Editorial Commentary

# Intra-operative conversion during video-assisted thoracoscopic surgery lobectomy is not a failure as long as emergency is avoided

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## Introduction

During the last 25 years, the introduction of minimally invasive surgery has deeply modified treatment and management of surgical thoracic diseases including lung cancer. Modern thoracoscopy, also known as video-assisted thoracoscopic surgery (VATS), owes its outstanding spreading to a meaningful series of advantages. These advantages can be summarized as follows: (I) less postoperative pain; (II) less inflammatory response; (III) shorter chest tube and hospital staying; (IV) faster recovery; (V) few postoperative respiratory problems; (VI) better cosmetic outcomes; (VII) better compliance with adjuvant therapies; (VIII) better early postoperative quality of life.

VATS advent was slower than laparoscopy despite minimally invasive technique is particularly suitable to thoracic surgery since this has been always characterized by severe postoperative pain adversely affecting outcomes. Moreover, chest wall rigid structure perfectly fits video assisted surgery main criteria.

Concentrating on oncologic pulmonary surgery, it is common knowledge that lobectomy is gold standard for resectable pulmonary carcinoma, but introduction of VATS lobectomy has been slower than others thoracoscopic procedures and confined to few academic centers worldwide. The main reasons were both technical and cost related. Anyway, as concerning technical difficulties there are many studies describing learning curve steps and training programs that should prompt surgeons to engage in VATS lobectomy. At the same time price are lowering. However, the number of VATS lobectomy performed per years seems to be still less than it could be, despite continuously growing. It is also not without significance that at the beginning there was a kind of reticence explained by uncertain oncological equivalence to open surgery determining a weak confidence about minimally invasive surgery.

## VATS lobectomy indications

Many series have already compared VATS lobectomy to thoracotomy in terms of radical tumor resection (1) and survival. Actually, the most authoritative guidelines recommend VATS lobectomy as the standard procedure in early staged lung cancer (2). In particular, Vannucci and Gonzalez-Rivas (3) published a paper to determine situations in which VATS lobectomy can be considered the gold standard. Their paper is very inspiring and starts from the established standpoint that VATS lobectomy was historically considered only for stage I lung cancer. Then, they reported the most important papers comparing VATS and open approach with the aim to deeper investigate meaningful topics such as nodal dissection and oncological efficacy, extended resection wider than lobectomy, complication and survival rates. From this literature review it appears that radical nodes dissection can be achieved by both VATS and open technique without significant

difference in terms of N1 and N2 upstaging and that almost all pulmonary resection, including bronchial or vascular sleeve resection, chest wall resection and *en-bloc* resection, can be performed by VATS in high specialized medical centers. At the same time, overall survival and disease survival rate are equivalent or even better in favor of minimally invasive surgery. As concerning contraindications, when VATS was introduced some conditions as pleural adhesion were considered an impediment, whereas now, thanks to technical skill improvements, they seem to be overcome by operator experience.

Therefore, Authors declared that there are no specific contraindications to VATS and, especially from an oncological point of view, contraindications, if present, are absolute and unrelated to any proposed approach. Their conclusions are challenging since they enlarge VATS lobectomy indications to all operable patients especially if performed by very skilled surgeons in high volume centers.

Many others prominent Authors have addressed this topic reaching more conservative conclusions. Hanna and co-workers (4) admitted that contraindications of VATS have changed over time thanks to improvements in instrumentations and surgeons experience. Some conditions as endobronchial tumors or induction therapy, for example, are no more an absolute contraindication. However, they recognized as limits to VATS some specific conditions as failure to obtain complete tumor resection with lobectomy, T4 or N3 factors. Moreover, they stated that the "ideal patient" for VATS is T1/T2-N0 one. Actually, indications to VATS in N2 are controversial.

Anyway, they also concluded that, beyond few absolute contraindications, there are many major and minor contraindications related to surgeons' experience and hospital volume.

Therefore, despite many different beliefs about the extent to consider VATS a gold standard for lobectomy, the most of Authors agree that its advantages are so meaningful to let appear unethical to perform thoracotomy when VATS is feasible.

Beyond early stage cases, since contraindications are mainly related to surgical experience, the next question is how to define when a surgeon is really skilled in VATS procedures.

