Case Report

Management of descending necrotizing mediastinitis with severe thoracic empyema using minimally invasive video-assisted thoracoscopic surgery: a case report

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Background: Descending necrotizing mediastinitis (DNM) is a rare but serious complication of odontogenic or pharyngeal infection spreading into the mediastinum. Very few childhood cases of DNM have been described.

Case Description: We report a case of DNM complicated with severe thoracic empyema in a previously healthy 6-year-old girl who was successfully treated using minimally invasive video-assisted thoracoscopic surgery (VATS). The patient presented with odynophagia and dental pain, followed by rapid clinical deterioration including high fever, tachypnea, and left chest pain. As chest computed tomography (CT) revealed features of DNM, she was transferred from the local hospital to our hospital for intensive care. Empirical treatment was started with meropenem and linezolid. However, her tachypnea and dyspnea progressed rapidly. An ultrasound-guided left-sided thoracentesis drained 80 mL of brown sticky pus and the pus culture yielded *Streptococcus constellatus*. A contrast-enhanced CT scan demonstrated large mediastinal abscess and severe thoracic empyema. We performed debridement and drainage of the mediastinum and pleura using VATS. She recovered and was discharged on hospital day 18.

Conclusions: Early diagnosis by cervicothoracic CT and multidisciplinary approaches including intensive care, broad-spectrum antibiotics, and aggressive surgical intervention are crucial to reducing morbidity and mortality. VATS is a minimally invasive and appropriate treatment strategy for children with DNM, especially complicated with thoracic empyema.

Keywords: Descending necrotizing mediastinitis (DNM); video-assisted thoracoscopic surgery (VATS); thoracic empyema; drainage; case report

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Introduction

As a rare complication of oropharyngeal and cervical infection, descending necrotizing mediastinitis (DNM) is one of the most dreaded forms of mediastinitis, with reported mortality ranging from 16.5% to 50% (1-3). Successful treatment of DNM relies on early diagnosis and aggressive surgical drainage of the mediastinal abscess (2,4). Up to now, very few childhood cases of DNM have been reported.

Video-assisted thoracoscopic surgery (VATS) in children was first reported as an initial diagnostic procedure in

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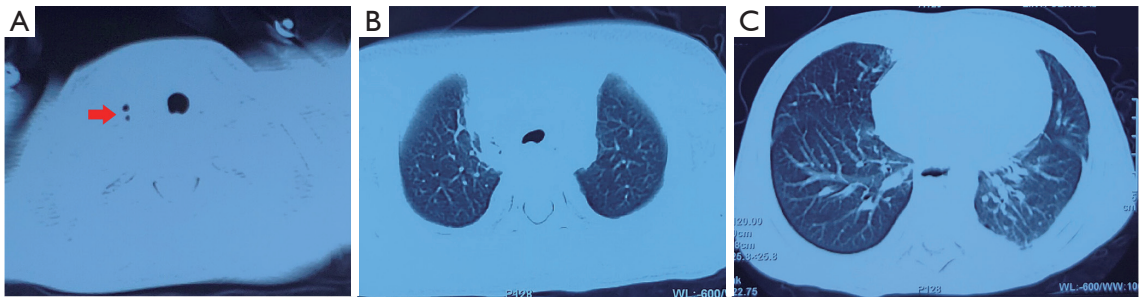


Figure 1 An urgent chest CT from the local hospital of the patient. (A) Air bubbles accumulated in the neck (red arrow); (B) mediastinal widening; (C) pneumonia and left pleural effusion. CT, computed tomography.

Table 1 Laboratory results of the patient during treatment

Laboratory tests	Reference range	Admission	D6	D10
White blood cell count (10^9/L)	3.5–9.5	4.85	17.36	8.66
Neutrophils (%)	40–75	71.0	80.1	78.2
C-reactive protein (mg/L)	0–8	306.5	95.8	7.9
Procalcitonin (ng/ml)	0–0.05	9.64	–	–
Lactate dehydrogenase (U/L)	120–250	433	–	–

D6, hospital day 6 (day 2 after surgery); D10, hospital day 10 (day 6 after surgery).

the 1970s (5). In recent decades, VATS has become more and more popular for a wide range of applications, from biopsy to advanced thoracic surgery, due to technological advancements in visualization and instrumentation. The advantages of VATS included less wound infection rate, lower postoperative pain, shorter hospital stay, and fewer long-term musculoskeletal sequelae (6). Using VATS, we report herein a successful treatment of a 6-year-old girl with DNM complicated with severe thoracic empyema. We present the following case in accordance with the CARE reporting checklist (available at https://tp.amegroups.com/article/view/10.21037/tp-22-60/rc).

