotic-Assisted Pulmonary Resection

Outcome	Open (n = 1,233)	VATS (n = 1,233)	Robotic-Assisted (n = 411)	*p* value VATS vs Robotic-Assisted	*p* value Open vs Robotic-Assisted
Mortality	2.0%	1.1%	0.2%	0.122	0.016*
LOS	8.2	6.3	5.9	0.454	<0.0001*
Routine discharge	59.5%	64.5%	63.7%	0.828	0.214
Prolonged LOS	9.6%	6.9%	4.4%	0.118	0.003*
Any complication	54.1%	45.3%	43.8%	0.674	0.003*
Bleeding complication	1.9%	1.3%	1.7%	0.633	0.795

*statistically significant difference between robotic-assisted and open

Analysis of High-Volume Surgeons (≥20 Lobectomies Per Year)

Propensity-Matched Analysis of Patients Undergoing Open, Video-Assisted Thoracic Surgery (VATS), or Robotic-Assisted Pulmonary Resection Among High-Volume (≥20 Cases Per Year) Surgeons

Outcome	Open (n = 1,020)	VATS (n = 1,020)	Robotic-Assisted (n = 340)	*p* value VATS vs Robotic-Assisted	*p* value Open vs Robotic-Assisted
Mortality	19 (1.9%)	16 (1.6%)	0 (0%)	0.02‡	0.011*
LOS (mean)	7.4	5.7	5.9	0.64	0.015*
Routine discharge	628 (61.6%)	705 (69.1%)	214 (62.9%)	0.089	0.712
Prolonged LOS	80 (7.8%)	70 (6.9%)	15 (4.4%)	0.118	0.062
Any complication	541 (53.0%)	470 (46.1%)	146 (42.9%)	0.411	0.008*
Bleeding complication	24 (1.4%)	17 (1.7%)	6 (1.7%)	0.922	0.590

*statistically significant difference between robotic-assisted and open
‡statistically significant difference between robotic-assisted and video-assisted

Conclusion

The authors write, "case volume for robotic pulmonary resections has increased significantly during the study period, and thoracic surgeons have been able to adopt the robotic approach safely. Robotic resection appears to be an appropriate alternative to VATS, and is associated with improved outcomes compared with open thoracotomy."

Financial Disclosure

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Thoracic Surgery Risks

Pulmonary Resection (Wedge Resection, Segmentectomy, Lobectomy): persistent air leak, pneumonia, prolonged mechanical ventilation >48 hours, atrial fibrillation, acute respiratory distress syndrome (ARDS), chylothorax, re-intubation, arrhythmias, bronchopleural fistula, phrenic nerve injury, esophageal injury, difficulty breathing, collapsed lung, pulmonary volvulus, recurrent laryngeal nerve injury leading to vocal cord dysfunction.

Important Safety Information

Serious complications may occur in any surgery, including *da Vinci*® Surgery, up to and including death. Examples of serious or life-threatening complications, which may require prolonged and/or unexpected hospitalization and/or reoperation, include but are not limited to one or more of the following: injury to tissues/organs, bleeding, infection and internal scarring that can cause long-lasting dysfunction/pain. Individual surgical results may vary.

Risks specific to minimally invasive surgery, including *da Vinci*® Surgery, include but are not limited to, one or more of the following: temporary pain/nerve injury associated with positioning; a longer operative time, the need to convert to an open approach, or the need for additional or larger incision sites. Converting the procedure could result in a longer operative time, a longer time under anesthesia, and could lead to increased complications. Contraindications applicable to the use of conventional endoscopic instruments also apply to the use of all *da Vinci* instruments. You should discuss your surgical experience and review these and all risks with your patients, including the potential for human error and equipment failure. Physicians should review all available information. Clinical studies are available through the National Library of Medicine at www.ncbi.nlm.nih.gov/pubmed.

Be sure to read and understand all information in the applicable user manuals, including full cautions and warnings, before using *da Vinci* products. Failure to properly follow all instructions may lead to injury and result in improper functioning of the device. Training provided by Intuitive Surgical is limited to the use of its products and does not replace the necessary medical training and experience required to perform surgery. Procedure descriptions are developed with, reviewed and approved by independent surgeons. Other surgical techniques may be documented in publications available at the National Library of Medicine. For Important Safety Information, indications for use, risks, full cautions and warnings, please also refer to www.davincisurgery.com/safety and www.intuitivesurgical.com/safety. Unless otherwise noted, products featured are available for commercial distribution in the U.S. For availability outside the U.S., please check with your local representative or distributor.

Precaution

The demonstration of safety and effectiveness for the specific procedure(s) discussed in this material was based on evaluation of the device as a surgical tool and did not include evaluation of outcomes related to the treatment of cancer (overall survival, disease-free survival, local recurrence) or treatment of the patient's underlying disease/condition. Device usage in all surgical procedures should be guided by the clinical judgment of an adequately trained surgeon.

The friable nature of pulmonary tissue enhances the risk of vascular, bronchiolar or other injury that will be difficult to control when using this device. Published clinical experience as well as clinical studies performed to support this marketing clearance have demonstrated that even surgeons considered expert in laparoscopy/thoracoscopy have substantial learning curves of 10 to 12 cases (Falk, et al., Total endoscopic computer enhanced coronary artery bypass grafting, *Eur J Cardiothorac Surg* 2000; 17: 38-45).

All materials will eventually become obsolete. When referencing printed or digitally replicated materials, please note the revision date that follows the part number (PN). Consult your *da Vinci* representative or visit the *da Vinci* Online Community for the latest revision.