Anesthetic management of patients undergoing mediastinal mass operation

Jie-chao Tan\textsuperscript{1,2}, Pei-shuang Lin\textsuperscript{1,3}, Li-xian He\textsuperscript{1,4}, Yong Lin\textsuperscript{1,5}, Yun-tai Yao\textsuperscript{1*} and the Evidence in Cardiovascular Anesthesia(EICA) Group

\textsuperscript{*}Department of Anesthesiology, Fuwai Hospital, National Center for Cardiovascular Diseases, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China; \textsuperscript{1}Department of Anesthesiology, Shunde Hospital of South Medical University, Foshan, China; \textsuperscript{2}Department of Anesthesiology, Fujian Medical University Affiliated First Quanzhou Hospital, Quanzhou, China; \textsuperscript{3}Department of Anesthesiology, Fuwai Yunnan Cardiovascular Hospital, Kunming, China; \textsuperscript{4}Department of Cardiovascular Surgery, Fujian Medical University Union Hospital, Fuzhou, China

Objectives: To summarize the anesthetic management of patients undergoing mediastinal mass operation.

Methods: Electronic databases were searched to identify all case reports of patients undergoing mediastinal mass operation. Information such as clinical characteristics, perioperative management and patients’ outcomes were abstracted and analyzed.

Results: Seventy-seven case reports with 85 patients aging from 34 days to 81 years were included. Mediastinal masses were located in anterior (n = 48), superior (n = 15), middle (n = 9) and posterior (n = 9) mediastinum, respectively. Clinical manifestations included dyspnea (n = 45), cough (n = 29), chest or radiating pain (n = 12), swelling (n = 8), fever (n = 7) and chest distress (n = 4). Most patients (n = 75) had signs of compression or invasion of vital structures. General anesthesia (n = 76) was the most commonly used method of anesthesia. Muscle relaxants were administered in 35 patients during anesthesia induction and spontaneous respiration was maintained in 37 patients. Mediastinal mass syndrome (MMS) occurred in 39 cases. Extracorporeal circulation was utilized in 20 patients intraoperatively. Three patients experienced cardiac arrest after ventilation failure and two patients died intraoperatively and one postoperatively.

Conclusions: Peri-operative management of patients undergoing mediastinal mass operation could be challenging. Pre-operative multi-disciplinary discussion, well-planned anesthetic management and pre-determined protocols for emergency situations are all vital to patient safety.

KEYWORDS mediastinal mass, anesthetic management, complications, risk stratification, airway management

Introduction

Peri-operative management of patients undergoing mediastinal mass operation could be challenging. Mediastinal mass syndrome (MMS), initially described by Bittar in the 1970s, is caused by a mediastinal mass, which can quickly deteriorate to acute respiratory and hemodynamic decompensation and is associated with increased morbidity and mortality (1, 2). Therefore, thorough pre-operative assessment, meticulous intra-operative
management and multi-disciplinary collaboration are essential when managing patients undergoing mediastinal masses operation (3). Due to absence of guidelines, we performed a literature review of relevant published case reports, to summarize the clinical characteristics, anesthetic management and outcomes of patients undergoing mediastinal mass operation.

Materials and methods

Search strategy

Relevant case reports were identified through computerized searches of PubMed, Embase and Ovid databases until May 15th, 2020, using different combinations of search terms “mediastinal mass”, “anesthesia” and “case” (Appendix). Chinese database CNKI was also searched (from the inception to May 15th, 2020). Databases search was updated on August 12th, 2020. Two authors (J.C.T. and P.S.L.) independently reviewed the titles and abstracts of all identified reports for eligibility, with obviously ineligible ones excluded. The eligibility of those remaining reports for final inclusion was determined further by examining the full text. Exclusion criteria included the following: (1) review articles, (2) animal studies, (3) duplicate publications, (4) studies lacking outcomes of interest.

Data abstraction

The following data from the included case reports were abstracted to a data collection form by two authors (J.C.T. and P.S.L.) independently: (1) literature information (author and year of publication); (2) patients characteristics (age, sex); (3) mediastinal mass features (location, size, pathology) and clinical manifestations (symptoms, signs and examination findings); (4) perioperative management (anesthesia techniques, extracorporeal circulation preparation) and (5) patients’ outcomes. Disagreements were resolved by discussion among all authors during the process of data abstraction.

Results

As depicted in the flow chart (Figure 1), the database search identified 103 potentially qualified articles. Seventy-seven case reports (85 patients in total) were determined eligible and included, 66 of which were written in English and the other 11 in Chinese. Descriptive analyses of these cases were presented in Table 1 (4–80).

