# Original Article: Open Thoracotomy in Pneumothorax Management

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## ABSTRACT

Open thoracotomy, a surgical procedure involving a large incision in the chest wall, has long been utilized in the management of pneumothorax. This procedure allows direct access to the pleural space, enabling effective intervention for complex cases or when less invasive techniques have proven unsuccessful. Indications for open thoracotomy include large or recurrent pneumothorax, significant underlying lung disease, or traumatic pneumothorax with associated injuries. The primary advantage of open thoracotomy is its versatility, as it provides wide exposure and direct visualization of the pleural cavity, facilitating the identification and management of the underlying cause of pneumothorax. This approach allows for the removal of blebs or bullae, repair of lung lacerations, and treatment of associated injuries, resulting in comprehensive management. However, open thoracotomy is a major surgical procedure associated with potential risks and complications, including postoperative pain, longer hospital stays, and slower recovery. The decision to proceed with open thoracotomy should be carefully considered, taking into account the patient's clinical condition, extent of pneumothorax, underlying lung disease, and the expertise of the surgical team. As less invasive techniques, such as video-assisted thoracoscopic surgery (VATS), continue to advance, the choice between open thoracotomy and VATS should be individualized based on the patient's needs and available resources.

## Introduction

Pneumothorax, the presence of air in the pleural space surrounding the lungs, is a potentially life-threatening condition that requires prompt and appropriate management [1-3]. While many cases of pneumothorax can be successfully treated with less invasive techniques such as needle aspiration or tube thoracostomy, there are situations where open thoracotomy becomes necessary. Open thoracotomy is a surgical procedure that involves making a large incision in the chest to access and treat the pneumothorax directly [4-6]. This approach allows for better visualization and control of the underlying pathology, making it a valuable option in specific cases.

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Pneumothorax can occur spontaneously, as a result of trauma, or as a complication of underlying lung disease. When air accumulates in the pleural space, it can lead to lung collapse, impaired oxygenation, and compromised respiratory function [7].

The management of pneumothorax aims to remove the air from the pleural space, restore lung expansion, and prevent recurrences. Less invasive techniques, such as needle aspiration and tube thoracostomy, are often the first-line approaches for initial management. However, in cases where these methods fail or are contraindicated, open thoracotomy may be required [8].

Open thoracotomy provides several advantages in the management of pneumothorax. Firstly, it allows for direct visualization and assessment of the underlying pathology. This is particularly beneficial in cases where there is suspicion of significant lung or pleural disease, such as bullae, blebs, or bronchopleural fistulas. By directly accessing the thoracic cavity, the surgeon can identify and address any specific abnormalities contributing to the pneumothorax, facilitating targeted treatment and reducing the risk of recurrence [9].

Secondly, open thoracotomy enables better control of bleeding and the ability to perform concurrent procedures if necessary. In cases where there is significant hemorrhage, such as in traumatic pneumothorax or in patients on anticoagulant therapy, direct surgical access allows for immediate hemostasis and the potential for rapid blood transfusion if required. Additionally [10], open thoracotomy provides the opportunity to address any associated pathology, such as lung resection for bullae or repair of bronchopleural fistulas, thereby optimizing the overall management of the pneumothorax [11].

Furthermore, open thoracotomy allows for thorough lung exploration and complete lung re-expansion. This is particularly relevant in cases where there is extensive lung collapse or loculated pneumothorax that cannot be adequately addressed through less invasive techniques. By manually expanding the lung and ensuring complete re-expansion, open thoracotomy helps to restore normal respiratory function and improve oxygenation, ultimately leading to better patient outcomes [12].

While open thoracotomy offers several advantages, it is important to recognize that it is a more invasive procedure and carries potential risks and complications. These include infection, bleeding, injury to surrounding structures, prolonged hospital stay, and longer recovery time [13]. The decision to proceed with open thoracotomy should be based on careful assessment of the patient's clinical condition, underlying pathology, and the expertise of the surgical team. Patient factors, such as comorbidities, overall fitness, and the ability to tolerate a more extensive procedure, should also be taken into consideration [14-16].

In recent years, there has been a shift towards less invasive approaches in the management of pneumothorax, such as video-assisted thoracoscopic surgery (VATS). VATS offers a minimally invasive alternative to open thoracotomy, providing similar benefits in terms of direct visualization, control of bleeding, and treatment of underlying pathology [17].

VATS involves the use of small incisions and the insertion of a video camera and specialized instruments to access the thoracic cavity. It has been shown to result in shorter hospital stays, reduced postoperative pain, and faster recovery compared to open thoracotomy. However, VATS may not be suitable for all cases, especially in emergency situations or in the presence of extensive adhesions or dense lung pathology.

In conclusion, open thoracotomy remains an important option in the management of pneumothorax, particularly in cases where less invasive techniques have failed or are

contraindicated. It provides direct access to the thoracic cavity, allowing for better visualization and control of the underlying pathology [18-20]. Open thoracotomy offers the advantages of thorough lung exploration, complete lung re-expansion, and concurrent procedures if necessary. However, it is essential to carefully consider the risks and potential complications associated with this more invasive approach. As less invasive techniques, such as VATS, continue to evolve, the decision to perform open thoracotomy should be individualized, taking into account the patient's clinical condition, underlying pathology, and the expertise of the surgical team.

## Positioning for Open thoracotomy

Open thoracotomy is a surgical procedure commonly employed in the management of pneumothorax when less invasive techniques have failed or are contraindicated. Proper positioning of the patient during open thoracotomy is crucial for ensuring optimal exposure, access to the thoracic cavity, and patient safety [21]. The positioning must allow for adequate visualization, accessibility, and comfort while minimizing the risk of complications. This article discusses the essential considerations and techniques for positioning patients undergoing open thoracotomy for pneumothorax management.

Before the procedure, a thorough evaluation of the patient's medical history, physical condition, and imaging studies should guide the decision regarding positioning. [22-24] The anesthesiologist and surgical team should collaborate to determine the most appropriate position that allows for optimal surgical access and patient safety. Common positions used for open thoracotomy include supine, lateral decubitus, and modified lateral decubitus positions (fig 1).

