CASE REPORT
Vol. 11 No. 1 January-March 2026
doi: 10.35366/122235

Management of pulmonary bullae by thoracotomy versus minimally invasive approach

Tratamiento de las bullas pulmonares mediante toracotomía frente a abordaje mínimamente invasivo

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ABSTRACT

The most common causes of bullous emphysema include smoking, exposure to biomass, and α-1 antitrypsin deficiency. Symptoms include progressive dyspnea, productive cough, decreased exercise tolerance, and wheezing. Surgical management options include thoracotomy or video-assisted thoracoscopy. When choosing the ideal approach for each patient, the extent and location of the bullae, comorbidities, and risk of recurrence, among other factors, must be considered. We present two surgical cases: a 45-year-old woman with a history of biomass exposure and a giant bulla causing acute respiratory distress, successfully treated with thoracotomy; and a 25-year-old man who developed a spontaneous pneumothorax with associated subpleural cysts at high altitude, managed via video-assisted thoracoscopic bullectomy.

Keywords: pulmonary bullae, bullous emphysema, chronic obstructive pulmonary disease, thoracotomy, video-assisted thoracoscopy.

RESUMEN

Las causas más comunes de enfisema bulloso incluyen el tabaquismo, la exposición a biomasa y la deficiencia de α-1 antitripsina. Los síntomas incluyen disnea progresiva, tos productiva, disminución de la tolerancia al ejercicio y sibilancias. Las opciones de tratamiento quirúrgico incluyen toracotomía o videotoracoscopia. Al elegir el abordaje ideal para cada paciente, se deben considerar la extensión y la ubicación de las bullas, las comorbilidades y el riesgo de recurrencia, entre otros factores. Presentamos dos casos quirúrgicos: una mujer de 45 años con antecedentes de exposición a biomasa y una bulla gigante que le causó dificultad respiratoria aguda, tratada con éxito mediante toracotomía; y un hombre de 25 años que desarrolló un neumotórax espontáneo con quistes subpleurales asociados con gran altitud, tratado mediante bullectomía videotoracoscópica.

Palabras clave: *bullas pulmonares, enfisema bulloso, enfermedad pulmonar obstructiva crónica, toracotomía, toracoscopia videoasistida.*

How to cite: Jiménez-González RJ, Ogaz-Escarpita MC, Carrera-Baca M, Castañón-Colunga EA, Guillén-Ramírez RM, Marmolejo-Rivera R et al. Management of pulmonary bullae by thoracotomy versus minimally invasive approach. Cir Card Mex. 2026; 11 (1): 35-38. https://dx.doi.org/10.35366/122235

Received: 16-07-2025. Accepted: 25-07-2025.

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Pulmonary bullae are air-filled spaces larger than 1 cm in the lung parenchyma.[1] They form as a result of the loss of distal lung architecture, causing airflow limitation due to tissue destruction and enlargement of the alveolar spaces beyond the terminal bronchioles. These lesions most commonly affect the upper lobe.[2] This clinical condition is called bullous emphysema.[3,4]

A giant bulla is defined as one that affects 30% or more of a hemithorax. These giant bullas can form slowly as they gradually fill with air, or they can enlarge rapidly and progress to become tension bullae.[2,5]

There are three types of bullous emphysema:[6]

- **Type I:** isolated bullae.
- **Type II:** subpleural bullae.
- **Type III:** generalized bullae affecting the entire lung.

The most common causes of bullous emphysema include smoking, exposure to biomass,[7] and α-1 antitrypsin deficiency.[3] Exposure to tobacco smoke causes the destruction of alveolar walls and permanent dilation of air spaces by inducing oxidative stress due to the presence of free radicals.[8] In relation to exposure to biomass, people exposed to this pollutant have a 2.44 odds ratio (95% CI, 1.9-3.33) of developing COPD.[9] Exposure to biomass is more common in women who perform domestic tasks in rural areas, such as preparing food on wood-burning stoves, in whom the relative risk of COPD was estimated at 3.2 (95% CI, 2.3-4.8).[9]

On the other hand, α-1 antitrypsin deficiency is a hereditary condition characterized by decreased plasma and tissue levels of alpha-1 antitrypsin. This protein protects lung tissue against elastases produced by neutrophils during inflammatory processes, participating in the modulation of the immune system and tissue repair.[10]

The clinical manifestations of bullous emphysema include progressive dyspnea, productive cough, decreased tolerance to physical activity, and wheezing. Physical examination usually reveals signs of pulmonary hyperinflation, such as decreased chest expansion and decreased breath sounds.[11,12] As the disease progresses, complications such as respiratory failure, spontaneous pneumothorax,[13] or infections may occur.[14]

On chest X-rays, pulmonary bullae appear as unilateral hyperlucency like that seen in pneumothorax. In addition, contralateral mediastinal shifts similar to that of a tension pneumothorax may occur.[15]

CASE DESCRIPTION

Case 1: this is a 45-year-old woman who presents to the emergency department complaining of sudden pain in the left hemithorax and dyspnea with oxygen saturation of 70%, she denies fever or cough, with a relevant history of prolonged exposure to biomass smoke as she has been cooking her food on a wood stove for 25 years; She also has systemic hypertension diagnosed a year ago and is being treated with metoprolol and enalapril.