The 85 patients aged between 34 days and 81 years, of whom 42 were males and 39 females (4 cases did not describe sex). Forty-eight (59.3%) cases of masses were located in anterior mediastinum, 15 (28.5%) in superior mediastinum, 9 (11.1%) in middle mediastinum and 9 (11.1%) in posterior mediastinum. The mass sizes ranged from 35mm × 44mm × 42 mm to 200mm × 200mm × 180 mm. Anterior mediastinum masses were usually bigger than those of other origins. Lymphoma (28/85, 32.9%) was the most common pathological type, followed by teratoma or seminoma (9/85, 10.5%). Of the 85 patients, 45 (59.2%) presented with dyspnea, 29 (38.1%) with cough, 12 (15.8%) with chest or radiating pain, 8 (10.5%) with swelling, 7 (9.2%) with fever, 4
| Case     | Sex | Age  | Symptoms and signs                          | Preoperative examination | MDT | Mediastinal mass | Supine | Compression or invasion | Risk | MMS | Outcomes |
|----------|-----|------|--------------------------------------------|--------------------------|-----|-----------------|--------|------------------------|------|-----|-----------------------|
| Yang 2020 | M   | 65 year | Cough, chest pain                          | √ UKN. √ UKN. √ UKN.    | PM  | UKN. Pheochromocytoma | Yes    | / / / /                | L   | ×  | Recovery              |
| Armas 2020 | M   | 28 year | Epigastic pain                             | √ UKN. √ UKN. UKN. AM   | 141*64*146 | Lymphoma | Yes    | / / / /                | M   | ×  | Recovery              |
| Liu 2020  | F   | 66 year | Dyspnea                                    | √ UKN. UKN. UKN. PM     | 101*74*49 | UKN.     | Yes    | / / / /                | M   | ×  | Recovery              |
| Mohammad 2019 | M   | 57 year | Asymptomatic                               | UKN. √ UKN. UKN. UKN. SM | UKN. Pericardial cysts | Yes    | / / / /                | L   | ×  | Recovery              |
| Young Il 2019 | M   | 67 year | Wheezing, cough, dyspnea                   | √ UKN. UKN. √ UKN. SM   | UKN. Goiter | Yes    | / / / /                | H   | ×  | Recovery              |
| Sandeep 2019 | M   | 8 month | Crying in supine position, cyanosis        | √ UKN. UKN. UKN. UKN. AM | UKN. Lymphoma | Yes    | / / / /                | H   | √  | Recovery              |
| Hartigan 2018 | M   | 69 year | UKN.                                       | √ UKN. UKN. UKN. UKN. AM | AM  | UKN. Carcinoma  | Yes    | / / / /                | M   | UCE. UKN.    |
| Dubey 2018 | M   | 17 year | Cough, dyspnea, chest distress, facial swelling | √ UKN. √ UKN. UKN. AM   | UKN. UKN. | No     | / / / /                | H   | √  | Recovery              |
| Kafrouni 2018 | F   | 30 year | Cough, dyspnea, weight loss                | √ UKN. UKN. UKN. UKN. AM | UKN. Lymphoma | Yes    | / / / /                | M   | √  | OP cancel              |
| Bruce 2018 | M   | 5 month | Wheezing                                   | √ UKN. √ UKN. UKN. AM   | 82*62*73 | Teratoma  | No     | / / / /                | H   | √  | Recovery              |
| Liu 2018  | F   | 5 year  | Cough                                      | √ UKN. UKN. UKN. UKN. PM | 111*91? | Neurogenic tumor | UKN   | / / / /                | H   | √  | Recovery              |
| Mitra 2018 | F   | 34 day | Dyspnea                                    | UKN. √ UKN. UKN. AM     | 50*45*30 | Teratoma  | Yes    | / / / /                | H   | UCE. Recovery |
| Liu 2017  | F   | 54 year | Dyspnea                                    | UKN. √ UKN. √ UKN. SM   | 61*86*91 | Bronchogenic cyst | Yes    | / / / /                | H   | UCE. Recovery |
| Freed 2017 | F   | 81 year | Dyspnea                                    | UKN. √ UKN. UKN. AM     | 75*47*45 | Thymoma    | Yes    | / / / /                | L   | √  | Recovery              |
| Saijinya 2017 | F   | 14 year | Dyspnea                                    | UKN. UKN. UKN. UKN. PM  | 140*35*40 | Enteric cyst | Yes    | / / / /                | H   | UCE. Recovery |
| Kusajima 2017 | F   | 30 year | Cough, dyspnea                             | √ UKN. UKN. UKN. UKN. AM | 113*87*68 | Lymphoma | No     | / / / /                | H   | ×  | Recovery              |
| Juan 2017  | F   | 44 year | Asymptomatic                               | √ UKN. UKN. UKN. UKN. AM | 50*64? | Pheochromocytoma | Yes    | UKN. UKN. UKN. L | ×  | Recovery |
| Nokes 2017 | F   | 49 year | Dyspnea                                    | √ UKN. UKN. UKN. UKN. AM | UKN. UKN. | Yes    | / / / /                | H   | ×  | Recovery              |
| Wang 2017  | F   | 56 year | Dysphagia                                  | √ UKN. UKN. UKN. SM     | 200*150*60 | Goiter  | Y      | / / / /                | M   | ×  | Recovery              |
| Ayte 2017  | F   | 6 month | Dyspnea                                    | √ UKN. UKN. UKN. AM     | 93*78* | Teratoma | Yes    | / / / /                | H   | √  | Recovery              |

(continued)
| Case    | Sex | Age | Symptoms and signs                                      | Preoperative examination | MDT | Mediastinal mass | Supine | Compression or invasion | Risk | MMS | Outcomes |
|---------|-----|-----|--------------------------------------------------------|--------------------------|-----|-----------------|--------|------------------------|------|-----|----------|
| Sulen 2016 | F   | 36 year | Cough, chest pain, dyspnea                             | √ UKN. UKN. UKN. UKN. PM | AM 80°75°53 Bronchogenic cyst Yes° | √ / / / H × Recovery |
| Dudley 2016 | M   | 28 year | Cough, dyspnea, sore throat, neck swelling             | √ UKN. UKN. UKN. UKN. AM | UKN. Seminoma No | √ / / / H UCE. Recovery |
| Maria 2016   | F   | 11 year | Facial and arm swelling                                | √ UKN. UKN. UKN. UKN. AM | 100°80°7 Lymphoma UKN. | √ / / / M √ Recovery |
| Wooles 2015  | M   | 59 year | Chest pain, hoarseness, dysphagia                       | √ UKN. UKN. UKN. SM     | UKN. Bronchogenic cyst No | √ / / / H √ Recovery |
| Scheele 2015 | M   | 23 year | Dyspnea                                                | √ UKN. UKN. UKN. UKN. AM | 150°100°160 Seminoma No | √ / / / H √ Recovery |
| Ghada 2015   | M   | 14 year | Dyspnea                                                | √ UKN. UKN. UKN. UKN. AM | 35°44°42 Lipoma Yes° | √ / / / H √ Recovery |
| Lee 2014     | F   | 35 year | Asymptomatic                                           | √ UKN. UKN. UKN. UKN. AM | 75°92°14 Teratoma Yes | / / / / L √ Recovery |
| Thakur 2014  | F   | 4 year  | Cough                                                  | √ UKN. UKN. UKN. SM     | 57°46°28 Bronchogenic cyst Yes° | √ / / / M × Recovery |
| Rajagopalan 2014 | F | 64 year | Dyspnea, cough, hoarseness of voice                     | √ UKN. UKN. UKN. UKN. AM | 103°104°127 Carcinoma Yes° | √ / / / H × Recovery |
| Sayd 2014    | F   | 37 year | Dyspnea                                                | √ UKN. UKN. UKN. UKN. AM | 170°90°120 UKN. No | √ / / / H √ Recovery |
| Brain 2014   | M   | 65 year | Fever, hypoxemia                                       | √ UKN. UKN. UKN. UKN. MM | 50°40°40 Lymphoma Yes | / / / / M × Recovery |
| Michael 2014 | M   | 24 year | Fatigue, fever, hoarseness, cough, dyspnea             | √ UKN. UKN. UKN. UKN. AM | UKN. Lymphoma Yes° | √ / / / H UCE. Recovery |
| Ward 2014    | F   | 39 year | Cough, shoulder pain, dyspnea                           | √ UKN. UKN. UKN. UKN. AM | UKN. Thymoma No | √ / / / H UCE. Recovery |
| Ibrahim 2013 | F   | 21 year | Cough, dyspnea                                         | √ UKN. UKN. UKN. UKN. AM | UKN. UKN. Yes° | √ / / / H √ Death |
| Christelle 2013 | M | 11 year | Dyspnea                                                | √ UKN. UKN. UKN. UKN. AM | 98°145°156 Lymphoma Yes° | √ / / / H × Recovery |
| Christelle 2013 | M | 15 year | Weight loss                                            | √ UKN. UKN. UKN. SM     | UKN. Lymphoma Yes° | √ / / / H × Recovery |

