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CLINICAL REPORT

Large mediastinal tumor in a neonate: an anesthetic challenge

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Abstract Mediastinal tumors pose a grave risk of cardiopulmonary complications during the perioperative course, particularly in neonates and small children. These tumors can cause displacement and compression of vital thoracic structures such as the tracheobronchial tree, the heart, and the great vessels. Catastrophic complications often occur during induction of anesthesia, use of muscle relaxants, positioning, and at the time of extubation. We present our experience of anesthetic management of a neonate with a mediastinal mass who had features of both airway and vascular obstruction.

Keywords Mediastinal mass · Superior vena cava syndrome · Neonate

Introduction

Patients with mediastinal mass present a grave risk of cardiopulmonary complications during the perioperative course. Infants and small children, however, have airways that are more compressible but are more susceptible than those of adults to extrinsic airway obstruction [1]. Large mediastinal tumors in the pediatric age group are challenging for the operative team, especially when these tumors are adjacent to major airway or vascular channels.

Catastrophic complications often occur during induction of anesthesia, use of muscle relaxants, positioning, and at the time of extubation. Anesthetic induction can result in loss of airway control in compromised airway or hypotension caused by reduced venous return or compression of major blood vessels, leading to life-threatening complications. The ability to identify patients and predictions of these complications in mediastinal masses is limited. Anesthetic management is often more difficult than in adults because appropriate equipment is not available. We present our experience of anesthetic management of a neonate with a mediastinal mass who had features of both airway and vascular obstruction.

Case summary

A 1-month-old male baby, weighing 3.2 kg with height of 60 cm, was admitted with history of excessive crying and breathlessness, especially on feeding, from the time of birth. He was born at 37 weeks of gestation with birth weight of 2.7 kg. The child had stridor, difficulty in breathing, and cyanosis, which was worse in the supine position. Clinical examination showed facial periorbital edema, conjunctival suffusion, and suprasternal retraction. Room air oxygen saturation measured by pulse oximetry (right upper limb) in the supine and prone positions was 88% and 92%, respectively. Hence, for investigation of the cause, the baby was nursed in prone position, and oxygen supplementation was done, which raised the saturation to 96%. A chest X-ray (Fig. 1) showed a large heterogeneous opacity merging with the heart shadow, extending to the left side and displacing the trachea to the right side.

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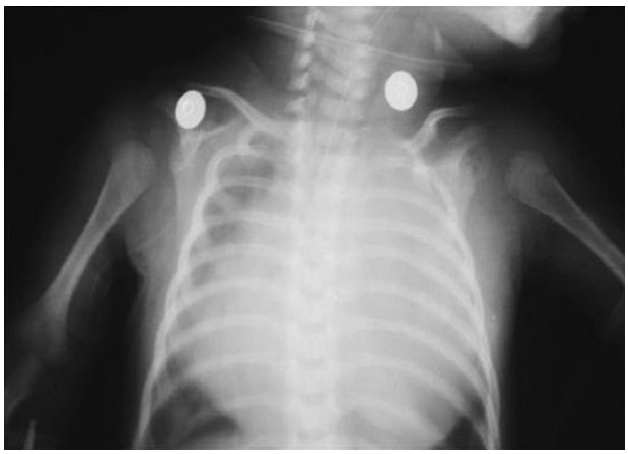

Fig. 1 Preoperative chest X-ray (CXR) shows large heterogeneous opacity merged with heart shadow occupying most of chest

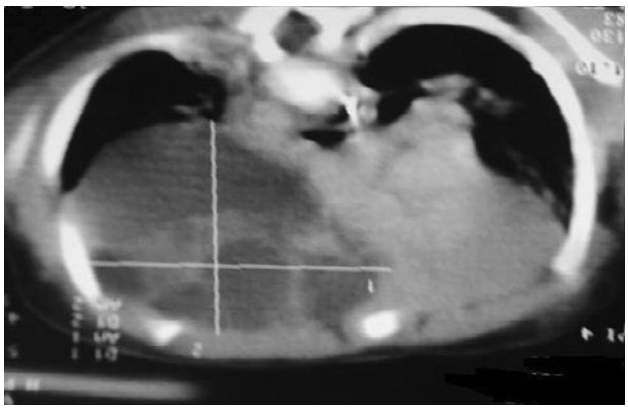

Fig. 2 Preoperative chest computed tomography (CT) (prone position) shows large multiseptate cystic mass with solid component in anterior mediastinum (5.3 × 4.6 × 5.6) on *left side* extending to superior mediastinum, pushing great vessels posteriorly and heart towards *right side*, with partial effacement of left mainstem bronchus and collapse of left lower lobe

