Editorial

Robotic-assisted thoracic surgery: a helpful tool or just another expensive gadget?

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It is almost 20 years ago that the first useful surgical telemanipulator was introduced. Since that time, the surgical robot, as it was called ever since, has been applied to a large number of different procedures throughout surgical specialties ranging from thyroidectomy over mitral valve repair and colorectal resections to prostatectomy. A lot of case reports and case series on successful procedures have been published and yet, surgeons struggle to define robotic surgery's place in every day practice.

From a technical point of view, surgeons experience benefits due to high definition 3-dimensional vision, improved ergonomics and a tremor filter. But what was most striking in the beginning was the robot's improved maneuverability due to the EndoWrist® technology: an additional joint inside the patient's body allows for seven degrees of freedom and a hand-like mobility. This allows for perfect imitation of open surgery, even in small and confined space (1). Despite its advantages and even though technology has made constant progress over time, there is still no tactile feedback implemented in the currently available robotic systems, which has been criticized by many (mainly non-users, however).

Since its early days, we read publications reporting on the feasibility and safety of different thoracic procedures, including lobectomies and segmentectomies, thymectomies and resections of mediastinal tumors as well as esophageal resections and other complex thoracic procedures (1-4). In comparison to conventional open surgery, robotic-assisted surgery achieves all advantages that we know and expect from every other minimally invasive approach, including less pain, shorter hospital stay and faster recovery (5).

But what about advantages compared to video-assisted thoracic surgery (VATS)? With respect to perioperative data, length of hospital stay is comparable (or maybe a little shorter for the robotic approach) (6,7) but operative time is longer in robotic-assisted cases (7,8). One reason for that may be the cumbersome and thus time-consuming set-up of the robotic system. Another reasonable explanation is the usually different levels of experience with many surgeons comparing their very first robotic cases with their advanced VATS results. Like in conventional VATS surgery the operative times decrease with increasing experience (2). Moreover, some reports even claim a faster learning curve for a robotic lobectomy (9). Also, the set-up time can be reduced with growing team-experience.

Postoperative morbidity and mortality are comparable between the two approaches with low mortality and acceptable morbidity (7). Reports exist on improved postoperative pain after robotic lobectomy (10).

In a recently published propensity matched analysis, there was no significant difference in 5-year overall survival between robotic and VATS lobectomy. However, 5-year disease free survival was superior in the robotic group; this was explained by an assumingly more accurate lymph node dissection with the robotic approach (11). Nodal upstaging, which was heavily discussed as a parameter for oncologic

accuracy in minimally invasive approaches during the last years, was found to be higher compared to conventional VATS in some institutional studies (12). A study analyzing a nationwide US-database, however, did not find any difference (7). So, conflicting data were on upstaging.

One might expect that the robotic system with its improved maneuverability might facilitate the—compared to a lobectomy—more delicate dissection of hilar structures in segmentectomies. As trends evolve towards parenchyma-sparing surgery, the robot seems to be an ideal tool to accomplish that goal. Robotic-assisted segmentectomy has been proven to be save and feasible (13). However, so far no data have been shown proving any benefits over a conventional VATS approach.

Other ideal applications, where the robot's specific characteristics might be advantageous, are resections more complex than a simple lobectomy like bronchial or vascular sleeve resections. Again, the maneuverability of the EndoWrist® instruments might be helpful to accomplish anastomoses. There are some case reports and early series describing the technical details of such procedures (3,14). Again, profound data are missing however.

What is really consistent over all studies are the increased costs with a robotic approach (8,15). Higher acquisition costs, higher maintenance costs as well as higher costs for robotic instruments, draping and other disposable products account for an increase in costs of up to 50% compared to a VATS approach (depending on the method used to calculate expenditures). All authors analyzing costs for a robotic lobectomy raise concerns about the expenses that come with the technique and the possible impact on health care systems. As there is only limited proven benefit to date, the question remains whether these additional costs are justified. On the other hand, as more competition is anticipated in the market soon, everyone is expecting a decline in the costs.

So far, high-level evidence allowing for a profound appraisal of robotic-assisted surgery does still not exist. There is no single prospective randomized controlled trial showing any clear benefit of robotic over conventional minimally invasive thoracic surgery. Louie *et al.* suggested some reasons why surgeons would nevertheless feel motivated to initiate a robotic program (10): one is the urge to overcome the rather long learning curve in conventional VATS lobectomy; second, surgeons might expect to improve patients' operative outcome when applying the robot; and third, a robotic approach is often used as a marketing strategy to attract more patients. All of these reasons might be true to a certain extent.

