The lobar *vs.* sublobar "limited" resection respiratory function preservation debate: learning to speak the same language

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"Do we speak the same language?"

It is in the nature of surgeons to evolve towards performing smaller incisions and less invasive techniques for the benefit of their patients. From an open pneumonectomy we have moved on to lobectomies and then sublobar resections; from an open thoracotomy we have evolved to a smaller "mini" thoracotomy, multiport and uniportal video assistant thoracic surgery (VATS) incisions and now robotic surgery (1-5). The quest to support the implementation of the limited resection into the cancer surgery armamentarium started many years ago. However, the concern with lung-sparing and minimal access techniques is that the oncological outcome may be compromised (6,7).

In an effort to address this concern, a randomized trial was conducted, which was not in support of the superiority of the "limited" resections over the traditional lobectomies in terms of oncological result and postoperative outcome (8). That study was, however, criticized due to inconsistencies regarding the collection of data; several non-anatomical resections (wedges) were included in the "limited" resection group, which may have altered the overall outcome of the study. More importantly, the aforementioned study unfortunately shed light on the discrepancies and the multitude of variables among data investigated and reported in different studies (7,9-12).

Therefore, before reaching a conclusion, it is of the utmost importance that studies incorporate all the possible confounding variables that could potentially influence the outcome and perform relevant analysis based on a "commonly agreed vocabulary", allowing the rest of the thoracic surgical community to understand the "common language".

"The respiratory benefit of segmental resections: a factitious observation or a fictional understanding of a different language?"

Why offer a less extended operation to patients, if there is nothing to earn in return? Therefore, the first and logical step in answering this query is to prove that a "limited" resection provides exactly what it implies: the advantage of limited reduction of pulmonary function. In the effort to investigate the former, pulmonary function tests (PFTs) measuring forced expiratory volume in the 1st second (FEV1), ± forced vital capacity (FVC), ± diffusional lung capacity for carbon dioxide (DLCO) have been investigated over the years. Moreover, several retrospective studies, lately with propensity scoring, have seen publicity in an effort to clarify if "limited" resections preserve respiratory function; results did not favor either way, with many studies showing preserved PFTs after segmentectomy when compared to lobectomy (13-16) and others unable to support this finding, with segmentectomies showing similar pulmonary function reduction with lobectomies (8,17,18). Unfortunately, again a lot of confusion has arisen, because once more we are not "*speaking the same language*".

Firstly, the timing of the PFTs performed after surgery is crucial because the amount of pain is different in the early postoperative period compared to, for instance, after 6 months, when the patient is resuming normality (8,19,20). Most studies do not provide a uniform timing of measurements and most importantly provide no information regarding the pain status of patients at the time of the measurements (19,20). Additionally, no other post-operative recovery data have been recorded/reported at the time of the performed measurements; reduced mobility or the development of postoperative complications along with their overall WHO performance score may impact on their ability to "blow" during the early postoperative spirometry.

Secondly, most studies do not discriminate between thoracotomies and VATS procedures, an omission extremely crucial for understanding the postoperative recovery of patients. It has been well established that VATS is associated with less early postoperative pain and greater discharge independence, among other benefits (11). In regards to PFTs, VATS procedures outperform open procedures (21).

Furthermore, anatomic segmentectomies are mingled in with wedge resections and all are regarded as "sublobar" or "limited" resections in many publications. These two types of resections are distinctly different, both in technical and oncological features (7,10). Additionally, the amount of parenchyma removed per case may vary. For example, the amount of lung removed during a small wedge resection is obviously of significant difference when compared to a left apical trisegmentectomy. However, a "generous" wedge could be similar to a superior segmentectomy or even similar to a middle lobectomy in terms of lung parenchyma removed! When studies report wedge resections, further details as to the extent of the actual parenchyma removed are usually not provided.

The site of the part of lung removal is another important factor, in our opinion, affecting the postoperative pulmonary function. This is supported with the fact that lung volume loss has been shown to be different between the various sites of lobectomies; for example upper right lobectomies lead to more volume loss than the lower ones, despite the fact that the upper right lobe is smaller than the ipsilateral lower one (22). Only recently has this factor started to undergo investigation, showing conflicting results regarding the preservation of FEV1 and DLCO after upper right or middle lobectomy in VATS procedures when considering the expected volume loss (16,23,24). This discrepancy has brought about the conception of post-removal compensatory hyperinflation of the remaining lung parenchyma (16,23), which, however, proves difficult to be quantified.

Furthermore, most of the patients suffer from different grades of chronic obstructive pulmonary disease (COPD), are active or ex-smokers and therefore an element of emphysema always exists; however, the total lung capacity (TLC) or residual volume (RV) is not reported. It is different when dealing with patients with low FEV1 and FVC, due to COPD compared to dealing with patients presenting with apical predominant emphysema with a high TLC and RV, who would benefit from a larger parenchymal resection (lobectomy) mimicking a LVRS (7,25,26).