## Learning curve period in VATS lobectomy

A recent survey released by the ESTS has shown that, compared to previous surveys, there is a strong trend on behalf of VATS for many thoracic procedures (5). However, despite evident advantages of VATS, statistic tell us that about 50% of patients are still referred to open approach, even in clinical stage I (4). Beyond high specialized academic centers, VATS lobectomy still represents a real challenge for surgeons, especially for those who have been trained before the thoracoscopy advent. Many specific programs have been organized to introduce thoracic surgeons into VATS and many papers have been published estimating the learning-curve for VATS lobectomy. The aim of these studies was to understand how many procedures are needed to obtain enough competence and efficiency.

Usually, learning curve is considered a period needed to reach steady state of monitored outcome indicators for the procedure to be learned. Learning curve is different for surgical trainees with less experience in open lobectomy and experienced surgeons starting to include VATS lobectomy in their activity.

As concerning trainees, Konge *et al.* (6) in 2012 showed that the learning curve can be overcome despite a very limited experience in traditional thoracic surgery and concluded that after 29 cases of training on selected cases under close supervision, the trainee could reach good results.

As concerns training consultant, the number of cases needed to overcome the learning curve ranged between 30 and 60. Petersen *et al.* reported that 47 VATS lobectomies are required to obtain results comparable with skilled surgeons (7). Zhao *et al.* has proposed 30 cases to reach a plateau of blood loss and operative time (8). Arad *et al.* instead suggested 60 cases (9), whereas Li *et al.* reported a range between 100 and 200 lobectomies (10).

When referring to learning curve, it is mandatory to clearly set out selection criteria. Indeed, learning curve period can be shorter or longer depending on whether difficult cases have been included or not (11).

That is way we have appreciated the study by Mazzella *et al.* (12) who in 2016 published a paper to understand which is the learning curve of an experienced consultant and focused their attention also on selection of the patients during the learning period in addition to other pre intra and post-operative data. They were able to conclude that 30 VATS lobectomies are enough to reach the level of competence (defined on a plateau in oncological radicality). But 90 cases were required to reach a level of experience (defined on conversion rate, hospital staying, operative time and air leaks). Basically, they realized that competence and efficiency are different targets and that learning curve in

 

VATS lobectomy is bimodal.

Since conversion rate is one of the most important criteria when dealing with learning curve, this is our next item to be addressed.

## Predictors and reasons for conversion during VATS lobectomy and their consequences

When VATS lobectomy cannot be carried out, conversion to open thoracotomy is mandatory. Conversion to thoracotomy may be required due to technical reasons or intra-operative complications. It is very interesting to observe that the overall rate of conversion varies from 2% to 23% (13-15) of VATS procedure, but the rate of catastrophic intra-operative events is just around 1% (16) although it could be underreported (17). Statistics are slightly different for trainees during their learning curve and may be influenced by patients' selection criteria.

Many possible predictors of conversion have been investigated in literature and the most important are two: tumor size (>3 cm) and induction therapy. Also, N2 disease is a conversion predictor, however this kind of surgery should be considered separately since not always recommended. On the contrary, no difference regarding age, gender, preoperative treatments, ASA score or pulmonary function have been registered.

According to some Authors, learning curve is a predictor of conversion as well, despite not all series are consistent. At the same time many papers report that causes for conversion change during the learning curve period with a majority of vascular emergencies in the first period.

In order to the aim of this paper, reasons for conversion are worthy of particular attention. These can be classified in emergency (or complications), technical/anatomical or oncologic. Emergency reasons are represented by vascular injuries causing significative bleeding that cannot be managed by thoracoscopic approach. Pulmonary artery bleeding provides most of the emergency conversions whose usually occurs during lymph node dissection, pulmonary artery branch manipulation or bronchial dissection. Technical reasons are several as pulmonary or mediastinal adhesions, limited space due to mediastinal adipositas, stapler malfunction, difficult to perform single lung ventilation, calcified nodes. By the way, dense pleural adhesions are the most frequent technical cause of conversion.

Oncologic reasons are due to tumor extension, infiltration of thoracic wall or nodal involvement. Conversion for technical and oncologic reasons usually is not life threatening and results after quit assessment of strengths and weakness. Instead, in case of vascular injury surgeon's experience is put to the test since bleeding must be detected and arrested in few seconds. Then vascular repair has to be completed. If these steps cannot be performed by VATS, thoracotomy must be instantly done.

There are many interesting papers addressing conversion impact on patients outcomes. Their results need a deep thought.

