CASE REPORT

# A Fatal Case of Descending Necrotizing Mediastinitis as A Result of Treatment Delay in Odontogenic Infection: Various Bacterial Infections and Coexisting Lung Tuberculosis

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**ABSTRACT**

**Introduction:** Descending necrotizing mediastinitis (DNM) is a rare but life-threatening complication of oropharyngeal and odontogenic infections. This case report highlighted that DNM is very complex because it causes infection with various types of bacteria, and the presence of pulmonary tuberculosis (TB) in the patient.
**Case:** A patient with untreated pulp gangrene for three months underwent drainage and tooth extraction surgery. Subsequently, the patient was diagnosed with DNM and underwent cervicotomy and sternotomy for debridement. Postoperative cultures revealed polymicrobial infections. Additionally, a follow-up chest X-ray confirmed active pulmonary TB. The simultaneous presence of multiple bacterial infections and TB necessitated aggressive treatment, including broad-spectrum antibiotics, anti-TB drugs per standard regimens, and close intensive care unit (ICU) monitoring. Over a month of ICU care, the patient's vital signs and postoperative wounds improved. This case was classified as Endo-Hasegawa IIC DNM caused by odontogenic infection with pulp gangrene, progressing from the submandibular space to the mediastinum. The coexisting pulmonary TB further complicated management. Drainage via cervicotomy and sternotomy allowed for extensive mediastinal exploration. However, delayed diagnosis led to complications, including sepsis and altered consciousness due to uncontrolled bacterial spread. This underscores the importance of early diagnosis and intensive, multidisciplinary management to improve outcomes.
**Conclusion:** Physicians need to be more aware of DNM as a potential complication of odontogenic infections and the possibility of a wide variety of bacterial and coexisting infections that may complicate treatment.

## INTRODUCTION

Descending necrotizing mediastinitis (DNM) is an infection in the mediastinum caused by the spread of disease from the oropharyngeal region.[1] This life-threatening condition can be caused by various infections, including infections in the teeth, sinusitis, pharyngeal soft tissue infections, trauma to the deep cervical region, or even pulmonary *Mycobacterium tuberculosis* (MTB) infection.[1,2] This descending infection is believed to occur due to the negative intrathoracic pressure.[3]

Descending necrotizing mediastinitis with various bacterial infections is typically more severe than DNM cases with only one type of infection. Most cases are usually polymicrobial and mixed infections between aerobic and anaerobic microorganisms. The presence of multiple bacterial pathogens can lead to greater tissue destruction and a more complicated course of the disease due to their synergistic pathogenicity effect. Those pathogens can form biofilms to protect themselves, causing the infections to become more persistent. Furthermore, one of the bacterial types, MTB, induces granuloma formation, leading to tissue necrosis and creating opportunities for secondary infections. Moreover, this pathogen can alter the host's immune

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response, further exacerbating the severity of DNM.[2]

The early stage of DNM, which usually occurs above the carina, has a lower mortality rate (0%-6%). However, the mortality rate increases when the infection has extended below the carina or enters the late stage, as the conditions become more severe and complex.[4] Descending necrotizing mediastinitis is a rare condition, making its prevalence challenging to document accurately. It occurs in approximately 2.6% to 45% of patients with deep neck infections, particularly those with cervical necrotizing fasciitis.[5,6] Early detection and management of this rare case should be performed adequately due to its high mortality rate (25%-40%). Moreover, the mortality rate in the final stages of this disease can reach 50%.[7] Any delayed diagnosis or management, such as antibiotic administration, drainage, debridement, and other treatment, will be associated with morbidity and fatal conditions.[1,8]

We reported a case of DNM, a potentially fatal and rare complication of common odontogenic infections caused by various bacterial infections, and coexisting with pulmonary TB. This particular case report aimed to emphasize the complex case of severe DNM due to simultaneous polymicrobial infections and provide information regarding the detection and management approach conducted on this patient.

