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The Variability of Practice in Minimally Invasive Thoracic Surgery for Pulmonary Resections

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Video-assisted thoracic surgery (VATS) has been extensively used to diagnose pulmonary conditions, such as interstitial lung disease and solitary pulmonary nodules. The progression to minimally invasive techniques has been almost a natural evolution of the use of VATS in the investigation of pleural effusions. More controversial are the indications of VATS for the treatment of pulmonary parenchymal conditions. Although minimally invasive thoracic surgery (MITS), under various denominations, is currently the accepted approach to the treatment of spontaneous pneumothorax, its use for the treatment of lung cancer and infectious conditions of surgical interest is still debated both from a philosophic and technical point of view.

Yim [1], in 2002, published a review on VATS major pulmonary resections aimed, after almost a decade since its introduction in clinical practice, at defining unresolved matters, such as the length of the minithoracotomy, the use of rib retraction, the relevance of visualization by the VATS monitor to accomplish procedure-related maneuvers, and whether the simultaneous stapled ligation technique could replace individual ligation of the hilar bronchovascular structures. At that time, it had already emerged clearly that a compromise solution was needed, which Yim named "minithoracotomy with videoassistance," to summarize the fundamental principles of a transition operation from conventionally open, muscle dividing, rib retracting with or without shearing approaches to an innovative, rigorous VATS technique where all these elements were not included.

The reasons to resort to minimally invasive pulmonary resections are diverse and have been well described in the recent literature [2]. Although the need for parenchymal-sparing operations had increasingly been advocated for patients with borderline respiratory function and infectious conditions of surgical interest, the emerging view of a different oncologic approach to early stage lung cancer has paralleled the focus on rigorous VATS techniques for pulmonary lobectomy and segmentectomy [3]. Indeed, at some point, the consensus on a reduced immunologic impact of VATS lobectomy, along with the suggestions of reduced postoperative pain and length of hospital stay, emerged in the literature. Concurrently, equivalent survival rates to lobectomy were being reported after segmentectomy for early manifestations of lung cancers, such as ground-glass opacities and small (<2 cm) sized nodular adenocarcinomas (ie, bronchoalveolar carcinoma [BAC]), especially if located in the outer third of the lung.

In addition, certain proponents have favored segmentectomy to remove pulmonary metastases,

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for certain nonmalignant diseases (ie, tuberculosis), and for patients aged over 75 years, when a pathologic margin greater than 1 cm (margin-to-tumor ratio >1) could be obtained.

The issue of the comparison between wedge resection and anatomic segmentectomy for non–small cell lung cancer dates back to the seminal Lung Cancer Study Group study [4]. In this trial, wedge resection was found to yield a threefold increased risk of recurrence compared with lobectomy. In addition, segmentectomy had a lower recurrence risk when compared with wedge resection. These findings have been subsequently confirmed by the independent work of Okada and el Sherif [5–7].

In 2007, a meta-analysis was conducted by the International Society of Minimally Invasive Cardiothoracic Surgery [8], based on a comprehensive review of all randomized (RCT) and nonrandomized controlled trials. It was aimed at comparing VATS with the conventional open approach to parenchymal-sparing resections. The following results were reported:

1. Baseline prognosis was more favorable for VATS compared with open in non-RCT, but not in RCT.
2. Postoperative complications were significantly reduced in the VATS group compared with open surgery considering aggregate results from non-RCT and RCT.
3. Overall blood loss was reduced with VATS (but there was no difference found in the incidence of excessive blood loss or reexploration for bleeding).
4. Postoperative pain was reduced at different levels up to week 4 for VATS. As a consequence, there was a significantly decreased use of pain medications.
5. Postoperative vital capacity was significantly improved in the VATS group. This beneficial effect was maintained and observed up to 1 year after surgery.
6. The degree of impairment of normal activities and the time to return to normal activity were significantly reduced in the VATS group (although no difference in function was noted after 3 years from surgery).
7. Length of stay in the hospital was reduced in the VATS group (although operative time was longer in the VATS group).
8. Time to adjuvant chemotherapy was reduced in the VATS group, although no difference was noted as to cancer recurrence rates.
9. The overall mortality was not different when only RCTs were considered. If non-RCTs were added in the analysis, however, the 1- and 5-year mortality was significantly better in the VATS group. Conversely, no advantage was seen in the stage-specific analysis.