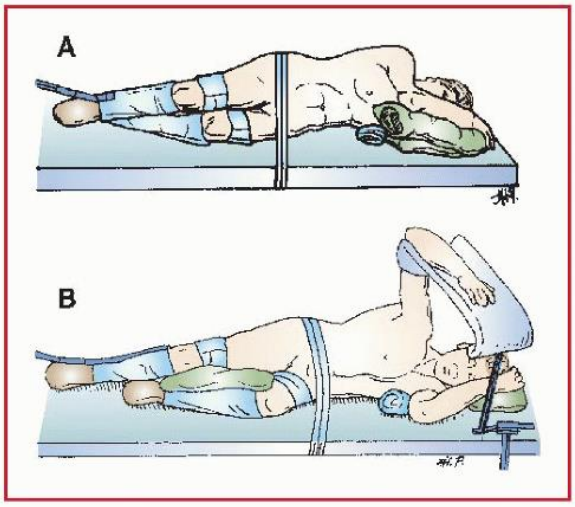


**Figure 1.** Positioning for Open thoracotomy

The supine position, with the patient lying flat on their back, is often the initial position during induction of anesthesia and preparation for the procedure [25-27]. This position provides easy access to the airway for intubation and allows for the placement of monitoring devices, intravenous lines, and arterial lines. Once the patient is under anesthesia, the surgical team can transition to the appropriate position for open thoracotomy [28].

The lateral decubitus position is commonly used for open thoracotomy in pneumothorax management. In this position, the patient is placed on their side, with the affected side facing upward. The shoulder and arm of the affected side are abducted and elevated to allow for better exposure of the thoracic cavity. The patient's torso is then rotated slightly anteriorly to facilitate access to the surgical site. Care should be taken to ensure proper padding and support for pressure points, such as the dependent shoulder, bony prominences, and the lower leg [29-31].

To further optimize exposure and access, a modified lateral decubitus position may be employed. In this position, the patient is tilted slightly backward, with the affected side elevated at a higher angle. This modification allows gravity to assist in lung deflation and

provides better visualization of the surgical field. The positioning can be adjusted during the procedure as needed to improve access to specific regions of the thoracic cavity [32].

Positioning devices and supports, such as bean bags, foam wedges, and rolled sheets, are used to maintain stability, prevent rotation, and support the patient during the procedure. These aids help in achieving the desired position and minimizing the risk of complications, such as nerve injuries, pressure injuries, and musculoskeletal strain [33-35].

Patient safety is of paramount importance during open thoracotomy. Adequate padding and protection of pressure points help prevent pressure injuries and nerve compression. Regular repositioning and monitoring of the patient's skin integrity are essential throughout the procedure. Additionally, careful attention should be paid to the patient's ventilation and hemodynamics during position changes to avoid compromise to respiratory function and cardiovascular stability.

In some cases, when the patient's condition or anatomical constraints prevent the use of lateral decubitus positioning, the supine position with a modified approach can be considered. This entails elevating the patient's back and placing a roll or wedge underneath to create a slight tilt, allowing better access to the thoracic cavity. However, it is important to note that this position may have limitations in terms of exposure and surgical access, and the decision should be made in consultation with the surgical team [36].

In conclusion, proper positioning is crucial for the successful management of pneumothorax with open thoracotomy. The lateral decubitus position, with appropriate modifications, is commonly employed to optimize exposure and access to the thoracic cavity. Adequate padding, supports, and regular monitoring of pressure points are essential to prevent complications. Patient safety, ventilation, and hemodynamic stability should be carefully maintained throughout the procedure. Individualized decision-making, based on the patient's condition, anatomical considerations, and the expertise of the surgical team, is paramount to ensure optimal positioning and successful outcomes in open thoracotomy for pneumothorax management.

## Posterolateral thoracotomy

Pneumothorax, the accumulation of air in the pleural space surrounding the lungs, can be a life-threatening condition that requires prompt intervention. While less invasive techniques such as needle aspiration and tube thoracostomy are effective in many cases, posterolateral thoracotomy remains a valuable surgical approach for the management of pneumothorax. This procedure involves making an incision in the posterolateral aspect of the chest, providing direct access to the pleural space and facilitating effective treatment of the underlying pathology. In this article, we will explore the role of posterolateral thoracotomy in the management of pneumothorax, its indications, surgical technique, and potential advantages(fig 2).

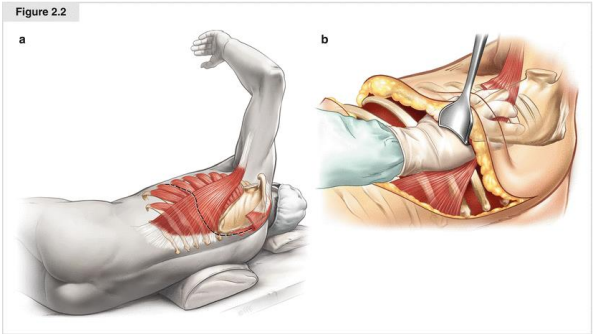


**Figure 2.** Posterolateral thoracotomy incision

Posterolateral thoracotomy is commonly employed in cases where less invasive techniques have failed or are contraindicated. It allows for direct visualization and intervention, which is particularly beneficial when there is suspicion of significant lung or pleural disease, such as complex bullae, blebs, or bronchopleural

fistulas. By providing direct access to the thoracic cavity, the surgeon can accurately assess the extent and nature of the underlying pathology, facilitating targeted treatment and reducing the risk of recurrence [37].

The surgical technique for posterolateral thoracotomy involves making an incision along the posterolateral aspect of the chest, typically between the fifth and seventh intercostal spaces. This incision provides excellent access to the pleural space while minimizing damage to the intercostal neurovascular bundles. Careful dissection is performed to expose the underlying ribs, which are then spread using a rib spreader to provide access to the pleural cavity. The surgeon can then explore the thoracic cavity, identify the source of the pneumothorax, and initiate appropriate interventions.

One of the advantages of posterolateral thoracotomy is the ability to perform concurrent procedures if necessary. In cases where there is significant lung pathology, such as large bullae or bronchopleural fistulas, the surgeon can perform lung resection or repair during the same procedure. This comprehensive approach addresses the underlying cause of the pneumothorax, reduces the risk of recurrence, and improves overall patient outcomes [38].