Case presentation

A 6-year-old previously healthy girl presented with odynophagia and dental pain of the right upper molars. One day later, she was admitted to the local general hospital with high fever of 40 ℃. Although broad-spectrum antibiotics were administered, the fever persisted. On the fourth day in the local hospital, dental pain gradually resolved but tachypnea and left chest pain developed. An urgent chest computed tomography (CT) revealed pneumonia, pleural effusion, mediastinal widening, and air bubbles accumulated in the neck (*Figure 1*). She was transferred immediately to our hospital for intensive care. On admission, her vital signs were temperature 38.6 ℃, pulse rate 138 beats/min, respiratory rate 40 breaths/min, blood pressure 114/69 mmHg, and pulse oximetry of 95% on room air. There was no redness, localized swelling, or enlarged lymph nodes on her neck. Initial laboratory findings were shown in *Table 1*. Empirical treatment was started with meropenem (60 mg/kg per day) and linezolid (30 mg/kg per day). However, her tachypnea and dyspnea progressed rapidly. An ultrasound-guided left-sided thoracentesis was performed and drained 80 mL of brown sticky pus on the second day in our hospital. The laboratory examinations of drainage revealed low glucose (0.09 mmol/L), high protein levels (41.6 g/L), and neutrophil predominance (90%). Pus culture for only aerobes yielded *Streptococcus constellatus*. The blood culture was negative. On the third day, a contrast-enhanced CT scan of the neck and chest was performed. Compared with the previous result of the CT scan in her local hospital, the area of mediastinal abscess enlarged clearly, and thoracic empyema was more severe (*Figure 2A-2C*, *Video 1*). Air

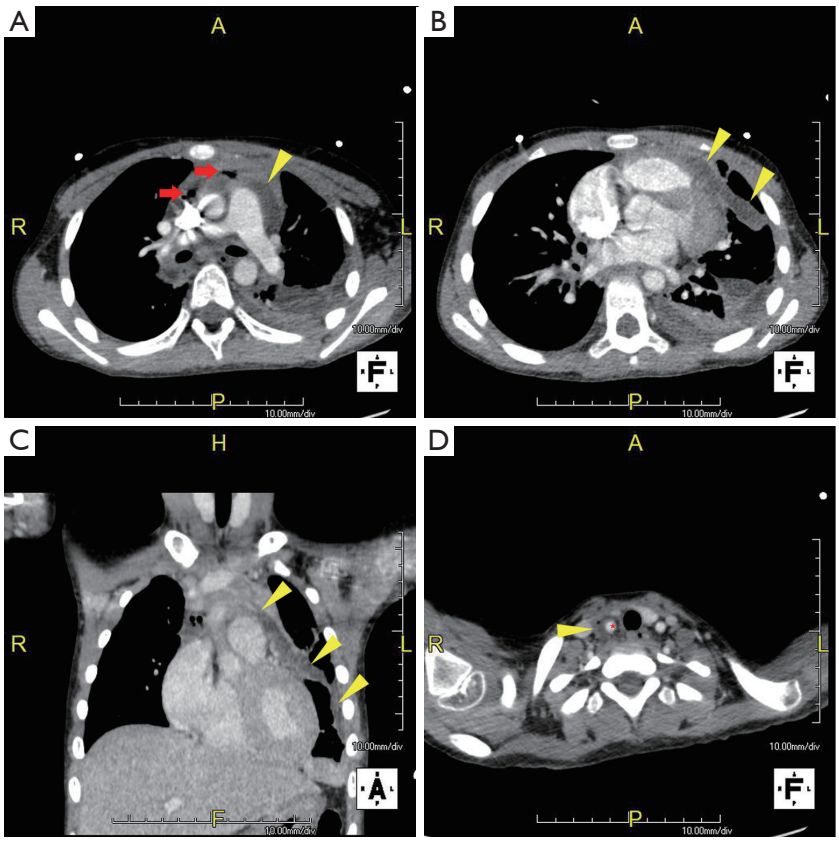
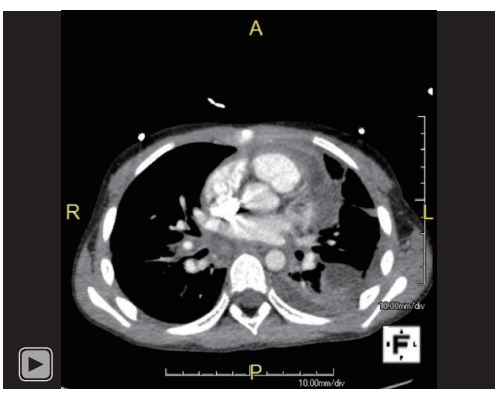


Figure 2 A contrast-enhanced cervicothoracic CT on the third day in our hospital. (A) An encapsulated abscess (yellow arrowhead) and air accumulated (red arrow) in the mediastinum with severe empyema in the transverse plane; (B,C) pus spreading from the mediastinum to the pleural cavity in the transverse and coronal planes (yellow arrowhead); (D) diminishment of the cervical abscess (yellow arrowhead) surrounding the right common carotid artery (red asterisk) in the transverse plane. A, anterior; P, posterior; R, right; L, left; H, head; F, feet; CT, computed tomography.