It is clear, from the increasing use of these approaches, that at some point in the recent past the thoracic surgical community accepted that there was a benefit to less invasive approaches for patients with lung cancer. This was furthered by the determination that there was at least the initial technology necessary to perform these operations. What surgeons still cannot agree on is the exact methodology of MITS. What thoracic surgeons do not agree on is as follows.

1. Video-assisted thoracic surgery is not necessarily a synonym of "minimally invasive" surgery because it specifically addresses only the issue of technique visualization or visualization enhancement. The term VATS does not directly address the issues of incisions or of approach in general. It does imply potential for improved visualization to thoracic surgical procedures by adding an "in field" light source and magnification. The difficulty arising from the use over many years of different terminology to define MITS is apparent, especially if applied to parenchymal-sparing resections.
2. The length of the use of thoracotomy, the role of this incision in the parenchymal-sparing resection performed by MITS, and the number of port sites needed to complete the operation are all unresolved matters. There seems to be consensus on the fact that no chest wall muscles above the intercostals should be divided to qualify as a MITS procedure.
3. When it comes to the technical definition of VATS lobectomy, rib spreading or retraction (even rib shearing or cutting) becomes another subject of controversy. According to some proponents of a stringently defined VATS lobectomy and segmentectomy, whereas the chest wall muscles and the overlying skin can be retracted, no spreading is allowed in the costal plane to decrease postoperative pain.
4. Many advocates of stringently defined VATS lobectomy claim that only the monitor should be used for visualization while performing the pulmonary resection because

direct visualization most often mandates the need for rib spreading.

5. Intraoperatively, the degree of lung manipulation may play a role in the immunologic disturbances and possibly on the oncologic outcome of the procedure. For this reason some surgeons decry the back and forth retraction and movement of the lung during the procedure and advocate for a so-called ‘‘no-touch’’ technique.

Other issues also need to be addressed regarding the pattern of work distribution. In this regard, two crucial questions demand answers. Is a dedicated operating room schedule and personnel (including surgeons) required for VATS lobectomies or for MITS procedures in general? Does the expected steep phase of the learning curve for a VATS lobectomy surgeon warrant a redistribution of the routine surgical workload and operating room time among his or her partners and colleagues?

These and other questions have been the matter of a survey project by the European Society of Thoracic Surgeons (ESTS). This survey project represents an attempt, by the leadership of the ESTS, to establish a framework for the definition and interpretation of technical and organizational characteristics related to the performance of MITS and, in particular, to VATS pulmonary resections. The results of this survey are hereafter reported.

The results of the European Society of Thoracic Surgeons Survey on the interpretation of minimally invasive thoracic surgery for major pulmonary resections

Several issues were addressed by the MITS survey, which was originally an ESTS project initially conducted on-line through the ESTS Web site (www.ests.org) as of November 2007. Afterward, the Survey was also made available in the Thoracic Portal of the Cardio-Thoracic Surgical Network (CTSnet; www.ctsnet.org) until April 2008. The questionnaire included 23 questions about MITS practice; an additional request for comments was also included as the twenty-fourth item on the survey.

After an on-line collecting period of 125 days, the total number of responses was 317. The ESTS members were invited to participate in the Survey through an email link connected to the Society’s Web site (www.ests.org). The overall number of responses from ESTS members was 219, of which 196 were complete answers (89%). In addition, as of December 2007, 98 responses were provided through the CTSnet; of these, 84 were complete answers (86%). Out of approximately 800 notification emails sent to ESTS members in the mailing list at the time the survey was opened, about 50 were undelivered because of an incorrect or absent email address. Accordingly, the response rate by ESTS members was 26.1% (196 out of 750). The response rate provided by the CTSnet link cannot be estimated because one cannot calculate the potential responders who have access to this resource (denominator). The inability to calculate an overall response rate is an acknowledged limitation of the study. This was recognized and accepted as a method of increasing accrual of completed surveys without affecting the overall value of the survey because members of CTSnet are thoracic surgeons.

