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Case Series

Ear, Nose and Throat Section

Deciphering Deep Neck Space Infections and its Management: A Case Series

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ABSTRACT

Deep Neck Space Infections (DNSI), which affect the potential deep cervical spaces often have a rapid onset and given their life-threatening complications, pose a significant challenge. For the most part, these infections arise from local extension of infections from a septic foci which is mostly of odontogenic and periodontal origin. A case series of neck space infections, their presentation, management and recovery is presented here. Although Contrast-Enhanced Computed Tomography (CECT) scan has been touted as a routine investigation of deep neck infections, it is found that imaging by ultrasound saves time and resources and is of immense diagnostic value in localising and delineating the exact space involved and detecting impending complications so as to pre-empt it. Also, true to the maxim, "…never let the sun set on an undrained abscess", surgical drainage on the first day even in stable cases followed by an empiric course of high dose broad spectrum antibiotics resulted in faster recovery.

Keywords: Dental abscess, Masticator space infection, Neck abscess, Submandibular space infection, Suppurative lymphadenitis in neck, Tooth decay, Trismus in neck abscess, Ultrasound in neck abscess

INTRODUCTION

Mosher said of deep neck infections, "Pus in the neck calls for the surgeon's best judgement, his best skill and often for all his courage" [1]. DNSI refers to bacterial infections in the complex potential spaces and fascial planes of the neck, either with cellulitis or an abscess formation in both children and adults [2].

Currently the primary source of deep neck infection in adults is odontogenic as opposed to oropharyngeal causes in children, and constitutes 31-49% of DNSI, with bacterial biofilms playing a key role in 65-80%, thus establishing a strong association with poor oral hygiene and lower socioeconomic status [3-5]. The source of infection is not clinically apparent in 17-57% of DNSI. It is seen more in males than females by a ratio of 1.6:1 and can occur at any age, but is most common in the 3rd to 5th decades [6].

Early diagnosis and management is essential to avert potentially serious or even fatal complications with special care in elderly, diabetics and immunocompromised patients.

Case 1

A 45-year-old female presented with a swelling over the left cheek which was insidious in onset, gradually progressive and was associated with severe pain, restricted mouth opening and toothache since three days. There was no history of fever, upper respiratory tract infection, sore throat, difficulty in swallowing and breathing or other co-morbidities. Examination revealed a swelling measuring 8×7 cm over the left masticator and submandibular spaces. On palpation, it was tender, firm and fluctuant with a local rise of temperature. Mouth opening was restricted to 2.5 cm. Ultrasound showed an ill-defined hypoechoic collection with fine internal echoes measuring approximately 15 mL involving the subcutaneous plane of left buccal space extending into the masticator space along the masseter muscle. Inferiorly, it extended into the submandibular space. Submandibular and parotid glands appeared normal with no evidence of focal lesion/collection. Incision and drainage was done on the first day under aseptic precautions. Around 10-15 mL of frank pus was drained and sent for culture and sensitivity. On opening the loculi, therapeutic irrigation with a mixture of 20 mL betadine (5% povidone-iodine) and 5 mL of 3% hydrogen peroxide solution was done. Betadine soaked wick was placed to facilitate drainage. The procedure was continued for five days by the end of which the pus discharge was minimal. Broad spectrum intravenous antibiotics-ceftriaxone and sulbactum with metronidazole (Injections Gramocef S 1.5 gm BD and Metrogyl 100 mL TID), an analgesic-diclofenac sodium (Injection Diclogesic RR 75 mg BD) was started empirically on day one with an anti-reflux medication-rabeprazole with domperidone (Tab. Cyra D 50 mg BD) for four days. Complete blood picture showed leukocytosis with a count of 16,930 cells/cu mm. Erythrocyte Sedimentation Rate (ESR) was 25 mm/hr. Gram stained smear viewed under conventional compound microscopy revealed occasional pus cells and gram positive cocci. Culture yielded no growth after 48 hours of aerobic incubation. Dental examination on day five revealed deep dental caries with apical periodontitis in the lower left 1st and 2nd molars for which extraction was advised. Patient was discharged on the 6th day with an oral antibiotic-cefixime and potassium clavulanate (Tab. Gramocef CV 325 mg BD) and an analgesic-aceclofenac and paracetamol (Tab. Hifenac P 425 mg) which continued from day four for five more days. The patient was diagnosed with left masticator and submandibular spaces infection and is fine on a follow-up of one and a half years [Table/Fig-1,2].

[Table/Fig-1]: Left masticator and submandibular spaces infection.
[Table/Fig-2]: After recovery from the infection. (Images from left to right).

