



Abruzzini procedure for the treatment of bronchopleural fistulas: surgical technique description using intraoperative recording

Paulo Henrique Peitl Gregório, Isabele Alves Chirichela, Patrício Javier Ulloa, Alessandro Wasum Mariani, Paulo Manuel Pêgo-Fernandes

Instituto do Coracao, Hospital das Clinicas da Faculdade de Medicina, Universidade de São Paulo, São Paulo, Brazil

Correspondence to: Paulo Henrique Peitl Gregório. Instituto do Coracao, Hospital das Clinicas da Faculdade de Medicina, Universidade de São Paulo, Av. Dr. Enéas de Carvalho Aguiar, 44. Cerqueira César, CEP 05403-000, São Paulo, Brazil. Email: phpgregorio@gmail.com.

Abstract: Despite all improvements in thoracic surgery over the last decades, chronic bronchopleural fistulas still pose a challenging disease to treat. The Abruzzini technique is often considered one of the last viable options to manage this undesirable complication. Unfortunately, surgical trainees are not regularly exposed to this procedure during their training since it is not routinely performed. Moreover, available educational resources are particularly restricted to text descriptions or illustrations. Those factors lead to insufficient training of this technique, which is fundamental to the thoracic surgery practice. In this article, we present a step-by-step description of the Abruzzini technique using an intraoperative video recorded with a rigid endoscope. This device allows improved teaching and guidance for every trainee in the operating room and grants further review for educational purposes after the surgery. The media used in the present description was collected from a surgery performed to treat a large right bronchopleural fistula, which was a result of a lung resection secondary to aspergilloma. In this case, an approach through the pleural cavity would not be feasible due to several previous surgeries, so a transsternal approach was planned. The bronchus was successfully closed and the patient did not present any signs of recurrence, with over 1 year of follow-up.

Keywords: Abruzzini procedure; bronchopleural fistula; pneumonectomy

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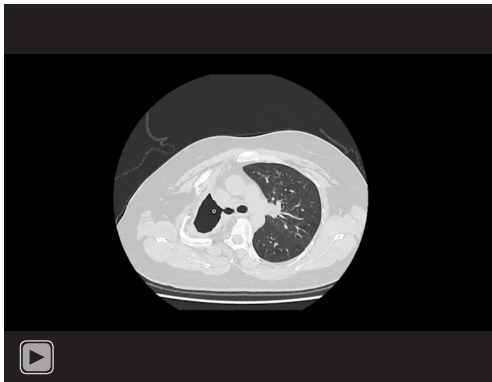
Introduction

In 1961, Abruzzini *et al.* described a transsternal transpericardial approach to treat bronchopleural fistulas after pneumonectomies (1). Several centers reported small case series with their experience and even some modifications to the original technique (2). One of the first substantial changes was the employment of stapling devices to close the open bronchial stump by Baldwin *et al.* (3). In the 90s, Spaggiari *et al.* reported a modification combining cervical video-mediastinoscopy, right anterior parasternal mediastinotomy, and left parasternal thoracoscopic access (4). Nowadays, Abruzzini procedure is not commonly done due to an ongoing decrease on the number of pneumonectomies performed. Unfortunately, infectious diseases such as

tuberculosis are still a source of lung sequelae that may require extensive interventions, especially in emerging countries (5).

The main indication for this technique is recurrent bronchopleural fistula in a chronic infected pleural cavity, for which other less invasive techniques of closure have already been tried or are not feasible (2). Patients that can tolerate general anesthesia and a major surgery are eligible for this procedure since there are no absolute contraindications. The transsternal approach has the advantage of accessing the bronchial stump through uninfected tissues and without chronic inflammation.

Teaching this technique to surgical residents is challenging since it is not commonly performed, and the available educational material is usually restricted to text



Video 1 Preoperative planning.

descriptions and illustrations. In addition, the manipulated area during the surgery is small and deep, making it challenging for everyone in the operating room to get familiarized with the maneuvers of the procedure. This scenario impairs the opportunity of learning for surgeons in training and may hinder patient's safety.

The use of a 10 mm/30° rigid endoscope during the surgery allows further review of the surgery and a learning opportunity for everyone in the operating room. In this article, we present a step-by-step video of the Abruzzini technique recorded with this device.

Surgical technique

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). The use of medical records and videos in this article were approved by the local institutional review board of Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (Approval Number: 63771822.5.0000.0068) and a written informed consent was obtained from the patient. A copy of the written consent is available for review by the editorial office of this journal.

Patient summary

In May 2011, a 26-year-old woman was admitted to the intensive care unit (ICU) due to hemoptysis, which was caused by invasive pulmonary aspergillosis. After the initial treatment, an aspergilloma developed in the right superior lobe which was treated with lobectomy in February 2012.

As a result of complications of this procedure, the patient was submitted to a completion right pneumonectomy and thoracostomy in March and April 2012, respectively.