Overall, the number of complete answers was 280 (88%) out of 317. Of these, 220 (78.6%) were entered by established surgeons or full consultants; 31 (11.1%) by junior consultants (within the first 5 years of practice); 18 (6.4%) by senior trainees (last 2 years of training); and 11 (3.9%) by junior trainees (first 3 years of training). In summary, 251 thoracic surgeons working at a consultant level and 29 trainees participated in the survey by providing a completed questionnaire.

Of the 251 consultants, 194 (77.3%) were ESTS members, whereas 57 (22.7%) were non-ESTS members. As to the age distribution of the participating consultants, four age groupings were proposed. Only 5% of the consultants were younger than 35 years. A total of 42% of respondents were age 35 to 45 years, whereas the 45- to 50-year-old and the older than 50 years groups represented 22% and 31% of the total consultants’ answers, respectively. As to the years of practice as a consultant, 77% of the participants had more than 5 years of practice experience at the consultant level. Of these, 24% had between 11 and 20 years of clinical practice at a consultant level, whereas another 21% had more than 20 years of experience at that level. As to the country of practice, the most represented were the United States (15.5%); Italy (10.4%); Spain (8.8%); Germany (8%); United Kingdom (5.2%); and, Turkey (4.4%). Eleven consultants (4.4%) skipped the question on the country of practice.

The questionnaire was structured into five sections focused on (1) the terminology and

definitions (five questions); (2) indications for MITS (eight questions); (3) robotic thoracic surgery (three questions); (4) case volume and learning curve (two questions); and (5) demographic data (five questions). For each question, the participant had to select one or more answers relevant to the current controversies discussed previously.

Results

The answers given to the questionnaire were stratified by years of experience in the consultant position, with 10 years being the selected arbitrary cut point between the two groups. A second stratification was done according to the socioeconomic status of the country of practice of the responding surgeon, distinguishing between low- and middle-income and high-income countries as per the ESTS three-tier subscription fee format inspired by the criteria of the World Trade Organization (www.ests.org).

Question 1. Which terminology do you prefer and do you use to describe less invasive thoracic surgical procedures?

Overall, 45% of the responders use VATS as the standard definition to describe less invasive thoracic procedures; VATS, in this case, meant video-assisted thoracic surgery. VATS intended as "video-assisted thoracoscopic surgery," "minimally invasive thoracic surgery," and "minimal-access thoracic surgery" were the preferred terminology for the remaining 32%, 18%, and 3%, respectively. About 1% of the responders did not express a definitive view. No major differences in the answer distribution were noted between the two categories of seniority. Similarly, when the responders were stratified by socioeconomic status of the country of origin, answers from middle to low income countries overlapped the ones from high income countries. The most prevalent answer to the question at hand was "video-assisted thoracic surgery" (Table 1).

Question 2. What is your current definition of "open" thoracic surgery?

The most prevalent answer to this question was defined by whether rib spreading was used. Furthermore, roughly 30% of the responders also indicated that, along with rib spreading, the length of the skin and the intercostal incision, and the division of chest wall muscles, were important factors in determining whether a minimally invasive or an open approach had been used (Table 2).

Question 3. How do you define a video-assisted thoracic surgery lobectomy? Part I

The consensus was that VATS lobectomy is performed through two or three port incisions with the addition of a minithoracotomy (access incision to remove the specimen) (Table 3).

Question 4. How do you define video-assisted thoracic surgery lobectomy? Part II

There was a general agreement (nearly 60% of the responders) that no rib spreading was an important component of a strictly defined VATS lobectomy (Table 4).