During the physical examination, a decrease in respiratory thoracic movements is detected, with abolished pulmonary sounds and tympanic percussion in the left hemithorax. A follow-up chest X-ray was taken, revealing the presence of a giant bulla covering approximately 90% of the left hemithorax *(Fig. 1)*.

The thoracic surgery department was consulted and the patient was scheduled for a posterior thoracotomy with muscle preservation. The surgical procedure was performed successfully, removing all of the tissue affected by the bulla. A size 24 drainage tube was left in place and a follow-up chest X-ray was taken 15 days after the surgery, showing favorable clinical progress *(Fig. 2)*.

Case 2: a 25-year-old male patient, previously healthy, with no known significant personal medical history, non-smoker, no exposure to biomass, no previous history of lung disease or chest procedures. During a trip to a mountainous area (higher altitude above sea level), he presented with sudden onset of dyspnea, initially mild, which worsened with altitude. This was accompanied by stabbing-like chest pain, located in the left hemithorax, without radiation, which increased with deep inspiration.

A chest X-ray was performed, which reported a left pneumothorax in the apical region of the superior lobe. Subsequently, a chest CT scan was performed, confirming left pneumothorax in the upper lobe and the presence of bilateral subpleural cysts in the lung apices and left lung base, all less than 1 cm in size, and left basal subsegmental atelectasis *(Fig. 3)*.

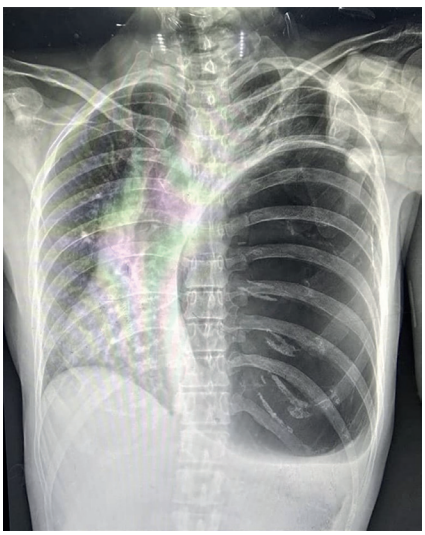

Figure 1:

Anteroposterior chest X-ray showing the presence of a giant bulla occupying 90% of the left hemithorax.

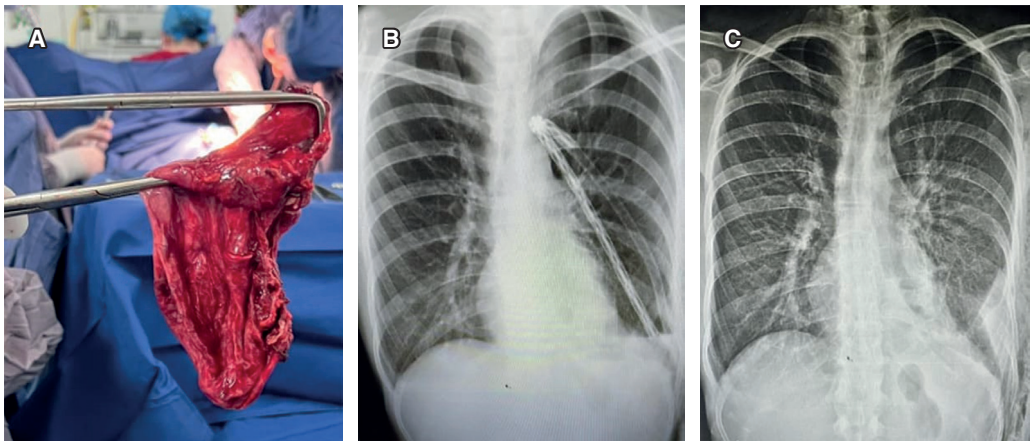

Figure 2:

A) Resection of the giant pulmonary bulla. **B)** Anteroposterior chest X-ray immediately after the surgical procedure. Placement of a size 24 Kardia Spiral pleural tube. **C)** Anteroposterior chest X-ray taken 15 days after the surgical procedure showing adequate re-expansion of the lung tissue with a favorable clinical outcome.