(continued)
| Case     | Sex | Age   | Symptoms and signs                                                                 | Preoperative examination | MDT | Mediastinal mass | Supine | Compression or invasion | Risk | MMS | Outcomes |
|----------|-----|-------|-----------------------------------------------------------------------------------|--------------------------|-----|-----------------|--------|-------------------------|------|-----|----------|
| Lalwani 2013 | M   | 23 year | Dyspnea, hoarseness                                                              | √                        | UKN | UKN.            | PM     | 130*150*130              | Carcinoma       | Yes | √           | √           | √      | /         | H      | UCE.        | Recovery           |
| Rim 2013  | F   | 60 year | Dyspnea                                                                          | √                        | UKN. | UKN.            | MM     | 73*59*61                | Schwannoma       | Yes | √           | √           | √      | √         | M      | ×           | Recovery           |
| Miyaguchi 2013 | M   | 15 year | Asymptomatic                                                                     | √                        | UKN. | UKN.            | AM     | 160*140*130             | Teratoma        | Yes | /           | √           | √      | √         | M      | ×           | Recovery           |
| Han 2013  | F   | 15 year | Ulceration                                                                       | √                        | UKN. | √               | UKN.   | 60*60*50                | Paraneoplastic pemphigus       | Yes | UKN.        | UKN.        | UKN.   | UKN.   | M      | ×           | Recovery           |
| Peter 2012 | F   | 57 year | Neck swelling                                                                     | √                        | UKN. | UKN.            | SM     | UKN.                    | UKN.            | Yes | √           | /           | /      | /         | H      | ×           | Recovery           |
| Chaudhary 2012 | M   | 42 year | Face, neck, chest and upper arms swelling                                        | √                        | UKN. | UKN.            | AM     | UKN.                    | Lymphoma       | Yes | √           | /           | √      | /         | M      | √           | Recovery           |
| John 2012 | F   | 9 year  | Cough, dyspnea, facial swelling                                                  | √                        | UKN. | UKN.           | AM     | UKN.                    | Carcinoma       | No  | √           | √           | √      | √         | H      | ×           | Recovery           |
| Gautam 2012 | M   | 1 month | Stridor, dyspnea, cyanosis, periorbital edema                                    | √                        | UKN. | UKN.           | AM     | 50*50*?                | Teratoma        | Yes | /           | √           | √      | /         | H      | ×           | Recovery           |
| Yao 2012  | F   | 59 year | Chest distress                                                                    | √                        | UKN. | UKN.           | AM     | 200*200*15              | UKN.            | Yes | √           | /           | √      | /         | H      | √           | Recovery           |
| Gardner 2011 | M   | 19 year | Cough, fever, weight loss                                                        | √                        | UKN. | UKN.           | AM     | UKN.                    | Lymphoma       | Yes | √           | /           | /      | /         | H      | √           | Recovery           |
| David 2011 | F   | 23 year | Chest pain, back pain                                                            | √                        | UKN. | UKN.           | AM     | 49*76*58                | Lymphoma       | Yes | /           | /           | /      | /         | M      | √           | Recovery           |
| Benedicte 2011 | F   | 4 year  | Dyspnea                                                                          | √                        | UKN. | UKN.           | AM     | 180*11*80               | Fibromatosis    | No  | √           | /           | √      | /         | H      | ×           | Recovery           |
| Betina 2011 | F   | 14 year | Cough, dyspnea                                                                   | √                        | UKN. | UKN.           | AM     | UKN.                    | Lymphoma       | Yes | √           | /           | √      | /         | H      | ×           | Recovery           |
| Woo 2010 | M    | 18 year | Cough, dyspnea, chest distress                                                   | √                        | UKN. | UKN.           | AM     | 120*90*150              | Lymphoma       | Yes | √           | /           | √      | /         | M      | √           | Recovery           |
| Chen 2010 | F   | 53 year | Cough, dyspnea                                                                   | √                        | UKN. | UKN.           | AM     | 200*100*70              | Goiter          | Yes | √           | /           | /      | /         | M      | √           | Recovery           |
| Yang 2009 | UKN  | 3 year  |                                                                                   | √                        | UKN. | UKN.           | MM     | UKN.                    | UKN.            | Yes | √           | /           | /      | /         | M      | √           | Recovery           |
| Yang 2009 | UKN  | 6 year  |                                                                                   | √                        | UKN. | UKN.           | MM     | UKN.                    | UKN.            | Yes | √           | /           | /      | /         | M      | √           | Recovery           |

(continued)
| Case | Sex | Age | Symptoms and signs | Preoperative examination | MDT | Mediastinal mass | Supine | Compression or invasion | Risk | MMS | Outcomes |
|------|-----|-----|-------------------|--------------------------|-----|-----------------|--------|------------------------|------|------|----------|
| Yang 2009 | UKN. | 16 year | Dyspnea | UKN. | UKN. | UKN. | UKN. | MM | 160*160*135 | UKN. | UKN. | Recovery |
| Yang 2009 | UKN. | 10 year | Dyspnea | UKN. | UKN. | UKN. | UKN. | MM | 160*160*135 | UKN. | UKN. | Recovery |
| Mourad 2009 | M | 42 year | Asymptomatic | UKN. | UKN. | UKN. | UKN. | AM | 220*190*170 | Thymolipoma | Yes | Recovery |
| Basem 2009 | M | 41 year | Dyspnea | UKN. | UKN. | UKN. | UKN. | AM | 100*90*110 | Carcinoma | Yes | Recovery |
| Basem 2009 | M | 62 year | Cough, dyspnea | UKN. | UKN. | UKN. | UKN. | AM | UKN. | UKN. | Yes | Recovery |
| Wang 2009 | M | 72 year | Dyspnea | UKN. | UKN. | UKN. | UKN. | AM | 40*50*70 | Goiter | UKN. | Recovery |
| Zhang 2007 | F | 72 year | UKN | UKN. | UKN. | UKN. | UKN. | PM | 34*40*7 | UKN. | UKN. | Recovery |
| Zhang 2007 | F | 56 year | UKN | UKN. | √ | UKN. | UKN. | AM | 35*30*7 | UKN. | No | Recovery |
| Frey 2006 | M | 10 year | Dyspnea, orthopnea, fever | UKN. | UKN. | √ | UKN. | AM | UKN. | Lymphoma | Yes | Recovery |
| Goppp 2005 | F | 42 year | Dyspnea, arrhythmia, chest pain, fever | UKN. | UKN. | UKN. | UKN. | AM | UKN. | Enteric cyst | Yes | Recovery |
| Qu 2005 | M | 3 year | Dysphagia | UKN. | √ | UKN. | UKN. | AM | UKN. | Enteric cyst | No | Recovery |
| Yasunori 2004 | M | 17 year | Dyspnea, tachycardia, hypotension | UKN. | UKN. | √ | UKN. | AM | UKN. | Lymphoma | Yes | Recovery |
| Dilworth 2003 | M | 9 year | Jugular vein distention, cough, dyspnea | UKN. | √ | UKN. | UKN. | AM | UKN. | Lymphoma | No | Recovery |
| Li 2003 | M | 3 month | Cyanosis | UKN. | UKN. | UKN. | UKN. | AM | UKN. | Enteric cyst | Yes | Recovery |
| Dilworth 2001 | M | 15 year | Cough, dyspnea | UKN. | √ | UKN. | UKN. | SM | UKN. | Lymphoma | No | Recovery |
| Tempe 2001 | M | 22 year | Chest and neck pain, dyspnea, neck swelling | UKN. | UKN. | √ | UKN. | AM | 120*100*7 | Lipoma | Yes | Recovery |
| Shi 2000 | F | 16 year | Chest distress | UKN. | UKN. | UKN. | UKN. | AM | 200*200*180 | UKN. | UKN. | Recovery |
| Vas 1999 | M | 2 month | Crying, cough, dyspnea | UKN. | UKN. | UKN. | UKN. | SM | UKN. | No | Recovery |