Another advantage of posterolateral thoracotomy is the potential for better control of bleeding. This is particularly relevant in cases of traumatic pneumothorax or in patients on anticoagulant therapy. Direct surgical access allows for immediate identification and control of bleeding sources, facilitating hemostasis and reducing the risk of complications associated with ongoing hemorrhage.

Additionally, posterolateral thoracotomy enables thorough lung exploration and complete lung re-expansion. In cases where there is extensive lung collapse or loculated pneumothorax, less invasive techniques may be insufficient to achieve full lung re-expansion. By manually expanding the lung and ensuring complete re-expansion, posterolateral thoracotomy helps restore normal respiratory function and improve oxygenation, leading to better patient outcomes [39].

However, it is important to note that posterolateral thoracotomy is a more invasive procedure with potential risks and complications. These include infection, bleeding, injury to surrounding structures, prolonged hospital stay, and longer recovery time. The decision to proceed with posterolateral thoracotomy should be based on a careful assessment of the patient's clinical condition, underlying pathology, and the expertise of the surgical team. Patient factors, such as comorbidities, overall fitness, and the ability to tolerate a more extensive procedure, should also be taken into consideration [40].

In recent years, there has been a growing interest in minimally invasive approaches, such as video-assisted thoracoscopic surgery (VATS), for the management of pneumothorax. VATS offers a less invasive alternative to posterolateral thoracotomy, providing similar benefits in terms of direct visualization and treatment of underlying pathology. VATS involves the use of small incisions and the insertion of a video camera and specialized instruments to access the thoracic cavity. It has been shown to result in shorter hospital stays, reduced postoperative pain, and faster recovery compared to posterolateral thoracotomy. However, VATS may have limitations in cases where there is extensive lung disease or adhesions [41].

In conclusion, posterolateral thoracotomy remains a valuable surgical approach in the management of pneumothorax when less invasive techniques have failed or are contraindicated. It provides direct access to the pleural space and allows for thorough exploration, accurate assessment, and targeted treatment of the underlying pathology. Concurrent procedures, better control of

bleeding, and complete lung re-expansion are among the advantages of posterolateral thoracotomy. However, the decision to perform this procedure should be individualized, considering the patient's clinical condition, underlying pathology, and the expertise of the surgical team. As minimally invasive techniques continue to evolve, the choice between posterolateral thoracotomy and less invasive approaches, such as VATS, should be made based on a comprehensive evaluation of the patient's specific needs and the available resources [42].

## Limited lateral thoracotomy

Pneumothorax, the accumulation of air in the pleural space surrounding the lungs, can be a critical condition requiring timely intervention. While less invasive techniques such as needle aspiration and tube thoracostomy are often effective, situations may arise where a more direct approach is necessary. In such cases, a limited lateral thoracotomy can be a valuable surgical option for pneumothorax management. This procedure involves making a small incision in the lateral aspect of the chest, providing direct access to the pleural space for effective treatment of the underlying pathology. In this article, we will explore the role of limited lateral thoracotomy in pneumothorax management, its indications, surgical technique, and potential advantages [43].

Limited lateral thoracotomy is typically employed when less invasive techniques have failed or are contraindicated. It allows for direct visualization and intervention, which is particularly beneficial when there is suspicion of significant lung or pleural disease, such as large bullae, blebs, or bronchopleural fistulas. By providing direct access to the thoracic cavity, the surgeon can accurately assess the extent and nature of the underlying pathology, facilitating targeted treatment and reducing the risk of recurrence [44].

The surgical technique for limited lateral thoracotomy involves making a small incision in the lateral aspect of the chest, usually between the fourth and sixth intercostal spaces. This incision provides adequate access to the pleural space while minimizing damage to the underlying structures. Careful dissection is performed to expose the underlying ribs, which may be spread using a rib spreader or manually retracted to provide access to the pleural cavity. The surgeon can then explore the thoracic cavity, identify the source of the pneumothorax, and initiate appropriate interventions(fig 3).

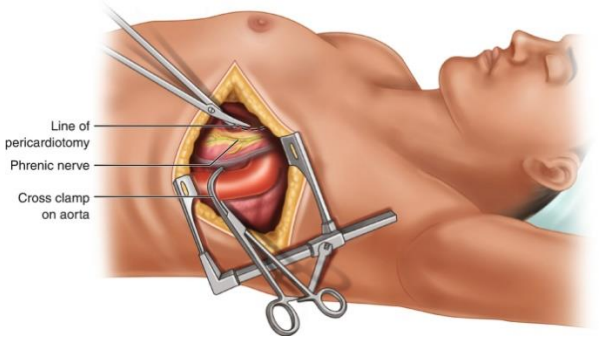


**Figure 3.** Limited lateral thoracotomy

One of the advantages of limited lateral thoracotomy is the smaller incision size and reduced tissue trauma compared to larger thoracotomy approaches. This can result in less postoperative pain, shorter hospital stays, and faster recovery for the patient. The smaller incision also has the advantage of better cosmetic outcomes, with a smaller scar compared to traditional thoracotomy incisions.

Limited lateral thoracotomy allows for thorough lung exploration and effective treatment of the underlying pathology [45].

This is particularly important in cases of extensive lung collapse or loculated pneumothorax, where less invasive techniques may be insufficient to achieve full lung re-expansion. By directly visualizing and addressing the underlying lung condition, limited lateral thoracotomy helps restore

normal respiratory function and improve oxygenation, leading to better patient outcomes. Additionally, limited lateral thoracotomy enables concurrent procedures if necessary. In cases where there is significant lung pathology, such as large bullae or bronchopleural fistulas, the surgeon can perform lung resection or repair during the same procedure. This comprehensive approach addresses the underlying cause of the pneumothorax, reduces the risk of recurrence, and improves overall patient outcomes [46].

However, it is important to note that limited lateral thoracotomy is still an invasive procedure with potential risks and complications. These may include infection, bleeding, injury to surrounding structures, prolonged hospital stay, and longer recovery time. The decision to proceed with limited lateral thoracotomy should be based on a careful assessment of the patient's clinical condition, underlying pathology, and the expertise of the surgical team. Patient factors such as comorbidities, overall fitness, and the ability to tolerate a surgical procedure should also be taken into consideration [47].

