

# Robotic-assisted resection of intralobar and extralobar pulmonary sequestration



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Disclosures: The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication April 4, 2022; revisions received Sept 28, 2022; accepted for publication Oct 3, 2022; available ahead of print Oct 5, 2022.

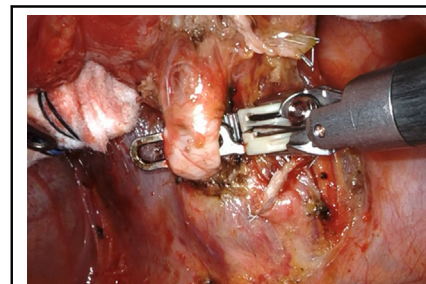
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JTCVS Techniques 2022;16:160-2

2666-2507

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<https://doi.org/10.1016/j.jtc.2022.10.001>



Isolation of one of aberrant arteries for intralobar sequestration arising from descending aorta.

## CENTRAL MESSAGE

Robotic resection of pulmonary sequestration, both intralobar or extralobar, is a feasible and safe less-invasive surgical procedure reducing the risk of intraoperative complications.

Video clip is available online.

Pulmonary sequestration (PS) is a rare pulmonary anomaly characterized by the presence of a nonfunctional pulmonary tissue and supplied by aberrant vessel(s) arising from the systemic circulation. There are 2 types of PS, depending on whether the presence of pleural covering: intralobar PS (75% of sequestrations), located within normal pulmonary parenchyma without pleural covering, and extralobar PS (25% of sequestrations), separated from the normal lung with its own pleura covering. Despite being a benign lesion, the associated complications, which include recurrent sepsis and hemoptysis, can be serious.

Surgical resection is the treatment of choice for any type of PS. In the past, thoracotomy was the main surgical approach; nowadays, less-invasive techniques are widely accepted as a valid surgical option proving to be safe, feasible, and effective; nevertheless, few reports described the use of robotic approach for PS.<sup>1-5</sup> We report 2 cases of robotic-assisted resection of PS, intralobar and extralobar, respectively, the latter being the first report with this approach.

## CASE REPORT

An institutional review board exemption was obtained for this retrospective review and the patients provided informed consent.

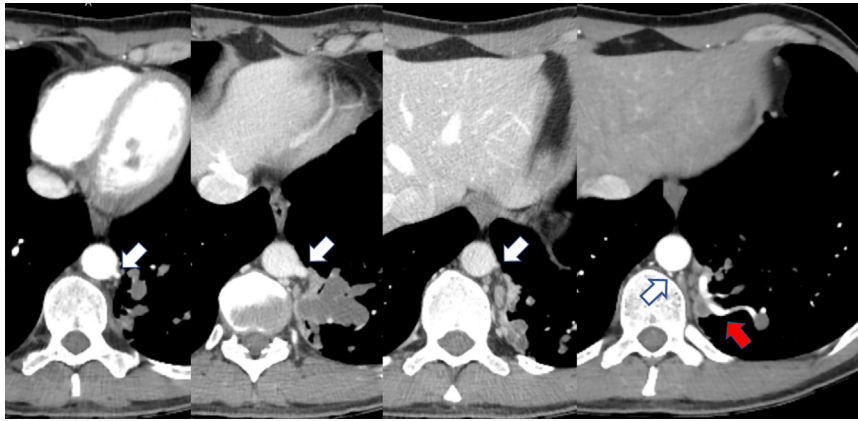
### Patient 1

A 38-year-old male patient was diagnosed with a left lower-lobe (LLL) intralobar sequestration on computed tomography (CT) of the chest performed for hemoptysis. A contrast-enhanced CT scan confirmed PS measuring 46 mm and identified 4 aberrant arteries arising from the descending aorta (Figure 1).

