

## Deep Neck Space Infections Leading To Life - Threatening Condition: Case Series

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### Abstract

Deep neck space infections typically has odontogenic origin and pose a therapeutic challenge because of the intricate anatomy and the potential for spreading to neighbouring neck spaces. An odontogenic space infection is a perfect example of how minor ailments left unaddressed can escalate into life-threatening conditions in the realm of dental practice. Odontogenic space infections, basically originates from dental sources and potentially spread into the deep fascial spaces in the head and neck due to complex anatomy. Deep space infections can possibly lead to serious complications, including the risk of fatal transformations such as mediastinitis, airway obstruction, Ludwig's angina and sepsis which can even cause death. We present three such cases that were complicated by deep neck space infection. In one case, the patient presented pain and swelling in the lower left side of face which on clinical examination and pathological findings revealed to be a submandibular space infection which later was spread towards the mediastinum. The second case was necrotizing fasciitis where the patient was unable to maintain oxygen saturation throughout. In the third case, the patient presented with pain and swelling over the right side of the face leading to deep neck space infection causing tracheal compression. The fourth case was again of necrotizing fasciitis which landed the patient in quite critical condition.

**Keywords:** Deep neck space infection (DNIs), Odontogenic, Risk factors, Mediastinitis, Ludwig's angina, Necrotizing fasciitis

### Introduction:

Infections of the deep neck fascial spaces and other craniofacial infections are most commonly odontogenic in origin. The bacterial infections spread into the deep fascial planes of the head and neck causing various complications such as retropharyngeal spread with airway obstruction, mediastinitis, Ludwig's angina, intracranial extension and pleuropulmonary spread. Anatomical factors play a crucial role in the presentation and progression of bacterial infections originating from the oral cavity and spreading beyond the jaws.<sup>1</sup> Odontogenic infections can follow pathways dictated by the anatomy of the head and neck, leading to the involvement of various spaces and tissues. The spread of the infection tends to follow the lines of least resistance, which are dictated by the bone and periosteum, muscle and fascia. Grondinsky and Holyoke demonstrated this in 1938.<sup>2</sup> This and other anatomical studies form the basis of the standard anatomical spaces of the head and neck.<sup>2,3,4</sup> Understanding the anatomy of fascial spaces and recognizing early symptoms is crucial for prompt intervention and preventing potentially life-threatening

consequences. The symptoms are often characterized by swelling in the affected area, accompanied by redness, tenderness, fever, trismus, difficulty in swallowing, drainage and difficulty in breathing. There is an increase in white blood cells (WBC) and C-reactive protein (CRP).<sup>5</sup> Securing the airway in patients with odontogenic space infection can pose challenges due to various factors such as upper airway obstruction, edema, and restricted mouth opening. In cases of deep neck space infections, airway restriction and dyspnea (difficulty breathing) can be critical issues requiring prompt and appropriate management. Necrotizing fasciitis is a complication of deep neck space infection which is a severe, rapidly progressing bacterial infection that affects the soft tissues, including the fascial planes, surrounding muscles, nerves, and blood vessels. It is a medical emergency due to its aggressive nature and potential for rapid tissue destruction. We present four cases of deep neck space infection which later gets complicated but with early recognition, aggressive surgical intervention, and appropriate antibiotic therapy we managed to provide better outcomes to the patients.

### Case 1

A 24-year-old female reported to the Department of Oral and Maxillofacial Surgery at our institute presenting with pain and swelling in the lower left side of her face for the past four days. The patient was apparently all right four days back when she noticed pain in her lower left back tooth region for which she consulted a nearby clinic. The patient underwent extraction with the mandibular left first molar under local anesthesia. Following the extraction the patient noticed an increase in the swelling of the affected side associated with pain and discharge from the extracted tooth socket. On extra-oral examination, the face appeared asymmetrical with swelling present over the left side of the face, approximately 1.5 cm anterior to the tragus. The overlying skin was reddish. There was a reduced mouth opening of 18mm. Tenderness was present on palpation over the left cheek. A corrugated rubber drain was already placed over the left submandibular region when the patient took primary treatment. Diffuse swelling was present with distension on the right side of the neck, extending to the anterior part of the neck reaching the mediastinum and causing tracheal compression (Fig.1). Crepitus was present over the right