In recent years, there has been a growing interest in minimally invasive approaches, such as video-assisted thoracoscopic surgery (VATS), for pneumothorax management. VATS offers a less invasive alternative to limited lateral thoracotomy, providing similar benefits in terms of direct visualization and treatment of underlying pathology. VATS involves the use of small incisions and the insertion of a video camera and specialized instruments to access the thoracic cavity. It has been shown to result in shorter hospital stays, reduced postoperative pain, and faster recovery compared to limited lateral thoracotomy. However, VATS may have limitations in cases where there is extensive lung disease or adhesions.

In conclusion, limited lateral thoracotomy is a valuable surgical option for the management of pneumothorax when less invasive techniques have failed or are contraindicated. It provides direct access to the pleural space, allowing for thorough exploration, accurate assessment, and targeted treatment of the underlying pathology. The smaller incision size and reduced tissue trauma offer potential advantages such as less postoperative pain, shorter hospital stays, and better cosmetic outcomes. However, the decision to perform limited lateral thoracotomy should be individualized, considering the patient's clinical condition, underlying pathology, and the expertise of the surgical team. As minimally invasive techniques continue to evolve, the choice between limited lateral thoracotomy and less invasive approaches, such as VATS, should be made based on a comprehensive evaluation of the patient's specific needs and the available resources.

## Axillary thoracotomy

Pneumothorax, the accumulation of air in the pleural space surrounding the lungs, is a potentially life-threatening condition that requires prompt intervention. While less invasive techniques such as needle aspiration and tube thoracostomy are commonly employed, there are cases where a more direct approach is necessary. Axillary thoracotomy is a surgical procedure that provides direct access to the pleural space through an incision made in the axillary region. This article will explore the role of axillary thoracotomy in pneumothorax management, its indications, surgical technique, and potential advantages [4].

Axillary thoracotomy is typically considered when less invasive techniques have failed or are contraindicated. It allows for direct visualization and intervention, which is particularly beneficial when there is suspicion of significant lung or pleural disease, such as large bullae, blebs, or bronchopleural fistulas. By providing direct access to the thoracic cavity, the surgeon can accurately assess the extent and nature of the

underlying pathology, facilitating targeted treatment and reducing the risk of recurrence.

The surgical technique for axillary thoracotomy involves making an incision in the axillary region, typically in the fourth or fifth intercostal space. This location provides excellent access to the pleural space while minimizing damage to the surrounding structures. Careful dissection is performed to expose the underlying ribs, which are then spread using a rib spreader or manually retracted to provide access to the pleural cavity. The surgeon can then explore the thoracic cavity, identify the source of the pneumothorax, and initiate appropriate interventions(fig 4).

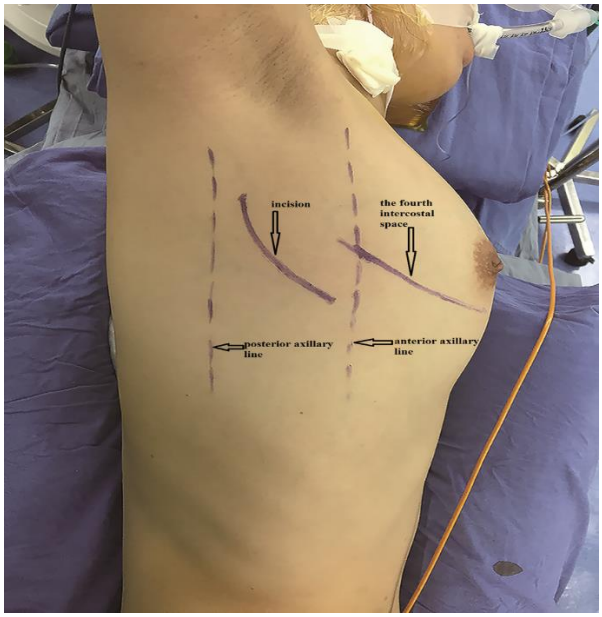


**Figure 4.** Axillary thoracotomy

One of the advantages of axillary thoracotomy is the avoidance of large incisions in the anterior or lateral chest wall, which can result in better cosmetic outcomes. The incision made in the axillary region is hidden within the natural folds of the skin, leading to a less noticeable scar compared to other approaches. This can be particularly important for patients who are concerned about the aesthetic impact of the surgical procedure [12].

Axillary thoracotomy allows for thorough lung exploration and effective treatment of the underlying pathology. This is particularly relevant in cases of extensive lung collapse or loculated pneumothorax, where less invasive techniques may be insufficient to achieve complete lung re-expansion. By directly visualizing and addressing the underlying lung condition, axillary thoracotomy helps restore normal respiratory function and improve oxygenation, leading to better patient outcomes. Additionally, axillary thoracotomy enables concurrent procedures if necessary. In cases where there is significant lung pathology, such as large bullae or bronchopleural fistulas, the surgeon can perform lung resection or repair during the same procedure. This comprehensive approach addresses the underlying cause of the pneumothorax, reduces the risk of recurrence, and improves overall patient outcomes.

However, it is important to note that axillary thoracotomy is an invasive procedure with potential risks and complications. These may include infection, bleeding, injury to surrounding structures, prolonged hospital stay, and longer recovery time. The decision to proceed with axillary thoracotomy should be based on a careful assessment of the patient's clinical condition, underlying pathology, and the expertise of the surgical team. Patient factors, such as comorbidities, overall fitness, and the ability to tolerate a surgical procedure, should also be taken into consideration [19].

In recent years, there has been a growing interest in minimally invasive approaches, such as video-assisted thoracoscopic surgery (VATS), for pneumothorax management. VATS offers a less invasive alternative to axillary thoracotomy, providing similar benefits in terms of direct visualization and treatment of underlying pathology. VATS involves the use of small incisions and the insertion of a video camera and specialized instruments to access the thoracic cavity. It has been shown to result in shorter hospital stays, reduced postoperative pain, and faster recovery compared to axillary thoracotomy. However, VATS may have

limitations in cases where there is extensive lung disease or adhesions.

