

Anaesthetic Challenges in a High-Risk Geriatric Patient with Obstructive Sleep Apnea, Pectus Carinatum, Poor Exercise Tolerance and Cardiac Ailment

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Abstract

Introduction: This case involves a 70-year-old male with obesity, hypertension, diabetes, smoking history, and COPD-like symptoms. Notably, he has obstructive sleep apnea (OSA) and pectus carinatum deformity, posing unique challenges. A past cardiac intervention adds further complexity.

Case presentation: The patient's OSA heightens perioperative respiratory risks, while pectus carinatum complicates airway management during open cholecystectomy. Comprehensive preoperative assessments, including cardiac evaluations, were crucial.

Conclusion: Successful anaesthetic management hinged on tailored strategies and interdisciplinary collaboration. This case underscores the significance of meticulous preoperative evaluation in navigating complexities arising from comorbidities and anatomical anomalies.

Keywords: Anaesthesia, Obesity, OSA, Pectus carinatum, Perioperative care.

Introduction

Pectus carinatum is a congenital chest wall deformity characterized by a sunken sternum, which can have significant implications for anaesthetic management, particularly with respect to airway access and respiratory function. The deformity can create anatomical challenges that complicate intubation, ventilation, and overall anaesthetic management [1,2].

The depression of the sternum can restrict lung expansion, leading to reduced tidal volumes and decreased functional residual capacity (FRC). This restrictive pattern is more pronounced when the deformity is severe, contributing to impaired oxygenation and ventilation, particularly under general anaesthesia, when respiratory drive is suppressed and respiratory compliance is further compromised. The reduced lung volumes can also predispose to atelectasis, particularly in the dependent lung during one-lung ventilation or in the lateral decubitus position.

It can be more difficult to visualize and protect the airway when pectus carinatum distorts the typical architecture of the upper airway. The chest wall deformity may cause narrowing of the thoracic inlet and increase the risk of difficult intubation, especially in the absence of prior imaging studies to evaluate the airway. The deformity may also hinder optimal positioning for endotracheal intubation and mask ventilation [3,4].

In moderate to severe cases, the anteriorly displaced sternum can exert direct pressure on the heart, particularly the right ventricle, leading to impaired cardiac output and reduced venous return. This may

complicate hemodynamic management during anaesthesia, especially in cases of preexisting cardiac conditions. Additionally, the deformity can affect thoracic compliance and increase intra-abdominal pressure, further compromising cardiovascular function.

Due to the restrictive nature of the deformity, patients are at increased risk for hypoventilation, particularly when anaesthetized. This risk applies during both controlled and spontaneous ventilation, as the combination of a suppressed respiratory drive and mechanical airway limitations can significantly increase the likelihood of hypoxia. The altered chest configuration may also interfere with the diaphragm's movement, further limiting effective ventilation and gas exchange.

The combination of reduced lung compliance, potential airway obstruction, and cardiovascular compromise necessitates meticulous preoperative planning. Fiberoptic intubation or video laryngoscopy may be required to manage the airway safely. Positive pressure ventilation and close monitoring of oxygenation and ventilation are critical, particularly during induction and emergence from anaesthesia, to prevent hypoxemia and hypercapnia. Additionally, volume-controlled ventilation strategies should be considered to optimize oxygenation and minimize the risk of barotrauma.

Case Report

The patient is a 70-year-old obese male, a shopkeeper by occupation, who was admitted for cholecystectomy surgery at the district hospital due to symptomatic cholelithiasis. He had been experiencing recurrent right upper quadrant pain, nausea, and occasional vomiting

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Figure 1: pectus carinatum in supine



Figure 2: pectus carinatum in sitting

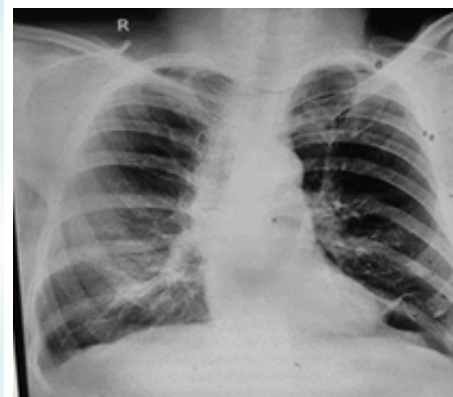


Figure 3: Chest X-ray PA view

over the past few months, which did not resolve with conservative management.