(continued)
| Case          | Sex  | Age  | Symptoms and signs                  | Preoperative examination | MDT | Mediastinal mass | Supine | Compression or invasion | Risk | MMS | Outcomes |
|--------------|------|------|-------------------------------------|--------------------------|-----|------------------|--------|------------------------|------|-----|----------|
|              |      |      |                                     | CT           | MRI | Echo | PFT | Location | Size (mm) | Pathology | Trachea | Bronchia | SVC | Heart |
| Licker 1997  | F    | 47 year | Dyspnea, hemoptysis, fever        | √             | UKN | UKN  | √   | UKN. SM | UKN.     | Carcinoma | Yes*   | /     | /     | /     | M ×  | Recovery |
| Goh 1999     | F    | 20 year | Cough                             | √             | UKN | UKN  | UKN  | UKN. AM | UKN.     | Lymphoma  | Yes    | √     | /     | /     | M √  | Recovery |
| Furst 1996   | F    | 9 year  | Cough                             | √             | UKN | UKN  | UKN  | UKN. SM | UKN.     | Vascular malformation | Yes*  | /     | /     | /     | M ×  | Recovery |
| Polaner 1996 | M    | 3 year  | Dyspnea                           | √             | UKN | UKN  | UKN  | UKN. AM | UKN.     | Lymphoma  | No     | √     | /     | /     | H ×  | Recovery |
| Hattamer 1996| F    | 29 year | Cough, dyspnea                     | √             | UKN | UKN  | √   | UKN. PM| 150*80   | Lymphoma  | Yes*  | /     | /     | /     | M ×  | Recovery |
| Frawley 1995 | M    | 13 year | Cough                             | √             | UKN | √    | √   | UKN. AM| UKN.     | Lymphoma  | Yes*  | /     | √     | /     | M ×  | Recovery |
| Susheda 1995 | M    | 8 year  |                                    | √             | UKN | √    | √   | UKN. SM| 31*50*28 | Lymphoma  | Yes    | UKN. UKN. UKN. | /       | M √  | Death   |
| Wang 1995    | F    | 28 year | Cough, chest pain                 | √             | UKN | UKN  | UKN  | UKN. UKN. | 340*180*80 | Teratoma  | Yes   | √     | √     | √     | M √  | Recovery |
| Montange 1994| F    | 12 year | Asymptomatic                      | √             | UKN | UKN  | UKN  | UKN. SM | UKN.     | Lymphoma  | Yes   | √     | /     | /     | L √  | Recovery |
| John 1988    | M    | 12 year | Jugular vein distention, dyspnea | √             | UKN | UKN  | UKN  | UKN. UKN.| UKN.     | Lymphoma  | Yes   | √     | /     | /     | M √  | Recovery |
| Prakash 1988 | M    | 24 year | Cough, neck and shoulder pain     | √             | UKN | √    | UKN | UKN. AM | UKN.     | Lymphoma  | Yes*  | √     | /     | √     | M √  | Recovery |
| Neuman 1984  | M    | 13 year | Cough, dyspnea, facial swelling   | √             | UKN | UKN  | UKN  | UKN. AM | UKN.     | Lymphoma  | No    | /     | /     | /     | H √  | Death   |
| Neuman 1984  | M    | 16 year | Cough, dyspnea, chest pain, night sweats | √             | UKN | UKN  | UKN  | UKN. AM | UKN.     | Lymphoma  | Yes*  | /     | /     | /     | M ×  | Recovery |
| Neuman 1984  | M    | 13 year | Chest pain, fever                 | √             | UKN | UKN  | UKN  | AM      | UKN.     | Lymphoma  | Yes   | /     | /     | /     | M ×  | Recovery |

AM, anterior mediastinum; d, day; f, female; LV, left ventricle; M, male; m, month; MM, middle mediastinum; MMS, middle mediastinum syndrome; OP, operation; PM, posterior mediastinum; SM, superior mediastinum; SP, supine position; SVC, superior vena cava; UCE, uncertain; UKN, unknown; Yes*, Yes but with symptoms and signs; y, years.
(5.2%) with chest distress and 6 (7.8%) patients were asymptomatic. Seventy-five cases had signs of compression or invasion of trachea (60/85, 70.6%), bronchia (55/85, 64.7%), superior vena cava (43/85, 50.6%) and heart (26/85, 30.6%). Examination such as Computed tomography (CT), transthoracic echocardiogram (TTE), pulmonary function testing (PFT) and magnetic resonance imaging (MRI) were performed in 84 (97.4%), 24 (28.2%), 10 (11.8%), and 5 (5.9%) patients, respectively. Fifty-one (60.0%) patients underwent open thoracotomy, 28 (32.9%) patients underwent video-assisted thoracoscopic surgery (VATS) and 6 (7.1%) patients underwent other surgery. Fifty-seven (67.1%) patients had mass resection, 27 (31.8%) patients received mass biopsy and 1 (1.1%) case did not report surgical procedure.