In conclusion, axillary thoracotomy is a valuable surgical option for the management of pneumothorax when less invasive techniques have failed or are contraindicated. It provides direct access to the pleural space, allowing for thorough exploration, accurate assessment, and targeted treatment of the underlying pathology. The avoidance of large incisions in the anterior or lateral chest wall can lead to better cosmetic outcomes. However, the decision to perform axillary thoracotomy should be individualized, considering the patient's clinical condition, underlying pathology, and the expertise of the surgical team. As minimally invasive techniques continue to evolve, the choice between axillary thoracotomy and less invasive approaches, such as VATS, should be made based on a comprehensive evaluation of the patient's specific needs and the available resources [22].

## Anterior thoracotomy

Pneumothorax, the presence of air in the pleural space surrounding the lungs, can be a serious medical condition that requires prompt intervention. While less invasive procedures such as needle aspiration and tube thoracostomy are often effective, there are instances where a more direct approach is necessary. Anterior thoracotomy is a surgical technique that provides direct access to the pleural space through an incision made in the anterior chest wall. In this article, we will explore the role of anterior thoracotomy in pneumothorax management, its indications, surgical technique, and potential advantages.

Anterior thoracotomy is typically considered when less invasive techniques have failed or are contraindicated. It allows for direct visualization and intervention, which is particularly beneficial in cases where there is suspicion of significant lung or pleural disease, such as large bullae, blebs, or bronchopleural fistulas. By providing direct access to the thoracic cavity, the surgeon can accurately assess the extent and nature of the underlying pathology, facilitating targeted treatment and reducing the risk of recurrence.

The surgical technique for anterior thoracotomy involves making an incision in the anterior chest wall, usually along the fourth or fifth intercostal space. This location allows for optimal access to the pleural space while minimizing damage to the surrounding structures. Careful dissection is performed to expose the underlying ribs, which may be spread using a rib spreader or manually retracted to provide adequate access to the pleural cavity. The surgeon can then explore the thoracic cavity, identify the source of the pneumothorax, and initiate appropriate interventions [39].

One of the advantages of anterior thoracotomy is the direct and comprehensive exposure it provides to the thoracic cavity. This allows for thorough lung examination and treatment of the underlying pathology. In cases where there is extensive lung collapse or loculated pneumothorax, less invasive techniques might be insufficient to achieve complete lung re-expansion. Through anterior thoracotomy, the surgeon gains direct visual and tactile feedback, enabling accurate assessment and targeted treatment, ultimately leading to improved patient outcomes.

Another advantage of anterior thoracotomy is the ability to perform concurrent procedures, if necessary. In cases where there is significant lung disease, such as large bullae or bronchopleural fistulas, the surgeon can perform lung resection or repair during the same procedure. This comprehensive approach addresses the underlying cause of the pneumothorax, reduces the risk of recurrence, and improves overall patient outcomes [8].

However, it is important to note that anterior thoracotomy is an invasive procedure with potential risks and complications. These may include infection, bleeding, injury to

surrounding structures, prolonged hospital stay, and longer recovery time. The decision to proceed with anterior thoracotomy should be based on a careful evaluation of the patient's clinical condition, underlying pathology, and the expertise of the surgical team. Patient factors such as comorbidities, overall fitness, and the ability to tolerate a surgical procedure should also be taken into consideration [12].

In recent years, there has been a growing interest in minimally invasive approaches, such as video-assisted thoracoscopic surgery (VATS), for pneumothorax management. VATS offers a less invasive alternative to anterior thoracotomy, providing similar benefits in terms of direct visualization and treatment of underlying pathology. VATS involves the use of small incisions and the insertion of a video camera and specialized instruments to access the thoracic cavity. It has been shown to result in shorter hospital stays, reduced postoperative pain, and faster recovery compared to anterior thoracotomy. However, VATS may have limitations in cases where there is extensive lung disease or adhesions.

In conclusion, anterior thoracotomy is a valuable surgical option for the management of pneumothorax when less invasive techniques have failed or are contraindicated. It provides direct access to the pleural space, allowing for thorough exploration, accurate assessment, and targeted treatment of the underlying pathology. The ability to perform concurrent procedures during the same operation adds to its advantages. However, the decision to perform anterior thoracotomy should be individualized, considering the patient's clinical condition, underlying pathology, and the expertise of the surgical team. As minimally invasive techniques continue to evolve, the choice between anterior thoracotomy and less invasive approaches, such as VATS, should be made based on a comprehensive evaluation of the patient's specific needs and the available resources.

## Blebectomy/bullectomy

Pneumothorax, the accumulation of air in the pleural space surrounding the lungs, is a condition that often requires intervention to prevent further complications. One of the surgical approaches used in the management of pneumothorax is blebectomy/bullectomy. This procedure involves the removal of blebs or bullae, which are abnormal air-filled spaces on the lung surface that can contribute to the development of pneumothorax. In this article, we will explore the role of blebectomy/bullectomy in pneumothorax management, its indications, surgical technique, and potential benefits.

Blebs and bullae are abnormal air-filled spaces that can develop on the lung surface. These structures are often associated with underlying lung disease, such as emphysema or chronic obstructive pulmonary disease (COPD). Blebs are small, thin-walled air sacs that are prone to rupture, whereas bullae are larger, more significant air spaces. When a bleb or bulla ruptures, air can escape into the pleural space, leading to the development of a pneumothorax.

Blebectomy/bullectomy is typically considered in cases where there is a high risk of recurrent pneumothorax due to the presence of large or multiple blebs/bullae. It is especially indicated in patients with underlying lung disease, such as emphysema or COPD, where the risk of bleb or bulla rupture and subsequent pneumothorax is increased. By removing these abnormal structures, the surgeon aims to reduce the risk of recurrence and improve overall lung function.

The surgical technique for blebectomy/ bullectomy involves making an incision in the chest wall, typically in the anterior or lateral aspect. The surgeon gains access to the pleural space and identifies the location of the blebs or bullae [10].

The abnormal structures are carefully dissected and removed, either by excising them directly or by using stapling techniques. The underlying

lung tissue is then carefully inspected for any additional blebs or bullae, which are also removed if present. Proper hemostasis is ensured, and the lung is re-expanded before closing the incision [21].