Question 5. How do you define video-assisted thoracic surgery lobectomy? Part III

The opinions were generally split as to whether direct visualization of the surgical field could also be acceptable in VATS lobectomy. The most prevalent answer (range, 52%–59%), however, supported the idea of the dissection being done by visualization through only the video monitor (Table 5).

Question 6. What are the main indications for minimally invasive procedures in your thoracic surgical practice?

Participants were asked to clarify the indications for minimally invasive procedures in their practice. Apparently, minimally invasive procedures are used primarily for diagnostic and minor therapeutic purposes, especially by surgeons from low- to middle-income countries. Whether this finding reflects different resource availability is possible but not confirmed by these data (Table 6).

Question 7. Of cases requiring access to the thoracic cavity, approximately how often do you currently use the standard posterolateral thoracotomy (dividing at least the latissimus dorsi or both the latissimus and the serratus anterior muscles) for lung surgery?

This question addressed the use of standard posterolateral thoracotomy in the participants' practice. Overall, 39% of the responders report still using the standard posterolateral thoracotomy in more than 50% of their cases. Surprisingly, no difference was noted as to the seniority

Table 1
Which terminology do you prefer and do you use to describe less invasive thoracic surgical procedures?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Video-assisted thoracic surgery	**114**	**45.4**	**48**	**42.9**	**66**	**47.5**
Video-assisted thoracoscopic surgery	81	32.3	34	30.4	47	33.8
Minimally invasive thoracic surgery	45	17.9	24	21.4	21	15.1
Minimal-access thoracic surgery	8	3.2	3	2.7	5	3.6
I do not know	3	1.2	3	2.7	0	0
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 2
What is your current definition of open thoracic surgery?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
It depends on the length of the thoracic skin incision	29	11.6	16	14.3	13	9.4
It depends on the length of the incision at the level of the intercostal muscles	10	4	5	4.5	5	3.6
It depends on whether the chest wall muscles (latissimus dorsi, serratus anterior) are divided	19	7.6	8	7.1	11	7.9
It depends on whether the ribs are spread	**113**	**45**	**46**	**41.1**	**67**	**48.2**
It depends on whether a rib is cut or sheared	1	0.4	0	0	1	0.7
All of the above	79	31.5	37	33	42	30.2
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 3
How do you define a video-assisted thoracic surgery lobectomy? Part I

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
One port-sized incision with an additional minithoracotomy (access incision)	18	7.2	7	6.3	11	7.9
Two port-sized incisions with an additional minithoracotomy	109	43.4	**57**	**50.9**	52	3.4
Three or more port-size incisions with an additional minithoracotomy	**120**	**47.8**	47	42	**73**	**52.5**
Muscle-sparing thoracotomy	4	1.6	1	0.9	3	2.2
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 4
How do you define video-assisted thoracic surgery lobectomy? Part II

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
No skin retraction or rib retraction or cutting	67	26.7	33	29.5	34	24.5
No rib spreading or cutting	**141**	**56.2**	**62**	**55.4**	**79**	**56.8**
With rib spreading	42	16.7	17	15.2	25	18
With rib cutting	1	0.4	0	0	1	0.7
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 5
How do you define video-assisted thoracic surgery lobectomy? Part III

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Dissection done using only the video monitor for visualization	**139**	**55.4**	**66**	**58.9**	**73**	**52.5**
Dissection can be done using both video monitor images and direct visualization	112	44.6	46	41.1	66	47.5
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 6
What are the main indications for minimally invasive procedures in your thoracic surgical practice?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Diagnostic only (ie, mediastinoscopy, video-assisted thoracic surgery for pleural effusions)	7	2.8	1	0.9	6	4.3
Diagnostic and minor therapeutic (ie, wedge resections of the lung for solitary pulmonary nodules, pneumothorax)	**127**	**50.6**	**54**	**48.2**	**73**	**52.5**
Diagnostic, minor and major therapeutic (typical segmentectomy, lobectomy, thymectomy)	117	46.6	57	50.9	60	43.2
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 7
Of cases requiring access to the thoracic cavity, approximately how often do you currently use the standard posterolateral thoracotomy (dividing at least the latissimus dorsi or both the latissimus and the serratus anterior muscles) for lung surgery?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
>50% of the cases	**98**	**39**	**42**	**37.5**	**56**	**40.3**
<30% of the cases	51	20.3	19	17	32	23
<10% of the cases	29	11.6	16	14.3	13	9.4
<5% of the cases	73	29.1	35	31.3	38	27.3
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 8
For what do you use video-assisted thoracic surgery for lung surgery

