



Robotic thoracic surgery: cost analysis

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Abstract: Since robotic-assisted thoracic surgery (RVATS) very beginning, cost was a concern when deciding whether or not to offer this new technique to our patients. As it happens to every newly developed technique cost tend to soften throughout time as new equipment providers appear, spreading out RVATS to new and previously unexplored frontiers. When compared to Thoracotomy, RVATS is extremely cost effective. That is not exactly true when the comparison is made with video-assisted thoracic surgery (VATS). We evaluated the total hospital costs, direct and indirect, associated with RVATS as compared to VATS Lobectomy in our first 4 cases as a business plan to support the implementation of our robotic program. In our initial cases our costs for RVATS outnumbered VATS costs by USD 1,320.79.

Keywords: Robotic-assisted thoracic surgery (RVATS); costs; video-assisted thoracic surgery (VATS); comparison

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Introduction

Since robotic-assisted thoracic surgery (RVATS) very beginning cost was a concern when deciding whether or not to use this new technique.

As a substantially high initial investment is required in order to purchase the equipment, Healthcare providers, still struggle to figure how to amortize the costs without making the method extremely expensive and unfeasible to clients.

As we started our Program in Rio de Janeiro, Brazil in early 2016, we used our first 4 cases to compare the costs.

For that, we compared our first 4 RVATS Lobectomy with 2 lobectomies performed in the same Hospital, by the same Surgical Team that performed the RVATS cases.

In what might one of the first cost comparison studies made specifically to robotic video-assisted thoracic surgery (VATS), Park and Flores stated at their work “Cost Comparison of Robotic, Video-Assisted Thoracic Surgery and Thoracotomy Approaches to Pulmonary Lobectomy.” (1), the cost difference for was USD 3,442 in favor of VATS. In their series RVATS costs were higher at admission day certainly because of the equipment costs and then, on the other days of the hospitalization were similar to VATS costs. Both RVATS

and VATS were much more cost effective when compared to Thoracotomy because of a decreased length of stay. Swanson and colleagues in their work “Comparing robotic assisted thoracic surgical lobectomy with conventional video-assisted thoracic surgical lobectomy and wedge resection: Results from a multihospital database (Premier).” (2) compared the costs of 15,502 patients operated. In total of 14,837 (96%) of them operated by conventional video-assisted lobectomy or wedge resection and concluded that the costs were higher on \$4,564.10 for lobectomies and on \$2,992.40 for wedge resections, respectively. Inpatient operating times were longer for both lobectomies and wedge resection when RVATS technique was applied and no difference in the length of stay has been noted.

In Orlando Health STS Database series, coordinated by Luis Herrera, MD (3) an estimated potential cost offset per procedure of \$4,091 *vs.* open thoracotomy and of \$619 *vs.* VATS was found

As shown in *Table 1* our RVATS costs were higher than VATS in 1,320.79 USD only, thus a lesser difference than Raja Flores and Bernard Park found in their above-mentioned article, provided the fact that we had a much lesser case number by then.

Table 1 Cost comparison RVATS vs. VATS: our numbers

Cost comparison	Total cost USD	S	Average costs
RVATS			7,642.94
Patient 1	7,301.84	3	
Patient 2	8,476.33	3	
Patient 3	7,598.78	3	
Patient 4	7,194.83	3	
VATS			6,322.15
Patient 1	6,858.23	5	
Patient 2	5,786.06	3	

RVATS 1,320.79 USD more expensive than VATS. RVATS, robotic-assisted thoracic surgery; VATS, video-assisted thoracic surgery; LOS, length of stay.

Table 2 Disposable costs per robotic case

Item	Cost (\$)
Cadiere forceps	200
Maryland forceps	200
Drapes	
Instrument arms (x2)	70
Camera arm	35
Camera	25
Total	530

Methods

Approval and requirement for the study was obtained from Samaritano Hospital Board. The type of surgical resection was determined by the individual surgeon's recommendation based on multiple factors that included expertise with a specific technique and the nature of the disease. VATS lobectomy was performed via a 2-incision technique. Our RVATS technique at the time was performed with Da Vinci Si (Intuitive Surgical, Sunnyvale, California, USA) equipment using 2 arms and the camera arm. No major operative technique changes were noticed between the two studied techniques.

Average costs for each group were generated for each hospital day, which included all direct and indirect costs with the exception of the cost of the surgeon's professional fee, which was added separately.

Comment

In our series of cases of lobectomy, by either VATS or RVATS, subjected to a cost analysis we have shown that our RVATS costs, despite our small number of cases at the time, were still higher when compared to VATS alone but with a much smaller difference than most of the comparison's series published to the date.

Taking into consideration real cost data that included all indirect, direct and surgeon's fees we demonstrated that patients undergoing RVATS lobectomy incurred costs that were higher than those undergoing VATS lobectomy by \$1,320.79. Sugi and Colleagues (4) compared 10 VATS lobectomies with 20 thoracotomy lobectomies, finding operative times and disposable costs to be significantly higher in the VATS group with a similar length of stay. However, the length of stay for both VATS and thoracotomy were long (25.2 and 27.7 days), and that possibly made a discerning relevant difference difficult.

When comparing the subsets of patients undergoing lobectomy by VATS alone versus RVATS we found that use of robotic technology resulted in increased costs primarily (Table 1) on the first hospital day. On further analysis this was attributable to two main areas. The first and most obvious was the additional disposable costs directly related to the robotic technique itself (Table 2). The second was perhaps a chance result that the robotic patients would require a higher percentage of additional procedural costs (Bronchoscopy, lysis of adhesions). This second area in our series is not very likely once we did not have to include additional procedures, at least not any more than we would do when we perform VATS alone.

In our study we did not add the cost of the robotic technology for the institution through amortization. Previous studies have attempted to do it in this following manner: calculate the sum of the initial institutional cost of the robot plus the annual service contract fee over the estimated life of the device and divide this sum by the total number of projected robotic cases done over the estimated life of the device.

Morgan and colleagues (5) evaluated cost of robotic versus conventional atrial sept defect and mitral valve repair. Before amortization they found no difference in total hospital cost. For amortization they then assumed a 5-year life span of the robot with an average of 100 cases per year. With an initial price of \$1,000,000 and yearly service fee of \$100,000, the authors calculated an

additional cost of \$2,800 per case.

We have shown that robotic assistance increases cost relative to the nonrobotic VATS alternative secondary to specialized disposable equipment required and through the theoretic cost of robotic technology to the institution.

However, as mentioned above, increased use over time will continually reduce this cost with each new case.

The costs derived from purchasing a robotic surgery equipment should, in our opinion, be considered an “essential expense” for an institution and, for that reason, should not be passed on to the final costumer. The fact that an Institution purchases such a new equipment and by charging extra fees for its use might lead to a situation where the equipment becomes underappreciated.

Conclusions

RVATS proved to be as effective and safe as VATS. Costs are still higher when compared to VATS, but considerably lower when compared to thoracotomy. There are some factors that unequivocally contribute to this cost difference. Reducing the initial cost of the robotic equipment and continually developing individual surgical skills which will bring down OR time related costs, are measures that will certainly narrow this cost difference.

In our study the cost difference between RVATS and VATS lobectomy was \$1,320.79 which, in our opinion, is very acceptable given the relatively small numbers of our series when this study was done and comparing to other studies cited in this work.

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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. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Individual informed consent was obtained.

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