## CASE

A 45-year-old male presented with a sharp toothache on the right side, persisting for three months before admission. The patient had not sought healthcare advice and habitually touched the aching tooth with his bare hands. Two weeks before admission, he was diagnosed with pulp gangrene. He underwent drainage and excision of the affected tooth, followed by surgery in the upper neck area at a peripheral hospital. Postoperatively, he developed swelling in the lower jaw, extending to his neck and chest, leading to his referral to our hospital.

Physical examination revealed red, warm swelling with tenderness in the right and left anterior neck areas, spreading to the infraclavicular and suprasternal notch. The swelling was cystic, indicating the presence of fluid. There was an incision wound in the bilateral submandibular region with pus seeping from the surgical wound in the neck area, along with necrotic tissue findings (Figure 1).

**Figure 1**. Patient's clinical findings of descending necrotizing mediastinitis

Laboratory results showed elevated leukocytes (12,850) and neutrophils (89.4%), suggesting bacterial infection and inflammation. Additionally, the laboratory results showed a high C-reactive protein (CRP) level of 68.2 mg/L (high). Liver function tests revealed a high serum glutamic-oxaloacetic transaminase (SGOT) of 67 U/L, but a normal serum glutamic-pyruvic transaminase (SGPT) of 44 U/L. Renal function parameters showed high urea 44.9 mg/dL and low creatinine 0.3 mg/dL level, but a normal estimated glomerular filtration rate (eGFR) of 149.6 mL/min/1.73 m². The blood glucose level was normal at 128 mg/dL. The patient denied having comorbidities like hypertension, diabetes mellitus type 2, or any other chronic diseases. A chest X-ray (Figure 2) showed a cavity with surrounding infiltrates in the upper field of the right lung (yellow arrow), which suggested the presence of TB. However, the patient denied any symptoms of TB, such as coughing, night sweats, decreased weight, hemoptysis, and so on. The chest X-ray also displayed a widening of the superior mediastinum (yellow line). Additionally, the thickening of the soft tissue with multiple air lucencies within the bilateral region of the colli suggested an infectious process (yellow circle).

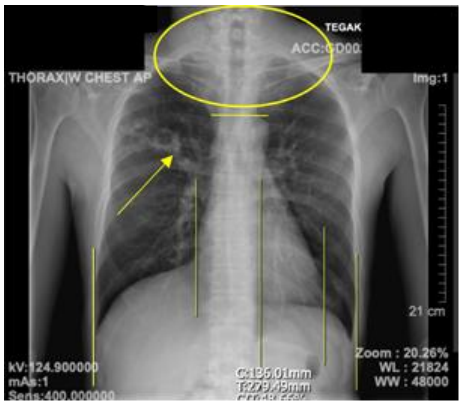


**Figure 2**. Patient's chest X-ray. Cavities with surrounding infiltrates in the upper field of the right lung, DDx: active pulmonary tuberculosis. Widening of the superior mediastinum. Thickening of soft tissue with multiple air lucencies within the visualized bilateral neck region, suggestive of an infectious process.

A neck X-ray (Figure 3) revealed partial diffuse soft tissue thickening with multiple air lucencies extending into the superior mediastinum, indicative of an infectious process. The differential diagnosis included necrotizing fasciitis of the colli region with DNM. Focal soft tissue thickening with a prominent air component in the right submandibular region suggested abscess formation (yellow round).


**Figure 3**. Patient's neck X-ray

The patient was diagnosed with DNM based on the chest X-ray findings and the clinical symptoms the patient displayed. Immediate surgical intervention was decided upon. The patient underwent cervical dissection, debridement, and pus drainage, as well as sternotomy with debridement and drainage of the mediastinum. Sternotomy was chosen due to the widening of the mediastinum. Meropenem (3x1 gram IV) was administered as a broad-spectrum antibiotic, and ketorolac (3x30 mg IV) as an analgesic before and after surgery.