Seventy-six (89.4%) patients were operated under general anesthesia (GA), 8 (9.4%) patients under sedation and 1 (1.2%) patient under local anesthesia. Fentanyl (n = 23), midazolam (n = 21), propofol (n = 19), ketamine (n = 15) and sevoflurane (n = 12) were most frequently used agents, followed by dexmedetomidine (n = 6), halothane (n = 5), remifentanil (n = 4), etomidate (n = 3), nitrous oxide (n = 3), diazepam (n = 2) and isoflurane (n = 2). Muscle relaxants were reported to be administered in 35 of the 85 included patients during anesthesia induction and in 5 patients after sternotomy, respectively. Succinylcholine (9/20, 45%) was the most commonly used muscle relaxant before endotracheal intubation. As for airway management, 66 (77.6%) patients were intubated with single lumen tube (SLT) including 1 with bronchial blocker (BB), 5 (5.9%) with double lumen tube (DLT), 4 (4.7%) with laryngeal mask airway (LMA) and 9 (10.6%) patients were tubeless. Spontaneous respiration was maintained in 32 (37.6%) patients, including 23 with spontaneous ventilation (SV) and 9 with assisted ventilation (AV).

Thirty-nine (45.9%) included patients developed MMS, 2 (2.4%) cases occurred before anesthetic induction, 13 (15.3%) cases after non-paralytic (without muscle relaxant) endotracheal intubation, 3 (3.5%) cases after muscle relaxant administration, 10 (11.8%) cases during position change, 10 (11.8%) cases during mass dissection, 3 (3.5%) cases during post-anesthesia recovery, respectively. Extracorporeal circulation (ECC) technique was applied in 20 (23.5%) patients: 2 initiated before anesthesia induction and 18 just with ECC standby. Three patients underwent ECC support due to severe intraoperative cardiopulmonary collapse. One patient experienced severe oxygen desaturation as the airway collapsed after endotracheal intubation without muscle relaxant and the operation was finally cancelled (12). Three patients died: 2 patients died from cardiopulmonary arrest as a result of ventilation failure during the anesthesia induction (37, 80); 1 patient had cardiac arrest intraoperatoratively due to suddenly increased airway resistance which deteriorated to sustained ventilation failure. The patient died on postoperative day 10 (75).

Discussion

Anesthetic management of mediastinal mass operation could be complicated by MMS characterized by acute respiratory and hemodynamic decompensation, which is caused by mechanical compression of mediastinal structures (81). However, no relevant guidelines for management of patients undergoing mediastinal mass operation is currently available. In the present study, we summarized the clinical characteristics, anesthetic management and outcomes of 85 patients undergoing mediastinal mass operation.

Comprehensive preoperative assessment is crucial in the management of patients with mediastinal mass (14, 39). Some risk stratifications have been proposed based on patients' preoperative signs and symptoms and the degree of major vessel or airway compression (2). CT scan, as an initial choice, provides anatomical details of masses and their relations with surrounding structures and helps in the creation of a deliberate plan for anesthetic and surgical management (28, 34). Compared with CT scan, MRI is more sensitive in soft tissue differentiation and delineating tissue boundaries. Echocardiography evaluates cardiac structural and functional alterations, which might influence anesthetic and surgical decision making (36). PFT, a tool to assess respiratory dysfunction and airway obstruction, may be of less value since there is conflicting evidence regarding the utility of PFT in risk stratification of mediastinal mass patients (7). By integrating the existing data of patients with mediastinal mass (2, 82, 83), we propose a classification to help categorize patients into three categories of risk (Table 2). A detailed preoperative multidisciplinary team (MDT) discussion is of vital importance (14, 37).

Some authors (5, 7, 8, 12, 24, 35, 44, 49, 57) have outlined some suggestions for the anesthetic management of mediastinal mass patients undergoing surgery. For example, avoidance of general anesthesia (especially paralytic agents) or maintenance of SV has been recommended (35, 69). It is a consensus to proceed with stepwise induction and avoid deep sedation (37). It has been agreed that, no single agent is superior to another one, and that any agent should be used judiciously in consideration of retaining SV. Frawley et al. (74) reported a lower incidence of respiratory depression when ketamine was used alone or when combined with midazolam, provided the dose of the latter was kept low (0.1 mg/kg). Propofol can maintain spontaneous respiration when given slowly (40), even though when combined with remifentanil which may result in increased PaCO₂ (83). Basem et al. (56) concluded that maintaining with dexmedetomidine (dose range of 0.2–0.7 µg/kg/h) could be very helpful and may reduce the risk of complete airway obstruction in the anesthetic management of mediastinal mass. Of the 85 patients, although 54 (63.5%) did not receive muscle relaxant in induction, the rate of MMS was not lower than that of patients who received muscle relaxant. A retrospective study by Ng et al. (84) found that positive-
pressure ventilation and intubation (though no muscle relaxation) was used in all cases that reported complications. Virtually all reported cases of severe MMS occurred after abolition of SV (1). Dubey (11) suggested that maintaining SV until sternotomy is a safer approach. If a muscle relaxant is required, manually assisted ventilation should be done firstly, to assure that positive-pressure ventilation is possible and then a short-acting muscle relaxant can be administered (12, 24). However, the return of spontaneous breathing is not quick enough in critical situations (2). As a result, we advocate no muscle relaxant and maintenance of SV in anesthetic induction. Of note, maintenance of SV cannot assure airway patency during anesthesia. Gardner (48) considered that partial upper airway obstruction may generate sufficiently negative intraluminal pressure to collapse the compromised segment in the rapidly spontaneously breathing patient, which explains why the dynamic airway collapse and the inability to ventilate despite maintenance of SV.

Opinions about airway management in patients with MMS differed among authors. Kafrouni et al. (12) suggested that both lungs ventilation via a reinforced SLT was preferred. In the current study, more than 60% cases were intubated with SLT. Sulen (24) advised that for patients with airway obstruction, the safest option was to place a bronchial blocker (BB) or double lumen tracheal (DLT) tube when patients remained awake. Compared with conventional intubation method, extraluminal use of BB has more advantages (6). DLT intubation was suitable for low risk of airway compression (30). Since the increased availability of fiberoptic bronchoscopy (FOB) in many institutions, awake intubation guided by FOB has become another useful option for airway management in mediastinal masses patients (especially those with airway compression). In Rajagopalan (32) and Miyachi's view (51), LMA or bi-level positive airway pressure (BiPAP) in sedation anesthesia can be used in patients with mediastinal mass that needs an incisional biopsy while maintaining SV. It is important to adhere to the general principles of maintaining effective ventilation and hemodynamic stability during induction and maintenance of anesthesia regardless of the technique used.