One of the primary benefits of blebectomy/bullectomy is the reduction in the risk of recurrent pneumothorax. By removing the blebs or bullae, the surgeon eliminates the potential source of air leakage into the pleural space. This can significantly decrease the likelihood of future pneumothorax episodes and improve the patient's quality of life. Additionally, by addressing the underlying lung disease, such as emphysema or COPD, the procedure can help alleviate symptoms and improve respiratory function.

Blebectomy/bullectomy can also be performed in conjunction with other surgical techniques. For instance, in cases where there is extensive lung disease, the surgeon may choose to perform lung volume reduction surgery (LVRS) in addition to blebectomy/bullectomy. LVRS aims to remove or reduce the size of overinflated and non-functional lung areas, improving lung function and overall respiratory status. This combined approach can be particularly beneficial for patients with severe emphysema or COPD, as it addresses both the underlying lung disease and the risk of recurrent pneumothorax [17].

It is important to note that blebectomy/ bullectomy is a surgical procedure with associated risks and potential complications. These may include bleeding, infection, air leakage, persistent or recurrent pneumothorax, or damage to surrounding structures. The decision to proceed with blebectomy/bullectomy should be based on a thorough evaluation of the patient's clinical condition, underlying lung disease, and the expertise of the surgical team. Patient factors, such as comorbidities, overall fitness, and the ability to tolerate a surgical procedure, should also be taken into consideration.

In recent years, there has been an increasing interest in less invasive techniques for the management of pneumothorax, such as video-assisted thoracoscopic surgery (VATS). VATS offers a minimally invasive alternative to traditional open surgery, allowing for smaller incisions and the use of a video camera and specialized instruments for visualization and treatment. VATS has been shown to result in shorter hospital stays, reduced postoperative pain, and faster recovery compared to open blebectomy/bullectomy. However, the choice between open surgery and VATS should be made based on the individual patient's condition, the extent of the underlying lung disease, and the expertise of the surgical team.

In conclusion, blebectomy/bullectomy is a surgical approach that plays a valuable role in the management of pneumothorax, particularly in cases with large or multiple blebs/bullae and underlying lung disease. By removing these abnormal structures, the risk of recurrent pneumothorax can be significantly reduced, improving patient outcomes. However, the decision to proceed with blebectomy/ bullectomy should be individualized, considering thepatient's specific clinical condition, underlying lung disease, and the expertise of the surgical team. As minimally invasive techniques continue to advance, the choice between open surgery and less invasive approaches, such as VATS, should be carefully evaluated based on the patient's needs and the available resources [29].

## Parietal pleurectomy

Pneumothorax, the presence of air in the pleural space surrounding the lungs, is a condition that often requires medical intervention to prevent further complications. One surgical approach used in the management of pneumothorax is parietal pleurectomy. This procedure involves

the removal or abrasion of the parietal pleura, the membrane lining the chest wall, to promote pleural adhesion and prevent air accumulation. In this article, we will explore the role of parietal pleurectomy in pneumothorax management, its indications, surgical technique, and potential benefits.

Parietal pleurectomy is typically considered in cases where there is a high risk of recurrent pneumothorax, particularly in patients with underlying lung disease or previous failed interventions. The procedure aims to create adhesion between the parietal pleura and the lung, sealing off potential spaces for air accumulation and reducing the risk of future pneumothorax episodes. By promoting pleural adhesion, parietal pleurectomy can effectively prevent air leakage and improve patient outcomes [33].

The surgical technique for parietal pleurectomy involves making an incision in the chest wall, typically in the anterior or lateral aspect. The surgeon gains access to the pleural space and carefully examines the pleural surfaces. The parietal pleura is then either removed or abraded using various techniques, such as mechanical abrasion, chemical agents, or electrocautery. The goal is to create inflammation and promote the formation of fibrous adhesions between the parietal pleura and the underlying lung. Once the procedure is completed, the lung is re-expanded, and the incision is closed.

One of the primary benefits of parietal pleurectomy is its potential to reduce the risk of recurrent pneumothorax. By creating pleural adhesions, the procedure effectively eliminates potential spaces for air accumulation, preventing air leakage into the pleural space. This can significantly decrease the likelihood of future pneumothorax episodes and improve the patient's quality of life. Furthermore, parietal pleurectomy can be performed as a standalone procedure or in combination with other surgical techniques, depending on the patient's specific needs and underlying lung condition.

Parietal pleurectomy can be particularly beneficial in patients with underlying lung disease, such as emphysema or chronic obstructive pulmonary disease (COPD). These conditions often involve the presence of blebs or bullae, which are abnormal air-filled spaces on the lung surface that can contribute to the development of pneumothorax. By promoting pleural adhesion, parietal pleurectomy not only prevents air leakage but also addresses the underlying lung disease. This comprehensive approach can help improve lung function and reduce the risk of recurrent pneumothorax in patients with emphysema or COPD.

It is important to note that parietal pleurectomy is a surgical procedure with potential risks and complications. These may include bleeding, infection, persistent or recurrent pneumothorax, or damage to surrounding structures. The decision to proceed with parietal pleurectomy should be based on a thorough evaluation of the patient's clinical condition, underlying lung disease, and the expertise of the surgical team. Patient factors, such as comorbidities, overall fitness, and the ability to tolerate a surgical procedure, should also be taken into consideration.

In recent years, there has been an increasing interest in less invasive techniques for the management of pneumothorax, such as video-assisted thoracoscopic surgery (VATS). VATS offers a minimally invasive alternative to traditional open surgery, allowing for smaller incisions and the use of a video camera and specialized instruments for visualization and treatment. VATS has been shown to result in shorter hospital stays, reduced postoperative pain, and faster recovery compared to open parietal pleurectomy. However, the choice between open surgery and VATS should be made based on the individual patient's condition, the

extent of the underlying lung disease, and the expertise of the surgical team [45].

In conclusion, parietal pleurectomy is a surgical approach that plays a valuable role in the management of pneumothorax, particularly in cases with a high risk of recurrence and underlying lung disease. By promoting pleural adhesion, the procedure effectively prevents air leakage and reduces the likelihood of future pneumothorax episodes. However, the decision to proceed with parietal pleurectomy should be individualized, considering the patient's specific clinical condition, underlying lung disease, and the expertise of the surgical team. As minimally invasive techniques continue to advance, the choice between open surgery and less invasive approaches, such as VATS, should be carefully evaluated based on the patient's needs and the available resources.