Tissue, pus, blood, and sputum samples were sent for bacterial, fungal, and mycobacterial stains and cultures. The tissue sample from the wound revealed infections with *Enterobacter roggenkampii* and *Acinetobacter baumannii*, which are resistant to chloramphenicol, cotrimoxazole, gentamicin, amikacin, ceftriaxone, ceftazidime, ciprofloxacin, piperacillin/tazobactam, cefepime, and levofloxacin. The sputum sample identified *Stenotrophomonas maltophilia*, resistant to chloramphenicol, cotrimoxazole, amikacin, piperacillin/tazobactam, tigecycline, levofloxacin, and *Elizabethkingia meningoseptica*, resistant to chloramphenicol, gentamicin, amikacin, aztreonam, ceftriaxone, ceftazidime, cefepime, tigecycline, and levofloxacin. The blood sample showed infections with *Enterococcus faecium*, resistant to erythromycin, tetracycline, amikacin, sulbactam/ampicillin, amoxicillin+clavulanic acid, ciprofloxacin, piperacillin/tazobactam, and levofloxacin. Both blood and tissue samples from the wound revealed *Acinetobacter baumannii*, resistant to erythromycin, tetracycline, amikacin, sulbactam/ampicillin, amoxicillin+clavulanic acid, ciprofloxacin, piperacillin/tazobactam, and levofloxacin.

Multiple bacterial infections complicated the patient's treatment. Post-surgery, we decided to do further examination with GenXpert to ensure the presence of TB in this patient, due to the chest X-ray having shown the presence of TB, although the patient did not have any TB symptoms. The GenXpert from the sputum sample confirmed the presence of MTB, which is sensitive to rifampicin. This means that this patient likely had pre-existing TB before getting diagnosed by DNM. The presence of multiple bacterial infections and pulmonary TB necessitated aggressive antibiotic treatment based on the culture, close monitoring, and intensive care unit (ICU) management. The patient was also given negative wound pressure therapy (NPWT) for faster and better wound healing. The patient had septic shock and neurogenic complications that made the patient unconscious and needed intubation due to respiratory distress. This patient's postoperative wound (Figure 4) appeared to be in excellent condition, suggesting that the DNM was not the cause of his prolonged recovery.

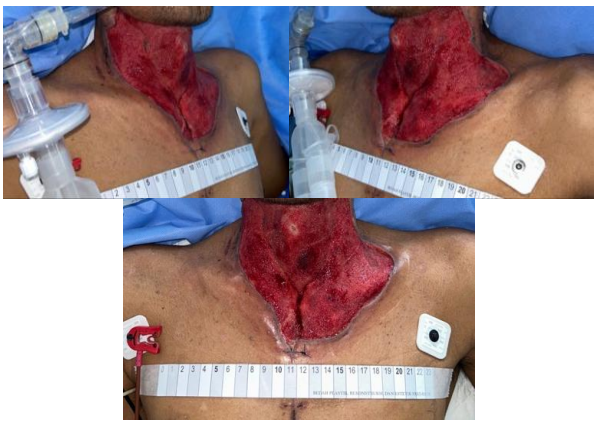

**Figure 4.** The patient's postoperative wound

We identified the same type of bacteria in the wound tissue sample and the bronchoalveolar lavage sample taken two weeks after hospitalization. This finding suggests that the bacteria responsible for DNM may have spread to the lungs, leading to pneumonia. The diagnosis of pneumonia was further confirmed by the presence of a new infiltrate in the lower left lung field on a follow-up chest X-ray (Figure 5) (green circle). The same X-ray also revealed infiltrates, cavities, and fibrosis in the upper to middle lobe of the right lung (red circle), likely resulting from the spread of pulmonary TB. The X-ray showed soft tissue edema in the colli-supraclavicular region with subcutaneous emphysema (green circle).

