

Peer Review File

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Reviewer A Comments:

The authors describe their approach to left and right upper lobe anatomic segmental lung resection. The paper is well-written.

General comments:

1. Since this is a manuscript that aims to describe the surgical techniques of anatomic segmentectomy, perhaps less emphasis should be given to the background commentary.

Reply 1: While we agree that the focus of the paper is on surgical technique, we feel that a more detailed background with references may help convince surgeons who are doing few or no robotic segmentectomy that it is a technically and oncologically safe alternative to a larger resection. The data we provide gives a reader additional references to evaluate the literature on their own.

2. The preoperative evaluation and considerations section needs more detail. Specifically, I would like to see much more emphasis on preoperative assessment of segmental anatomy based on CT imaging. The use of hi-res contrast CT imaging (possibly 3D modeling) and careful inspection of the CT preop to define the involved segment, vascular anatomy and anticipated margin (2cm) should be emphasized. This is the key to being able to perform segmental resections, especially complex segmentectomy). Discussion should include possibility of having to resect 2 adjacent segments if adequate margin cannot be achieved.

Reply 2: We have added several sentences to the preoperative planning section to emphasize the importance of reviewing preoperative imaging, particularly the CT scan for defining the anticipate margins, as well as anticipating the surgical anatomy.

Changes in text: (lines 108-117) “A key aspect of surgical planning and choosing between segmentectomy and a larger resection is a preoperative computed tomography (CT) scan. We use a high-resolution, intravenous contrast-enhanced chest CT scan when evaluating a lesion for resection. Three-dimensional CT reconstruction is also useful when available. We specifically identify the segment containing the lesion, and measure the anticipated margins (2cm). If the lesion is less than 2cm from the border of the segment, we then discuss taking the neighboring segment versus the lobe if it would be tolerated. In addition to assessing the margins, we review the vascular and bronchus anatomy of the segment planned for resection, specifically looking for variant anatomy. Reviewing the preoperative CT scan for these details is imperative for surgical planning.”

3. A section should describe in more detail the options to define the intersegmental plane. These could include use of near infrared imaging (describe specific details, timing of injection, dose, marking border etc.), selective jet ventilation with IO bronchoscopy, inflation/deflation techniques, etc.

Reply 3: We have a short segment on identifying the intersegmental plan. The details of ICG use have been added.

Changes in text: Intraoperative bronchoscopy with selective jet ventilation is also an option to identify the intersegmental planes. Our preference is to utilize the near-infrared technology offered on the DaVinci robot (Firely™) and infuse 5 mg indocyanine green (ICG) intravenously to identify the borders between the ischemic segment (after pulmonary artery division), and the perfused remaining segments (Figure 3).

4. Port placement- only a single 12mm port is usually needed regardless of the segment resected. I have no problem with use of two 12 mm ports, just wouldn't imply that it is a needed, just a surgeon preference. Would describe use of CO2 insufflation in more detail (pressures, device choice e.g., Airseal).

Reply 4: We added that is our preference to use two 12mm ports for anterior segments and why. We also added our use of insufflation.

Changes in text: A second 12mm stapler port is placed as medial as possible to the camera port, at the cardiophrenic recess near the sternum. For most upper lobe segments, we it is our preference to use two 12mm staple ports, as described above. it allows for easier access to the vessels and bronchus having two angles to fire the stapler. However, for it is also acceptable to use a single 12mm port and three 8mm ports for all upper lobe segmentectomy.

5. Lymphadenectomy – the N2 dissection is well described but I did not see mention of resection of the hilar (10) nodes. This should be performed during the initial node dissection. Please comment on the utility of intraoperative frozen section to ensure absence of nodal mets (especially N1 stations) for NSCLC cases. May not matter with metastasectomy cases.

Reply 5: We discuss when we resect the hilar nodes. We mention sending the 10 node routinely for frozen section and proceeding with a lobectomy if positive.

Changes in text: (line 165) At this point, we also sample the station 10 nodes and send them for frozen section. If they are positive for malignancy, a lobectomy is performed.

6. For each segmental resection described I would suggest referring to the segment also in terms of its numerical assignment e.g. “Right upper lobe (RUL) apical (RS1) segmentectomy”.

Reply 6: This has been added to the individual descriptions of each segmentectomy.

7. The manuscript would benefit from some description of the common bronchial and arterial anatomic variations. This can best be incorporated into each of the segmentectomy sub sections.

Reply 7: We have added common variations to watch out for in several individual descriptions.

Specific comments:

1. RS1: It can be useful to retract the lung anteriorly also to reveal the posterior aspect of B1. Also, I would include mention of the possibility of a recurrent A2 branch that needs to be preserved if it is present.