## Discussion

Open thoracotomy, also known as thoracotomy, is a surgical procedure that has been used for many years in the management of pneumothorax. It involves making a large incision in the chest wall to gain access to the pleural space and address the underlying cause of the pneumothorax. In this discussion, we will explore the role of open thoracotomy in pneumothorax management, its indications, potential benefits, and considerations [8].

Open thoracotomy is typically considered in cases of pneumothorax where less invasive interventions have failed or are not feasible. It may be necessary when the pneumothorax is large, recurrent, or associated with significant underlying lung disease or trauma. The procedure allows direct visualization of the pleural space, facilitating the identification and management of the underlying cause of the pneumothorax, such as the removal of blebs or bullae, repair of lung lacerations, or treatment of diaphragmatic injuries [9].

One of the primary benefits of open thoracotomy is its versatility and the ability to address complex cases of pneumothorax. Unlike less invasive techniques, such as video-assisted thoracoscopic surgery (VATS), open thoracotomy provides wide exposure and direct access to the pleural space. This allows the surgeon to thoroughly evaluate the entire lung and pleural cavity, identify any abnormalities or sources of air leakage, and perform the necessary interventions. It is particularly beneficial in cases where there is extensive lung disease or when simultaneous procedures, such as lung resection or repair, are required [12].

Open thoracotomy also offers the advantage of immediate control of bleeding and the ability to manage other associated injuries. In cases of traumatic pneumothorax, where there may be associated chest wall or vascular injuries, open thoracotomy allows for rapid identification and control of hemorrhage, repair of damaged structures, and overall stabilization of the patient. This comprehensive approach can be life-saving in critical situations and provides the surgeon with the necessary tools to manage complex cases effectively [15].

However, open thoracotomy is a major surgical procedure with potential risks and complications. The large incision and extensive dissection required can result in significant postoperative pain, longer hospital stays, and slower recovery compared to less invasive techniques. Additionally, open thoracotomy carries the risks associated with general anesthesia, such as respiratory complications, cardiovascular events, and infections. The decision to proceed with open thoracotomy should be carefully considered and individualized based on the patient's clinical condition, the extent of the pneumothorax, underlying lung disease, and the expertise of the surgical team [17].

In recent years, there has been a shift towards less invasive approaches for pneumothorax

management, such as VATS. VATS offers the advantages of smaller incisions, decreased postoperative pain, shorter hospital stays, and faster recovery. It allows for visualization and treatment of the pleural space using a video camera and specialized instruments. VATS has been shown to be effective in many cases of pneumothorax and has gained popularity as an alternative to open thoracotomy [47].

## Conclusion

In conclusion, open thoracotomy plays a crucial role in the management of pneumothorax, particularly in complex cases where less invasive interventions have failed or are not feasible. It provides direct access to the pleural space, allowing for thorough evaluation and management of the underlying cause of the pneumothorax. However, the decision to proceed with open thoracotomy should be carefully considered, taking into account the patient's specific clinical condition, the extent of the pneumothorax, underlying lung disease, and the expertise of the surgical team. As less invasive techniques continue to advance, the choice between open thoracotomy and VATS should be individualized based on the patient's needs, the complexity of the case, and the available resources.

## References

[1]SM Ronagh, PANAHALI A, LOTFI A, Ahmadpour PF. Razi Journal of Medical Science. **2018**. [Google Scholar], [Publisher]

[2]R Gheisari, Resalati F, Mahmoudi S, Golkari A, Mosaddad SA. Journal of Oral and Maxillofacial Surgery. **2018**;76(8):1652.e1-.e7.[Crossref], [Google Scholar], [Publisher]

[3]R Gheisari, Resalati F, Mahmoudi S, Golkari A, Journal of Oral and Maxillofacial Surgery. **2018**;76(8):1652.e1-.e7.[Crossref], [Google Scholar], [Publisher]

[4]R Gheisari, Doroodizadeh T, Estakhri F, Tadbir A, Soufdoost R, Mosaddad S. Journal of Stomatology. **2019**;72(6):269-73. [Crossref], [Google Scholar], [Publisher]

[5]R Azhough, R., Jalali, P., E J Golzari, S. et al. Indian J Surg. **2020**; **82**:824–827. [Crossref], [Google Scholar], [Publisher]

[6]R Azhough R, Azari Y, Taher S, Jalali P. Asian Journal of Endoscopic Surgery. **2021**;14(3):458-63. [Crossref], [Google Scholar], [Publisher]

[7]Moharrami M, Nazari B, Anvari HM. Trauma Monthly. **2021**; 26(4):228-234. [Crossref], [Google Scholar], [Publisher]

[8]Mobaraki-Asl N, Ghavami Z, Gol MK. Journal of education and health promotion. **2019**;8:179.

[9]MN Darestani, et al., Photobiomodulation, Photomedicine, and Laser Surgery. **2023**. [Crossref], [Google Scholar], [Publisher]

[10] Mahmoudi H, et al., Nanomedicine Research Journal, **2022**, 7(3), 288-293, [Crossref], [Google Scholar], [Publisher]

[11] Mahdavi F, Osquee HO..2020; 23(3): 34-39. [Crossref], [Google Scholar], [Publisher]

[12] M.K Gol., A. Dorosti, and M. Montazer, Journal of education and health promotion, **2019**. 8. [Crossref], [Google Scholar], [Publisher]

[13] M Yazdanian, A Rahmani, E Tahmasebi, H Tebyanian, A Yazdanian, SA Mosaddad. in Medicinal Chemistry. **2021**;21(7):899-918. [Crossref], [Google Scholar], [Publisher]

[14] M Najafi, A Jahanbakhshi, et al., Current Oncology, **2022** 29 (5), 2995-3012 [Crossref], [Google Scholar], [Publisher]

[15] M Montazer., et al., Gynecology and Infertility, **2019**. 22(8): p. 10-18. [Crossref], [Google Scholar], [Publisher]