Case 2

A 77-year-old female presented with a swelling over the left-side of the neck since one week. It was insidious in onset, gradually progressive and was associated with severe anterior cervical pain and difficulty in swallowing since three days. There was no history of fever, cold, cough, sore throat, toothache, difficulty in breathing or change in voice. Patient was on medication for diabetes and hypertension since three years. Examination revealed a diffuse swelling measuring 12×10 cm in the left submandibular and anterior cervical spaces extending up to the posterior triangle and crossing the midline up to the medial border of sternocleidomastoid muscle. It was soft to firm in consistency, fluctuant and tender on palpation. Skin over the swelling was erythematous with a local rise of temperature. An oropharyngeal examination revealed a partially edentulous dentition with tenderness over the floor of mouth. Complete blood picture revealed leukocytosis with 19,340 cells/cu mm. Blood sugar levels were deranged with a fasting blood sugar of 504 mg/dL and postprandial sugar of 630 mg/dL. HbA1c level was 14.9%. Creatinine level was 1.2 mg/dL and blood urea was 67 mmol/L. Ultrasound revealed an ill-defined hypoechoic collection with fine internal echoes measuring about 30 mL in the subcutaneous plane involving the left submental, submandibular and anterior cervical spaces extending medially across the midline up to the medial border of sternocleidomastoid muscle. Inferior extension was up to the clavicle with no retrosternal extension. Diffuse inflammatory changes were noted in the subcutaneous fat with increased echogenicity and vascularity suggestive of cellulitis. No extension of collection into the floor of mouth, carotid and anterior visceral spaces were seen. Submandibular glands appeared normal. Few enlarged hypoechoic lymph nodes with loss of fatty hilum were noted in the left cervical level 2 and 3 lymph nodes suggestive of necrotic lymphadenopathy secondary to an infective or neoplastic aetiology. Right cervical lymphadenopathy was also noted. Incision and drainage was done on the first day. Around 20-25 mL of pus was drained and sent for culture and sensitivity. Betadine soaked wick was placed after therapeutic irrigation with a mixture of 40 mL betadine (5% povidone-iodine) and 10 mL of 3% hydrogen peroxide solution twice a day for six days. Patient was started empirically on intravenous antibiotics-ceftriaxone and sulbactum with metronidazole (Injections Gramocef S 1.5 gm BD and Metrogyl 100 mL TID), an analgesic-diclofenac sodium (Injection Diclogesic RR 75 mg BD), insulin injection (Human Actrapid 18-18-10 units), anti-reflux-rabeprazole with domperidone (Tab. Cyra D 50 mg BD) and antihypertensive medications-atenolol (Tab. Aten 25 mg BD) for seven days. Gram stained smear revealed many pus cells and gram negative bacilli. Ziehl-Neelsen (ZN) stain of the pus revealed no acid-fast bacilli. Culture yielded no growth after 48 hours of aerobic incubation. Discharge stopped completely within a week and the patient was discharged with an oral antibiotic-cefixime and potassium clavulanate (Tab. Gramocef CV 325 mg BD) and an analgesic-aceclofenac and paracetamol (Tab. Hifenac P 425 mg) for five days along with an oral hypoglycaemic-glimepiride, metformin and pioglitazone (Tab. Sugamide PM 1 mg BD) and an antihypertensive drug- atenolol (Tab. Aten 25 mg BD). Anterior cervical skin loss secondary to the incision and drainage healed by secondary intention in four weeks. The patient was diagnosed with left submandibular and anterior cervical spaces infection secondary to suppurative lymphadenitis and is fine on a follow-up of one and a half years [Table/Fig-3,4].