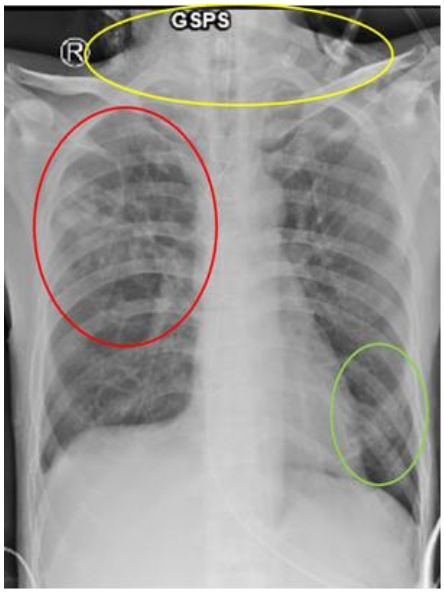


**Figure 5.** A newer patient's chest X-ray showed signs of pneumonia

The patient's condition was further complicated by multiple bacterial infections, which caused septic shock, along with coexisting pulmonary TB. The patient was initially hospitalized in the ICU for approximately three months. He was then transferred to the general ward once his hemodynamics, vital signs, and infection parameters improved. After about a month in the general ward, his infection parameters and vital signs remained stable, but his level of consciousness only improved to Glasgow Coma Scale (GCS) E4M4Vt. Due to personal family reasons, the patient's family requested to take him home for home care, and he was discharged accordingly.

## DISCUSSION

Descending necrotizing mediastinitis represents a severe form of mediastinitis resulting from odontogenic infection or deep cervical space involvement. Despite therapeutic advancements, DNM carries a mortality rate ranging from 24-50%.[7] Given its high lethality and potential fatality, immediate and intensive management is imperative. We presented a male patient with Endo-Hasegawa IIC DNM caused by odontogenic infection (pulp gangrene), who underwent cervicotomy and drainage sternotomy but subsequently remained in the ICU for 25 days due to multiple bacterial infections and coexisting TB that complicated treatment.

This clinical scenario is uncommon. While mediastinitis commonly stems from abscess rupture in the esophageal region or complications of cardiothoracic surgery, DNM exhibits a broader spread pattern extending beyond the inferior facial region. In this case, the infection likely originated in the submandibular space, progressed to retropharyngeal and parapharyngeal spaces, and potentially infiltrated the perivascular space into the mediastinum. Factors contributing to this spread include gravitational effects, increased intrathoracic negative and pleural pressures during inspiration, and compromised facial plane barriers. Coexisting comorbidities and a suboptimal lifestyle can further exacerbate disease progression. In this case, the patient was newly diagnosed with pulmonary TB post-hospital admission and poor oral hygiene, potentially complicating the clinical course. When the infection spreads deeply to the mediastinum, it indicates late diagnosis. Hence, the mortality will rise.[1,9,10]

The diagnosis of DNM in this patient was established based on the criteria set by Estrera, *et al*. (1983), which include clinical manifestations of oropharyngeal infection, imaging findings suggestive of mediastinitis such as diffuse soft tissue thickening with multiple air lucencies extending into the superior mediastinum (indicative of an infectious process), intraoperative identification of necrotizing mediastinal tissues, and a correlation between oropharyngeal infection and the occurrence of DNM.[11] The patient experienced leakage from the odontogenic surgery wound site, indicating ongoing active oropharyngeal infection. Neck and chest X-rays revealed infectious processes in the right submandibular and bilateral neck regions, extending into the superior mediastinum. There were no computed tomography (CT) scan data for this patient. As a recommendation, a CT scan is more specific in identifying DNM by showing fluid density, gas accumulation in the mediastinal compartments, and necrotic infiltration into soft tissues.[12] Intraoperative findings confirmed pus in the aforementioned regions, including the anterior and posterior mediastinum, but not in the right and left intrapleural spaces. Therefore, the patient's diagnosis is Endo-Hasegawa IIC DNM due to odontogenic infection (pulp gangrene) following submandibular drainage incision and tooth extraction.

