Capnodissection Pleurectomy – An Innovative Surgical Technique: A Case Report

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Submitted to: Interactive Journal of Medical Research
on: November 12, 2023

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Abstract

Spontaneous pneumothorax (SP) is one of the most common conditions encountered in thoracic surgery. This condition can be treated conservatively or surgically based on indications and guidelines. Traditional surgical management includes pleurodesis (mechanical or chemical) in addition to bullectomy if the bullae can be identified. Mechanical pleurodesis is usually performed by surgical pleurectomy or pleural abrasion.

In this case report, we present a case of a young patient with spontaneous pneumothorax who needed a surgical intervention and we performed a new, innovative, surgical technique for surgical pleurectomy where we used carbon dioxide (CO2) for dissection of the parietal pleura (capnodissection). This technique provided similar efficiency to the traditional procedure but less risk of bleeding and complications.

(JMIR Preprints 12/11/2023:54497)
DOI: https://doi.org/10.2196/preprints.54497

Original Manuscript

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Abstract

Spontaneous pneumothorax (SP) is one of the most common conditions encountered in thoracic surgery. This condition can be treated conservatively or surgically based on indications and guidelines. Traditional surgical management includes pleurodesis (mechanical or chemical) in addition to bullectomy if the bullae can be identified. Mechanical pleurodesis is usually performed by surgical pleurectomy or pleural abrasion.

In this case report, we present a case of a young patient with spontaneous pneumothorax who needed a surgical intervention and we performed a new, innovative, surgical technique for surgical pleurectomy where we used carbon dioxide (CO2) for dissection of the parietal pleura (capnodissection). This technique provided similar efficiency to the traditional procedure but less risk of bleeding and complications.

Keyword: “capnodissection”, “novel technique”, “thoracic surgery”, “surgical innovation”.

Introduction

Spontaneous pneumothorax (SP) is a condition in which pneumothorax occurs without trauma or iatrogenic cause. It can be classified as a primary spontaneous pneumothorax (PSP) where there is no obvious underlying lung disease. The most common cause is usually a small bulla or bleb in the lung [1-2]. Comparatively, secondary spontaneous pneumothorax (SSP) happens due to underlying lung diseases such as chronic obstructive pulmonary disease (COPD) [3]. The new British Thoracic Society (BTS) guidelines advise surgical treatment for spontaneous pneumothorax at initial presentation if recurrence prevention is deemed important (e.g., patients presenting with tension pneumothorax, or those in high-risk occupations). Elective surgery should be considered for patients with a second ipsilateral or first contralateral pneumothorax [4].

The surgical treatment which is recommended by the BTS guidelines for spontaneous pneumothorax is surgical pleurodesis with or without bullectomy [4]. There are two common procedures to perform surgical pleurodesis; the first one is surgical pleurectomy and the second one is pleural abrasion. The surgical pleurectomy is considered more efficient but it can be associated with an increased risk of bleeding and infection [5]. The novel surgical technique that we providing here can give a similar success rate and less risk of complications such as bleeding or infection.

Case Presentation

Our patient was a young male who was previously healthy. He presented with a recurrence of a spontaneous pneumothorax for the first time (two SPs in total). The previous episode was treated conservatively seven months prior and his Computed Tomography (CT) scan on this episode showed that he has small apical bullae. The decision was made to list the patient for elective surgical treatment and after discussion with the patient, he was listed for a pleurectomy and bullectomy.

On the day of the operations, a standard anterior Video Assisted Thorascopic Surgery (VATS) approach was taken. A small incision was made at the 6th intercostal space and another small port site was performed for the camera which was later converted into the drain site (Multimedia Appendix 1). CO2 insufflation at 6-8 mmHg on high flow was used to achieve capnothorax. A small anterior VATS incision was made at the 6^{th} intercostal space and the dissection of the parietal pleura was performed extrapleurally using Roberts forceps in a traditional technique. The forceps were exchanged for a curved metal sucker and the CO2 attached at high flow and used to mobilize the whole parietal pleura from apex to inferior, then posterior to anterior (Multimedia Appendix 2). The posterior parietal pleura was then excised off the ribs using thorascopic scissors 4 cm from the sympathetic chain posteriorly, 2 cm lateral to the internal mammary vein anteriorly, and 2cm cranially to the diaphragm. Lastly, a bullectomy was performed using a manual stapler to excise the presumed culprit apical bullae seen on CT. Blood loss was minimal approximately 50 ml predominantly from VATS entry. Operative time was approximately 40 minutes. The postoperative care was routine and drain was removed after 48 hours. The patient was discharged on the third day post-operatively.

Discussion

The use of carbon dioxide (CO2) in thoracic surgery has increased significantly with the growing use

of a minimally invasive approach. Capnothorax leads to better visualization by collapsing the lung and reduces the rate of complications [6-7]. In our department, we usually use CO2 with robotic and video-assisted thoracoscopic procedures (RATS and VATS, respectively) for these reasons.