Video 1 Axial contrast-enhanced cervicothoracic computed tomography on the third day in our hospital. A, anterior; P, posterior; R, right; L, left; F, feet.

and fluid extended to the upper mediastinum rapidly and accumulated in this region. However, the low-density area of the abscess surrounding the right common carotid artery in the neck diminished (*Figure 2D*). The patient was therefore diagnosed with DNM complicated with severe empyema at the left side. VATS for left thoracic and mediastinal drainage was performed under general endotracheal anesthesia with two-lung ventilation (cuffed endotracheal tube size: 5 mm) on the next day. With the patient in the right lateral decubitus position, three 5-mm thoracic ports were introduced in the 4th, 7th, and 6th intercostal spaces, in the anterior, middle, and posterior axillary lines, respectively. Intrapleural carbon dioxide insufflation at low pressure of 2–4 mmHg was required

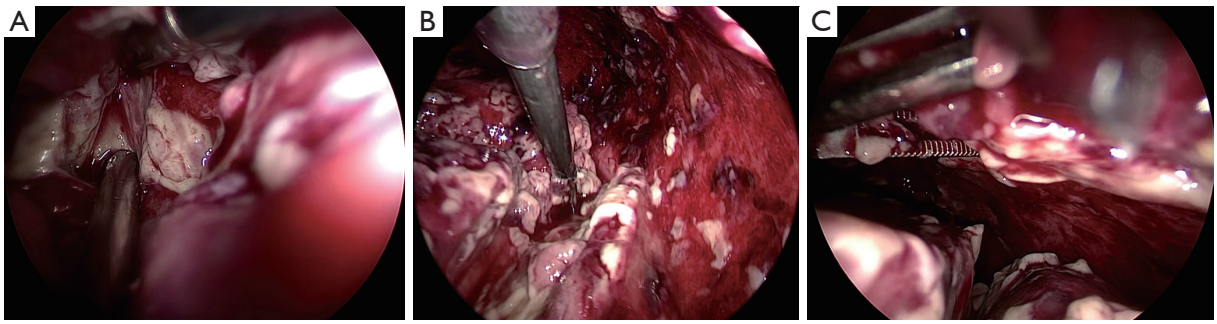


Figure 3 Thoracoscopic views. (A) Debridement of the mediastinum; (B) debridement of the left oblique fissure; (C) debridement of parietal pleura.

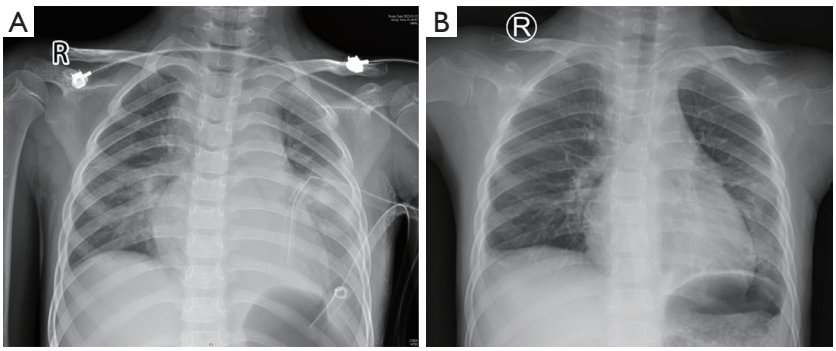


Figure 4 Chest radiographs after video-assisted thoracoscopic surgery. (A) Less noticeable fluid residue before removing drains on hospital day 10; (B) near-normal mediastinal contours before discharge on hospital day 18. R, right.

for collapse of the ipsilateral lung. To obtain optimal visualization of the whole pleural cavity, each of the three ports could be used as the observation hole, and the other two ports were used as the operation holes. The procedure involved surgical debridement of the mediastinum and pleura with complete excision and decortication of necrotic tissue (*Figure 3*). Through the incisions of introduced ports, two drains (22F single-lumen chest tubes) were positioned in the left thoracic cavity and the opened mediastinum via the thoracic cavity, respectively. Drainage cultures were negative. Cervicotomy and transcervical drainage of the mediastinum was not performed due to the absence of swelling on the neck during the physical examination and diminishment of cervical abscess in the CT image. Her fever resolved within three days after surgery. As the fluid from the drainage tubes gradually decreased, both drains were removed after confirming by chest X-ray that residual fluid was less noticeable on hospital day 10 (*Figure 4A*). On the same day, the C-reactive protein (CRP) level decreased to 7.9 mg/L (*Table 1*), meropenem was changed to ceftazidime at 100 mg/kg per day for the purpose of step-down antibiotic therapy, and the patient was transferred to the department of pediatric infectious diseases from the pediatric intensive care unit in our hospital. She made a full recovery and was discharged without any complications on hospital day 18 after near-normal mediastinal contours on chest radiography was confirmed (*Figure 4B*).