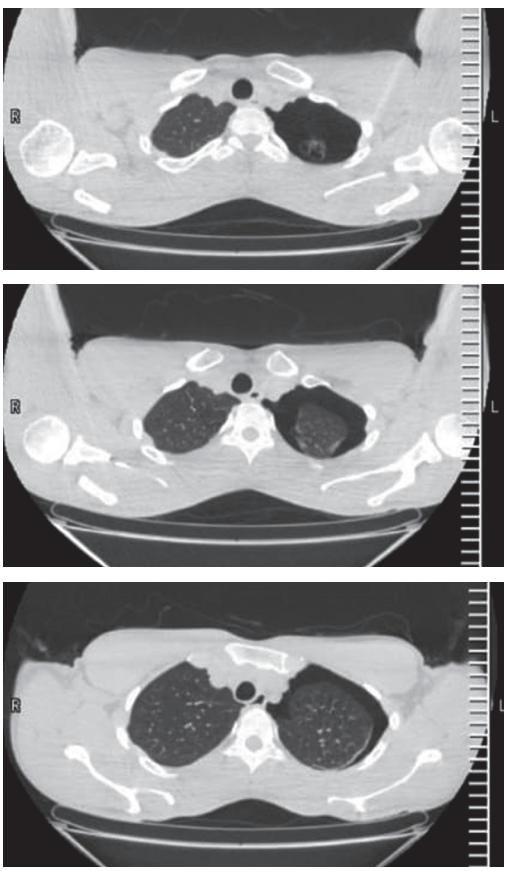

Figure 3: Axial chest tomography showing left pneumothorax predominantly affecting the upper lobe, bilateral apical subpleural cysts, and left basal cysts.

Regarding the surgical management of this patient, due to the size of the lesions, a minimally invasive approach was chosen using *video*-assisted thoracoscopic bullectomy with linear resection *(Fig. 4)*.

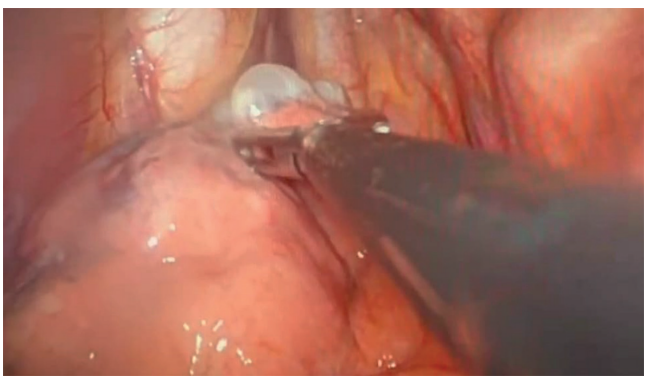

Figure 4: Minimally invasive approach using video-assisted thoracoscopic bullectomy with linear resection.

COMMENT

There are two surgical approaches to treating pulmonary bullae: an open approach using thoracotomy and a minimally invasive approach by thoracoscopy.

Thoracotomy is the preferred approach for emergency cases or for extensive defects affecting a large part of the lung tissue.[16] Another indication for thoracotomy is the presence of pachypleuritis, since when it is extensive (> 2 cm), open surgery is recommended. In addition, other researchers mention that recurrences are less frequent with thoracotomy than with video-assisted surgery.[17] Thoracotomy requires the use of selective bronchial intubation to allow airway management, favoring left or right lung collapse to facilitate surgical access to the affected lung.[18] However, the disadvantage is a longer recovery time due to tissue manipulation and a higher risk of infection.[19]

The video-assisted thoracoscopy approach has the benefit of being both a diagnostic and therapeutic procedure, widely used in the management of pleural effusions, lung biopsies,

or pneumothorax management.[20,21] This procedure has many advantages, such as shorter recovery time, reduced use of postoperative analgesics, and lower incidence of complications.[22] In addition, several authors mention that this type of approach is particularly effective in pediatric patients, minimizing intraoperative bleeding, achieving more cosmetic results, and shortening hospital stays.[23] Other authors mention that minimally invasive approaches in pediatrics provide a better quality of life in psychological and physical terms.[24] However, one of the possible disadvantages of this approach includes a longer duration of the surgery[25] and probably a higher total cost of the surgical procedure.[26]

CONCLUSIONS

Choosing the type of surgical approach for the treatment of pulmonary bullae remains controversial since several factors must be considered, such as the size of the lung flaw, as well as the patient's age, presence of comorbidities, risk of recurrence, among others. However, the best approach in managing this pulmonary pathology will always be the individualized treatment, where treatment and management are tailored to the characteristics of each patient.

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Funding: none.

Disclosure: the authors have no conflicts of interest to disclose.