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Case Report

"Manually Ventilating Test" in Anesthesia Management in Children with Massive Anterior Mediastinal Masses Requiring Tracheal Intubation: A Case Series

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Abstract

The risk of life-threatening complications during induction of anesthesia in patients with anterior mediastinal mass is well recognized. Maintenance of spontaneous ventilation during anesthesia is an accepted standard goal in all published reports. However, the decision to paralyze the patient, which is really needed in most surgical procedures, is still a challenging event. In this study, "manually ventilating test" as a predictive test was assessed to make the decision to paralyze children with massive anterior mediastinal masses who needed tracheal intubation. . It seems that manually ventilating test may at least be a simple and reliable test to identify cases that could be paralyzed successfully.

Keywords: General Anesthesia, Intubation, Mediastinal Neoplasms.

Introduction

Patients with a large mediastinal mass present a difficult challenge for anesthetists because of compression of adjacent vital structures. Obstruction of the intra-thoracic trachea is a major anesthetic risk for these patients. It is often impossible to maintain a patent airway when the patient lies supine, is deeply anesthetized, or is paralyzed with muscle relaxants (1,2). Care of these patients clearly requires individualized and creative approaches. Difficulty with ventilation and cardiac arrest in the course of anesthesia for diagnostic or therapeutic procedures in patients with mediastinal mass are well described (3-5). Some centers have reported an incidence in pediatric patients of 7–20% during anesthesia and 18% in the postoperative period. The incidence in adults is believed to be much less(6), because the narrow compliant airways in children are more susceptible to obstruction. Anesthetic deaths have mainly been reported in children (7).

A number of approaches and recommendations are suggested to proceed a safe anesthesia, although they have their own limitations in pediatric patients. As many cases need paralyzing duringa procedure, the main question is not answered definitely yet: which patients can receive muscle relaxants safely without producing airway obstruction and catastrophic sequels? Here we evaluate "manually ventilating test" as a predictive test to make the decision to paralyze children with a mediastinal mass who need tracheal intubation.

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Materials and Methods

This is a prospective study of 20 symptomatic children with large mediastinal masses who might need tracheal intubation and paralyzing in the course of their elective surgical procedures in our center from 2007 to 2011. These patients were scheduled for biopsy or resection of their mediastinal or neck masses that were diagnosed by CT scan or chest ultrasonography. All patients were anesthetized with sevoflurane and varying mixtures of N2O and O2 or pure O2 depending on their oxygenation status. After a smooth induction and gradually deepening a few manually assisted ventilations were applied as a test to ascertain the efficacy of positive pressure ventilation (PPV). Then, PPV was possible, the patient was paralyzed and intubated by injecting cisatracurium and fentanyl. Afterwards, anesthesia was maintained by propofol or remifentanyl infusion and mixture of N2O and O2. Otherwise, if PPV was not possible manually, the decision to continue anesthesia with spontaneous breathing or to stop anesthesia was made considering the planned procedure and its duration, the patient cardio-respiratory status, and the ability to supplement a regional block. If the decision to continue anesthesia was made, spontaneous ventilation was maintained during the whole time of the procedure and a regional or local anesthesia was supplemented with meticulous attention to prevent pulmonary aspiration. A rigid pediatric bronchoscope was available in the operating room.

Results

There were 20 symptomatic patients with an average age of 6.30±4.77 year old (1.5 months-14 years old). Pathologic and imaging diagnoses are presented in (Table1).