MMS can occur in every stage of perioperative period (2). Airway compression can occur in preoperatively asymptomatic adults with mediastinal mass (48). Acute respiratory decompensation may be precipitated by positional changes (8). Positioning change may help to relieve the mass effect of tumors (31, 37, 43, 46). It is vital to identify comfortable position in terms of respiration and hemodynamics in those symptomatic patients prior to surgery. The right lateral decubitus position can prevent MMS when the sitting position is not effective during general anesthesia (52). When intraoperative MMS does occur due to mass dissection, operation should be paused and compression be relieved immediately (81).

In high-risk patients classified as unsafe, decompensation after anesthesia induction should be expected and the option of connection to an extracorporeal circulation must always be provided (8, 52, 66). In the current study, ECC was prepared in 15 medium to high risk patients and 3 of them completed the operation with ECC when there was a severe cardiopulmonary failure intraoperatively. ECC were established before anesthesia induction and completed the operation successfully in 2 high risk patients. Three patients died of acute respiratory failure without ECC support and 1 patient’s operation was canceled because of the cardiopulmonary system unsteadiness, also with an absence of ECC preparation. Tempe et al. (66) cannulated the femoral vessels and kept ECC ready because it was thought that there was a definite danger of the patient developing airway...

### TABLE 2 Risk classification & categories of mediastinal mass patients.

| Risk classification | Signs and symptoms | Imaging examination findings |
|---------------------|---------------------|----------------------------|
| Safe                | –                   | –                          |
| Unsafe              | +                   | –/NA                       |
| Uncertain           | +                   | +: Tracheobronch CSA < 50% or compressed heart/great vessel |

| Risk categories | Signs and symptoms          | Supine tolerability | Tracheobronch | Heart or great vessel |
|-----------------|-----------------------------|---------------------|---------------|-----------------------|
| Low             | Negative                    | Yes                 | Negative      | Negative              |
| Medium          | Chest distress              | Yes (discomfortable)| Displaced     | Displaced             |
|                 | Dyspnea                     |                     | or CSA < 50%  |                       |
|                 | Swelling                    |                     |               |                       |
|                 | Tachycardia                 |                     |               |                       |
| High            | Cyanosis                    | No                  | CSA > 50%     | Tamponade             |
|                 | Orthopnea                   |                     |               |                       |
|                 | Stridor                     |                     |               |                       |
|                 | SVC syndrome                |                     |               |                       |

Abbreviation: CSA, cross-sectional area; CT, computed tomography; ECHO, echocardiography; MRI, magnetic resonance imaging, NA, not available, SVC, superior vena cava.
Perioperative management of patients with mediastinal mass. CT, computed tomography; ECC, extracorporeal circulation; FOB, fiber optic bronchoscope; GA, general anesthesia; ICU, Intensive care unit; MDT, multidisciplinary team; MMS, mediastinal mass syndrome; PEFR, peak expiratory flow rate; PFT, pulmonary function testing; SV, spontaneous ventilation; TTE, transthoracic echocardiogram.
obstruction. Maria et al. (26) and Brandon (21) provided a successful example of ECC used in this context to assist with high-risk MMS patients with impending respiratory collapse. Recently, extracorporeal membrane oxygenation (ECMO) has become popular, which could be utilized as an easy form of ECC supporting circulatory and/or pulmonary functions in high-risk MMS patients.

Following surgery, patients in the unsafe risk category should be transferred to an intensive care unit (ICU). The extent of postoperative monitoring for patients in the uncertain risk category should be decided depending on preoperative findings and intraoperative course (2). It is worth noting that completion of the operation does not mean that the alert could have been lifted. Unexpectedly, 2 (28, 79) patients experienced MMS in recovery period. One had failed extubation and was transferred to ICU and the other one had tracheal compression with ventilation obstruction. The sitting position is preferable for resuscitation in the presence of an airway obstruction (52). By combining the above-mentioned practice and suggestions, a recommended management protocol (Table 3) and flowcharted (Figure 2) was formed for patients undergoing mediastinal mass operation.

### Conclusions

To sum up, pre-operative multi-disciplinary discussion, well-planned anesthetic management and pre-determined protocols for emergency situations are all vital to patient safety.

### Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author/s.

### Author contributions

JcT: Methodology, Software, Data curation, Writing-original draft, Validation. PsL: Methodology, Writing-Validation. LxH: Methodology, Writing-Validation. YL: Methodology, Writing-Validation. YtY: Conceptualization, Methodology, Data

---

**TABLE 3** Recommended management of patients undergoing mediastinal mass operation.

**Preoperative examination and treatment**

| Procedure | Description |
|-----------|-------------|
| CT        | High-resolution CT angiography and multiplanar reconstruction |
| MRI       | Assessment of mediastinum and chest wall invasion |
| Echocardiography | Evaluation of compression, cardiovascular structure/function and volume status |
| PFT       | Prediction of peri-operative respiratory complications |
| FDG-PET   | Diagnosis, tumor staging and prognosis |
| Irradiation/chemotherapy | Possible mass size reduction before operation |

**Preoperative assessment**

- **MDT**: Anesthesia, surgery, oncology, radiology, critical care, pathology, etc.
- **Risk classification**: As shown in Table 2

**Anesthesia management**

- **Premedication**: Preoperative sedatives should be administered cautiously
- **Transfer**: Transfer of high-risk patients should be accompanied by anesthesiologists
- **Equipment**: Multi-functional operating table is available for prompt intraoperative position change
- **Monitoring and venous access**: Arterial line is placed prior to induction
- **Anesthesia induction**: Avoid deep sedation and proceed with stepwise induction
- **Endotracheal intubation**: Awake fiberoptic intubation with a reinforced single-lumen endotracheal tube is preferred

**MMS management**

- **Table-tilted to rescue position**
- **Sternal-lifting or mass pull-up by surgeon**
- **Inotropic support, volume replacement**
- **Extracorporeal circulation**

CT, computed tomography; FDG-PET, fluorodeoxyglucose positron emission tomography; MDT, multiple disciplinary team; MMS, mediastinal mass syndrome; MRI, magnetic resonance imaging; PFT, pulmonary function test.
curation, Writing—original draft, Validation. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Bittar D. Respiratory obstruction associated with induction of general anesthesia in a patient with mediastinal Hodgkin’s disease. Anesth Analg. (1975) 54:399–403. doi: 10.1213/00109527-19750500-00038

2. Erdos G, Tanova I. Perioperative anaesthetic management of mediastinal mass in adults. Eur J Anaesthesiol. (2009) 26:627–32. doi: 10.1017/S0952847909001095