Case 3

A 40-year-old male presented with swelling over the left-side of face and neck since four days. It was insidious in onset and gradually progressive. It was associated with painful swallowing and restricted neck movements. There was no history of fever, upper respiratory tract infection, difficulty in breathing or other co-morbidities. Examination revealed a 12×15 cm swelling over the left-side of face extending from the tragus to the clavicle involving the parotid, submandibular, anterior cervical spaces and posterior triangle. It was tender and firm in consistency. Mouth opening was adequate and examination of the oropharynx was normal. Ultrasound revealed an ill-defined heterogenous collection with predominant air foci measuring about 80-100 mL involving the left parotid, submandibular, anterior cervical spaces and posterior triangle extending up to the left anterior chest wall. Diffuse inflammatory changes with increased echogenicity and vascularity suggestive of cellulitis were also noted. Hypoechoic enlarged lymph nodes were noted in the parotid gland and left levels 2 and 3. Complete blood picture revealed leukocytosis (21,870 cells/cu mm). ESR was 98 mm/hr. Liver function tests were deranged (SGOT-123 U/L, SGPT-204 U/L and ALP-185 U/L). Incision and drainage was done on the first day under aseptic precautions. Around 40-50 mL of foul smelling frank pus was drained and sent for culture and sensitivity. Betadine soaked wick was placed after therapeutic irrigation with 40 mL betadine (5% povidone-iodine) and 10 mL of 3% hydrogen peroxide twice a day for seven days. Broad spectrum intravenous antibiotics-ceftriaxone and sulbactum with metronidazole (Injections Gramocef S 1.5 gm BD and Metrogyl 100 mL TID) and an analgesic-diclofenac sodium (Diclogesic RR 75 mg BD) was started empirically on day one with an anti-reflux medication-rabeprazole with domperidone (Tab. Cyra D 50 mg BD) for seven days. The patient was discharged with an oral antibiotic-cefixime with potassium clavulanate (Tab. Gramocef CV 325 mg BD) and an analgesic-aceclofenac with paracetamol (Tab. Hifenac P 425 mg BD) for seven days. Gram stained smear viewed under conventional compound microscopy reported pus cells with gram positive cocci and gram negative coccobacilli. Culture yielded no growth after 48 hours of aerobic incubation. The patient was diagnosed with left parotid, submandibular and anterior cervical spaces infection extending up to the thorax and is fine on a follow-up of six months [Table/Fig-5,6].

[Table/Fig-3]: Left submandibular and anterior cervical spaces infection.
[Table/Fig-4]: Skin loss after drainage of the abscess. (Images from left to right).

[Table/Fig-5]: Left parotid, submandibular, anterior cervical spaces infection extending up to the thorax.
[Table/Fig-6]: After recovery from the infection. (Images from left to right).

DISCUSSION

Grodinsky, citing Malgaigne, noted "the cervical fasciae appear in a new form under the pen of each author who attempts to describe them" [7]. The cervical fascia is divided into the superficial and deep fascia. The deep fascia is subdivided into three layers, the superficial layer (investing layer), middle layer with the muscular and visceral layers, and deep layer with the alar and prevertebral fascia [8]. On the other hand, "The fascial planes are potential areas between layers of fascia. These areas are normally filled with loose connective tissue, which readily breakdown when invaded by infection" as stated by Shapiro [9].

The deep spaces may be classified as spaces localised above the hyoid level like peritonsillar, parapharyngeal, submandibular, sublingual, parotid, masticator and temporal spaces, spaces that involve the entire circumference of the neck which include retropharyngeal, prevertebral and anterior visceral and the suprasternal space below the hyoid bone [8]. Holmes CJ and Pellecchia R also divided the deep neck spaces into primary and secondary fascial spaces. Infection may directly spread into the primary space, or may spread via a primary space to the secondary space [10].

Infections of odontogenic and submandibular origin affect the investing layer, which includes the submandibular and masticator spaces. Infections of the 2nd and 3rd molars also affect the middle layer, where infection can spread inferior to the dentate line of the mandible [11].

Peritonsillitis is the cause in 7-20% of the DNSI. Acute rhinosinusitis, salivary gland infections, sialolithiasis, cervical lymphadenitis, cellulitis of skin, necrotic malignant lymph nodes, infected cysts of branchial clefts and thyroglossal duct, laryngocoeles, acute mastoiditis progressing to a Bezold's abscess, Diabetes Mellitus (DM), mycobacterial and thyroid infections are causes worth mentioning [6,8,12-14].

The microbiology is polymicrobial reflecting normal endogenous upper aerodigestive tract flora which comprise a wide range of aerobic, microaerophilic, facultative and anaerobic bacteria, fungal species, viruses and even protozoans. Recent 16rRNA sequencing methods have detected 600 species of which, aerobic streptococcus species and non streptococcal anaerobes are the chief offending agents [15,16]. Greater prevalence of facultative or obligate anaerobes and a limited number of streptococcus (S.pyogenes, S.milleri, S.viridans group) are reflected in dental infections as 60% of oral flora cannot be cultured by routine culture methods [17,18]. Anaerobes are Peptostreptococcus, Fusobacterium and Bacteriodes (Prevotella) [19]. Liberal use of antibiotics and inherently fastidious anaerobic organisms could pose a challenge to culture the causative organism in 25% of cases [20].

