

**ANAESTHESIA CONSIDERATIONS OF A PATIENT WITH LARGE
BULLOUS LUNG DISEASE- A CASE REPORT**

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ABSTRACT:

Introduction: A bulla is defined as an intraparenchymal air-filled space of more than 2 cm in diameter in distended state within the lung which has developed because of emphysematous destruction of the lung parenchyma and loss of alveolar structural tissue. Indications for surgical resection of bullae include incapacitating dyspnea, a large bulla that fills >30% of the hemithorax, as seen in this case. Patients with Lung emphysematous bulla are at increased perioperative risk of rupture & barotrauma resulting in tension pneumothorax & compromised respiratory status. After a meticulous clinical and radiological assessment, patients with bullae can be taken up for surgeries like local excision/bullectomy, lobectomy, segmental resection, and minimal access surgeries.

Case Report: We present an atypical case of a 26-year-old female with a large bulla measuring 16 x 21 x 17cm arising from left lower lobe with centrilobular emphysema with passive collapse of left upper lobe and gross mediastinal shift to the right, managed successfully using lung isolation technique and peri-operative pain management.

Conclusion: Anaesthetic management of a patient with lung bulla is challenging. Anesthesiologist should deliberate over an extensive preoperative assessment to identify the high-risk factors, reversibility of underlying lung pathology, need and dependency on mechanical ventilation, and establish a successful perioperative management plan for a smooth, pain free post-operative recovery in such patients. In this case, we describe the anaesthetic considerations of a patient with multiple large lung bullae underwent elective bullectomy under general anaesthesia. No serious complications occurred during intraoperative and postoperative course.

KEYWORDS: Lung Emphysematous Bulla, Pneumothorax, One-lung Ventilation, Vanishing Lung Syndrome, General Anaesthesia, Thoracotomy

CASE REPORT: 26year old female, para three, live births three, farmer by occupation, weighing 30kg with height of 145cm, non-smoker, known case of left lung emphysematous bulla with right mediastinal shift, emergency ICD tube was inserted on the left side under local anaesthesia about a year ago. In 2022, 2nd ICD tube inserted for the similar history, which was removed after 4 days as air leak had ceased. Currently she presented with complaints of grade 3 dyspnea and generalized weakness over a period of 1.5 months with loss of appetite for 15 days. No history of Tuberculosis or Asthma reported.

She had a successful operative history of emergency exploratory laparotomy for ileocaecal intussusception at 16 weeks of gestation in 2020 under general anaesthesia.

On hospital admission, she was afebrile, conscious, oriented and vitally stable. On general physical examination, she's poorly built and nourished. She showed no signs of cyanosis,

clubbing, pallor, icterus, and edema. Her BP recorded as 100/60mmHg, heart rate of 140/min, respiratory rate of 21/min and oxygen saturation was 84% on room air. Airway examination revealed adequate mouth opening, with Mallampati grade 1 with good dentition & unrestricted neck movements.

Systemic examination revealed reduced air entry on left lower lung zone with crepitations. Normal heart sounds with no murmur. Midline laparotomy incision of previous abdominal surgery had seen. A bulge on the left frontotemporal region was present since childhood. Non-itchy, hypopigmented lesions were seen over right scapular and neck region, dermatology reference confirmed as Becker's nevus.

Blood investigations were within normal limits. An electrocardiogram showed normal findings. The initial Arterial blood gas analysis showed the following findings: pH-7.216, PO₂-75.2mmHg, PCO₂- 70.8mmHg & HCO₃ -27.7mmol/L.

A Chest X-ray on admission showed multiple large cavitary lesion seen on left lower lung zone. PFT suggestive of Restrictive lung disease with small airway obstruction and poor bronchodilator reversibility with FEV1 of 28%, FVC of 27%, MVV <50% (1). USG Abdomen revealed asymptomatic hepatic cyst of benign etiology.



Fig 1: Chest Xray-PA view showed multiple rounded radiolucent structures in left lower lung Zone.

? Bullae

CT Thorax showed a large bulla of size 16 x 21x17cm arising from left lower lobe with centrilobular emphysema and chronic atelectasis of left upper lobe and posterior segments of left lower lobe & gross right mediastinal shift with compression of right lung.