3. Pearson JK, Tan GM. Pediatric anterior mediastinal mass: a review article. Semin Cardiothorac Vasc Anesth. (2015) 19:248. doi: 10.1177/1089253215579931

4. Yang Z, Shi Q, Bao F. A case of an unexpected posterior mediastinal functional paraganglioma: case report and literature review. BMC Anesthesiol. (2020) 20:109. doi: 10.1186/s12871-020-01026-6

5. Amin A, Primm AN. Anesthetic management of a patient with an anterior mediastinal mass undergoing endoscopic retrograde cholangiopancreatography in the prone position: a case report. A J Pract. (2020) 14:25–7. doi: 10.1213/XAA.0000000000001142

6. Liu Z, Iia Q, Yang X. Awake intubation and extraluminal use of uniblocker for one-lung ventilation in a patient with a large mediastinal mass: a case report. BMC Anesthesiol. (2020) 20:125. doi: 10.1186/s12871-020-01041-7

7. Mohammad HG, Samaan A, Arjang K. Anaesthetic management of a patient with a giant pericardial cyst compressing the right atrium. Case Rep Anesthesiol. (2019) 2019:2320879. doi: 10.1155/2019/2320879

8. Jeeson YI, Jun IG, Ha SS, Kwon HH, Lee YM. Extracorporeal membrane oxygenation for the anesthetic management of a patient with a massive goiter causing severe tracheal obstruction with positional symptoms. Medicine. (2019) 98(e17650). doi: 10.1097/MD.0000000000017650

9. Diwan S, Patil S, Jadhav S, Nair AS. Comprehensive perioperative management of an infant with huge mediastinal mass. Saudi J Anaesth. (2019) 13:24-6-8. doi: 10.4103/sja.SJA_788_18

10. Dubey PK, Tripathi N. Anaesthetic considerations in a patient with large anterior mediastinal mass. J Cardiothor Vasc Anesth. (2019) 33:1073–5. doi: 10.1053/j.jvca.2018.03.023

11. Hartigan PM, Ju-Mei N, Gill RR. Anaesthesia in a patient with a large mediastinal mass. N Engl J Med. (2018) 379:587–9. doi: 10.1056/NEJMc1804797

12. Kafrouni H, Saroufim J, Massih MA. Intraoperative tracheal obstruction and using a double lumen tube for airway patency. Turk J Anaesthesiol Reanim. (2017) 45:374-6. doi: 10.5152/TJAR.2017.81557

13. Dudley M, Lipnick M. Multidisciplinary management of an adult with a mediastinal mass. Crit Care Med. (2016) 44:487. doi: 10.1097/01.ccm.0000510322.61298 fb

14. Maria E, Jeffrey M, Iac O, B, Fraser J. Use of a sternal elevator to reverse complete airway obstruction secondary to anterior mediastinal mass in an anesthetized child. Pediatr Surg Case Rep. (2016) 8:42-5. doi: 10.1016/j.jspcr.2016.03.019

15. Woolers NR, Hoskinson E, Eley M. An unusual cause of stridor in an adult: mediastinal foregut duplication cyst. BMJ Case Rep. (2015) 2015:205833. doi: 10.1136/bcr-2014-205833

16. Scheele B, Ascher K, Karolina D, Csete M, Prone positioning for cardiorespiratory collapse in an adult patient with anterior mediastinal mass after general anesthesia. Chest. (2013) 143:287–8. doi: 10.1378/chest.1208071

17. Al-Mobarak G, Bryant AS, Crawford BJ, Dukes CM, Kelly DR, Young DW, et al. Surgical and anesthetic management of a mediastinal fatty tumor. Lipoblastoma. Ann Thorac Surg. (2015) 100:97–8. doi: 10.1016/j.athoracsur.2015.04.103

18. Lee J, Rim YC, In J. An anterior mediastinal mass: delayed airway compression and using a double lumen tube for airway patency. J Thorac Dis. (2014) 6:699-103. doi: 10.3978/j.issn.2072-1439.2014.04.30

19. Thakur P, Bhatia P, Sitalakshmi N, Virmani P, Anaesthesia for mediastinal mass. Indian J Anaesth. (2014) 58:215–7. doi: 10.4103/0019-5049.130840

20. Rajagopal S, Harbott M, Oritz J, Bandi V. Anaesthetic management of a large mediastinal mass for tracheal stent placement. Braz J Anaesthesiol. (2016) 66:215–8. doi: 10.1016/j.bjan.2014.01.009

21. Said SM, Telesz BJ, Maldusi G, Quevedo FJ, Suri RM, Allen MS, et al. Awake cardiopulmonary bypass to prevent hemodynamic collapse and loss of airway in a severely symptomatic patient with a mediastinal mass. Ann Thorac Surg. (2014) 98:87–90. doi: 10.1016/j.athoracsur.2014.06.104

22. Brain C. Cardiovascular collapse and hypoxemia in a man with a right-sided mediastinal mass, undiagnosed atrial septal defect, and right-to-left shunt. J Clin Anesth. (2016) 28:688–92. doi: 10.1016/j.jclinane.2014.05.011

23. Fabbro M, Patel PA, Ramakrishna H, Valentine E, Ochocha EA, Agostides JG. Challenging perioperative management of a massive anterior mediastinal mass
Can RL. Case report: giant cardiac malignancy in a nine-year-old female.

Transesophageal echocardiography for mediastinal mass surgery improves outcomes. J Anesthesiol Clin Pharmacol. 2011:782391. doi: 10.1155/2011/782391

Castleman disease in a patient with severe paraneoplastic pemphigoid: a case report. J Anaesthesiol Clin Pharmacol. 2013;33:1497–8. doi: 10.4097/kjap.2013.33-110

Mediastinal mass resection: femorofemoral cardiopulmonary bypass before induction of anesthesia in the management of airway obstruction. J Cardiothorac Vasc Anesth. (2001) 15:233–6. doi: 10.1097/01.JCV.0000053427.10808.FF

Gop AR. Anesthetic management of a patient with a mediastinal foregut carcinoma. J Anaesthesiol Clin Pharmacol. 2005;21:1276–80. doi: 10.4103/0971-9784.210111

Malignant tracheal stenosis:a case report. J Anesth. (2010) 24:534–7. doi: 10.1111/j.1600-1262.2010.04255.x

Mass resection of posterior mediastinal tumor in a child with a large anterior mediastinal mass. J Clin Anesth. (1996) 8:208–10. doi: 10.1016/S0025-6196(12)64915-5

Anesthetic management of an infant with anterior mediastinal mass. Paediatr Anaesth. (2004) 14:479–82. doi: 10.1111/j.1460-9592.2004.91101.x

