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(CASE REPORT)

Superior laryngeal nerve block for awake intubation in pediatric patients with mediastinal tumors and superior vena cava syndrome undergoing thoracotomy biopsy surgery

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Abstract

Mediastinal tumors can occur in pediatric patients, where thoracotomy biopsy is a diagnostic modality that can be performed. Anesthesia management in this case can be quite challenging due to the mediastinal tumor, which can cause compression of the airway, potentially leading to apnea during anesthesia. Additionally, some of the current awake intubation techniques are more frequently used in older patients. Some modifications of the awake intubation guidelines can be made and adjusted according to the patient's clinical condition. Ensuring sedation, comfort, and patient cooperation are key to the success of this technique. A combination of regional anesthesia techniques can assist with analgesia both during and after surgery. We present a successful case of awake intubation in a 15-year-old male with mediastinum tumor and Grade I Superior Vena Cava Syndrome.

Keywords: Mediastinal Tumor; Pediatric; Anesthesia; Superior Laryngeal nerve block; Awake Intubation

1. Introduction

A mediastinal tumor refers to the growth of a mass within the mediastinum, the anatomical space between the lungs that houses critical structures such as the thymus, heart, major blood vessels, nerves, lymph nodes, trachea, and esophagus. Epidemiological data indicate that the majority of patients diagnosed with mediastinal tumors are over 40 years of age (56%), followed by 33% aged 20–40 years, and 11% under 20 years of age[1]. The prevalence of SCV syndrome is unknown since the clinical research about SVC in children is very low since the rarity of the case itself. The clinical presentation of mediastinal tumors is diverse and often non-specific as in adults or children, and posing significant challenges in diagnosis and management[2]. In cases of suspected tumor invasion and worsening symptoms, pediatric patients may experience respiratory disorders, extremity paralysis, diaphragm and vocal cord dysfunction, Horner's syndrome, and superior vena cava syndrome. Additionally, systemic symptoms may arise due to imbalances in hormones, antibodies, and cytokines. Complications of mediastinal tumors are generally caused by compression and/or invasion of the mass into surrounding tissues or organs. Common complications include superior vena cava syndrome and pleural effusion. In children, symptoms of Superior Vena Cava Syndrome (SVCS) typically include facial swelling, neck vein distention, swelling in the upper extremities, difficulty breathing (dyspnea), coughing, prominent chest veins, and sometimes a feeling of fullness in the upper body, all stemming from the obstruction of blood flow in the superior vena cava, leading to venous congestion in the upper body. In a pediatric patient the airway structure especially below the age of 8 is more collapsible than adult. In several case, the child had clinically normal airways preoperatively but became severely obstructed after the induction of anesthesia, when position of head changed from neutral to lateral position for surgery. Obstruction was most probably due to the extrinsic compression of distal end of ETT by tumor mass. Site of obstruction was confirmed by passing of suction catheter through the endotracheal tube. It

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was relieved when patient was placed back in the neutral position, presumably due to lifting of some of the weight of the tumor off the trachea. In patients having anterior mediastinal mass, anticipation of problems that can occur during general anesthesia are airway obstruction and major vessel compression, especially in children where the weight of the mass easily collapsed and obstruct the main vein/aorta. The ability to rapidly alter both patient position and anesthetic technique are key factors in preventing anesthetic complications.

Anesthetic considerations in such cases are particularly complex due to potential tumor-induced compression of the airway and cardiovascular structures, which can lead to significant morbidity and mortality during anesthesia. Furthermore, awake intubation techniques, which are frequently employed in managing such cases, are predominantly designed for and utilized in older patients.

2. Case Report

A 15-year-old male presented with progressive shortness of breath over the past two weeks. His symptoms were initially accompanied by a cough and fever, which have since resolved. The dyspnea worsens in the supine position and improves when lying on his right side. Additionally, the patient reported an unintentional weight loss of approximately 2 kg over the past month and noted facial swelling that began four days prior, though he denied swelling in the upper extremities. There is no history of food or drug allergies, nor any prior surgical interventions. The patient denies any history of previous surgery. As a student, the patient was able to engage in moderate to strenuous activities without experiencing chest pain or shortness of breath prior to the onset of illness.

