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Clinical Communication

Anterior mediastinal masses: A single centre-based retrospective study

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ABSTRACT

Background: Anterior mediastinal masses pose a serious challenge to anaesthetists and surgeons alike. It is sometimes associated with a severe cardiorespiratory compromise during surgery. The aim of this study was to evaluate the incidence of difficulty in airway management, intraoperative cardiorespiratory and postoperative complications in patients undergoing surgery for anterior mediastinal mass excision.

Materials and Methods: We conducted a single centre-based retrospective observational study of the data of patients with anterior mediastinal mass who were treated surgically between February 2016 to January 2021. All the data of the patients were kept confidential. Data were collected from electronic medical records, operation theatre records, anaesthesia charts, intensive care unit (ICU) records, and discharge sheets. Demographic data, medical history, and preoperative imaging investigations were noted. The difficulty in airway management, amount of blood loss, blood transfusion, and other significant events during the intraoperative period were noted. In the postoperative period, the duration of mechanical ventilation, re-exploration, duration of ICU stay, hospital stay, and other complications were recorded.

Results: In our study, no patient suffered difficulty in intraoperative airway management(N=29). The intraoperative complication was seen in 13% of cases in the form of significant hemodynamic compromise. No patient underwent re-exploration. The mean blood loss during surgery was 455 ml. The mean duration of postoperative mechanical ventilation was 17 hours, and the ICU stay was 2.3 days. Postoperative complications were seen in 6% of cases (2 patients).

Conclusion: Despite best management, some complications may happen in this subset of patients. A comprehensive multidisciplinary approach can minimize the risk of catastrophic hemodynamic and airway compromise during surgical excision.

1. Introduction

Anterior mediastinal masses are in close proximity to the heart, important vascular structures, and major airways. Clinically, they can be asymptomatic or can present due to compression of nearby structures, nerves, or myasthenia gravis. Fatal airway collapse may occur in these patients during general anesthesia (GA), and this complication is more pronounced in paediatric patients. [1,2]

The main aim of this retrospective observational study was to evaluate the challenges in perioperative anaesthetic management of patients undergoing surgery for anterior mediastinal mass excision.

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2. Aims and Objectives

2.1. Primary outcome

To evaluate the incidence of difficulty in airway management, perioperative cardiorespiratory, and postoperative respiratory complications in patients undergoing surgery for anterior mediastinal mass excision.

2.2. Secondary outcome

1. To note the duration of mechanical ventilation, intensive care unit stay, hospital stay, and other complications in the postoperative period.

3. Materials and Methods

After the Institute Ethical Committee's approval, we conducted a single-centre-based retrospective observational study of patients with anterior mediastinal masses who were treated surgically between February 2016 to January 2021. We conducted a retrospective study of the last five years because only those case files could be retrieved from the medical record section of our institute. All the patient data was kept confidential. Data was collected from electronic medical records, operation theatre records, anaesthesia charts, ICU records, and discharge sheets. Demographic data, medical history, and preoperative imaging investigations were noted. The difficulty in airway management, amount of blood loss, blood transfusion, and other significant events during the intraoperative period were noted. In the postoperative period, the duration of mechanical ventilation, re-exploration, duration of intensive care unit stay, hospital stay, and other complications were recorded.

3.1. Statistical analysis

All the data was noted on a Microsoft Excel sheet (Microsoft 365) and statistical analysis was done using SPSS software Version 22.0 (IBM Corp., Armonk, NY, USA). Qualitative variables were presented as mean, and quantitative variables were reported as numbers and percentages.

4. Results

In our study period, 29 patients underwent anterior mediastinal mass surgery or excisional biopsy. Their mean age was 29 years, and the patient's age ranged from 9 to 68 years. There were 20 male and nine female patients.

Excision was approached via median sternotomy in 26 patients and via thoracotomy in 3 patients. Anaesthesia was induced intravenously with fentanyl and thiopentone/etomidate. Intubation was done with direct laryngoscopy after administering rocuronium in all patients. Lung isolation with a double-lumen tube (DLT) was achieved in 5 cases. There was no intraoperative hypoxemia related to airway obstruction in any of the patients. Four patients (13%) exhibited intraoperative complications in terms of hemodynamic instability and injury to nearby structures. A 16-year-old male who underwent debulking surgery for a mediastinal germ cell tumour had intermittent brief hypotension due to surgical manipulation and blood loss. Another 10-year-old child with a nonseminomatous germ cell tumour post chemotherapy had massive blood loss during surgery, resulting in hypotension and ventricular fibrillation, managed with cardiopulmonary resuscitation (CPR) and two direct current (DC) cardioversion shocks, vasopressor boluses and infusions, blood, and blood product transfusions. In an 11-year-old child with adherent embryonal rhabdomyosarcoma left pulmonary artery (LPA) had a rent during adhesiolysis. Immediately emergency CPB was instituted, and LPA platy was done using pericardium. He had an episode of seizure on postoperative day 2. Non-contrast CT (NCCT) head was normal. His left dome of the diaphragm was shifted upward in chest X-ray (CXR) compared to preoperative CXR. His duration of mechanical ventilation was 7 hours, and he had no difficulty in breathing during the postoperative period. Intraoperatively, a 45-year-old man with malignant thymoma and preoperative chemotherapy was found to have a 15x20 cm large, vascularized tumour, densely adhered with surrounding vascular structure. Excision was attempted on CPB for 2.5 hours, but tumour could not be excised, so surgery was abandoned. He had a massive transfusion during the intraoperative period and was shifted to the ICU on vasopressors infusion. He developed acute kidney injury (AKI) and underwent one cycle of hemodialysis in the postoperative period, although the AKI was later resolved. He was difficult to wean from mechanical ventilation, so tracheostomy was done, and he was later discharged two months after surgery with home-based oxygen therapy. Postoperative complications were seen in 2 cases and were seizures, phrenic nerve palsy and AKI.(6%).