The patient has a long history of weight management issues spanning over two decades, with a weight of 93 kg and a BMI of 31 kg/m². A largely sedentary lifestyle, limited by joint discomfort and progressive breathlessness, has made it challenging for him to lose weight. Approximately eight years ago, he was diagnosed with chronic obstructive pulmonary disease (COPD) and had been managing his symptoms with Tiotropium 18 mcg inhaled once daily and Salmeterol 50 mcg inhaled twice daily, which provided some symptomatic relief. His recent pulmonary function tests (PFT) indicated an FEV1 of 55% predicted and an FEV1/FVC ratio of 0.58, consistent with moderate airflow obstruction. His exercise capacity was limited, with an estimated functional capacity of less than 4.0 METs, as he experienced significant fatigue and shortness of breath after minimal exertion, such as walking for 10-15 minutes or climbing one flight of stairs. His symptoms of breathlessness had gradually worsened over time, limiting his ability to engage in strenuous activities.

Four years ago, a sleep study confirmed the diagnosis of obstructive sleep apnea (OSA), with an apnea-hypopnea index (AHI) of 32 events per hour, indicating moderate severity. CPAP therapy was recommended; however, the patient reported poor adherence due to discomfort with the mask. A follow-up sleep study conducted shortly before admission reconfirmed moderate OSA, with an AHI of 30 and frequent episodes of nocturnal hypoxemia, where oxygen saturation levels dropped to 85%.

The patient reported progressively worsening orthopnea accompanied by increasing fatigue and daytime somnolence, while family observations of disrupted nocturnal breathing with apneic episodes and gasping suggest the presence of obstructive sleep apnea. About a decade ago, the patient reportedly experienced a cardiac event and was briefly hospitalized, although no specific records were available. His family recalled that he had episodes of chest pain and high blood pressure, but he had not pursued any further cardiology follow-up afterward. He had been taking Metoprolol 50 mg daily as a preventive measure but had not undergone any recent cardiac evaluations. His exercise tolerance was limited and he frequently experienced fatigue and shortness of breath with minimal exertion.

The patient also had a 10-year history of type 2 diabetes mellitus, managed irregularly with medication. Despite inconsistent

adherence, his HbA1c during this admission was 6.3%, indicating reasonable glycemic control, and serial blood glucose levels remained within acceptable ranges. This stable HbA1c suggested that his diabetes was relatively well-managed at the time, though his history of irregular medication use highlighted the need for consistent follow-up to prevent potential long-term complications.

The patient had a significant smoking history totaling 45 pack-years. Although he had successfully quit smoking five years prior, he had recently relapsed due to stress and was smoking approximately five cigarettes per day. His family expressed concern about this return to smoking, particularly given his COPD and previous cardiac history. Additionally, the patient had a history of pectus carinatum, a chest wall deformity present since birth. Although mild in his early years, the condition had progressively limited his respiratory function, especially as he aged. The pronounced anterior chest wall prominence further restricted lung expansion, adding to his respiratory challenges in the setting of COPD and obesity. Despite recommendations for corrective bracing during childhood, he had not pursued any treatment for this condition, which remained untreated. The combined impact of pectus carinatum, COPD, and obesity further contributed to his limited exercise tolerance and chronic breathlessness.

Current medications on admission included Tiotropium 18 mcg inhaled once daily, Salmeterol 50 mcg inhaled twice daily, Metoprolol 50 mg taken orally once daily, Atorvastatin 20 mg taken orally at bedtime for dyslipidemia, and Pantoprazole 40 mg taken orally once daily before breakfast for gastroesophageal reflux disease (GERD).

Preoperative Assessments

Preoperative evaluation of this 70-year-old male focused on optimizing management of multiple comorbidities, including COPD (FEV1 55%), obstructive sleep apnea (AHI 32), obesity (BMI 31), type 2 diabetes, and a history of cardiac symptoms. He had limited functional capacity (less than 4 METs) and a significant smoking

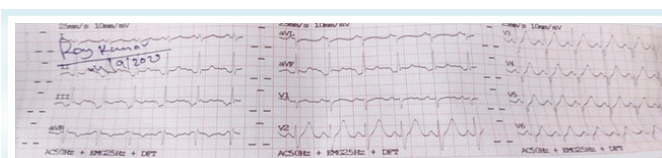


Figure 4: ECG

history (45 pack-years) with recent relapse.