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Never, I only use video-assisted thoracic surgery to diagnose pleural conditions	6	2.4	1	0.9	5	3.6
Diagnosis of interstitial lung disease and peripheral solitary pulmonary nodules and treatment of pneumothorax	**129**	**51.4**	51	45.5	**78**	**56.1**
The above and for segmental or lobar lung resections	116	46.2	**60**	53.6	56	40.3
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 9
Among the following answers, what is the main reason that you perform video-assisted thoracic surgery lobectomy?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Better ability to tolerate the procedure in cases of borderline cardiopulmonary function	44	17.5	22	19.6	22	15.8
Better oncologic operation	2	0.8	1	0.9	1	0.7
Decreased postoperative pain	**152**	**60.6**	**65**	**58**	**87**	**62.6**
Decreased length of hospitalization	53	21.1	24	21.4	29	20.9
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 10
What is the second most important reason that you perform video-assisted thoracic surgery lobectomy?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Better ability to tolerate the procedure in cases of borderline cardiopulmonary function	58	23.1	20	17.9	38	27.3
Better oncologic operation	1	0.4	0	0	1	0.7
Decreased postoperative pain	76	30.3	35	31.3	41	29.5
Decreased length of hospitalization	**116**	**46.2**	**57**	**50.9**	**59**	**42.4**
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 11
Of the lobectomies you perform every year, what percentage are video-assisted thoracoscopic surgery lobectomies?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
>50% of the cases	37	14.7	23	20.5	14	10.1
<30% of the cases	31	12.4	15	13.4	16	11.5
<10% of the cases	36	14.3	16	14.3	20	14.4
<5% of the cases	**147**	**58.6**	**58**	**51.8**	**89**	**64**
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 12
Over time, which factors have been influential in increasing or decreasing your likelihood to offer minimally invasive procedures?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Scientific evidence on safety and effectiveness	**126**	**50.2**	**60**	**53.6**	**66**	**47.5**
Patient demand for less invasive options	26	10.4	13	11.6	13	9.4
Referring physician demand for less invasive options	6	2.4	1	0.9	5	3.6
Medicolegal litigation environment	1	0.4	1	0.9	0	0
Changes in technology available to assist with these procedures	58	23.1	20	17.9	38	27.3
Opinion and practice of peers and partners	34	13.5	17	15.2	17	12.2
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 13
Why do you think video-assisted thoracic surgery lobectomy has not yet gained widespread popularity?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Not enough scientific evidence to establish safety and effectiveness	33	13.1	13	11.6	20	14.4
Difficult technique, steep learning curve	48	19.1	24	21.4	24	17.3
Resistance by older surgeons	22	8.8	14	12.5	8	5.8
Logistic and financial issues (ie, capital cost of necessary equipment and technology)	12	4.8	5	4.5	7	5
Lack of adequate training and retraining in video-assisted thoracic surgery pulmonary resections	28	11.2	13	11.6	15	10.8
All of the above	**108**	**43**	**43**	**38.4**	**65**	**48**
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 14
Do you consider robotic thoracic surgery to be a component of minimally invasive thoracic surgery?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Yes, it is an evolution of video-assisted thoracic surgery	**150**	**59.8**	**67**	**59.8**	**83**	**59.7**
Yes, simply because it avoids a traditional sternotomy or thoracotomy	19	7.6	13	11.6	6	4.3
Yes, because it entails a lesser degree of lung manipulation, hence less immunologic disturbances	3	1.2	2	1.8	1	0.7
No, my criteria for minimally invasiveness are not met by robotic surgery	79	31.5	30	26.8	49	35.3
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 15
What proportion of your procedures do you perform with the use of robotic assistance each year?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
None	**230**	**91.6**	**101**	**90.2**	**129**	**92.8**
<3%	10	4	5	4.5	5	3.6
<5%	5	2	3	2.7	2	1.4
<10%	4	1.6	3	2.7	1	0.7
>10%	2	0.8	0	0	2	1.4
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 16
Why do you think robotically guided thoracic surgery has not yet gained widespread popularity?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Financial issue (ie, capital costs, nonreusable equipment costs, and so forth)	**69**	27.5	**31**	27.7	**38**	27.3
Lack of technologic refinement in current generation of equipment	10	4	4	3.6	6	4.3
Robotic-assisted procedures are unlikely to gain widespread popularity until there is more widespread acceptance and use of video-assisted thoracic surgery and other minimally invasive approaches	14	5.5	5	4.5	9	6.5
Lack of evidence demonstrating advantage for the patients over video-assisted thoracic surgery	30	12	17	15.2	13	9.4
All of the above	**128**	**51**	**55**	**49.1**	**73**	**52.5**
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 17
If you worked in a group of four surgeons, how many should be doing video-assisted thoracic surgery lobectomies?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Depends on the workload and the available resources but at least one	**99**	39.4	40	35.7	**59**	42.4
Only one	20	8	14	12.5	6	4.3
Only two	32	12.7	12	10.7	20	14.4
Everybody	**100**	**39.8**	**46**	**41.1**	54	**38.8**
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

