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A multidisciplinary approach to the management of anterior mediastinal masses in children

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ABSTRACT

Purpose: Anterior mediastinal masses (AMM) pose a diagnostic challenge to surgeons, oncologists, anesthesiologists, intensivists, and interventional radiologists as induction of general anesthesia can cause airway obstruction and cardiovascular collapse. We hypothesized that in the majority of patients, diagnosis can be obtained through biopsy of extrathoracic tissue.
Methods: We performed a retrospective review of all patients in the solid tumor oncology clinic with a diagnosis of AMM between 2002 and 2012 including preoperative evaluation and management prior to obtaining a tissue diagnosis, clinical course and complications.
Results: We identified 69 patients with AMM (mean age 12.2 ± 4.4 years, 64% male) secondary to Hodgkin lymphoma (34), Non-Hodgkin lymphoma (26), and other diagnoses (9). The majority of patients (56, 81.2%) underwent biopsy of tissue outside of the mediastinal mass. Local anesthesia with sedation was used for successful biopsy in 21 (30%) patients. Four (5.8%) required repeat biopsy due to inadequate sample obtained at initial procedure. Three (4.4%) suffered respiratory complications with no fatalities or severe complications.
Conclusions: Our data demonstrate that in the majority of children with AMM, tissue biopsy can be successfully obtained from tissue outside of the mass itself with minimal complications and highlight the importance of multidisciplinary preoperative planning to minimize anesthetic risks.

Anterior mediastinal masses (AMM) can pose a significant diagnostic challenge as they carry with them a risk of airway obstruction or cardiovascular collapse at the time of induction of anesthesia to obtain biopsy material [1]. This rare but potentially fatal complication requires the expertise of a multidisciplinary team of physicians, including surgeons, oncologists, anesthesiologists, and radiation oncologists faced with the task of safely obtaining tissue for diagnosis. The stakes are even higher in children with AMM, as the majority of anesthetic related deaths have been reported in children [2]. We hypothesize that in many patients, diagnosis and treatment initiation can be achieved without the use of general anesthesia through biopsy of extrathoracic tissue, leading to an acceptably low risk of anesthesia and airway related complications.

1. Materials and methods

Following the approval of our institutional review board, we reviewed the medical records of all patients with a diagnosis of AMM with tissue diagnosis obtained at the Children's Hospital Colorado (CHCO) from 2002 to 2012. The study cohort was established from a list of all patients with a solid tumor treated at CHCO that is maintained by the Division of Pediatric Oncology. The medical records of all patients seen in the clinic during this time were reviewed in order to determine which patients had a diagnosis of AMM. The records of those patients with a diagnosis of AMM were then reviewed. Data collected from the medical record include details of the initial clinical presentation, imaging obtained, preoperative plan for anesthetic and surgical approach, intraoperative and postoperative complications, and clinical course.

With regards to our institutional practices, our multidisciplinary management involves coordination of the oncology, anesthesiology, and surgical teams with involvement of other specialties such as interventional radiology or radiation oncology if needed. We did not have a formal preoperative conference in place throughout the study period. When a patient presents or is transferred to our institution with an AMM, the oncology team contacts both designated surgical and anesthesia representatives who then either review the case personally or ask a colleague to review it. The anesthesiologist then discusses with

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the surgeon and oncologist their recommendations for anesthetic management and procedure, either individually or via conference call. Operative plans are made based on these consultations among all invested parties. In general, patients who are not candidates for general anesthesia include those with significant clinical symptoms (orthopnea, coughing when supine, SVC symptoms), tracheal compression >50% on imaging, bronchial compression, or signs of cardiac tamponade.

At our institution, there is not a protocol for general anesthesia however, this usually includes induction with an inhalational agent, and spontaneous breathing with either an endotracheal tube or a laryngeal mask.

Statistical analysis was conducted in Prism 6.0b (by GraphPad Software, Inc. La Jolla, CA, USA). Categorical variables were compared between the groups using a Fisher's exact test. Continuous variables were compared using the t test for normally distributed data or Wilcoxon two sample test for non-parametric data. Statistical analysis was performed based on available data. Differences were considered significant when $P < 0.05$.