Table 1: Histological and imaging diagnoses of the patients

	Age(y)	Sex	CT scan report	Pathologic diagnosis
1	3	Male	Left upper mediastinal mass + cervical lymphadenopathy	Neuroblastoma
2	10	Female	Posterior-anterior mediastinal mass + extra medullary metastasis L2-L5	Malignant small round cell tumor (Ewing sarcoma)
3	11	Male	Anterior medistinal mass	Lymphoblastic lymphoma
4	8	Male	Superior & posterior mediastinal mass	Ganglioneuroma
5	11	Male	Mediastinal mass with pericardial involvement, plural effusion	Malignant round cell tumor, Acute lymphoblastic leukemia in bone marrow aspiration
6	3	Male	-	Non- Hodgkin lymphoma
7	1.5	Female	Anterior mediastinal mass	Malignant small round cell tumor
8	2	Female	-	Necrotizing granuloma
9	5.5	Female	Anterior mediastinal mass	Malignant small round cell tumor
10	4.5	Male	Superior posterior mediastinal mass, bilateral plural effusion	Nueroblastoma
11	6 mo	Female	Posterior mediastinal mass 43×56 mm	Immature teratoma
12	8 mo	Female	Posterior mediastinal mass, cystic and solid	Immature teratoma
13	5	Male	Posterior mediastinal mass, cervicodorsal deformity, right plural effusion	Gastric cyst
14	6	Male	-	Neuroblastoma
15	26 mo.	Female	Posterior mediastinal mass	Neuroblastoma
16	14	Male	Posterior mediastinal mass, invasion to inferior vena cava and right atrium	Ewing sarcoma
17	12	Male	Superior mediastinal mass	Small round cell tumor (Ewing sarcoma)
18	1.5mo	Male	Posterior mediastinal mass, extra medullary	Neurofibroma
19	14	Female	Anterior mediastinal mass, par aortic lymphadenopathy, renal mass	Malignant lymph proliferation
20	12	Female	Anterior mediastinal mass, lung metastasis	Small round cell tumor

Nineteen cases could be ventilated manually, all of whom could be paralyzed and intubated successfully. One case scheduled for open thoracotomy could not be ventilated manually, leading to a change in the surgery plan. Spontaneous ventilation was maintained with laryngeal mask airway and ultrasonography-guided needle biopsy was performed. All cases had uneventful anesthesia and recovery.

Discussion and Conclusion

In addition to continuous monitoring of gas exchange and hemodynamics, different approaches and techniques are recommended for a safe anesthesia in patients with large mediastinal masses. These include maintaining spontaneous ventilation until securing a definite airway or completing the procedure(8), preoperatively determining patients' respiratory flow-volume and peak expiratory flow rate (9), predicting tracheal cross-sectional area and anesthetic management by chest CT(10), availability of a rigid bronchoscope, and in the presence of severe symptomatic obstruction, tracheal stenting prior to mediastinoscopy (11).

Maintaining spontaneous respiration is a well-accepted technique whenever a difficult airway is anticipated. However, the same main concern in unexpected inability of ventilation in paralyzing patients remains unresolved. In a recent study, airway collapse with an anterior mass despite spontaneous breathing in an adult has been reported (12). The authors strongly recommended pre-induction placement of femoral cardiopulmonary bypass (CPB) cannulae and readiness to immediately initiate cardiopulmonary bypass in high-risk patients. These recommendations have been mentioned before (13,14). However, CPB and bronchoscopy are rather rescue treatments in case of a sudden cardiopulmonary collapse. CPB as a prophylactic procedure is troublesome and if available, reserved only for a few cases with severe cardiopulmonary compromise.

Usefulness of flow-volume loop studies in airway management of these patients has not been demonstrated (15,16).

Although preoperative pulmonary CT scan may be useful in determining high-risk patients, the same concern still exists. In addition, CT scan is a static study, while airway obstruction is a dynamic event in the patient with anterior mediastinal mass and is dependent on respiratory cycle and patient position. Difficulty in immobilizing a restless child with respiratory distress is another limitation of imaging studies.

Manually ventilating test is a simple, noninvasive maneuver to assess patency of airway during which negative intrapleural pressure is lost. Patency of a narrowed airway in patients with large compressive anterior mediastinal masses is maintained by negative pressure of the surrounding parenchyma. In some severe critical stenosis, it will be lost with any intervention that leads to removal this negative pressure, such as creating apnea by injecting any hypnotic-sedative or muscle-paralyzing drugs. By performing a few "manually assisted "positive ventilations, intrapleural negative pressure will be lost, leading to circumstances as if the patient is paralyzed. Therefore, if positive pressure ventilation is possible easily, it will be possible after injecting muscle relaxants along with intubating the patient. This test was also mentioned in another study (17), although it was not analyzed in detail. The most promising result of our study is that of nineteen cases who could be ventilated manually, all of them could be paralyzed, intubated and given PPV successfully. In other words, fortunately this test has no false positive results in our study. Therefore, we can conclude that manually ventilating test may at least be a simple and reliable test to

identify cases that could be paralyzed successfully. However, more cases are needed to make a strong recommendation.

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