CT Brain showed Fibrous Dysplasia without any evidence of intra-parenchymal lesions.

Ventilation-perfusion scan showed large left bulla with loss of lung parenchyma & normal perfusion in right lung.



Fig 2: X-Ray Abdomen

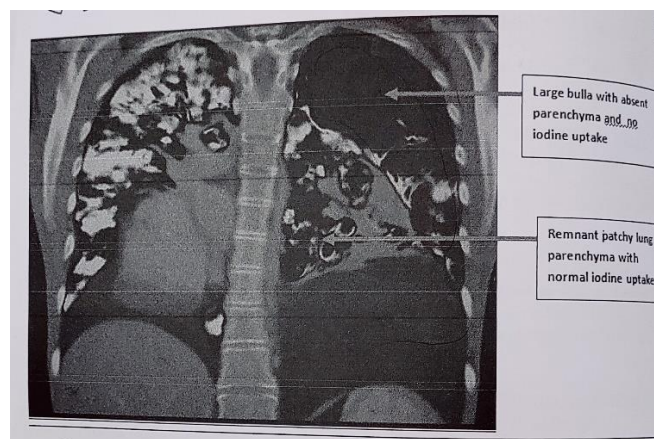
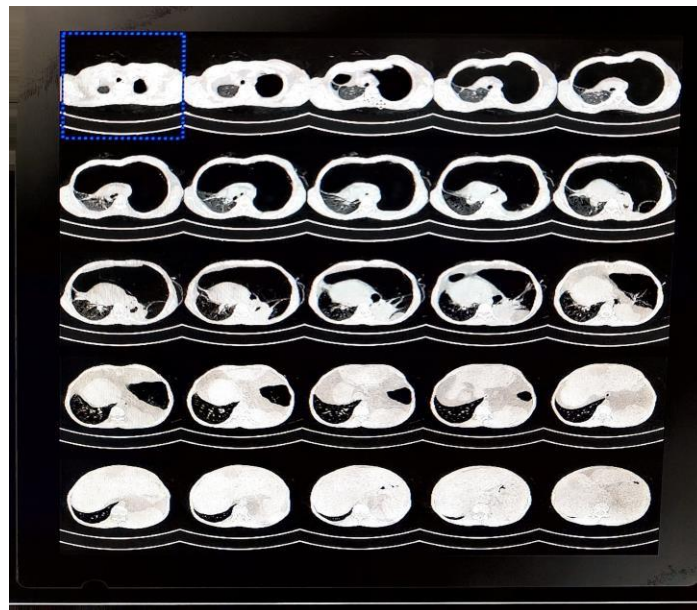


Fig 4: V-Q Scan showed large left bulla with loss of parenchyma and no iodine uptake.

She was planned for elective left lower lobe bullectomy under general anaesthesia.

On the day of surgery, PAC, consent, NBM status and investigations were confirmed, shifted inside the OT and multipara monitors including 5-lead ECG, NIBP, pulse-oximetry and 2 wide-bore 18-G peripheral intravenous cannula were secured. She was preoxygenated with 100% oxygen using facemask for 4-5minutes. After premedication with 0.6mg Midazolam and 80mcq fentanyl, anaesthesia was induced with intravenous Propofol 60mg and muscle relaxant succinylcholine 75mg. After 60sec of apneic oxygenation, the pharynx was sprayed with 10% lignocaine spray and a 35-Fr right-sided DLT was introduced with the help of a laryngoscope MAC blade 3. Correct positioning of the tube was confirmed with chest auscultation.



The ventilator settings were adjusted to minimize dynamic hyperinflation of lung with pressure support of 12-14cmH₂O, respiratory rate of 22-25breaths/min, no PEEP, I:E ratio was 1:2.5, keeping PIP less than 20cm H₂O and a high inspiratory flow rate to maximize expiratory time on PCV mode. Anaesthesia was maintained with 50:50 oxygen-air mixture, muscle relaxant Rocuronium and MAC of 0.5 Sevoflurane. A left radial artery catheter and right internal jugular venous catheter were placed.