In the following years, it was confirmed by bronchoscopy and computed tomography (CT) scan that there was no bronchopleural fistula, therefore two procedures were done to treat the open thoracostomy. First, it was widened to allow proper irrigation of the cavity. After ensuring proper cleaning in the following months, 4 ribs were resected, and a muscle flap was harvested to perform a thoracoplasty. Unfortunately, the infection recurred and the thoracostomy had to be reopened in 2016. Then the patient decided that she did not want to be submitted to further interventions. Anticipating that the thoracostomy would spontaneously close again, a small-bore chest tube was left in the pleural cavity to guide the drainage of the secretions. During the following years, the patient did not attend to regular consultations and the open thoracostomy gradually closed around the chest tube as seen in *Video 1*.

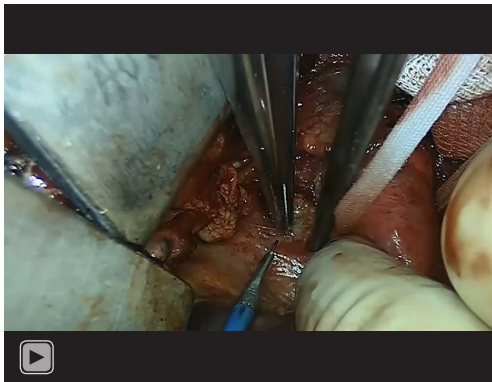
In May 2021, she presented in the outpatient clinic with significant dyspnea on exertion. A bronchoscopy was performed and showed that a large bronchopleural fistula had developed. A transsternal transpericardial approach to close the bronchopleural fistula was done 2 weeks later and the technique is described below.

Preoperative planning (*Video 1*)

Bronchoscopy and chest contrast-enhanced high-resolution CT should be done and reviewed carefully (*Video 1*—preoperative evaluation). Chest CT (00m03s–00m43s) will provide essential information about the fistula such as location, length of the bronchial stump, surrounding structures, etc. Especially after left pneumonectomies, a significant ipsilateral shift of the mediastinum can make the exposure of the retropericardial structures troublesome, and thus, the careful tomographic assessment may foresee those difficulties.

Bronchoscopy (00m43s–01m08s) will also provide important information about the bronchial stump, including its length, inflammatory conditions, among others. The usefulness of intraoperative bronchoscopy is described below.

It is recommended that any gross infection of the pleural cavity should be treated before the procedure. In this case, the big size of the fistula did not allow proper instillation of any kind of solution through the cavity, and thus, it was decided to correct the fistula before any debridement or cleaning.



Video 2 Operative steps.

Operative steps (Video 2)

Preparation

The positioning of the staff and room setup should follow the same recommendations as for other thoracic procedures performed through a full sternotomy. Remember to check the position of the monitors which will display the rigid endoscope and bronchoscope image.

A gel pad is placed under the shoulders to dislocate the thorax anteriorly, making it easier to access the tracheobronchial tree.

Intubation is usually done with a long single-lumen endotracheal tube. Its tip must be placed in the healthy bronchus. During the procedure, the endotracheal tube is retracted, and the adequate closure of the bronchial stump may be checked. In addition, the healthy bronchus should be looked for unexpected distortions.

Draping is done as usual for a full median sternotomy.

The anesthesiologist should be instructed to regularly suction the airways to avoid dripping of any secretions to the healthy side. It is also recommended to previously discuss the intubation strategy with anesthesiologists to align on the procedure needs.

Initial steps and mobilization of the great vessels (Video 2—procedure)

Generally, one of the biggest concerns is the great vessels that need to be gently retracted to reach the retropericardial structures. Extreme caution is needed to avoid damage to those structures when manipulating the tracheobronchial tree, especially if a stapler is used.

Standard median-sternotomy is done to access the mediastinum (00m06s–00m20s).

After opening the anterior pericardium remove any

adhesions, which may occur after pneumonectomies due to chronic infectious (00m21s–00m35s).

Mobilization and retraction of the aorta (Ao) and superior vena cava (SVC) must be done to expose the right pulmonary artery (RPA) and posterior pericardium. In this video, the SVC was not dissected because the mediastinum was too shifted to the right side, and so, the need for traction of this vessel was not necessary (00m36s–01m17s).

After tractioning the Ao, the RPA must be dissected and secured properly. It will be located anteriorly to the posterior pericardium and slightly inferior to the position of the carina. The SVC usually must be retracted laterally during this step, but in this case the mediastinum was so shifted that the SVC was already in a lateral position (01m18s–02m05s).

Proceed to the opening of the posterior pericardium with the electrocautery to access the tracheobronchial tree. Gently remove any adhesions close to the carina for better exposure (02m22s–03m04s).

If a right pneumonectomy was done previously, the RPA stump may be shortened to reduce the risk of accidental damage. The ligature can be done using a 2-0 twisted polyester and cotton suture (one ligature to each stump) and adding a transfixing (4-0 polypropylene) ligature to the proximal stump (03m05s–03m15s).