supra-clavicular region. On intra-oral examination, pus discharge was present from the extraction socket of the left mandibular first molar associated with vestibular tenderness over the region of the left mandibular first and third molars. We carried out blood investigations and X-rays. The blood profile revealed a low Hb count of 5g/dl. General condition was worsening with SPO<sub>2</sub> falling to 76%. The patient was immediately put on oxygen support. Chest X-ray and USG of the neck was performed which revealed Subcutaneous Emphysema on the left side of the neck (Fig.2). Immediate drainage was done bedside (Fig.3). Transverse incision was given over the supraclavicular triangle, and artery forceps was introduced following the roof of the neck and supraclavicular space was reached. 200ml pus was drained and the sample was sent for sensitivity. Pus was viscous in consistency containing blood clots and smelling of rotten eggs. Romovac drain was placed and secured with 2-0 silk. Copious irrigation and dressing were done. Immediately after the procedure patient's SPO<sub>2</sub> level was increased to 90-92%.



Fig.1 Swelling present over right neck reaching towards mediastinum.

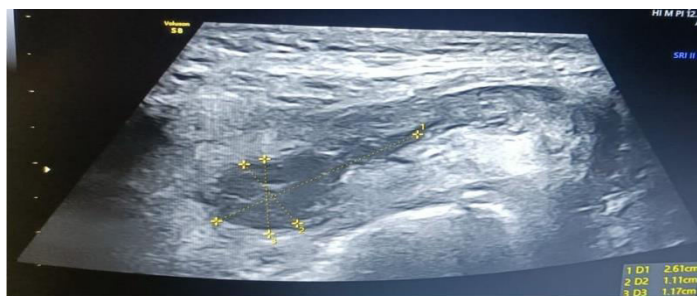


Fig.2 USG of neck showing collection of fluid in left submandibular region, crossing midline and reaching up to left side; also air density is noted along anterior wall of neck in the subcutaneous

At the seventh day, the amount of discharge collected from the drain was reduced to 5-10ml. The supra-clavicular drain was removed after nine days. Sufficient mouth opening was achieved later on and the patient was advised

physiotherapy for maintaining adequate mouth opening. In the end, we successfully intervened to rescue the patient from a life-threatening condition.



Fig.3 Supraclavicular drain placement.



Fig.4 Postoperative .

### Case 2

A 50-year-old female reported to our department presenting with pain and swelling over the right side of her face and neck for the past 10 days. The patient was apparently alright ten days back when she started experiencing pain in her right mandibular posterior tooth. The pain was sharp shooting in nature. The patient underwent extraction with respect to the right mandibular first molar under local anesthesia at her nearby dental clinic. After a few days she noticed swelling over the right side of her face and neck which was later followed by pus discharge and a foul smell. On extra-oral examination, the face was bilaterally asymmetrical due to diffused swelling present over the right side of her face which was dome-shaped, non fluctuant, measuring approximately 12x9 cm in size, descending in the neck and reaching the mediastinum causing respiratory distress. Tenderness was present over the right side of the face and neck. The mouth opening was 19 mm. Blood investigations were carried out. FNAC was done where 3 ml of brownish fluid was aspirated and sent to the pathology lab. Blood profile investigation revealed a low Hb count of 7g/dl. Incision and drainage were done using conventional technique. 200 ml of pus was drained. Offending teeth were extracted. The open dressing was given over the right side of the submandibular region. Drain was placed over the right supraclavicular region. Supportive therapy of antibiotics and anti-inflammatories were prescribed. There was a decrease in pus simultaneously with a decrease in the tissue space after healing. After months there was complete healing.