She was positioned in the right lateral position and a left posterolateral thoracotomy was commenced. The patient was hemodynamically stable.

Once the pleura was opened & bullae were visualized, OLV was commenced by clamping the tracheal lumen to isolate the operated lung with pressure support of 14-15cmH₂O and high respiratory rate of 25-30breaths/min.

The bullae were stapled across its bases and eventually removed. No air-leak and proper ventilation was checked by the surgeons. Due to atelectasis of left upper lobe, left upper lobectomy was planned intraoperatively. After resecting the bulla, one-lung switched to double-lung ventilation and operated lung slowly expanded with a low tidal volume until complete lung re-expansion was observed with the improvement in oxygen saturation to 100%.

Afterwards, two intercostal chest tubes were inserted to drain pleural cavity. Patient transfused with 1.5L of crystalloid and one unit of blood intraoperatively for blood loss of around 400-500ml and urine output of 800ml.

At the completion of surgery, intercostal nerve block using injection 0.5% 10ml Bupivacaine was given by the surgeons to provide postoperative analgesia. Surgery went successful and uneventful.

DLT was replaced by single-lumen endotracheal tube of size 7.0mm. Once the patient was awake and breathing spontaneously, muscle relaxation was reversed using combination of Inj. Neostigmine 2.0mg and Glycopyrrolate 0.25mg, she was extubated smoothly and was then transferred to the CCU for next 24hours for postoperative care and later, shifted to thoracic ward on postoperative day 2. The arterial blood gas analysis picture on postoperative day 2 showed: pH-7.391, PO₂-36.6mmHg, PCO₂-261.4mmHg & HCO₃⁻ -22mmol/L on facemask. The postoperative day 3 chest X-ray showed near total opacification noted in the left hemithorax.

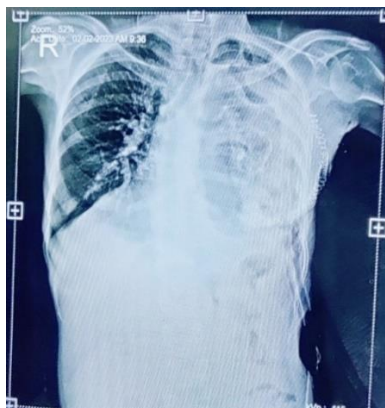


Fig 4: Day 3 Post-op CXR showing near total opacification noted in the left hemithorax

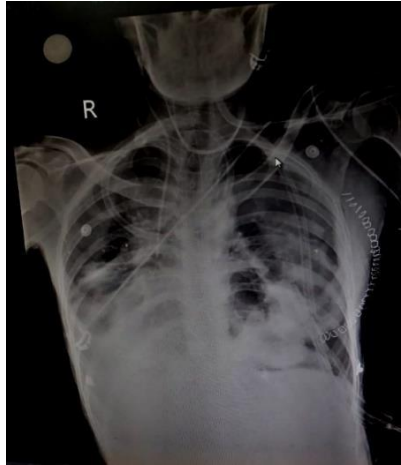


Fig 5: Day 7 Post-op CXR showing collapsed right lower lung and emphysematous changes noted in left upper lobe.

Incentive Spirometry and nebulization were continued afterwards and on day 12 post-operative, a repeat HRCT Thorax scan advised and revealed significant reinflation of right lung with mediastinum in normal position and mild reinflation of left lung. She is comfortable and maintaining well on room air.

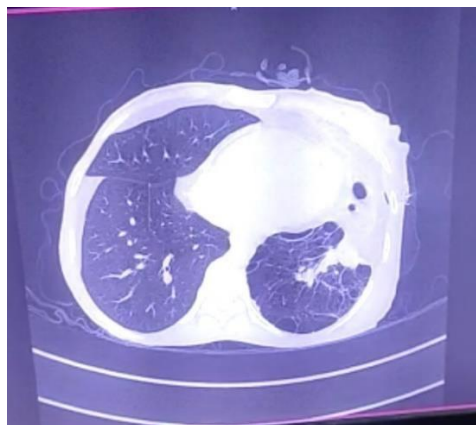


Fig 6: Day 12 Post-op HRCT Thorax revealed reinflation of left lung and right lung both.