On physical examination, his vital signs were as follows: blood pressure (BP) of 145/90 mmHg, heart rate (HR) of 84 beats per minute, respiratory rate (RR) of 18 breaths per minute, and SpO₂ of 94% on room air. His Mallampati score was Class III, indicating a potentially difficult airway, and neck mobility was slightly restricted due to his obesity. His blood glucose levels were stable, with an HbA1c of 6.3%, suggesting reasonably well-controlled diabetes. The ECG showed normal sinus rhythm without significant ischemic changes, but no recent cardiology follow-up had been done. Given his comorbidities, the airway was assessed as potentially difficult, and management strategies like preoxygenation, Bougie or Stylet-Assisted Intubation, video laryngoscopy, Supraglottic Airway Devices and possibly fiberoptic intubation were considered. Laboratory tests and imaging revealed no acute concerns. Overall, his preoperative evaluation was focused on minimizing the risk of respiratory and cardiac complications, ensuring safe anaesthesia management, and addressing his comorbid conditions appropriately

- **Cardiac Consultation:** The patient underwent a thorough cardiac evaluation, which included ECG (Fig. 4), an echocardiogram. Fortunately, the echocardiogram revealed normal cardiac function.
- **Respiratory Evaluation:** Given the patient's history of chronic smoking, COPD-like features, and pectus carinatum deformity, a detailed respiratory assessment was conducted. This evaluation aimed to assess the patient's baseline lung function and identify potential perioperative respiratory complications (Fig. 3).
- **Pectus carinatum Deformity:** The patient's pectus carinatum deformity posed challenges in airway management [3, 4]. There was no scoliosis or any other spinal deformity. Lateral view of x ray chest showed abnormal outward protrusion of 2nd to 8th costal cartilage. Chest x-ray showed prominent bronchovesicular markings.

Type of Anaesthesia

General anaesthesia was chosen for this patient due to the complexity of the open cholecystectomy, which required complete immobility and airway control. Given the patient's history of COPD, OSA, and obesity, along with moderate airway challenges (Mallampati Class III, limited mouth opening), general anaesthesia allowed for secure endotracheal intubation, ensuring controlled ventilation and minimizing the risk of hypoxemia during the procedure. Additionally, general anaesthesia provided optimal conditions for preoxygenation, apneic oxygenation, and postoperative pain management, while also preventing potential discomfort or anxiety, given the patient's existing respiratory issues and previous challenges with sedation.

Anaesthesia procedure

Given the patient's significant comorbidities, including COPD, OSA, and obesity, intubation was performed under general anesthesia using a standard approach. Preoxygenation was done for 3-5 minutes using 100% oxygen via a facemask to maximize the oxygen reserves before the induction. After ensuring optimal preoxygenation, induction was initiated with Propofol 2 mg/kg intravenously, achieving rapid onset and deep sedation. To provide adequate muscle relaxation and facilitate intubation, a neuromuscular blocker, Rocuronium 0.6 mg/kg was administered, ensuring paralysis for smooth intubation.

Given the patient's moderate airway difficulty (Mallampati Class III, restricted mouth opening), direct laryngoscopy was performed, and an endotracheal tube (ETT) of size 8mm was successfully placed after visualizing the glottis.

Once the ETT was secured, anesthesia was maintained with a combination of Sevoflurane 1-2% in oxygen and nitrous oxide, with remifentanyl infusion at 0.05-0.1 mcg/kg/min for intraoperative analgesia. Opioid analgesia was provided via Fentanyl 50-100 mcg intravenously, based on the surgical stimulation. Invasive monitoring was established, including blood pressure and capnography, to ensure optimal hemodynamic stability. Maintenance fluids included lactated Ringer's solution, and postoperative analgesia was planned with Paracetamol 1 gm IV and Fentanyl boluses, with consideration for additional NSAIDs as per the patient's risk profile. Given the patient's risk of postoperative respiratory complications, careful monitoring of SpO₂, ET CO₂, and ventilator parameters was ensured throughout the procedure.

Challenges encountered

Difficult intubation

Given the patient's history of COPD and OSA, it is highly likely that both preoxygenation and apneic oxygenation were performed. Preoxygenation would have been carried out to optimize oxygen reserves, improving the patient's oxygen saturation before intubation. This is especially important in patients with respiratory compromise to delay desaturation. Additionally, apneic oxygenation, using oxygen delivery via nasal cannula or similar devices, have been employed during intubation to maintain oxygen levels while the patient was apneic, preventing rapid desaturation, a crucial step in patients with compromised lung function. Both techniques have helped minimize risks and support successful intubation in this patient.

Pre operatively all the preparation for difficult intubation along with expert help was arranged. Close collaboration among three senior Anaesthetists was required to perform a difficult intubation (Cormack laryngoscopy grade III and IV views), involving 2+1 (as per DAS guideline) attempt with a stellate bougie and ramping techniques. His Mallampati score is Class III, suggesting limited visibility of the airway, and his thyromental distance measures 5 cm, which may complicate intubation. The inter-incisor gap is <4 cm, further challenging airway access. The patient has a preoperative SpO₂ of 94% on room air, and his exercise capacity is approximately 4 METs, limited by significant shortness of breath with minimal exertion.