### Case 3

A 29-year-old female reported to casualty at our hospital presenting with reduced mouth opening, pus drainage and foul smell from her lower left side of the cheek since two months. The patient was apparently alright two months back when she started getting toothache in her left mandibular posterior region followed by mild swelling over the left side of her face. Swelling increased gradually on both the left and right side of her face. The patient consulted a general physician for whom she was prescribed medicines that she did not take. After one month swelling reduced significantly. After 15-20 days patient again had swelling on the left side of her face associated with fever. After one week there were pustules of yellow colour which bursted, leading to pus discharge associated with foul smell. The fact that the swelling reduced significantly initially but then recurred, along with the presence of pustules, foul-smelling and pus discharge, indicates an active and possibly worsening infection. The general condition of the patient was very poor. Mouth opening was restricted to 1 mm. On extra-oral examination abscess cavity was present on the left side of her cheek with a foul smell and pus discharge (Fig.5). Tenderness was present over that region and her temperature was elevated.



Fig.5 Abscess cavity with pus discharge and overlying necrotized tissue.

The patient was admitted to the ICU and blood investigations were carried out. A swab culture was sent for culture and sensitivity test. Her Hb count was down to 3 g/dl. RBC and platelet count were also decreased. Her blood pressure was

80/50 mm hg. The patient was disoriented, irritable and uncooperative. Four units of blood transfusion was done. Bedside debridement was done and romovac drain was placed.



Fig.6 (A) and (B) show the debridement of the necrotized tissue and placement of the drain.

Heavy doses of antibiotics and anti-inflammatories were given with fluids. The patient's general condition improved gradually with the Hb count raised to 12 g/dl. The patient's mouth opening was increased to 15 mm after one week. Later skin graft was placed.

#### Case 4

A 45-year-old female reported to casualty at our hospital presenting with swelling present all over her face and neck since 5-7 days. The patient was apparently alright one week back when she noticed swelling all over her face, neck and then over the entire body. On physical examination, she had respiratory distress. Her vital signs were monitored immediately. Her temperature was 99 degrees Fahrenheit. Blood pressure was 90/50 mm hg, respiratory rate was 24 breaths per minute. The patient was disoriented and uncooperative. On extra-oral examination swelling on the left side of her face was extending from the left infraorbital rim to the lower border of mandible crossing the midline supero-inferiorly and antero-posteriorly from the ala of the nose to the tragus of the ear. The swelling was soft and fluctuant. The overlying skin was necrosed and a foul smell was present. Mouth opening was limited to 4-5 mm. Intra-oral abscess opening was present where pus was draining buccally in the region of the first and second right mandibular molars where the first mandibular molar was grossly carious. Blood profile revealed Hb level down to 5.6 g/dl and elevated ESR levels. Incision and drainage was done using the conventional method. Necrotized skin was removed and a skin graft was placed.

#### Discussion:

Deep neck space infections pose a growing challenge to the healthcare system. Odontogenic infections and their associated complications display diverse clinical

presentations and manifestations.<sup>6</sup> These infections in the soft tissues of the oral cavity can spread downwards along the fascial planes, often originating from the molars of the mandible<sup>7</sup>. While initially localized, these infections have the potential to escalate swiftly and result in severe complications if not promptly addressed or inadequately treated. The head and neck region comprises interconnected spaces and fascial planes that provide pathways for infection propagation, extending into various areas including the submandibular, sublingual, buccal, pterygomandibular, and infratemporal spaces. These interconnected spaces facilitate the extensive spread of infections if not controlled. Notably, the submandibular space is commonly affected in both singular and multiple space odontogenic infections, followed by the buccal and parapharyngeal spaces<sup>7,8,9</sup>. Infections descending through the head and neck region follow the cervical fascial planes, which encompass superficial and deep layers, further divided into superficial, middle, and deep layers, thereby delineating distinct deep neck spaces<sup>10,11,12</sup>.