In 2016, Augustin *et al.* reported their experience with 232 VATS lobectomy of whom 15 (6.5%) were converted to open thoracotomy. In particular, they noted that conversion was not related to higher overall postoperative complications or longer chest tube staying and in-hospital mortality. Only hospital stay got worse in the conversion group. All the conversions were safely performed without intra-operative deaths (18). Other Authors reported similar experience with no in-hospital mortality after conversion to thoracotomy during VATS lobectomy and non-statistical significant outcomes worsening (19,20).

However, there are also different experiences. The ESTS Minimally Invasive Thoracic Surgery Interest Group (MITIG) published a paper about major intra-operative complications during VATS anatomical lung resections and concluded that these occurrences (about 1.5% of patients operated on by VATS) are infrequent and seem not to be related to surgical experience but have an important impact on patient's outcomes (21). Indeed, they recorded 3 intra-operative and 10 in-hospital deaths correlated to major intra-operative complications. That is why they recommended ability to recognize when a dangerous situation is occurring in order to prevent unmanageable bleeding. In this way, they distinguished between conversion to avoid complication and conversion to fix complication; definitively two different situations.

In 2010, Gopaldas *et al.* published a paper not focused on conversion and its impact on outcomes but just as interesting for our purposes (22). They reported on a huge population that intra-operative complication during VATS lobectomy are significantly more frequent than during open lobectomy showing a prevalence of 1.5%.

## Is intra-operative conversion during VATS lobectomy a failure?

Recently, Fourdrain and coworkers published a paper entitled "Intraoperative conversion during VATS does not

 

constitute a treatment failure" (23). They started from the assumption that VATS advantages over open surgery have been already highlighted and therefore VATS lobectomy is replacing thoracotomy approach even in challenging cases. However, despite many studies have investigated and compared outcomes associated with VATS and thoracotomy, few series have been reported evaluating VATS resection with intra-operative conversion. They reported their experience with a population of 610 patients whose underwent 301 thoracotomy and 309 intention to treat VATS with 56 conversions. The Authors interesting used a propensity score analysis to assess 90-day mortality and morbidity rates between converted VATS and open surgery group and found that (I) VATS + conversion group were more likely to have cardiac or respiratory comorbidities than full VATS group; (II) 18.1% of patients underwent conversion during VATS; (III) the leading causes of conversion were pleural adhesions (28.6%) and vascular lesion (25%); (IV) postoperative mortality was higher in conversion group than in thoracotomy group but without statistical significance; (V) postoperative morbidities were similar in open and conversion group but lower in full VATS group. Based on these data they concluded that conversion during VATS lobectomy is not disadvantageous compared to immediate open surgery.

Moreover, they went further claiming that these findings should be applied not only for standard cases but even for the most demanding such as advanced disease or challenging anatomical restoration. So, they concluded that VATS approach should be preferred to open surgery as a general rule, since even if intra-operative conversion could be required that did not disadvantage any patients.

The paper is interesting with meaningful conclusions, however, as Authors themselves underlined, there were some limitations and one in particular is very significant. Due to the small number of conversions, they were not able to predict the impact on outcomes of every conversion reason. So, they could not assert if emergency and non-emergency conversions did affect outcomes at the same way.

## Conclusions

To summarize, advantages of VATS over open thoracotomy have been proved just as its oncologic efficacy and favorable overall and disease survival. Concerning VATS lobectomy indications, it is common opinion that early stages should be approached by minimally invasive technique but also demanding cases are affordable by now. The only limitation would seem to be surgeon and its staff experience to the point that someone argued that no absolute contraindications to VATS lobectomy should be placed. A surgeon is considered expert for most demanding cases after about 90 procedures.

At the same time, it has been confirmed that early and mid-term outcomes are similar when thoracotomy and converted VATS lobectomy are compared. That would indicate that VATS approach is totally safe and should be preferred regardless of conversion odds.

On one side we support this kind of message since it prompts to provide patients the advantages of minimally invasive surgery. On the other hand, we would not perpetrate the message that conversion is always safe. In our opinion conversion during VATS lobectomy must be considered a chance to be used in a smart way. Leaving aside long-term postoperative outcomes, when conversion is performed for technical or oncologic reasons, which are non-emergency conversions, it does not put patients at risk. Instead, when conversion is due by an emergency such as vascular injuries, even in experienced hands it could represent a high risk. Furthermore, vascular injuries are often consequence of neglected technical or oncological reasons.

So we encourage to choose VATS approach for every anatomical lobar or sublobar resection but, at the same time, we recommend attention to recognize dangerous situations and, in case of obstacles, to convert without hesitation. Conversion is smart when avoid emergency, otherwise it is a dangerous question mark to be avoided.

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## Footnote

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

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