A computed tomography (CT) scan without sedation in the prone position (Fig. 2) confirmed a 5 × 5 cm loculated multivariate mediastinal cystic tumor on the left side that was displacing the mediastinum to the right side. Two-dimensional echo delineated the mass to be extracardiac, overlying the heart superiorly, but the pulmonary vessels and aorta were normal. Tumor excision was planned through left thoracotomy approach.

Intraoperative management

Anesthetic induction and airway control were challenging as the baby was not tolerating the supine position for even a few minutes. An injection of atropine 0.2 mg was administered intravenously as premedication through a 24 G cannula in the right foot dorsum. After preoxygenation, awake tracheal intubation with a 3-mm endotracheal tube was done in supine position, maintaining spontaneous respiration and tone of muscles before induction of anesthesia, but the baby failed to maintain saturation (dropped to 74%) and blood pressure (systolic blood pressure dropped to 50 mmHg) in the supine position after tracheal intubation. The baby was turned prone immediately, and the endotracheal tube was further engaged to the right bronchus, facilitated by turning the neck to the left side, and unilateral lung ventilation was carried out with 100% oxygen, immediately improving the saturation. The baby was then turned to supine position, which was well tolerated. Central venous and arterial lines were placed in right femoral vein and artery, respectively. Anesthesia was maintained with ketamine 5 mg followed by 3 μg/kg/min and atracurium 1.2 mg followed by 0.2-mg boluses intravenously. The infant was turned on his side, after confirming right endobronchial intubation and his ability to maintain normal vital signs. A trial of left thoracotomy position was made, which was also tolerated well. Subsequently surgery was accomplished successfully and the endotracheal tube (ETT) was withdrawn to tracheal level. The later course was uneventful, and the trachea was extubated successfully after 2 days. Histopathology revealed the tumor to be a mature teratoma.

Discussion

Mediastinal tumors pose a grave risk of cardiopulmonary complications during the perioperative course, particularly in neonates and small children. These tumors can cause displacement and compression of vital thoracic structures such as the tracheobronchial tree, the heart, and the great vessels, as in our patient who had displacement of the tracheobronchial tree and heart.

A thorough preoperative assessment and discussion by the operative team is important to anticipate the problems and plan management. Important respiratory findings in the history and physical examination include tachypnoea, orthopnoea, nocturnal dyspnoea, and stridor, suggesting an airway compression. Patients may lie or sleep preferentially in a particular posture [2], as the prone position chosen by our patient. Symptoms such as facial puffiness, suffusion, and nonpulsatile distended neck veins suggest superior vena cava obstruction, as in our case. Compression and distortion of the trachea, carina, bronchi, and great vessels is a particular risk in children because of the increased compliance of these structures at this age [3].

The severity of symptoms depends on the size and location of the tumor within the mediastinum relative to other nearby structures. Tumors may compromise the airways and may weaken the long segments of the

tracheobronchial tree, which may become evident during induction of anesthesia and emergence from anesthesia, respectively [4]. It is essential to assess the patency of the airway at both tracheal and bronchial levels. Airway obstruction with general anesthesia is likely to occur if the diameter of the trachea is decreased by 50% [5].

Radiologic imaging by chest radiograph, CT scan, and magnetic resonance imaging (MRI) is pertinent to see the mass effect of tumor and its anatomical relationship with various thoracic vital structures. These static images help us to know the degree and level of airway compromise in nonanaesthetized awake patients but may not accurately quantify the degree of compression and may fail to predict the course after induction of anesthesia. Flow volume loops when sitting and supine may give a more dynamic assessment of the airway, as well as flexible fiberoptic bronchoscopy done under local anesthesia or sedation in adults. This approach may not be possible in younger patients.