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from the patient's parent or legal guardian for publication of this case report and accompanying images. A copy or the written informed consent is available for review by the editorial office of this journal.

Discussion

DNM is a rare but fatal complication of odontogenic or pharyngeal infection, such as Ludwig's angina, which is an

infection of the submandibular space, usually secondary to infection of the second or third lower molar (7). These infections spread along the deep fascial spaces down to the mediastinum via the loose anatomical structures, such as the pretracheal space, perivascular space, and prevertebral space (3). In 1983, Estrera *et al.* first described DNM, which was found during surgery or post-mortem examinations (1). As DNM is rapidly progressive and highly lethal, prompt diagnosis, broad-spectrum antibiotic therapy, aggressive surgical drainage, as well as intensive medical care are crucial for successful treatment and recovery (8).

The most common symptoms of DNM include fever, odynophagia, cervical swelling, cervical pain, and dyspnea (9). Thoracic or back pain is less frequent. Only based on clinical symptoms and physical examination, DNM cannot be diagnosed early since these symptoms are not specific. Endo *et al.* reported an adult DNM case, in which a physical examination of the neck showed no abnormalities but a suspected retropharyngeal abscess immediately spread to the mediastinum instead of the cervical area via the prevertebral space (10). Similar to the case above, our patient also had a near-normal appearance of the neck on physical examination. It is therefore crucial to perform a CT scan immediately when DNM is suspected. Moreover, the cervicothoracic CT scan is the most effective tool for diagnosing DNM, assessing the range of mediastinitis, and guiding the surgical procedures (9).

According to previous studies, the most frequently isolated pathogen from pus cultures in children was *Streptococcus aureus* (11-13). In the present case, pus culture yielded *Streptococcus constellatus*. Mixed polymicrobial aerobic and anaerobic infections were reported in over 50% of the adult patients with DNM, which indicated broad-spectrum antibiotic therapy is crucial (9,14). Common choices for empiric therapy in adult patients were cephalosporins combined with metronidazole (9,15). In childhood cases, empirical treatment was started with vancomycin or meropenem more commonly (13,16,17).

It is universally accepted that antibiotic therapy alone is insufficient for eradicating the DNM (9). Aggressive surgical debridement and drainage of the mediastinum are fundamental. In adults, the optimal mediastinal drainage can be achieved with a variety of surgical approaches, such as a transcervical approach and transthoracic approaches including a posterolateral thoracotomy, median sternotomy, subxiphoid approach, and video-assisted thoracoscopic approach, but the best surgical approach remains controversial (4,8,18). As a minimally invasive approach to drain the mediastinum, VATS drainage in adults was first described in 1997 (18), and has been reported to be feasible and effective for treating the whole mediastinum (19). Compared with thoracotomy, VATS has fewer wound infection rates, shorter hospital stays, and fewer long-term musculoskeletal complications (6). However, the role of VATS in children with DNM has not been clear since only one case of management of DNM by VATS has been reported to our knowledge (16). Similar to the case above, our patient also developed severe empyema rapidly due to the spreading of pus from the mediastinum to the pleural cavity (*Figure 2B,2C*). Thanks to VATS, we could perform not only an aggressive surgical debridement of the mediastinum and pleura with complete excision and decortication of necrotic tissue, but also thorough mediastinal drainage by the incisions of introduced ports. However, we decided to avoid performing the cervicotomy or transcervical drainage of the mediastinum because our patient is unique in that there was no swelling on the neck and decreasing size of cervical abscess on CT. As a kind of traditional open surgery, transverse cervicotomy requires the use of a large incision and causes a visible scar in the neck unavoidably (20). Although cervicotomy is recommended as the standard care in adult DNM by most authors (9,14,15), we decided to choose an individual strategy according to clinical features of our young patient and achieved a satisfactory outcome. It should be emphasized that we would not hesitate to perform transcervical drainage if the patient had displayed an incomplete clinical resolution of the neck infection.

In conclusion, this case report suggests that early diagnosis by cervicothoracic CT and multidisciplinary approaches including intensive care, broad-spectrum antibiotics, and aggressive surgical intervention are crucial to reducing morbidity and mortality of DNM. VATS is a minimally invasive and appropriate treatment strategy for children with DNM, especially complicated with thoracic empyema.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at https://tp.amegroups.com/article/view/10.21037/tp-22-60/rc

Peer Review File: Available at https://tp.amegroups.com/article/view/10.21037/tp-22-60/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tp.amegroups.com/article/view/10.21037/tp-22-60/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from the patient's parent or legal guardian for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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