2.1. Preoperative Examination

Preoperative examination included a thorough evaluation especially patient's cardiopulmonary status. On physical examination, there is asymmetric chest wall movement, with the right hemithorax lagging behind. Venectasia was noted over the right hemithorax. Patient was comfortable in a semi sitting (45 degree) position, and can only last 1 minute in a supine/ lay flat position. Respiratory rate was 23–25 breaths per minute. Breath sounds were diminished in the right lung without rales or wheezing. Oxygen saturation was 97% on 3 L/min nasal cannula. The Sabrazez test duration was 15 seconds. On cardiovascular physical examination, the following were found: Blood pressure was 90/60 mmHg, heart rate 105 beats per minute, and heart sounds (S1, S2) were regular without murmurs or gallops. A positive Pemberton sign was observed, indicating Superior Vena Cava Syndrome Grade I. No facial swelling, neck vein distention, swelling in the upper extremities was observed.

Routine blood work was within normal limits, on chest CT Scan revealed a solid mass with cystic/necrotic components in the right thoracic cavity is suspected to originate from the right mediastinum. The mass measured 17.21 x 13.29 x 20.54 cm and displaced the heart and great vessels to the left. No vascular infiltration was identified., there was compressive atelectasis of the right lower lung lobe, obstructive pneumonitis of the right upper lung lobe, and right pleural effusion. Echocardiographic examination revealed global normokinesis, mild to moderate tricuspid regurgitation (TR), and a low probability of pulmonary hypertension (PH), with no available data on left ventricular (LV) or right ventricular (RV) systolic function. Since the patient is a teenager and able to comprehend the instruction and procedure, we explain the whole procedure he was going to go through and patient showed great cooperation so we decided to carry on with this technique.

2.2. Anesthesia Management

In the preoperative room, airway preparation included nebulization with 4% lidocaine for 5 minutes, followed by topical application of 10% xylocaine spray (two sprays on the tip of the tongue and two sprays at the base of each tonsillar pillar). Premedication was administered with Diphenhydramine 5 mg IV, Dexamethasone 5 mg IV, and Fentanyl 50 mcg IV. Induction was initiated with a loading dose of dexmedetomidine at 0.4–0.8 mcg/kg/hour over 10 minutes, ensuring the patient maintained spontaneous breathing and targeting a Richmond Agitation-Sedation Scale (RASS) score of -1 to -2 (light sedation). Patient was still able to follow command but lightly sedated. By the 8th minute, the desired RASS score was achieved. Patient was on face mask oxygen 6 lpm.

An arterial line was established in the left radial artery using local infiltration with 2% lidocaine, and a central venous catheter (CVC) was inserted into the femoral vein under ultrasound guidance. A superior laryngeal nerve block was performed bilaterally using the hyoid bone landmarks (right and left greater cornu), with 2 ml of 2% lidocaine injected at each site. Additionally, an ultrasound-guided erector spinae plane (ESP) block was performed at the T5 level, utilizing 20 ml of 0.25% bupivacaine for regional anesthesia.

Prior to intubation, an additional two sprays of 10% xylocaine were applied to the base of each tonsillar pillar. Patient was position in a semi-recumbent position (half sitting/ 45 degree head up). Intubation was performed using a video laryngoscope with a 6.5 mm endotracheal tube (ETT). Intubation was done using videolaryngoscope and was successfully done in a first attempt despite not being entirely relaxed. There are a mild gag reflex but only during the ETT insertion. The heart rate was slightly increase from 82bpm to 95bpm and BP was also increase from 100/70 mmHg before intubation into 120/85 mmHg after intubation. But otherwise, patient stay calm and comfortable. The ETT position was verified and securely fixed. Patient then positioned into lateral decubitus. During the surgical procedure, anesthesia was maintained with a combination of oxygen, compressed air, sevoflurane (0.5%–1% vol), and dexmedetomidine (0.2–0.8 mcg/kg/hour). Invasive systolic blood pressure was maintained between 85–110 mmHg and diastolic blood pressure at 50–68 mmHg during awake intubation with a video laryngoscope. The heart rate remained stable between 88–98 bpm. The surgery lasting two hours with minimal bleeding and was conducted under a combination of intravenous and inhalational anesthesia, ensuring optimal hemodynamic stability and anesthetic depth. Patient then extubated after fully regained consciousness and no complication during surgery and extubation.

2.3. Postoperative Care

Postoperatively, he was given multimodal analgesia with Fentanyl 200 mcg and Ketamine 20 mg in 50 ml of 0.9% NaCl, administered at a rate of 2.1 ml/hour, along with Paracetamol 500 mg orally every 8 hours and Ibuprofen 200 mg orally every 8 hours. The patient was evaluated one hour after surgery, reporting minimal pain with an NRS (Numeric Rating Scale) of 1/10 at rest and 2/10 with movement. Three hours after surgery, the patient began moving by turning to the left and right sides and reported minimal pain with an NRS of 1/10 at rest and 2/10 with movement. Six hours after surgery, the patient started sitting up with the help of the bed while eating and reported minimal pain, with an NRS of 2/10 at rest and 2/10 with movement. Twelve hours after surgery, the patient still reported minimal pain, with an NRS of 1/10 at rest and 2/10 with movement. The patient began mobilizing 48 hours post-op by sitting on the edge of the bed. The following day, the patient was able to walk to the bathroom with assistance from family members. The patient was discharged after 4 days post-op.