Dissection and closure of the bronchial stump

Blunt dissection of the tissues adjacent to the trachea and a Mixer Forceps may be useful to achieve proper separation of the esophagus and the trachea. During the dissection of the tracheobronchial tree, it is recommended to use an orogastric/nasogastric tube to improve the identification of the esophagus (03m16s–03m55s).

A 3.5 mm width cardiac tape should be introduced around the bronchus stump, so proper mobilization can be done. After that, introduce a small diameter videobronchoscope in the endotracheal tube using a double swivel adapter (03m56s–04m22s).

Simultaneously to the bronchoscopy, the stapling device is introduced in the operative field and placed in position to staple the stump. Sometimes, optimal positioning is tricky, and special attention is required to avoid damaging adjacent structures such as the SVC and the right atrial appendage. The image of the videobronchoscope should be visible to the surgeon, so when the stapler closes around the stump, it is possible to check if the stapling line is not distorting the contralateral (healthy) bronchus or the trachea (04m23s–04m44s).

After checking the correct placement of the device, the stump may be stapled, and its conditions must be checked. A Covidien™ TA-DST 3.0–3.5 mm stapler was used in this video, and thus, the distal stump must be divided from the now-closed bronchus using a scalpel blade number 11. Some authors report the use of an endoscopic stapler for this procedure, and in this scenario the manual split of the proximal and distal stumps is not required (04m45s–05m40s).

Ideally, the residual distal stump should be removed to avoid recurrence of the fistula or complications such as mediastinitis due to communication of the pleural cavity with the mediastinum. In the presented video the residual stump was too adhered to the surrounding tissues, so it was only closed with separate 3-0 polypropylene stitches (05m41s–06m24s).

Irrigation with saline solution over both stumps is done to check for any air leaks (06m25s–06m32s).

A 28-Fr chest tube is placed with its tip positioned close to the manipulated area. Proceed with the closure of the sternotomy as usual (06m33s–06m45s).

Comments

The use of a rigid endoscope during surgeries where the manipulated structures are in such a small space as in the Abruzzini procedure, brings an outstanding opportunity for surgeons in training to better understand the technique. Some centers use headcams for other surgeries with the same purpose, but we believe in small and deep operative fields, such as during this procedure, the long rigid (5 or 10 mm) endoscope is a better option to show what is being manipulated.

The transsternal approach is a safe and reliable technique to close bronchopleural fistulas when other methods have failed. The shortening of the pulmonary artery stump and intraoperative bronchoscopy may be useful to provide a good exposure, and consequently, a better dissection of the bronchial stump. When there is significant mediastinal shift, the manipulation of the large vessels, especially the Ao, must be gentle to avoid accidental injuries.

The removal or closure of the distal (remaining) bronchial stump is crucial to achieve a successful closure of the fistula, with no postoperative infection or recurrence. If the bronchial stump cannot be removed, it should be closed, and the patient should be carefully monitored for mediastinal infections. Obliteration of the mucosa of the remaining stump using cauterization/electrocoagulation has been reported by some authors to avoid mucous production (2).

Antibiotics may be used in this scenario, but there is not enough evidence proving any benefit.

After the closure of the fistula, the remaining pleural cavity should be treated with thoracoplasty or other techniques with the same purpose. For this patient, a thoracostomy was reopened on the site of the small-bore chest tube 1 week after the Abruzzini procedure and debridement was performed. For 2 weeks, daily irrigation with saline solution was done and then it was closed after filling the pleural cavity with antibiotic solution.

The follow-up of such patients must be rigorous. Endoscopic evaluation between 1 and 2 months after the procedure to check the conditions of the bronchial stump is advised. Regular appointments should be planned in the first year to inquire about symptoms that may indicate the recurrence of the fistula. The fulfillment of those two criteria suggests a successful repair. The patient of the presented case has been followed for 15 months and has not shown any sign of recurrence.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://jovs.amegroups.com/article/view/10.21037/jovs-22-27/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). The use of medical records and videos in this article were approved by the local institutional review board of Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (Approval Number: 63771822.5.0000.0068) and a written informed consent was obtained from the patient. A copy of the written consent is available for review by the editorial office of this journal.

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References

1. Abruzzini P. Trattamento delle fistole del bronco

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- principale dopo pneumonectomia per tubercolosis (tecnica personale). *Chirurgia* 1961;3:165-71.
2. Ginsberg RJ, Saborio DV. Management of the recalcitrant postpneumonectomy bronchopleural fistula: the transsternal transpericardial approach. *Semin Thorac Cardiovasc Surg* 2001;13:20-6.
3. Baldwin JC, Mark JB. Treatment of bronchopleural fistula after pneumonectomy. *J Thorac Cardiovasc Surg* 1985;90:813-7.
4. Spaggiari L. Video-assisted Abruzzini technique for bronchopleural fistula repair. A pathology study. *J Cardiovasc Surg (Torino)* 2000;41:957-9.
5. Fogel N. Tuberculosis: a disease without boundaries. *Tuberculosis (Edinb)* 2015;95:527-31.