[16] M Milanifard, Weakness and Irritability, GMJ Medicine, **2021** 5 (1), 391-395 [Crossref], [Google Scholar], [Publisher]

[17] M Khanbabayi Gol., F. Jabarzade, V. Zamanzadeh, Nurs Midwifery J, **2017**. 15(8): p. 612-9. [Google Scholar], [Publisher]

[18] M Khanbabaei Gol., et al., The Iranian Journal of Obstetrics, Gynecology and Infertility, **2019**. 22(5): p. 52-60. [Crossref], [Google Scholar], [Publisher]

[19] M Jalessi, A Jahanbakhshi, et al., Interdisciplinary Neurosurgery, **2015** 2 (2), 86-89 [Crossref], [Google Scholar], [Publisher]
[20] M Irajian, Beheshtirooy A. International Journal of Current Microbiology and Applied Sciences. **2016**;5(1): 818-825.[Google Scholar], [Publisher]
[21] M Haghdoost, Mousavi S, Gol MK, Montazer M. International Journal of Women's Health and Reproduction Sciences. **2019**; 7(4): 526-30. [Google Scholar], [Publisher]
[22] M Haghdoost, Mousavi S, Gol MK, Montazer M. International Journal of Women's Health and Reproduction Sciences. **2019**; 7(4): 526-30. [Google Scholar], [Publisher]
[23] M Eydi, Golzari SEJ, Aghamohammadi D, Kolahdouzan K, Safari S, Ostadi Z. Anesthesiology and Pain Medicine; **2014**: 4(2),e15499 [Crossref], [Google Scholar], [Publisher]
[24] M Eidy, Ansari M, Hosseinzadeh H, Kolahdouzan K. Pakistan Journal of Medical Sciences. **2010**; 26(4):778-781. [Google Scholar], [Publisher]
[25] M Bonyadi, Esmaeili M, Abhari M, Lotfi A. Genetic testing and molecular biomarkers. **2009**, 13: 689–92. [Crossref], [Google Scholar], [Publisher]
[26] Kheradjoo H, et al., Molecular Biology Reports, **2023**, 50, 4217–4224, [Crossref], [Google Scholar], [Publisher]
[27] K Hashemzadeh., M. Dehdilani, and M.K. Gol, Crescent Journal of Medical & Biological Sciences, **2019**. 6(4). [Google Scholar], [Publisher]
[28] Irajian M, Faridaalaee G. Iranian Journal of Emergency Medicine. **2016**;3(3): 115-118. [Crossref], [Google Scholar], [Publisher]
[29] H Danesh, et al., Journal of Medicinal and Chemical Sciences, **2022**, 561-570, [Crossref], [Google Scholar], [Publisher]
[30] H Ansari lari, et al. Advances in Materials Science and Engineering. **2022**;2022:8621666. [Google Scholar], [Publisher]
[31] Golfeshan F, Ajami S, Khalvandi Y, Mosaddad SA, Nematollahi H. Journal of Biological Research - Bollettino della Società Italiana di Biologia Sperimentale. **2020**;93(1). [Google Scholar], [Publisher]
[32] G Sharifi, A Jahanbakhshi, Journal of Neurological Surgery Part A: Central European Neurosurgery, **2013** 74, e145-e148 [Crossref], [Google Scholar], [Publisher]
[33] G Sharifi, A Jahanbakhshi, et al., Global spine journal, **2012** 2 (1), 051-055 [Crossref], [Google Scholar], [Publisher]
[34] Forghani N, Jalali Z, Ayramlou H, Jalali P. J Clin Images Med Case Rep. 2022;3(1):1626.
[35] FB SS Seyedian, A shayesteh, Elsevier, **2018** 2526-2530 [Crossref], [Google Scholar], [Publisher]
[36] F Golfeshan, Mosaddad SA, Ghaderi F., Medicine. **2021**;2021:3304543. [Crossref], [Google Scholar], [Publisher]
[37] F Golfeshan, Mosaddad SA, Babavalian H, Tebyanian H, Mehrjuyan E, Shakeri F. India Section B: Biological Sciences. **2022**;92(1):5-10. [Google Scholar], [Publisher]
[38] F Beiranvandi, et al., Journal of Pharmaceutical Negative Results, **2022** 4417-4425 [Crossref], [Google Scholar], [Publisher]
[39] Eskandar S, Jalali P. Revista espanola de cardiologia (English ed.).**2020**; 74(8): 725–726. [Crossref], [Google Scholar], [Publisher]
[40] E Yahaghi, F Khamesipour, F Mashayekhi, F Safarpoor Dehkordi, MH Sakhaei, M Masoudimanesh, MK Khameneie. BioMed Research International. **2014** 12;2014: 757941. [Crossref], [Google Scholar], [Publisher]
[41] E Tahmasebi, M Alam, M Yazdanian, H Tebyanian, A Yazdanian, A Seifalian, et al. Journal of Materials Research and Technology. **2020**;9(5):11731-55. [Crossref], [Google Scholar], [Publisher]
[42] E Tahmasebi, M Alam, M Yazdanian, H Tebyanian, A Yazdanian, A Seifalian, et al. Journal of Materials Research and Technology.

**2020**;9(5):11731-55. [Crossref], [Google Scholar], [Publisher]
[43] D Alvandfar., M. Alizadeh, M. Khanbabayi Gol, The Iranian Journal of Obstetrics, Gynecology and Infertility, **2019**. 22(9): p. 1-7.[Crossref], [Google Scholar], [Publisher]
[44] D Aghamohamadi., M.K. Gol,. Int J Womens Health Reprod Sci, **2020**. 8(2): p. 227-31. [Google Scholar], [Publisher]
[45] AR Baghestani, P Shahmirzalou, S Sayad, ME Akbari, F Zayeri, Asian Pacific journal of cancer prevention: APJCP, **2018** 19 (6), 1601 [Crossref], [Google Scholar], [Publisher]
[46] A Susanabadi, et al., Journal of Chemical Reviews, **2021**, 3 (3), 219-231, [Crossref], [Google Scholar], [Publisher]
[47] A Afshari, et al. Advances in Materials Science and Engineering. **2022**;2022:6491134. [Crossref], [Google Scholar], [Publisher]