Preoperative radiologic data evaluation in our case showed the great vessels to be pushed posteriorly, the heart toward the right side with partial effacement of the left mainstem bronchus and collapse of the left lower lobe. Thus, if cardiopulmonary collapse occurred, the appropriate position for repositioning the patient was the prone position. Temporary right mainstem intubation helped with ventilation, which could have been predicted preoperatively from the imaging. The benefit of the same position should be taken during difficult moments during induction of anesthesia. Some investigators advocate preoperative radiotherapy and chemotherapy to reduce the size of the mass and therefore the risks of anesthesia, whereas others suggest the likelihood of tissue distortion and histology alteration that can compromise the accuracy of diagnosis and curative treatment [6]. Hence, such therapy was not administered in this patient in view of the prevailing controversies.

Spontaneous respiration should be preserved as far as possible, because it has been noted that the degree of respiratory obstruction decreases with spontaneous ventilation [3, 6, 7], avoiding the risk of airway collapse in conjunction with positive pressure ventilation and muscle relaxation. The chest wall tone is reduced and the active negative force of active inspiration is lost, thereby releasing the extrinsic support of the airway. The endotracheal tube cannot protect the great vessels and collapse of the bronchi below the tip of the endotracheal tube, resulting in airway collapse even after successful intubation of the trachea [3]. Initial maneuvers during airway collapse include increased oxygen concentration, continuous positive airway pressure (CPAP), positive pressure ventilation with positive end-expiratory pressure (PEEP), and repositioning of the patient into the lateral or even prone position [3]. The gravitational impact of mass results in additional airway obstruction, causing airway obstruction in the supine position. Changing the patient to a favorable position may help to shift the tumor weight away from the trachea or main bronchus. Thus, the prone position in our case facilitated relieving obstruction.

Anesthetic induction can be inhalational with a volatile agent such as sevoflurane, or by intravenous titration of propofol, with or without ketamine. If the CT scan shows an area of noncompressed distal trachea to which the endotracheal tube can be advanced before induction, awake intubation of the trachea is done before induction [3], and that is why we chose awake intubation. Ketamine was used for maintenance as it allows delivery of high FiO_2 and does not deteriorate muscle and sympathetic tone, in contrast to other commonly used anesthetics. Dexmedetomidine would have been another alternative had it been available at our institute. Airway maintenance and oxygenation is the prime concern during the early part of the surgery. Maintenance of spontaneous respiration is the anesthetic goal so long as it is possible. Failure to restore normal vital signs could have led to abortion of anesthesia; i.e., "awaken the patient" is an option to rescue an emergency situation during the induction of anesthesia. Rigid bronchoscopy may be lifesaving in the event of tracheal or bronchial collapse under anesthesia. The backup plan includes ready availability of personnel and equipment for emergency airway management including rigid bronchoscopy, tracheostomy, and consideration of cardiopulmonary bypass (CPB). However, it requires at least 5–10 min to cannulate and establish adequate circulation and oxygenation with CPB [8], even with a primed pump and a prepared team, and the usefulness of CPB as a 'standby' during induction of anesthesia is a myth.

Compression of cardiovascular structures may be asymptomatic in resting phase but may present only after induction of anesthesia and positive pressure ventilation. Hypotension and low cardiac output resulting from mass effect and surgical manipulation of tumor on heart and major vessels may result in cardiovascular collapse and hypoxia. Cardiovascular collapse is attended by fluid bolus, repositioning of the patient (which was successful in our case), and, if these measures fail, immediate sternotomy and elevation of the mass may be lifesaving [9]. Postoperatively such patients may need elective ventilation and intensive care unit support, as was carried out in our case.

In conclusion, these types of cases should be preferably operated on by an experienced team in well-equipped operation rooms in tertiary care institutes. Institutions and operative teams should have algorithms [10] to manage mediastinal masses. Preoperative thorough assessment, evaluation, and planning by the team play a vital role in

smooth and successful accomplishment of these surgical cases.

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