Changes in text: (line 188) Before dividing the segmental artery, ensure there is no recurrent A2 branch, which should be preserved.

2. RS2: Again, mention possible recurrent A2 branch that needs division. For S2 resection the posterior oblique fissure typically needs to be divided before division of the vessels and bronchus. Ideally, the intersegmental veins should be preserved.

Changes in text: (line 201) If there is poor exposure of the vessels and bronchus at this point, the posterior oblique fissure may need to be divided before proceeding. The posterior segmental artery is then dissected free and stapled, but again, watch for a recurrent A2 branch, which should be preserved if present.

3. RS3: Horizontal fissure always needs to be completed, usually prior to bronchovascular dissection. Would add the frequent occurrence (52%, Nomori) of a separate arterial branch from the truncus intermedius.

Changes in text: (line 214) horizontal fissure.

4. LS1+2+3: Would describe the existence of a separate posterior branch (A1+2 c or A1+2 b+c) in 85% of cases (Nomori). Did not see description of LS1+2 segmentectomy or LS3 segmentectomies but, admittedly, these are rare.

Changes in text: (line 231) The artery to the trisegment is then dissected free and divided, taking care to identify a separate posterior branch (A1+2 c or A1+2 b+c), which occurs frequently.

5. LS4+5: Should describe existence of A4+5 from posterior trunk or main PA, rather than from interlobar PA, in 30% cases (Nomori).

Changes in text: (line 241) . In a minority of cases, there is an A4+5 branch arising from the posterior trunk or main PA. Division of the arterial branches.

Reviewer B Comments:

This is an excellent review of upper lobe segmentectomy, however, the following comments/recommendations need to be revised:

1. In line 110, they discuss a 4cm incision - I assume this is a typo, but if not, it needs clarification.

Reply 1: This was a typo. It should read “1cm incision”.

Changes in text: (line 137) We first place the 8mm camera port in eighth intercostal space via a 41 cm incision in the posterior axillary line.

2. In transitioning between the paragraph on RUL apical segment to the paragraph on RUL posterior segment they should explicitly state that the approach for the posterior segment starts from a posterior hilar view as opposed to what they described in the prior paragraph.

Reply 2: Clarification has been added to the first line of the RS2 section.

Changes in text: (line 197) We begin by retracting the lung anteriorly, beginning with a posterior view of the hilum.

3. It would be useful to the reader for more information on the specific protocol for ICG (i.e., dilution, dose, timing, etc.).

Reply 3: ICG details have been added.

4. Figure 4 is the only image showing the technical component of the operation. It would improve the manuscript to include additional images (or video if possible) showing the described key technical steps of the operations.

Reply 4: Video has been submitted and should be included with the final publication.

Reviewer C Comments:

The perioperative management gives a clear idea. The introduction of the operative technique shows rather a standardized approach for all. This is appreciated in modern surgery notably when it comes to teaching junior surgeons and residents. However, I'd like to make the following minor remarks:

1. Lines 84-91: When it comes to imaging techniques, the only thing I can read is a PET scan. There is no mentioning of contrast-enhanced CT scan. Without this, I don't see how the surgeon can define the vascular anatomy of the patient. This also leads me to a very important point, what about 3D reconstructions? Do you use them in your center? If so, for all segments, or only complex ones? As part of the preoperative planning, I don't know how one can evaluate the resections margins (2cm), the exact position of the lesion from inter intersegmental plane, calculate the volume of the remaining segment(s) to see if it's all worth it (For e.g, right S1-2 leaving a small S3). Can you elaborate please?

Reply 1: We have elaborated on the use of contrast-enhanced CT scan with 3D reconstruction in patient selection and preoperative planning.

2. Line 88 (Mediastinal staging in most patients). Are we talking about patients with GGOs too?

Reply 2: We have added "with solid lesions" to clarify those who need mediastinal staging.

Changes in text: (line 102) Positron emission tomography-computed tomography, mediastinal staging in most patients with solid lesions.

3. Line 108 (bed is flexed). Does the anesthetist check the intubation tube once this is done? From our personal experience, this is one of the moments where the tube can move a bit outside the main bronchus rendering lung deflation difficult.

Reply 3: Yes, it is standard for us to confirm positioning of the single lumen endotracheal tube. We mention this in the first paragraph of the surgical technique section (line 128).

4. Line 101 Surgical technique: Could you please present your department's current experience? When did you start your robotic program? How many RATS per year? RATS segmentectomies more precisely. Do all surgeons use the technique you describe when it comes to patients' positioning, trocars placement...etc.

