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ORIGINAL ARTICLE

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The cat-scratch procedure: A new technique for surgical management of primary spontaneous pneumothorax

Davor Stamenovic

Department of Thoracic Surgery, University Thoracic Center Mainz, Johannes Gutenberg University Mainz, Mainz, Germany

Correspondence
Davor Stamenovic, MHBA Department of Thoracic Surgery, Center for Thoracic Diseases, Johannes Gutenberg University Mainz, Langenbeckstraße 1, 55131 Mainz, Germany.
Email: davor.stamenovic@unimedizin-mainz.de

Abstract

Introduction: Surgery is an option as the primary treatment for patients with primary spontaneous pneumothorax. Talc pleurodesis and subtotal parietal pleurectomy have demonstrated virtually equal effectiveness in reducing recurrence but result in significant scarring, hindering further chest access if necessary. This paper introduces a new, less invasive technique for the surgical management of primary spontaneous pneumothorax.

Methods: The procedure can easily be conducted via a uniportal thoracoscopic approach. Following the standard identification of the air leak and subsequent bullectomy, short intermittent incisions are made in the parietal pleura, each following the course of the first, second, and third ribs, respectively. Subsequently, a paravertebral block catheter and a pleural drain are inserted, completing the procedure.

Results: Five patients underwent surgery using this approach. All five were discharged without any post-operative complications and showed no signs of recurrence within 2 weeks following surgery.

Conclusion: This paper presents a new, less invasive, and less extensive form of pleurectomy for primary spontaneous pneumothorax. The primary advantage of this technique is its ability to maintain chest accessibility, especially considering that some patients with pneumothorax may require further lung surgery in the future. In addition, the procedural time is shorter, and it is expected to have a smaller negative impact on respiratory mechanics.

KEYWORDS
Lung surgery, pleurectomy, pneumothorax, surgical technique, uVATS

1 | INTRODUCTION

Primary spontaneous pneumothorax (PSP) is a relatively common condition, with approximately 10 000 cases recorded annually nationwide in Germany according to the German S3 Guideline. Treatment options for the initial episode of pneumothorax are conservative management, needle aspiration, chest tube insertion, and primary surgical intervention.[1]

Traditionally, conservative strategies or chest tube insertion have been practised in Germany for the first episode of PSP. However, even after the first episode, the recurrence risk remains over 30%.[2] The low invasiveness of thoracic surgical treatment, combined with the high recurrence rate of the condition, is increasingly bringing primary surgery to the forefront, even in the first episode.[3]

A recent guideline from the British Thoracic Surgical Society reported that primary surgery for acute pneumothorax treatment has

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comparable hospital stays, a lower recurrence rate, similar complication rates, and comparable mortality to the aforementioned alternatives.[1] This raises the logical question of whether we should increasingly offer thoracoscopic surgical intervention as the primary treatment for PSP, leading to a significant increase in pneumothorax surgeries.

The next unanswered question is what type of operation should be offered for PSP. The classic options for minimally invasive pneumothorax surgery are subtotal parietal pleurectomy, pleural abrasion, and talc pleurodesis. According to current studies, performing bullectomy with or without surgical pleurodesis is effective for treating PSP.[1] While pleural abrasion reportedly shows less success in preventing recurrence than pleurodesis,[4] the exact type of surgical pleurodesis that is most effective for preventing recurrence cannot be determined based on the available evidence. The disadvantage of talc pleurodesis and, even more so, subtotal pleurectomy, is the "finality" of the procedures. After performing talc pleurodesis or subtotal pleurectomy, accessing the thorax again (eg, for a later tumour operation) is very difficult, if not impossible.

This study aims to introduce our new, less invasive technique for minimally invasive surgical treatment of PSP and present the initial results.

2 | METHODS

The operation was performed under general anaesthesia in all five cases. All patients were intubated with a double-lumen tube. Total intravenous anaesthesia was administered. The operation was performed under one-lung ventilation.

An approximately 2-cm skin incision was made at the level of the fifth-sixth intercostal spaces, and after entering the thoracic cavity, a soft tissue protection film was placed. In cases where a chest tube drainage was present, the drainage access was used for the operation (Video S1).

Subsequently, a paravertebral block catheter was placed in the fifth-sixth intercostal space for peri- and post-operative regional anaesthesia.

Intrathoracically, the air leak was initially sought, and if found, it was treated with a stapler device in the form of a wedge resection in all of the patients. If bullous changes were present, they were also resected with a stapler device.