Deep neck infections can instigate cellulitis, characterized by soft tissue inflammation and infection. Cellulitis progression can be rapid, leading to swelling, pain, and erythema in the affected area. Additionally, these infections can localize and give rise to abscess formation, marked by a collection of pus surrounded by inflamed tissue. Abscesses often induce severe pain, swelling, and systemic symptoms such as fever and malaise. The spread of infection into the mediastinum, the area within the thoracic cavity between the lungs, can result in mediastinitis, a serious and potentially fatal condition marked by chest discomfort, breathing difficulties, sepsis, and systemic organ dysfunction<sup>7</sup>. Deep neck space infections may lead to systemic complications like bacteremia, sepsis, and infective endocarditis, particularly in individuals with preexisting medical conditions or weakened immune systems. Due to the complex anatomy

of the neck, surgical treatment tends to be challenging. Moreover, in most of our cases, severe and lethal complications did occur and associated systemic disorders were shown to aggravate the disease. The most common etiology for deep neck space infection in our cases was the odontogenic origin. Among the array of complications associated with deep neck space infections, Necrotizing fasciitis stands out as a significant concern. As two of our patients suffering from it were quite critical in condition. Necrotizing fasciitis is a distinct clinical infection that is relatively rare. "Necrotizing fasciitis" is the preferred term when the infection's most prominent feature involves extensive necrosis of the superficial fascia, leading to widespread undermining of surrounding tissue and severe systemic toxicity, regardless of the specific bacterial etiology.<sup>13</sup> The primary treatment for necrotizing fasciitis is surgical intervention. Adequate surgical management involves promptly removing all necrotic tissue and draining affected fascial planes through extensive fasciotomy until healthy fascia is reached. The aim is to conduct definitive surgery, regardless of its extent, during the initial operation. Early and thorough surgical debridement and fasciotomy have shown better outcomes in terms of survival compared to delayed surgical intervention.<sup>14</sup> One of our patients was complicated with descending mediastinitis. Swift diagnosis and immediate treatment played a pivotal role in saving the patient's life. Two primary factors facilitate the spread of deep neck infections (DNIs) towards the mediastinum: the anatomical configuration of the cervical region, characterized by nearly enclosed spaces along the fascial planes spanning the neck and chest, and the influence of gravity and recurrent alterations in negative intrathoracic pressures during respiration. The diagnostic criteria for descending necrotizing mediastinitis were originally established by Estrera et al. in 1983.<sup>15</sup> These criteria include: 1) severe infection's clinical manifestation, 2) the presence of characteristic radiographic features, 3) confirmation of necrotizing mediastinal infection during surgery or post-mortem examination, and 4) demonstrated a causal relationship between oropharyngeal infection and the development of the necrotizing mediastinal process.<sup>7,15</sup>

According to the investigations, the majority of patients in our department underwent treatment involving incision and drainage, followed by antibiotics tailored to the culture and sensitivity results of the aspirate. The most prevalent organisms were Streptococcus species, followed by Staphylococcus and Klebsiella. A combination of antibiotics, such as ceftriaxone, metronidazole, and piperacillin with tazobactam, was commonly administered to most patients, followed by incision and drainage. A comprehensive knowledge of DNI etiology and cervical anatomy, including neck fascias and spaces, is essential for effective surgical management. This understanding helps determine the suitable approach to abscess formation and allows anticipation of the procedure's extent and invasiveness. In addition to appropriate surgical treatment, the selection of antibiotics is crucial in

managing DNIs. Administering antibiotics promptly after bacterial inoculation is essential to maximize protective effects and prevent the spread of infection, inhibiting the invasion and proliferation of pathogens in the wound.<sup>7</sup>

### Conclusion:

The clinical presentation and manifestations of deep neck space infections and their complications exhibit variability. Recognizing the key features of these infections, and prompt surgical intervention is crucial for saving the patients from life-threatening complications.

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