When the community of robotic surgeons thoroughly wants to define the current and increase the future role of the robot, it will be important to elaborate new and meaningful data. Just summarizing already existing data to so-called meta-analyses does not fulfill this requirement. What is of upmost importance is to increase and spread knowledge by educating fellow surgeons. One thing that was greatly achieved from the very beginning within the community of VATS surgeons was the willingness to share experience. As a consequence thousands of VATS thoracic surgeons today all follow one of only three to four major concepts on how to perform a VATS lobectomy (i.e., 3-port, 2-port, uniportal and totally endoscopic techniques); in contrast, the only few hundreds of robotic surgeons still are using myriad self-instructed techniques which vary considerably. This severely hinders multicentric studies and thus the elaboration of profound and reproducible data. The legitimate expectation and need of the community of dedicated minimally invasive thoracic surgeons is more technical standardization and tips and tricks for different anatomic resections. This will set the base for the clinical and consequently for the scientific future of robotic thoracic surgery and hopefully help to answer the question whether a robotic approach is worth the extra money that we are spending every time we switch it on.

May the articles summarizing the Ruijin experience contribute!

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Footnote

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

References

1. Bodner J, Wykypiel H, Wetscher G, et al. First experiences with the da Vinci operating robot in thoracic surgery. Eur J Cardiothorac Surg 2004;25:844-51.
2. Augustin F, Bodner J, Wykypiel H, et al. Initial experience with robotic lung lobectomy: report of two different approaches. Surg Endosc 2011;25:108-13.
3. Schmid T, Augustin F, Kainz G, et al. Hybrid video-assisted thoracic surgery-robotic minimally invasive

right upper lobe sleeve lobectomy. Ann Thorac Surg 2011;91:1961-5.
4. Wu H, Yang S, Guo W, et al. Ruijin robotic thoracic surgery: S1+2+3 segmentectomy of the left upper lobe. AME Med J 2017;2:2.
5. Dylewski MR, Ohaeto AC, Pereira JF. Pulmonary resection using a total endoscopic robotic video-assisted approach. Semin Thorac Cardiovasc Surg 2011;23:36-42.
6. Yang CF, Sun Z, Speicher PJ, et al. Use and Outcomes of Minimally Invasive Lobectomy for Stage I Non-Small Cell Lung Cancer in the National Cancer Data Base. Ann Thorac Surg 2016;101:1037-42.
7. Louie BE, Wilson JL, Kim S, et al. Comparison of Video-Assisted Thoracoscopic Surgery and Robotic Approaches for Clinical Stage I and Stage II Non-Small Cell Lung Cancer Using The Society of Thoracic Surgeons Database. Ann Thorac Surg 2016;102:917-24.
8. Augustin F, Bodner J, Maier H, et al. Robotic-assisted minimally invasive vs. thoracoscopic lung lobectomy: comparison of perioperative results in a learning curve setting. Langenbecks Arch Surg 2013;398:895-901.
9. Veronesi G. Robotic surgery for the treatment of early-stage lung cancer. Curr Opin Oncol 2013;25:107-14.
10. Louie BE, Farivar AS, Aye RW, et al. Early experience with robotic lung resection results in similar operative outcomes and morbidity when compared with matched video-assisted thoracoscopic surgery cases. Ann Thorac Surg 2012;93:1598-604; discussion 1604-5.
11. Yang HX, Woo KM, Sima CS, et al. Long-term Survival Based on the Surgical Approach to Lobectomy For Clinical Stage I Nonsmall Cell Lung Cancer: Comparison of Robotic, Video-assisted Thoracic Surgery, and Thoracotomy Lobectomy. Ann Surg 2017;265:431-7.
12. Wilson JL, Louie BE, Cerfolio RJ, et al. The prevalence of nodal upstaging during robotic lung resection in early stage non-small cell lung cancer. Ann Thorac Surg 2014;97:1901-6; discussion 1906-7.
13. Rinieri P, Peillon C, Salaün M, et al. Perioperative outcomes of video- and robot-assisted segmentectomies. Asian Cardiovasc Thorac Ann 2016;24:145-51.
14. Lin MW, Kuo SW, Yang SM, et al. Robotic-assisted thoracoscopic sleeve lobectomy for locally advanced lung cancer. J Thorac Dis 2016;8:1747-52.
15. Deen SA, Wilson JL, Wilshire CL, et al. Defining the cost of care for lobectomy and segmentectomy: a comparison of open, video-assisted thoracoscopic, and robotic approaches. Ann Thorac Surg 2014;97:1000-7.

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