2. Results

We identified 69 patients with AMM over the ten-year time period. The mean age at diagnosis was 12.2 ± 4.4 years, and ranged from 1 to 19 years. Sixty-four percent of the patients were male. The various diagnoses included Hodgkin lymphoma (N = 34), Non-Hodgkin lymphoma (N = 26), thymoma (N = 3), histiocytosis (N = 2), and one patient with each of the following: neuroblastoma, germ cell tumor, lipoblastoma, and benign lymphoid hyperplasia. Seventy-four percent of patients presented with one or more of the following symptoms: shortness of breath (SOB) (55%), cough (51%), orthopnea (33%), or superior vena cava (SVC) syndrome (32%) (Table 1). All patients had imaging in the form of CT scan available for review. Thirty patients (43%) had evidence of tracheal compression on imaging, however degree of compression was not measured or recorded. No complications were documented at the time of CT scan. In general, imaging was obtained without of the use of sedation or anesthesia. Only 3 patients were under three years of age (an age at which sedation is frequently used during CT scan) at the time of diagnosis. One patient was intubated by EMS and remained intubated for the CT scan. For the remaining two, there was no documentation of sedation used to obtain a CT scan. Of note, 4 of the asymptomatic patients had evidence of tracheal compression on CT. A total of 12 patients (17%) had an echocardiogram prior to tissue biopsy. These studies were obtained at the discretion of the treating physician, in each case to evaluate cardiac function in the setting of the AMM or a suspected effusion. Two patients had a murmur and one had evidence of SVC syndrome. The remaining 9 patients underwent echocardiogram to evaluate cardiac function in the setting of AMM. All 12 echocardiograms revealed normal cardiac size and function. Only one patient underwent pulmonary function testing (PFT) as part of the preoperative evaluation. Due to the retrospective nature of the data collection, we could not determine if preoperative echocardiogram or PFTs led to a change in patient management. However, 7 of the 12 patients undergoing echocardiograms were managed with general anesthesia and the remaining 5 patients were managed with local anesthesia. The approach correlated with the presence or absence of tracheal compression. Those with tracheal compression were managed with local anesthesia while those with no tracheal compression were managed with general anesthesia.

In total, 62 patients (90%) had a preoperative anesthesia consultation and operative plan documented preoperatively to make decisions regarding general anesthesia or local anesthesia with or without conscious sedation, patient positioning, and whether or not extracorporeal membrane oxygenation (ECMO) should be used as backup. In 57 of 58 patients with adequate data available, the pre-operative anesthesia plan was followed. In one patient, the procedure was performed with local anesthesia instead of the pre-planned general anesthesia. In 3 patients, ECMO was made available for backup but was never utilized.

Anesthetic and operative approaches to tissue biopsy varied based on the preoperative assessment and plan. Seventy percent of patients (n = 48) underwent general anesthesia for tissue biopsy. The remaining 30% underwent conscious sedation with local anesthesia. Differences in respiratory symptoms at presentation, based on anesthetic management are shown in Table 1. Patients managed with local anesthesia were more likely to present with SOB, cough, orthopnea, with a trend towards higher rates of SVC syndrome. Only one patient managed with local anesthesia was asymptomatic at presentation.

Procedures performed included extrathoracic lymph node or mass biopsy (64%), percutaneous needle aspiration of the mass or of pericardial or pleural fluid (17%), open biopsy or resection of the mass (10%), and thoracoscopic biopsy of the mass (9%) (Table 2). In 65 of 69 (94%) patients, adequate tissue for diagnosis was obtained at the initial procedure. Of those four patients who required a repeat procedure for diagnostic purposes, one initially underwent non-diagnostic thoracentesis followed by diagnostic lymph node biopsy, another had a non-diagnostic thoracentesis followed by diagnostic CT guided AMM biopsy, one had a non diagnostic lymph node biopsy followed by a diagnostic video assisted thoracoscopic surgery (VATS) biopsy procedure, and the final patient had a non diagnostic VATS AMM biopsy which was repeated. There was no change in anesthetic management at the time of repeat procedure in any patient. Two patients who had failed thoracentesis underwent local anesthesia with conscious sedation at the successful repeat procedure. The other 2 patients underwent general anesthesia at both procedures.

Two other patients also required repeat procedure for mass excision. One patient required repeat biopsy and partial excision due to a poor response to initial therapy following initial diagnosis of lymphoblastic lymphoma, and a second patient returned to the OR for thymoma excision following initial diagnostic biopsy.

Steroids and/or radiation therapy was used in a subset of patients prior to tissue biopsy in order to reduce the risk of cardiorespiratory complications. A total of 18 patients received preoperative steroids due to evidence of airway compression. Seven of those 18 also received pre-diagnostic radiation therapy. With growing concern for the diagnostic difficulty resulting from pre-biopsy steroid treatment [3], use of pre-diagnostic steroids decreased throughout the study period, with only 5 of the 18 patients receiving steroids after 2007. Rates of lymphoma did not differ between the steroid and non steroid group (94% vs 84%; p = 0.42). 17 of 18 patients who received steroids were ultimately diagnosed with lymphoma. The remaining patient was diagnosed with lipoblastoma. Of those who received additional pre-diagnostic radiation to the AMM, 3 underwent biopsy (1, open; 2, VATS) with adequate tissue for diagnosis and the remaining 4 underwent percutaneous needle

Table 1
Symptoms on presentation.

Symptom	All Patients (n = 69)	General Anesthesia (n = 48)	Local Anesthesia (n = 21)	p value
Shortness of breath, n (%)	38 (55%)	22 (45.8%)	16 (76.2%)	0.034
Cough, n (%)	35 (51%)	10 (41.7%)	14 (66.7%)	<0.001
Orthopnea, n (%)	23 (33%)	12 (25%)	12 (57.1%)	0.014
Superior vena cava syndrome, n (%)	22 (32%)	12 (25%)	10 (47.6%)	0.092
Asymptomatic, n (%)	18 (26%)	17 (35.4%)	1 (4.8%)	<0.01