The surgical procedure (Video 1) was a 4-arm approach by the Xi DaVinci (Intuitive Surgical). Pleural adhesions were liberated and pulmonary ligament was divided. A total of 5 anomalous arteries were isolated: 4 were transected using an EndoWrist stapler (Intuitive Surgical), and one was transected after applications of Hem-o-lok (Teleflex). A segmental resection was performed and the resected sample was extracted with the use of an Endo Bag (Medtronic). Operative time was 110 minutes. The patient was discharged the third postoperative day without complications. Histology confirmed intralobar sequestration. The patient was well at the 14-month follow-up evaluation.

### Patient 2

A 41-year-old male patient was diagnosed with an intrathoracic triangular mass incidentally discovered on a check-up CT of the chest. A contrast-enhanced CT scan diagnosed an extralobar PS (70 mm) with a dense central core (38 mm)



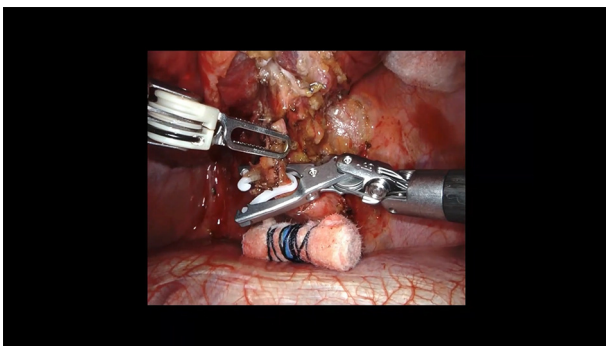
**FIGURE 1.** Contrast-enhanced computed tomography scans of the chest showing intralobar sequestration with 4 different feeding vessels (white arrows in the first 3 parts). The fourth part shows the small fourth small feeding vessel (blue arrow) and the main feeding vessel (red arrow).

and identified a small aberrant artery arising from the intrabdominal aorta (Figure 2, A).

Our surgical approach (Video 2) was similar to the previous one. Extralobar lesion appeared as a pedunculated lumpy mass covered on the surface by a dense vascular network (Figure 2, B) with a soft pedicle and dense adhesions (Figure 2, C). The pedicle was isolated, transected by an EndoWrist stapler and lesion was removed. Operative time was 50 minutes. The patient was discharged the second postoperative day without complications. Histology confirmed extralobar sequestration. Patient is well at 8-month follow-up evaluation.

## DISCUSSION

Surgery is the treatment of choice for PS and consists of surgical resection of the affected segments, after control of the systemic aberrant vessels which should be carefully isolated, sutured, and resected. Thus, their preoperative identification with contrast-enhanced CT scan is crucial improving safety in surgical resection, notably in less-invasive approaches.

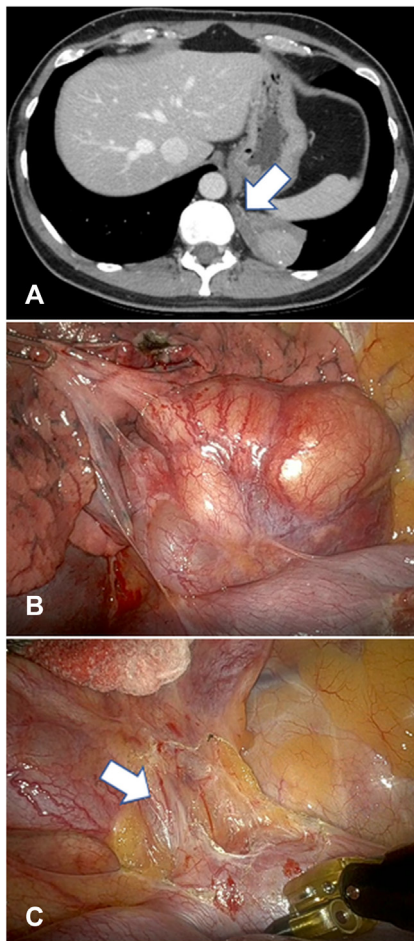


**VIDEO 1.** Intrapulmonary sequestration. Video available at: [https://www.jtcvs.org/article/S2666-2507\(22\)00522-3/fulltext](https://www.jtcvs.org/article/S2666-2507(22)00522-3/fulltext).