Awake fiberoptic intubation was not performed in this case primarily because the patient's airway, while presenting moderate challenges due to pectus excavatum and COPD, was not deemed to pose an immediate threat to airway patency. The Mallampati score and thyromental distance suggested moderate difficulty, but not a high-risk scenario that would necessitate awake fiberoptic intubation. Additionally, the patient had a history of OSA and fatigue, which could have made remaining conscious during the procedure uncomfortable and challenging. Given the setting at a district hospital, where fiberoptic equipment and specialized personnel might not be readily available, standard laryngoscopy was deemed the most practical and feasible option. Furthermore, the patient was stable with an SpO₂ of 94% on room air, and there was no history of a

difficult airway or previous intubation issues, leading the anaesthesia team to opt for the less invasive and more commonly performed laryngoscopic intubation.

Intraoperative Anaesthetic Challenges

a. In the intraoperative period, the patient's peak airway pressure was elevated, ranging between 30-35 cm H₂O, primarily due to the increased airway resistance associated with obesity and COPD. Ventilation was managed using Assist-Control mode on the ventilator with a respiratory rate (RR) of 12-14 breaths/min and FiO₂ at 0.4-0.5 to maintain adequate oxygenation. The tidal volume was set at 6-8 mL/kg of ideal body weight to minimize over-distension of the lungs, and end-tidal CO₂ (ETCO₂) was monitored, showing levels of 40-45 mmHg, slightly elevated due to the patient's impaired gas exchange. The oxygen saturation (SpO₂) remained stable at 95-98%, indicating satisfactory oxygenation. In terms of arterial blood gas (ABG) values, the pH was within the normal range of 7.35-7.45, with PaCO₂ slightly elevated at 40-45 mmHg, reflecting mild CO₂ retention due to his underlying respiratory condition. The PaO₂ was maintained at 80-100 mmHg, ensuring adequate oxygenation under controlled ventilation. His HCO₃ level remained within the normal range (24-28 mEq/L), and the base excess was between 0 to -2 mEq/L, consistent with stable metabolic status. These values were indicative of effective respiratory management during the procedure. Continuous positive airway pressure (CPAP) therapy was planned for the postoperative period to mitigate these risks.

b. In the intraoperative period, the patient's hemodynamic stability was closely monitored, given his age, obesity, and cardiac history. His blood pressure (BP) was maintained at 130/80 mmHg using intravenous fluids as needed to counteract any intraoperative hypotension, which can be common in obese patients due to decreased cardiac output and venous return. The patient received intravenous fluids at a rate of 5-7 mL/kg/hour, totaling approximately 350-490 mL per hour, based on his ideal body weight. Lactated Ringer's solution was the main crystalloid used for maintenance, with a total of 2-3 liters administered throughout the procedure, adjusted according to intraoperative blood loss and urine output. Blood loss

was minimal, approximately 50-100 mL, and was replaced with crystalloids to maintain circulating volume. The heart rate (HR) remained stable at around 80-90 bpm, with intermittent increases during surgical stimulation, managed with boluses of fentanyl for analgesia. Central venous pressure (CVP) was monitored to guide fluid resuscitation, and the patient required a careful balance to prevent fluid overload, which could exacerbate respiratory and cardiac issues. Throughout the procedure, arterial blood pressure was tightly controlled, with mean arterial pressure (MAP) kept above 65 mmHg to ensure adequate perfusion to vital organs. Urine output was maintained at 0.5-1 mL/kg/hour, indicating appropriate fluid balance. No significant arrhythmias were noted, and the patient's hemodynamic status was managed with appropriate adjustments to fluid administration and medications to ensure stable cardiovascular function.

Postoperative Care

1. Pain Control: Postoperatively, the patient received intravenous fentanyl and paracetamol for effective pain management.
2. Postoperative CPAP Therapy: Due to the high risk of postoperative respiratory complications in OSA patients, the patient was placed on CPAP therapy immediately after extubation in the ICU to prevent airway obstruction and maintain oxygenation.

Conclusion

This case highlights the intricate management of a high-risk patient with OSA, pectus carinatum deformity, and complex medical comorbidities during open cholecystectomy. Despite numerous challenges, including airway difficulties and respiratory concerns, the collaboration among cardiac, medical, Anaesthesia, and surgical teams played a pivotal role in ensuring the patient's safety and successful perioperative care. The utilization of CPAP therapy in the postoperative period proved crucial in managing OSA-related risks effectively. The case also emphasizes the importance of addressing respiratory issues in patients with pectus carinatum deformity to optimize perioperative outcomes.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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