The surgical pleurodesis of spontaneous pneumothorax is the recommended treatment in the BTS guidelines because it gives better long-term outcomes with less risk of recurrence in the future [4]. Surgical pleurectomy, in spite of it is efficiency, carries a risk of bleeding, infection, and re-operation [8]. Surgical pleural abrasion is another method that can be used for surgical pleurodesis. Chang et al., published the first systematic review and meta-analysis in which they compared surgical abrasion versus surgical apical pleurectomy. They found that there is no difference in the recurrence but pleural abrasion has a shorter length of stay in hospital, post-operative chest tube duration, operative time, and less surgical blood loss [9]. This may cause clinicians to consider a change of practice from surgical pleurectomy to abrasion. A systematic review of randomized controlled trials found that spontaneous pneumothoraces managed with chest drain alone had recurrence rates of 26.1% to 50.1% whilst after VATS talc pleurodesis this was 0.0% to 3.2%. Alternative chemical pleurodesis can be achieved with tetracycline rather than talc though recurrence rates are reported as 13.0% to 33.3% [10].

Our literature search in did not find any studies in which capnodissection was used for pleurectomy as a treatment of spontaneous pneumothorax. However, Dai, et al. recently published their findings when using CO2 for visceral pleurectomy and decortication in patients with malignant mesothelioma. They found that the positive pressure of CO2 can facilitate dissection of the visceral pleura making the procedure easier whilst achieving an acceptable post-operative air leak and chest drain output. They concluded that capnodissection can be used in pleurectomy and decortication for patients with mesothelioma [11]. It should be taken into consideration that whilst the effect of capnodissection on gas exchange has not been rigorously studies, there is evidence to show hypercarbia can result from CO2 insufflation for capnothorax during VATS/RATS procedures [12]. This must be taken into account by surgeons and anaesthetists to consider compensatory ventilator strategies, especially in patients with compromised gas exchange.

Our experience with the use of capnodissection for surgical pleurectomy was successful and after seventeen months from the procedure, the patient didn’t have any recurrence or complications. Also, this technique was not time-consuming (40 minute operative time) and the patient was discharged after 48 hours with surgeons noticing less pain in comparison to the traditional surgical pleurectomy, though pain is subjective. After VATS talc pleurodesis, the chest drain typically is removed no sooner than the second postoperative day, with discharge later that day. There is a theoretical risk of increased recurrence as whilst the relatively atraumatic nature of this technique may reduce patient pain, it may also reduce the pro-inflammatory process required for pleurodesis and hence recurrence prevention [13]. More cases and longer follow-up are required to investigate the non-inferiority of our technique to the traditional procedure.

Conclusions

In this case, capnodissection of the parietal pleura was a novel, safe and successful technique that may decrease the risk of bleeding and post-operative pain.

Acknowledgements

The authors would like to thank the Imperial College London Library for access to article processing charges (APCs) waiver through the Imperial-JMIR unlimited Open Access (OA) deal.

Funding statement

This manuscript was unfunded.

Conflicts of Interest

None declared.

Ethical Statement:

The patient kindly agreed to recording of the procedure during the consenting process for the operation, and the utilization of their non-identifiable data for this case report and publication which was further discussed between the patient and author GQ.

Data Statement:

Data regarding this manuscript have been deposited in multimedia appendices. Corresponding author PR will enable further data sharing upon reasonable request.

Conflicts of Interest:

All authors state that there are no conflicts of interest to declare.

Author Contributions:

Author GQ conceived the idea of the case report, assisted during this procedure, and lead on manuscript writing, PR was involved in manuscript writing, internal review, and internal editing, SS was involved in internal review, PH and NS were anaesthetists for this case, MB was the operating surgeon. Generative artificial intelligence was not involved in any part of this manuscript.

Abbreviation

SP: Spontaneous Pneumothorax
CO2: Carbon Dioxide
PSP: Primary Spontaneous Pneumothorax
SPS: Secondary Spontaneous Pneumothorax
COPD: Chronic Obstructive Pulmonary Disease
BTS: British Thoracic Society
VATS: Video Assisted Thorascopic Surgery
RATS: Robot Assisted Thoracopic Surgery
CT: Computerised Tomography

Multimedia Appendices

Multimedia Appendix 1 – VATS ports set up and surgical instruments.
Multimedia Appendix 2 – Video of capnodissection in action with surgeon narrative.

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Supplementary Files

Multimedia Appendixes

VATS ports set up and surgical instruments.
URL: http://asset.jmir.pub/assets/28cf892acda55e17da5717fcc1695aa0.png

Video of capnodissection in action with surgeon narrative.
URL: http://asset.jmir.pub/assets/95fe22b5631ba641ad9e88930db8acc3.mp4

TOC/Feature image for homepages

VATS ports set up and surgical instruments for capnodissection pleurectomy.