3. Discussion

Awake intubation in pediatric remain a big challenge for the anesthesiologist. To perform smooth and successful intubation, a combination of adequate analgesia and sedation, a cooperative patient and an adequately experienced anesthesiologist are essential. To reduce anxiety and improve the patient's cooperation, preoperative visit by the anesthesiologist and a thorough explanation to the patient and his or her guardian/parent is necessary[6]. In this case, we evaluate the cooperation of the patient first before we proceed using this technique. We also ensure the adequate analgesia using a block on the superior laryngeal nerve to prevent airway reflexes during endotracheal tube (ETT) intubation. Blocking both the superior laryngeal nerves and the recurrent laryngeal nerves should be sufficient to prevent reflexive contractions as the endotracheal tube passes through the glottis and enters the trachea[3].

A supralaryngeal airway block is used to anesthetize the nerves supplying the supraglottic structures, primarily for procedures like awake fiberoptic intubation, upper airway surgeries, and pain management. The two main nerves targeted are the glossopharyngeal nerve (CN IX), which provides sensory innervation to the posterior tongue, pharynx, and soft palate, and the superior laryngeal nerve (SLN, a branch of CN X), which innervates the hypopharynx and supraglottic structures. The glossopharyngeal nerve block can be performed via the **oropharyngeal approach**, where a local anesthetic is injected at the base of the palatoglossal arch, or the **peristyloid approach**, where the anesthetic is injected near the styloid process. The SLN block is performed by injecting a local anesthetic just below the greater cornu of the hyoid bone using the thyrohyoid membrane approach. Both techniques effectively suppress airway reflexes and provide analgesia for upper airway interventions.

The analgesic effects of the supralaryngeal airway block include pain relief, suppression of the gag and cough reflexes, and reduced need for systemic sedation or opioids. This makes it particularly useful in awake intubations, bronchoscopy, and other airway procedures where patient comfort and cooperation are essential. By blocking sensory input to the upper airway, the procedure enhances tolerance to airway manipulation, facilitating a smoother experience for both the patient and the clinician.

We also performed Erector Spinae Block at T5 to ensure analgetic in surgical site for this patient. ESPB has been extensively used in perioperative pain management for adults and pediatric patients undergoing thoracotomy[4]. Fang, B., Wang, Z., and Huang, X., have conducted a comparative study between Thoracic Paravertebral Block (TPVB) and Erector Spinae Plane Block (ESPB) in thoracotomy surgeries, there was no difference in satisfaction with pain management between the ESPB group and the TPVB group (P = 0.73), hypotension occurred significantly more

frequently in the TPVB group than in the ESPB group (21.7% vs. 6.7% respectively), as did bradycardia (4 patients in the TPVB group versus 0 patients in the ESPB group)[5].

Hassan M. H., used a loading dose and infusion of dexmedetomidine provided conscious sedation while preserving spontaneous breathing, and the co-infusion of TCI remifentanil provided analgesic and synergistic sedation effects for the procedure[6]. Pediatric patients require increased dosage of the drugs because of their larger body surface area, which leads to an increased volume of distribution. While remifentanil has a lot of advantage, but the risk of rigidity in paediatric patient is also a concern. We found that using dexmedetomidine as a sole of sedation agent is adequate to lightly sedated the patient. We continuously monitored EtCO2 and SpO2 to detect any episode of apnea and desaturation, invasive blood pressure with an arterial line to observe hemodynamic changes during the surgery, and a systematic rescue plan is essential for any incidence of an emergency airway situation.

4. Conclusion

Mediastinal tumors can occur in pediatric patients, where thoracotomy biopsy is a diagnostic modality that can be performed. Anesthesia management in this case can be quite challenging due to the mediastinal tumor, which can cause compression of the airway, potentially leading to total blocking of the airway during anesthesia. Additionally, some of the current awake intubation techniques are more frequently used in older patients. Some modifications of the awake intubation guidelines can be made and adjusted according to the patient's clinical condition. Ensuring sedation, comfort, and patient cooperation are key to the success of this technique. A combination of regional anesthesia techniques can assist with analgesia both during and after surgery

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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