As a recurrence prevention measure, instead of the classic pleurectomy, the cat-scratch pleural incision was performed. Starting at the level of the first rib at the costovertebral joint (lateral to the sympathetic trunk), short intermittent incisions were made along the course of the first rib until shortly before reaching the sternum. The same were then made along the second and third ribs. Finally, an 18-French chest tube was placed through the uniportal access, and the incision was closed in layers. The chest tube was connected to an electronic drainage system. In our department, suction (−15 cm water) is applied to the chest tube for 48 h in patients with pneumothorax, and the drainage is removed when no air leak is present.

All patients were followed up in our outpatient clinic 2 weeks after discharge to exclude early recurrences. They were instructed to immediately seek medical assistance at our facility should their symptoms recur.

All patients were contacted at least 6 months after discharge and before the conception of this manuscript to confirm the absence of pneumothorax recurrence.

A positive ethics vote was obtained from the Ethics Committee of the State Chamber of Physicians of Rhineland-Palatinate (approval number: 2021-15 979) for retrospective analysis. Because of the retrospective nature of the study, written consent was not necessary.

3 | RESULTS

All five patients underwent surgery in 2022. The mean age of the patients was 21.8 (standard deviation [SD] 3.27) years. Three patients underwent surgery during the first episode, and two patients underwent surgery during the second episode. Three patients were initially managed with a chest tube, and two patients were initially managed surgically.

The mean operative duration was 31 (SD 4.6)min. The total hospital stay was 4.8 (SD 0.8) days. In four patients, the chest tube was removed on the second post-operative day, and in one case, it was removed after 3 days. All patients were discharged the following day. No post-operative complications were observed.

All five patients were followed up in our outpatient clinic 2 weeks post-operatively. Chest X-ray imaging showed good lung expansion in all five cases without residual pneumothorax.

No known recurrence occurs within 18 months after surgery.

4 | DISCUSSION

The surgical treatment of PSP has been discussed in several studies. The three known surgical techniques all have advantages and disadvantages.

Subtotal parietal pleurectomy is likely the most radical of the three techniques. An advantage, in our experience, is the low recurrence rate, although we will never be able to prove this in a study due to the very high number of patients required. Disadvantages of the technique are the more complex operation, the need for multiple accesses to allow adequate pleurectomy, the lack of options for regional analgesia procedures, and the inaccessibility of the thorax if the patient requires another operation on the same side in the future. Furthermore, it remains unclear whether the extent of pleurectomy affects respiratory dynamics, as there are currently no studies on this topic.

A less invasive form of subtotal pleurectomy is pleural abrasion. With pleural abrasion, the pleura is roughened with sterile sandpaper, inducing pleurodesis. The advantage of this technique is the short operation time, the possibility of using regional pain management procedures, the feasibility of performing the procedure through single

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access, and the accessibility of the thorax for reoperation. In our experience, the disadvantage, compared with talc pleurodesis and subtotal pleurectomy, is the significantly higher recurrence rate, although this has not been confirmed in any study to date.

The last and probably most widely used technique is talc pleurodesis. With talc pleurodesis, sterile talc is instilled into the pleural space, inducing pleurodesis. Talc pleurodesis is the only aforementioned technique that can be performed without a need for surgery using a chest tube. Furthermore, the operation time for talc pleurodesis is short, and the operation can be performed through a single port. In our opinion, regional anaesthesia is not advisable due to the ubiquitous spread of talc intrapleurally. Moreover, associations between talc pleurodesis and post-operative acute respiratory distress syndrome, pulmonary fibrosis, or malignant diseases have been described in the past, although newer studies refute these associations.[5]

To combine the advantages of the aforementioned techniques and minimise the disadvantages as much as possible, we developed the cat-scratch operation. The idea behind the pleural incisions came from the known fact that after thoracic surgery, the lung is most adherent at the incision site, regardless of whether the surgery is thoracoscopic or open. Assuming that the cause of the majority of pneumothoraces is apical changes, we made the pleural incisions to create subsequent lung adherence at this site. In this case, the operation can be performed through a single port, regional anaesthesia is possible, the operation time is short, and in a need for revision, the thorax is easily accessible. No perioperative or post-operative complications were observed in the first five patients. The effectiveness of the technique and the potential benefits in terms of pain or lung function will be analysed in further prospective studies.

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CONFLICT OF INTEREST STATEMENT

The author has declared no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ORCID

Davor Stamenovic https://orcid.org/0000-0003-3302-3471

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SUPPORTING INFORMATION

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