Reply 4: Respectfully, we would rather leave out our specific volume as this is not typical for this type of article.

5. Lines 109-110 We first place the 8mm camera port in eighth intercostal space via a 4cm incision in the posterior axillary line for upper lobe operations. I don't understand why to place an 8mm port via a 4cm incision. Is it 4 cm away from an anatomic landmark?

Reply 5: This is a mistake in the text, this has been changed to 1cm.

6. In figure 1, I clearly notice a CO2 insufflation tube, however this is not mentioned in our text. Can you please comment about this aspect? notably in regards to the pressure you use in mmHg?

Reply 6: This was pointed out by another reviewer, we have added that we insufflate to 8 mmHg.

7. In the same figure, we don't see how the upper limbs are positioned? Could you describe that please? I also that the conversion thoracotomy site in case of troubles should be described. Posterolateral? Lateral?

Reply 7: Added a final line to the surgical technique section to specify conversion to a posterolateral thoracotomy in the event of major vascular injury.

Changes in text: (line 133) Both arms are placed out in front of the patient, flexed at the shoulder to 90 degrees and resting on padded arm boards. The upper arm should be on an elevated arm board.

8. As a general note, it would be highly appreciated to integrate the segments numbers as well using those to define arterial, venous and bronchial branches.

Reply 8: We have added the segment numbers to the individual operative technique sections.

9. Lines 150-153, Why would you send the station 11 between the pulmonary artery and the main bronchus, rather than the sump lymph node?

Reply 9: We do the send the sump node. We also sample the station 10 node.

10. When it comes to anatomical variations, notably in your description of the left upper lobe segmentectomies, I do believe that you should include the most dangerous ones to consider, as for e.g., a pre-bronchial lingular artery as this could be the source of technical difficulties and possibly incidents during dissection.

Reply 10: We have added a comment on variant anatomy, particularly with the LUL. We do mention the lingular branches as potential sources of bleeding.

Changes in text: (line 235) These branches are commonly pre-bronchial and can be a potential source of bleeding if not preserved during the dissection.

11. In the case of left upper segmentectomies, I notice that left S1-S2 segmentectomy is missing. Can you elaborate?

Reply 11: This has been added to the text.

12. Last but not the least, I highly suggest to include small, short operative videos if available to show different stages of your dissection approach.

Reply 12: A video has been provided to the publisher and should be available with the final publication.

Reviewer D Comments:

Thank you to the authors for submitting a well written manuscript describing their approach to upper lobe segmentectomy using the robot. I enjoyed reading this. I have the following comments:

1. I understand that they are supporting the role of the robot VATS. In their manuscript they emphasize the retrospective study by Coyan demonstrating a reduction in total cost compared to VATS. However, this study is an outlier, in that most other studies have suggested that the robot is more expensive. Additionally, they should mention the recent randomized study by Hecheng Li et al, published in the *Annals of Surgery* (RVLob trial) which reported higher costs in the robotic arm.

Reply 1: We have clarified that some centers have shown reduced costs with mature robotic programs, but this is not the rule. We have also added a comment regarding the findings in the RVLob trial.

Changes in text: (line 82) While some centers have reduced cost with the robotic approach,²³ this is not the rule as demonstrated in the RVLob trial which reported higher costs associated with robotic lobectomy compared to VATS.

2. Line 110, as pointed out by the other reviewers, I believe the comment about the 4 cm incision for the camera is a typo- can the authors clarify?

Reply 2: Thank you, this was a typo and has been corrected.

3. Line 130- do you mean right sided upper lobe resections, and are you referring to the space between the truncus artery and bronchus in the supra-hilar area?

Reply 3: Yes, this is the suprahilar area.

Changes in text: (line 164) For upper lobe segments, we then perform a suprahilar dissection to clear off the pulmonary artery (PA). At this point, we also sample the station 10 nodes and send them for frozen section. If they are positive for malignancy, a lobectomy is performed.

4. Please use the segment numbers as well as the location.

Reply 4: This has been changed in the text.

5. Regarding defining the intersegmental plane, can you clarify do you use both the lung insufflation technique as well as well as ICG infusion at the same time, or select one of these approaches. Please provide more detail for each-for instance what is “gentle insufflation” and how much ICG do you inject?

Reply 5: We have clarified our use of ICG (dosage and timing) as well as our pressure for insufflation as requested by other reviewers.

6. On the left side, do the authors perform any upper lobe segments other than lingulectomy or tri-segmentectomy? If so, could you provide some operative details on these segments?

Reply 6: Although more rare, we have added S1+S2 and S3 to the left procedures.