The average blood loss during surgery was 455 ml. Blood was transfused in 12 patients; the mean transfusion was two units. The mean duration of mechanical ventilation and ICU duration was 17 hours and 2.3 days, respectively. None of the cases were reexplored. The average length of stay in the hospital from operation admission to discharge was 10.5 days.

5. Discussion

In this retrospective review, we intended to describe our last five years of clinical experience in patients undergoing surgery/excision biopsy for anterior mediastinal mass. We identified a 13% incidence of intraoperative complications. There was no intraoperative hypoxemia related to airway obstruction in any patients. The incidence of intraoperative airway obstruction in our series was 0%. A study by Philip M et al. also observed no worsening of central

airway compression in adults with large mediastinal masses when induction, positive pressure ventilation, and paralysis were introduced in a staged manner.[3] The incidence of intraoperative airway obstruction in our series was similar to a study by Bechard P et al.[2] Airway compromise did not occur in any patient in their study, despite some of the patients having severe compression of the tracheobronchial tree as determined by preoperative CT scans and bronchoscopic evaluation. It is a consensus to proceed with stepwise induction and avoid deep sedation.[4] It has been agreed that no single agent is superior to another one and that any agent should be used judiciously to retain spontaneous ventilation. Infants and small children may be more susceptible than adults to extrinsic airway obstruction because the airways are more compressible. Also, small decreases in airway diameter produce relatively larger decreases in the tracheal luminal area and increases in airway resistance. In our study, the mean age of the patient is 29 years, so our study mainly comprises adult patients. This may be the reason for no airway obstruction in our study.

The proximity of anterior mediastinal masses to major vascular structures in the thorax enhances the risk of vascular injury during tumour excision, as observed in one of our patients who suffered an intraoperative LPA injury. Two post-chemotherapy patients had intraoperative hemodynamic compromise due to surgical manipulation and blood loss. The procedure may be abandoned, and massive transfusion may be required during the intraoperative period, as happened in one of our patients. Cancer patients are at a greater risk of significant bleeding due to tumour-related factors such as proximity or invasion of major vascular structures or hypervascularization of the cancerous tissue.[5] In the study by Jahangir N et al., the decision not to proceed for excision was taken in 2 cases, as extensive growth of tumour involved surrounding vital structures.[4] In a study by Agathos EA et al., a large middle mediastinal mass completely encircled the right pulmonary artery and was not detachable from the artery. So, the tumour was resected along with the involved segment of the pulmonary artery on CPB, and the pulmonary artery defect was repaired using a knitted double velour graft.[6] From the surgeon's standpoint, the assistance of CPB can greatly facilitate tumour dissection. On the other hand, systemic heparinization during CPB can increase the risk of hemorrhagic complications during tumour dissection and postoperative bleeding.[7]

The post postoperative in our study were seizure, phrenic nerve palsy and AKI. Following CPB, the pathophysiological reasons for generalized seizures are multifocal injury, small emboli, or inadequate cerebral blood flow. Periods of hypotension may reduce blood flow, causing ischemic brain injury to vulnerable territories or preventing micro-emboli clearance within the smaller vessels.[8] The phrenic nerve can be invaded by mediastinal tumours, especially those larger than 10 cm, and is highly susceptible to injury during surgery.[9] The recovery time of phrenic nerve injury is commonly between 6 and 12 months. Patients can recover spontaneously with respiratory exercises if the symptoms are mild, such as in this case of unilateral phrenic nerve injury. In a study by Bechard P et al., postoperative respiratory complications were pneumonia, airway edema, and atelectasis. All life-threatening respiratory events occurred in the first 48 postoperative hours. Nevertheless, they found a relatively high incidence of early life-threatening respiratory complications in the postoperative period (6.7%). The first 48 postoperative hours seem crucial in this regard.[2]

In the postoperative period, one of our patients suffered from AKI. Insufficient renal flow due to hypotension or massive transfusion could have contributed to AKI in this patient. Intraoperative PRBCs transfusion modulates the release of inflammatory mediators in patients undergoing CPB by enhancing the inflammatory response and by direct transfusion of bioactive substances.[10]

6. Limitations

The study was done in a single centre, and the total number of subjects was small for a retrospective study (N =29). Incomplete and inaccurate medical records could have influenced the number of intraoperative and postoperative complications we got in our study. The youngest patient in our study was nine years old, and the mean age of our study population was 29 years. So, it is not a representation of the pediatric age group.

7. Conclusion

The anterior mediastinal masses are a major perioperative challenge because of concomitant encroachment and invasion of adjacent vital structures such as the heart, major vessels, and central airways. Apart from the most feared airway complications associated with mediastinal mass excision anaesthetists must also be very aware of hemodynamic compromise due to excessive blood loss or inadvertent injury, which may sometimes necessitate the need to go on CPB. These intraoperative hemodynamic complications may increase postoperative patient morbidity. Intensive monitoring with an arterial line, generous intravenous access for volume resuscitation, availability of blood, defibrillator, and thorough preparation for clinical rescue, including cardiopulmonary bypass, are crucial for successful management.

8. Source of Funding

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9. Conflict of Interest

None.

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