Table 18
How do you envisage the training pathway of a resident for video-assisted thoracic surgery lobectomy?

	Overall response count	Overall response %	<10-y practice count	<10-y practice %	>10-y practice count	>10-y practice %
Stepwise, from classic open to classic video-assisted thoracic surgery to video-assisted thoracic surgery lobectomy	**202**	80.5	**95**	84.8	**107**	77
With separate video-assisted thoracic surgery lobectomy fellowship after conventional training	49	19.5	17	15.2	32	23
Answered question	**251**	**100**	**112**	**100**	**139**	**100**
Skipped question	**0**	**0**	**0**	**0**	**0**	**0**

level, whereas fewer surgeons from high-income countries seemed to use this approach for most of their cases (Table 7).

Question 8. For what do you use video-assisted thoracic surgery for lung surgery?

As expected, more than half of the participants claimed to use VATS lung surgery for the diagnosis of interstitial lung disease and pulmonary nodules, in addition to the treatment of pneumothorax. Nevertheless, 46% of respondents declared using VATS lung surgery also for anatomic sublobar and lobar resections. Of these, most (54%) were surgeons within the first 10 years of independent practice. Once again, worthy of note was the minor impact of VATS lung surgery for major pulmonary resections among responders from low- to middle-income countries (38%) compared with the ones from high-income countries (49%) (Table 8).

Question 9. Among the following answers, what is the main reason that you perform video-assisted thoracic surgery lobectomy?

By far, the primary reason was the reduced incidence of pain compared with standard thoracotomy (61%) with a substantial agreement between consultants with different experience and from countries of differing socioeconomic status (Table 9).

Question 10. What is the second most important reason that you perform video-assisted thoracic surgery lobectomy?

When the participants were asked for the secondary reason for performing VATS lobectomies, 46% claimed a reduced length of hospitalization compared with standard thoracotomy, again with no difference between consultants' subgroups (Table 10).

Question 11. Of the lobectomies you perform every year, what percentage are video-assisted thoracic surgery lobectomies?