As regards to surgical approach, traditional thoracotomy was successfully replaced by thoracoscopic approach, which has, however, some drawbacks, mainly the difficult management of anomalous vessels in case of disastrous bleeding; in fact, during the thoracoscopic approach, in case of accidental injury of an aberrant artery, it appears more difficult to manage the hemorrhage due to the vessel retraction below the diaphragm. Recently, the robotic approach has been applied for treatment of PS, but only a few cases have been reported.<sup>1-5</sup> The benefit of the robotic over the thoracoscopic approach is the belief that vascular injury of the feeding vessels is less likely by virtue of its 3-dimensional visualization, the greater dexterity, and the more precise dissection of sequestered tissue in the face of chronic inflammatory adhesions. The chronic inflammatory changes and secondary adhesions seen in adults with both intralobar or extralobar sequestration is usually the main factor prohibiting the completion of a resection thoracoscopically and necessitating conversion to open surgery. Thus, in expert hands, the robotic technology is likely to result in less bleeding complications and less conversions to open surgery.

To date, a total of 8 cases of robotic resection of PS (all with intralobar sequestrations) have been reported (4 male: median age, 30.5 years; range, 20-62 years).<sup>1-5</sup> Of these, 5 were located in LLL,<sup>2,4</sup> 2 in right lower lobe,<sup>1,3</sup> and one was a horseshoe PS.<sup>5</sup> Vessel resection was performed by ligation or stapling. Median operating time was 205 minutes (range, 100-235 minutes), median hospital stay was 3 days (range, 3-7 days).

Since 2005, we performed a total of 12 resection for PS. There were 6 men, median age 34 years (range, 22-65 years); 9 were in the LLL, one in the right lower lobe, and one had bilateral lower lobe PS. All, except 2, were intralobar PS. A wedge resection was performed in 6, lobec-



**FIGURE 2.** A, Contrast-enhanced computed tomography scans of the chest showing extralobar sequestration with a dense central core and a small aberrant artery (*arrows*) arising from intrabdominal aorta. B, Intraoperative view of extrapulmonary sequestration having a soft pedicle (C) with small vessels (*arrows*).

tomy in 4, and resection of extralobar PS in 2. Thoracotomy was performed in 6 cases, video-assisted thoracoscopic surgery in 4, and robotic in 2. We were the first to report an ex-



**VIDEO 2.** Extrapulmonary sequestration. Video available at: [https://www.jtcvs.org/article/S2666-2507\(22\)00522-3/fulltext](https://www.jtcvs.org/article/S2666-2507(22)00522-3/fulltext).

tralobar PS with the robotic approach and the use of EndoWrist.

### CONCLUSIONS

Our experience suggests that robotic technology, thanks to the improved instrument dexterity, proper eye–hand coordination, ergonomic position, and fine human tremor filtering, allows a safer and more precise dissection of lobes and/or sequestered tissue and their feeding vessels than other approaches (video-assisted thoracoscopic surgery and thoracotomy), resulting in less intraoperative complications (bleeding) and less conversion to open surgery.

### References

1. Al-Mufarrej F, Margolis M, Tempesta B, Gharagozloo F. Robot-assisted thoracoscopic resection of intralobar sequestration. *J Laparoendosc Adv Surg Tech.* 2009; 19:389-91.
2. Melfi FM, Viti A, Davini F, Mussi A. Robot-assisted resection of pulmonary sequestrations. *Eur J Cardiothorac Surg.* 2011;40:1025-6.
3. Gulkarov I, Ciaburri D, Tortolani A, Lazzaro R. Robotic-thoracoscopic resection of intralobar sequestration. *J Robot Surg.* 2012;6:355-7.
4. Konecna J, Karenovics W, Triponez F. Robot-assisted segmental resection for intralobar pulmonary sequestration. *Int J Surg Case Rep.* 2016;22:83-5.
5. Dagono C, Sarsam M, Brun AL, Longchamp E, Sage E, Chapelier A, et al. A horseshoe intralobar lung sequestration resection by bilateral robot-assisted surgery. *Ann Thorac Surg.* 2022;113:e95-7.