The optimal management of DNM necessitates appropriate antibiotics, airway patency maintenance,

infection source control, and cervical-mediastinal drainage. The initial antibiotics administered were metronidazole and levofloxacin, followed by the patient's antibiotic sensitivity profile based on bacterial culture results. According to Endo, *et al*. (2021) classification, surgical approaches are recommended.[13] Type I DNM is recommended for transcervical drainage. For type IIA, drainage is performed via cervicotomy and subxiphoid or anterior mediastinotomy incisions. Drainage for type IIB and IIC DNM may involve a combination of cervicotomy and thoracotomy. However, many experts employ alternative methods for cervical and mediastinal drainage, such as transcervical, subxiphoid, median sternotomy, and even video-assisted thoracic surgery (VATS).[13]

This case utilized cervicotomy and sternotomy for drainage. During cervicotomy, the operator observed pus clearly in the submandibular, retropharyngeal, and paravascular spaces. Subsequently, the operator identified a tract leading to the retrosternal area, which led to the decision to perform sternotomy. The advantage of sternotomy is facilitating more effective exploration, debridement, and drainage of the mediastinal compartments, including intrapleural spaces. This method is also used when there is suspicion of the pericardium or pleura-related infection, which can be seen from redness of the chest or widened mediastinum. However, there is a higher risk of wound dehiscence and osteomyelitis. In addition to finding pus in the anterior and posterior mediastinum, the operator encountered adherent and white-colored thymus tissue, which was subsequently excised (thymectomy). Exploration of the intrapleural space revealed no fluid or pus. Following this, irrigation with sterile water and placement of drains in both intrapleural spaces, substernal, and neck were performed. Drains were removed once minimal, serous fluid production was observed.[14–16] Routine evaluation after surgery can be performed by clinical appearance observation, and laboratory tests such as complete blood count, CRP, procalcitonin, and blood gas analysis.[14–16] Negative wound pressure therapy could encourage faster and better postoperative wound healing by reducing inflammatory exudate and promoting granulation tissue.[17]

Postoperatively, the patient experienced several complications, including septic shock attributed to newly diagnosed pulmonary TB and pneumonia, as well as decreased consciousness following status epilepticus with exacerbation of myoclonic seizures worsened by sepsis. Several patients have experienced pneumonia in the postoperative period.[18] The pneumonia was caused by *Acinetobacter baumanii*, which spread DNM to the lungs. Due to its multiple virulence factors and resistance to several antimicrobials, *Acinetobacter baumannii* can cause fatal pneumonia.[19] Moreover, the patient's deterioration was complex and multifactorial, involving comorbidities and delayed treatment of the odontogenic infection, which contributed to the involvement of multiple bacteria. This is why the patient spent an extended stay in the ICU. Intensive and multidisciplinary management involving respiratory, anesthesiology, and neurology teams was crucial in controlling the patient's deterioration.[20]

## CONCLUSION

Descending necrotizing mediastinitis is a life-threatening condition requiring prompt diagnosis, appropriate management, and intensive post-intervention monitoring to reduce patient mortality and morbidity. There is a need to increase physicians' awareness of DNM as a potential complication of odontogenic infections. Furthermore, there is the possibility of a wide variety of bacterial and coexisting infectious diseases that may complicate the treatment. In this case, surgical and aggressive antibiotic treatments based on culture, close monitoring, and ICU management were crucial.

### Consent

Written informed consent was obtained from the patient's family.

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### Conflict of Interest

The authors declared there is no conflict of interest.

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### Authors' Contributions

Conceptualization: SW. Methodology: TFH, APV, GNS, PAG. Validation: SW. Investigation: TFH, SW. Resources: TFH, APV, GNS, PAG, SW. Data curation: TFH, APV, GNS, PA. Writing—original draft preparation: TFH, APV, GNS, PAG. Writing—review and editing: TFH, APV, SW. Visualization: TFH, PAG. Supervision: SW. All authors contributed and approved the final version of the manuscript.

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