Anesthetic management of giant mediastinal tumor resection in 4 children. Int J Anesthesiol Clin Pharmacol. 2012;28:246–2. doi: 10.4103/0971-8447.225430

The use of heliox and the laryngeal mask airway in a child with an anterior mediastinal mass resection. Paediatr Anaesth. (2005) 15:308–10. doi: 10.1111/j.1460-9592.2004.91101.x

Neuropathic pain: a case report. J Clin Anesth. (1995) 7:479–81. doi: 10.1016/0952-8180(94)00028-3

Mediastinal mass: do we need to worry much? Jpn J Thorac Cardiovasc Surg. (2009) 57:266–9. doi: 10.1007/s11748-009-0003-7

Paediatr Anaesth. (2014) 24:534–7. doi: 10.1111/paane.12306

Mediastinal mass resection: risk evaluation and perioperative management in a patient with congenital diaphragmatic hernia. J Hebei Med. (2008) 4:306–9. doi: 10.1007/s11748-009-0003-7

Mediastinal tumor:a case report. J Anesth. (2000) 14:479–82. doi: 10.1016/S0025-6196(12)64915-5

Anesthetic evaluation and management of a patient with anterior mediastinal mass supported with veno-arterial extracorporeal membrane oxygenation. Pediatr Crit Care Med. (2006) 7:479–81. doi: 10.1097/01.PCC.0000235427.10808.FF

Horan SP. Anesthetic management of a patient with an obstructing tracheal mass: a new way to manage the airway. Acta Anaesthesiol Scand. (1999) 43:84–6. doi: 10.1111/j.1365-2044.1999.00961.x

Mediastinal mass presentation for emergency surgery. J Clin Anesth. (1995) 7:479–81. doi: 10.1016/0952-8180(94)00028-3

Posterior mediastinal duplication cyst: a case report. Jpn J Thorac Cardiovasc Surg. (2005) 52:476–9. doi: 10.1007/s00540-010-0946-x

Mediastinal mass resection: veno-arterial extracorporeal membrane oxygenation. Paediatr Anaesth. (2010) 20:1097–1101. doi: 10.1111/j.1460-9592.2009.03258.x

Mediastinal tumor resection: femorofemoral cardiopulmonary bypass before induction of anesthesia in the management of airway obstruction. J Cardiothorac Vasc Anesth. (2001) 15:233–6. doi: 10.1097/01.JCV.0000053427.10808.FF

Anesthetic management of a patient with an obstructing tracheal mass: a new way to manage the airway. Acta Anaesthesiol Scand. (1999) 43:84–6. doi: 10.1111/j.1365-2044.1999.00961.x

Anesthetic management of a patient with a mediastinal foregut tumour: a case report. J Anaesthesiol Clin Pharmacol. 2003;19:225–8. doi: 10.1007/s11748-003-0003-7

Membrane oxygenation. Paediatr Crit Care Med. (2006) 7:479–81. doi: 10.1097/01.PCC.0000235427.10808.FF

Membrane oxygenation. Paediatr Crit Care Med. (2006) 7:479–81. doi: 10.1097/01.PCC.0000235427.10808.FF

Anesthetic management of giant mediastinal tumor resection in 4 children. Int J Anesthesiol Clin Pharmacol. 2012;28:246–2. doi: 10.4103/0971-8447.225430
Appendix. Search strategy

**PUBMED**

1. ((((((("mediastin"[All Fields] OR "mediastinally"[All Fields]) OR "mediastine"[All Fields]) OR "mediastinum"[All Fields]) OR "mediastinitis"[MeSH Terms]) OR "mediastinitis"[All Fields]) OR "mediastinum"[Mesh Terms]) OR "mediastinum"[All Fields]) OR "mediastinal"[All Fields]) AND "mass"[All Fields]

2. "anaesthetically"[All Fields] OR "anaesthetics"[All Fields] OR "anesthesics"[Pharmacological Action] OR "anaesthetics"[MeSH Terms] OR "anesthesics"[All Fields] OR "anesthesiology"[MeSH Terms] OR "anesthesiology"[All Fields] OR "anaesthetized"[All Fields] OR "anaesthetised"[All Fields] OR "anaesthetising"[All Fields] OR "anaesthesia"[All Fields] OR "anaesthetization"[All Fields] OR "anaesthetic"[All Fields] OR "anaesthetic"[All Fields] OR "anaesthetic"[All Fields] OR "anaestheticization"[All Fields] OR "anesthetize"[All Fields] OR "anesthetized"[All Fields] OR "anesthetizes"[All Fields] OR "anesthetizing"[All Fields] OR "anaesthesia"[All Fields] OR "anaesthetics"[MeSH Terms] OR "anesthesia"[All Fields] OR "anaesthetica"[All Fields] OR "anaesthetica"[All Fields] OR "anaesthesias"[All Fields]

3. ((((((("management"[All Fields] OR "managing"[All Fields]) OR "managements"[All Fields]) OR "managing"[All Fields]) OR "management"[All Fields]) OR "organization and administration"[All Fields]) OR ("organization"[All Fields] AND "administration"[All Fields]) OR "organization and administration"[All Fields]) OR "management"[All Fields]) OR "disease management"[MeSH Terms]) OR ("disease"[All Fields] AND "management"[All Fields]) OR "disease management"[All Fields])

4. "case reports"[Publication Type] OR "case report"[All Fields]

5. #1 AND #2 AND #3

6. #1 AND #2 AND #4

7. #5 OR #6

**EMBASE**

("mediastinal mass"[exp OR "mediastinal mass" OR [mediastinal AND ("mass"[exp OR mass]) AND ("anesthesia"[exp OR anesthesia] OR ("anesthetic"[exp OR anesthetic]) AND "management"[exp OR management]) AND ("mediastinal mass"[exp OR "mediastinal mass" [OR [mediastinal AND ("mass"[exp OR mass]) AND ("anesthesia"[exp OR anesthesia] OR ("anesthetic"[exp OR anesthetic]) AND "case report"[exp OR "case report" OR (case AND report)])

**OVID**

1. mediastinal mass.ti,ab,tx.

2. anesthetic.ti,ab,tx. OR anesthesia.ti,ab,tx.

3. case report.ti,ab,tx.

4. #1 AND #2 AND #3

**CNKI**

(SU = "纵隔肿瘤" OR SU = "纵隔占位") AND (SU = "麻醉管理" OR SU = "麻醉经验" OR SU = "麻醉方法") OR (SU = "纵隔肿瘤" OR SU = "纵隔占位") AND (TI = "病例报道" OR AB = "病例报道" OR KY = "病例报道")