DISCUSSION: An emphysematous bulla is also referred to as Vanishing lung syndrome, which was first described by Burke (2). In 1937, Burke described a case of bullae in a 35-year-old man who had progressive dyspnea, respiratory failure and radiographic and pathologic findings of bullae. Lung Bulla is defined as pathologically dilated air spaces of more than 2cm diameter distal to the terminal bronchioles. It is a rare manifestation of Chronic Obstructive Pulmonary Disease (COPD).

It mainly affects middle-aged tobacco smokers, younger marijuana users and those with alpha-1 antitrypsin deficiency. It is associated with Marfan syndrome, Ehlers-Danlos syndrome, alpha-1 antitrypsin deficiency. The bullae commonly involve the upper lobes with an asymmetric distribution and paraseptal location.

The bulla does not participate in bronchoalveolar oxygenation and causes dyspnea, hypoxia, chest pain, and/or hemothysis. This can result in spontaneous, or tension pneumothorax

complicated by mechanical ventilation, bullae infection, compressive atelectasis or even malignancy such as lung cancer (3). The incidence of lung cancer associated with emphysematous bullae has been reported to be 6.1%.

Positive pressure ventilation can cause the bulla to enlarge or rupture which can lead to bronchopleural fistula, inadequate ventilation and the risk of tension pneumothorax requiring an immediate ICD insertion. Rupture of the bulla wall may also occur with release of gas into the interstitial lung tissue resulting into episodes of mediastinal and subcutaneous emphysema without evidence of pneumothorax.

The clinical and radiographic picture of bullae may initially be misinterpreted as spontaneous pneumothorax. High resolution Computerized tomography (HRCT) is the best imaging technique to determine the extent and distribution of bulla for suitability of lung volume reduction surgery and to differentiate bullae from pneumothorax.

The management of bullous disease can be conservative or surgical resection referred as Bullectomy. Total resection of the bulla is important due to risk of development of bronchogenic carcinoma in later life (5). Bullectomy can be performed with conventional thoracotomy or via VATS. A non-excisional treatment option is the Brompton technique, first described by Monaldi. In this technique, the bulla is drained percutaneously, and a mushroom Foley catheter is left behind after septectomy(3).

Bullectomy helps in recruiting alveoli compressed by bullae, improves ventilation-perfusion ratio and improves airflow (7,8). It is indicated for expanding bulla, repeated pneumothoraces due to bullous rupture or compression of normal or adjacent lung tissue.

The postoperative complications would be prolonged air leak, atrial fibrillation, prolonged mechanical ventilation, pneumonia and postoperative incisional pain (4). One of the most difficult postoperative complications is persistence air leakage which can prolong hospital stay significantly (6).

Anesthetic considerations for management of this case includes use of a double-lumen endobronchial tube to isolate operated lung while allowing ventilation of the contralateral lung. One lung ventilation would improve surgical access to the operated lung. An inhalational induction was instituted to avoid IPPV and maintenance of airway. Avoidance of nitrous oxide for the risk of expansion or rupture of the bulla resulting in life-threatening tension pneumothorax or pneumopericardium. The patient also needed a high inspired oxygen concentration to maintain adequate arterial oxygen saturations. Keeping Peak inspiratory pressure less than 20cm H₂O, tidal volume of 5-6ml/kg of ideal body weight, no application of PEEP, increase expiratory time to prevent air trapping (I:E ratio-1:2.5 or 3) and early extubation.

ABBREVIATIONS:- DLT: Double-lumen tube, ICD: Intercostal drainage tube; CT: Computed Tomography; HRCT: High resolution CT scan; PFT: Pulmonary Function Test; FEV1: Forced expiratory volume at 1 second; EtCO₂: End-tidal CO₂; VATS: Video-assisted thoracic surgery; VLS: Vanishing Lung syndrome; PEEP: Positive end-expiratory pressure; IPPV: Intermittent Positive pressure ventilation; OLV: One-lung Ventilation; PCV: Pressure controlled volume; PIP: Peak Inspiratory Pressure; I:E- Inspiratory:Expiratory.

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