Most (59%) declared that VATS lobectomies account for less than 5% of their lobectomy cases. About 15% of the participants claimed to perform more than 50% of their lobectomies by the VATS approach. In this subset of responders, there were twice as many younger consultants than consultants with more than 10 years of seniority. If one analyzes the answers according to the socioeconomic backgrounds, 69% of surgeons from low- to middle-income countries performed less than 5% of their lobectomies by VATS, as opposed to 56% in the higher-income subset. Compared with surgeons from low- to middle-income countries, the prevalence of surgeons from high-income countries performing VATS lobectomies in over 50% of their lobectomy candidates was threefold higher (18% versus 5%) (Table 11).

Question 12. Over time, which factors have been influential in increasing or decreasing your likelihood to offer minimally invasive procedures?

Overall, 50% thought that the availability of scientific evidence on safety and effectiveness of these procedures played a major role in their decision to adopt these new approaches in their clinical practice. This was a shared opinion among surgeons, irrespective of their seniority and their socioeconomic background. Interestingly, the most senior surgeons seemed to believe that additional technologic advancements were still needed to increase the impact of minimally invasive surgery on their practice (Table 12).

Question 13. Why do you think video-assisted thoracic surgery lobectomy has not yet gained widespread popularity?

Most (43%) were inclined to think that there was an ensemble of factors preventing further diffusion of VATS lobectomy. Most (48%) of the consultant surgeons in practice for more than 10 years supported this view. Worthy of note was the fact that younger consultants hinted at the issue of a possible resistance to change by older surgeons (12% versus 6%). Interestingly, although surgeons from high-income countries seemed to emphasize the difficult learning curve for this procedure, their counterparts from middle- to low-income countries tended to relate the lack of widespread popularity of VATS lobectomy to logistic and financial issues (Table 13).

Question 14. Do you consider robotic thoracic surgery to be a component of minimally invasive thoracic surgery?

Overall, 60% replied that they considered robotic surgery a direct evolution of VATS. In this setting, consultants with lower seniority and the ones from middle- to low-income countries were more convinced than senior colleagues that robotic surgery could fully replace, at some point, the thoracotomy or the sternotomy approach. More than 30%, however, especially the consultants with longer seniority, denied that robotic surgery met their criteria for minimal invasiveness. In addition, when the collected data were stratified by national income, surgeons from higher-income countries also tended to be more skeptical about considering robotic surgery as a part of the minimally invasive armamentarium compared with their counterparts from the middle- to low-income countries (34% versus 25%) (Table 14).

Question 15. What proportion of your procedures do you perform with the use of robotic assistance each year?

Overall, 92% of the respondents did not perform any robotic cases. When the results were stratified according to the socioeconomic background, this percentage increased to 98% and decreased to 89% for middle- to low-income and higher-income countries, respectively (Table 15).

Question 16. Why do you think robotically guided thoracic surgery has not yet gained widespread popularity?

Participants replied that many issues factored into this situation but a particularly important consideration seemed to be the costs of the device. Moreover, 15% of the younger surgeons (versus 9% senior) and 13% of those from higher-income countries (versus 5% from middle- to low-income countries) seemed to believe that no distinct advantage of robotic over VATS has been demonstrated. A total of 9% of the consultants from middle- to low-income countries (versus 4% from high-income countries) thought that the evolution to robotic approaches will be limited until VATS clearly defines its role in the thoracic surgical armamentarium (Table 16).

Question 17. If you worked in a group of four surgeons, how many should be doing video-assisted thoracic surgery lobectomies?

The opinions were split between the view that everybody should be equally able with this procedure and that, given a definite workload, at least one surgeon should be dedicated to VATS lobectomy. The latter argument, in particular, seemed to be supported by surgeons with higher seniority (12.5% versus 4.3%) (Table 17).

Question 18. How do you envisage the training pathway of a resident for video-assisted thoracic surgery lobectomy?