Most importantly, the criteria by which a segmentectomy or wedge resection is offered instead of a lobectomy are varied with several studies not even reporting a reason (9). A "limited" resection has traditionally been offered to poor cardiorespiratory candidates who it is felt would not withstand a lobectomy. But it is often not clear "who" has been deemed a poor candidate for a lobectomy and on what grounds. Different co-morbidities may characterize a patient as "high risk" for morbidity. Additionally, cardiopulmonary limits and "cut-off points" are being challenged as VATS techniques are constituting the majority of our practice and as our experience in performing complicated procedures through VATS approaches is solidifying and increasing (27,28). On the other hand, "high-risk" patients are logically accompanied with a higher probability for morbidity and therefore the postoperative respiratory recovery will be different in these patients. It is evident that who is suffering from what and to what extend does play a key role in identifying the "limited" resection offering criteria and consequently the postoperative respiratory behaviour.

Finally, how efficient are the calculated preoperative predicted FEV1 or DLCO (ppoFEV1, ppoDLCO) in providing an estimate of respiratory morbidity and long-term respiratory benefit? The answer to the first part of the question is depicted in the information that "the actual FEV1 measured immediately postoperatively" is possibly more accurate than ppoFEV1 (29) and "unknown" is the answer to the second part of the question, since no definite studies regarding the quality of life after segmentectomy versus lobectomy have been published.

Can we "speak the same language"?

In order to obtain a more accurate pulmonary function measurement, perfusion (Q) imaging, dynamic perfusion

magnetic resonance imaging (MRI) and quantitative CT scans have previously been used in order to stratify patients, in terms of operability, in an effort not to exclude patients from the best treatment available because of an exaggerated low pulmonary function calculated with the traditional ppo FEV1 and/or ppoDLCO (30,31). An effort to bring this technology to the debate of lobar versus "limited" resection was made by Nomori and associates, who used lung perfusion single-photon emission computed tomography (SPECT) to prove the parenchymal preservation benefit with less parenchyma removed (32). In this study, the smaller the number of segments resected, the better preserved the lung parenchyma, with the exception of an upper left division segmentectomy, which was found to have the same postoperative lung function with an upper left lobectomy. This article might just represent the first objective attempt in depicting the lung parenchymal differences according to number of segments resected apart from PFTs. However, a few drawbacks that could potentially diminish the end-result characterize this article: (I) no VATS cases were included and only lateral thoracotomy incisions were taken into account; (II) no data regarding the emphysematous status of the preoperative lungs was provided; (III) the follow up PFTs were performed variably before 6 months and within a range of 6–13 months after the first measurement; (IV) no specific data on how much parenchyma is preserved after other specific types of resections i.e., basal segmentectomies, right middle lobectomies etc. were provided and (V) bigger tumours were resected in the upper left division and upper left lobectomy cases, which means that more parenchyma was involved by the tumor preoperatively.

Based on this study however, it becomes apparent that we can apply technology to lift the bias of the variation of data resulting from simple spirometric measurements.

After all: do we really need to "speak the same language"?

All the above suggest that most probably there may be a respiratory benefit of some of the "limited" resections over the traditional lobectomies. However, we need to somehow coordinate and objectively measure that benefit, in order to prove that it constitutes a fact and not a random statistical finding! The aforementioned is of utmost significance, especially for the respiratory compromised "high-risk" patients who would otherwise be deemed inoperable.

Nevertheless, the fact that we "can do it" or that we are "skillful" enough as surgeons to do a very limited and complicated key hole operation, even if it is oncologically similar to the old fashioned lobectomy, does not mean that we will do so, unless the benefit from such an operation will be passed onto the patients' recovery! How much deterioration in FEV1/DLCO corresponds to clinical deterioration and impact? Did the operated patients stop smoking? Did they complete a rehabilitation program? What was their postoperative quality of life even after a "limited" resection? Achieving to avoid a pulmonary function deterioration of i.e., 20%, by performing a "limited" resection, does not contribute to a better quality of life for a patient who smokes and presents with respiratory infections every 2 months or whose exercise tolerance is limited by peripheral vascular disease or rheumatoid arthritis, for instance. On the contrary, in some cases it would be preferable to proceed with an open, "quicker" lobectomy than persevering with a VATS lengthy segmentectomy, of course depending on the surgeon's experience.

Therefore, all the above confusing and conflicting terms and conditions in thoracic surgery ought to be addressed, resolved and clarified, in order to allow us to compare apples with apples and oranges with oranges, and ultimately to support recommendations to patients and the evolution of surgeons based on best evidence practice.

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Footnote

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