There was an overwhelming majority (80%) favoring a stepwise approach to this procedure, from open to VATS. Younger surgeons expressed this view slightly more consistently than older surgeons (85% versus 77%) who were more inclined to propose an extracurricular training time rather than including this into the traditional training programs (23% versus 15%). When the socioeconomic background was analyzed, surgeons from middle- to low-income countries favored the learning of VATS lobectomy as part of a classic stepwise approach, contrary to their colleagues from higher-income countries who seemed to prefer a separate, dedicated VATS lobectomy training period (Table 18).

Summary

Thoracic surgeons participating in this survey seemed to have clearly indicated their perception

of VATS major lung resections, in particular VATS lobectomy.

1. The acronym VATS as a short form of "video-assisted thoracic surgery" was the preferred terminology.
2. According to the respondents, the need or use of rib spreading served as the defining characteristic of "open" thoracic surgery.
3. It was most commonly suggested that VATS lobectomy is performed by means of two or three port incisions with the addition of a minithoracotomy or access incision.
4. Rib spreading (shearing) was not deemed acceptable as part of a strictly defined VATS procedure.
5. Although there was no general consensus, respondents suggested that the preferred approach for visualization in a VATS procedure was only through the video monitor.
6. Although minimally invasive procedures for lung resection are still mainly being used for diagnostic and minor therapeutic purposes, young surgeons seemed to be more likely to recommend VATS lung surgery for major pulmonary resections than their more senior colleagues.
7. The survey confirmed that the use of the standard posterolateral thoracotomy is still widespread. Almost 40% of the surgeons claimed to use the standard posterolateral thoracotomy for more than 50% of their cases and less than 30% use it for less than 5% of cases.
8. The major reasons to perform VATS lobectomy were perceived to be reduced pain and decreased hospitalization.
9. Approximately 60% of the surgeons claimed to perform VATS lobectomy in less than 5% of their lobectomy cases. Younger consultants reported using VATS lobectomy in up to 50% of their lobectomy cases. There was the suggestion that lack of resources could justify the minor impact of VATS lobectomy in the thoracic surgical practice in middle- to low-income countries.
10. The currently available scientific evidence on safety and effectiveness, and technologic advancements were emphasized as the two factors having a major impact on the development of minimally invasive thoracic surgical practice.
11. Any lack of popularity of VATS lobectomy was presumed to be caused by several equally important factors. Resistance to change by more senior surgeons ranked highly among younger surgeons, however, as an explanation for the slow adoption of this technique. Senior surgeons, however, seemed to focus their attention on the steep learning curve of VATS lobectomy. In addition, surgeons from middle- to low-income countries recognized certain financial and logistic difficulties as major determinants of the lack of popularity of VATS lobectomy.
12. Most surgeons thought that robotic thoracic surgery represented an evolution of VATS. Nevertheless, almost 30% did not think current robotic methods meet the criteria for minimally invasive surgery. More than 90% of the participants stated that they did not perform robotic thoracic surgery. This was reportedly because of costs, but also because of the fact that robotic approaches have not yet demonstrated a distinct advantage over nonrobotic VATS procedures.
13. It was suggested that in every unit or department there should be at least one surgeon with a specific interest and capability in VATS lobectomy. The younger surgeons, however, seemed to envisage more widespread competency being optimal.
14. Most suggested that training in VATS lobectomy be done in a stepwise fashion starting from the classical open technique. Older surgeons wanted to see this as an extracurricular activity following completion of the current training curriculum rather than included in the traditional training program.

In the opinion of the thoracic surgeons taking part in this survey, pulmonary resections not performed according to these standards could not be called VATS procedures but should be included within the MITS category at large, along with other diagnostic and therapeutic interventions. In addition, the survey confirmed that the time-honored muscle-dividing thoracotomy is still widely used. The opportunity for a progressive move toward the routine use of less invasive approaches for major pulmonary resections, however, is already well within sight. Given the results of the ESTS survey supporting a stepwise teaching process leading to VATS lobectomy, hybrid and minimally invasive open lung resections (discussed elsewhere in this issue) collectively defined as MITS may serve as starting point in this process

to expand the appropriate use of VATS lobectomy in the modern thoracic surgical practice.

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