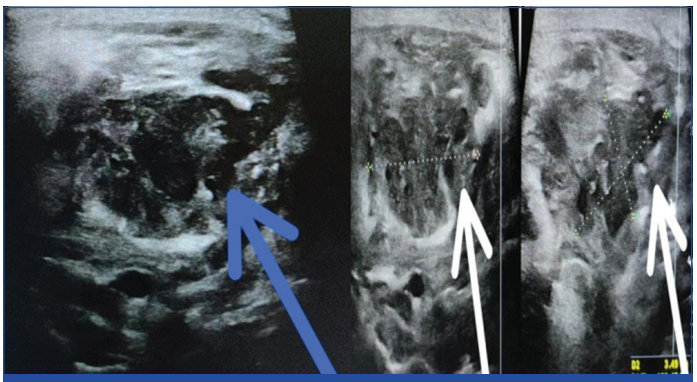
Generalised inflammatory symptoms such as pain, fever, swelling, malaise, fatigue, redness and localising symptoms of odynophagia, dysphagia, dyspnoea, hot potato voice, hoarseness, sialorrhoea, trismus, otalgia, torticollis and cough direct the clinician towards a possible site of infection and potential severity [17,21]. Immunocompromised status like DM, HIV or steroid use should be accounted for with a higher level of vigilance as they are susceptible to more virulent organisms and disease progression can be aggressive and fatal [8]. Pulse rate, blood pressure, temperature and respiratory rate recording is mandatory. Spiking temperatures should raise concerns of septicaemia, thrombophlebitis of Internal Jugular Vein (IJV) or mediastinal extension. A normal pulse oximetry reading is a poor proxy for airway status as it does not typically fall until airway is completely occluded [17].

Common clinical signs include pyrexia, swelling in the neck, tenderness or fluctuance, crepitus caused by airway trauma or gas producing organisms and lymphadenopathy. An oropharyngeal examination for signs of inflammation, asymmetry and uvular deviation is important [8]. Trismus and swelling indicate that the infection has spread to the muscles of mastication involving masseteric, pterygoid, retropharyngeal or parapharyngeal spaces. An alveolar swelling and decayed, loose, tender, broken tooth or a periapical infection would reveal an odontogenic infection [17].

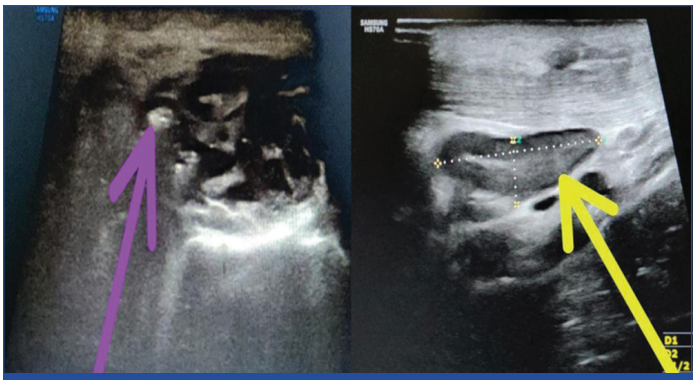
A Complete Blood Count (CBC) with a differential demonstrates leukocytosis. Steroid related leukocytosis can potentially confound a clinical picture but should not be withheld in case of an upper airway inflammation. A lack of leukocytosis may indicate viral illness, immunodeficiency, or tumours [17]. Patients with HIV and tuberculosis exhibit persistent leucopenia with a count of <8000 per milliliter prompting a screening [8]. Urea, creatinine, C-reactive protein, ESR and electrolyte assays should be assessed. Blood and aspirate cultures are recommended. Positive gram stain cultures without growth points toward an anaerobic organism [8,17].

Radiographic evaluation is done using X-rays, ultrasound, Computed Tomography (CT) scan and Magnetic Resonance Imaging (MRI). For dental focal infections or infections of unknown aetiology, an orthopantomogram is acquired. Translucencies at the apex of the dental root are a common finding with dental related abscess [8,17].

Ultrasound offers potential advantages of being safe, less expensive, portable, non invasive and can be performed at the bedside even in patients with impaired organ functions as it does not require contrast. In view of non ionising waves, multiple exposures can be carried out with a reduced long-term harm. A unique feature is the ability to recognise and verify deep body organs and lesions having similar density on conventional radiographic studies. Sonographic reduction of echo intensity is indicative of an abscess. Accurate dimensions of the abscess cavity and its precise depth below the skin surface can be ascertained. It shows internal muscle structures more clearly than CT with the aid of high resolution transducer [22]. [Table/Fig-7-10] shows USG images of collection, dimensions, depth, air foci and cervical lymphadenopathy in cases of an abscess formation.



[Table/Fig-7]: Heterogenous collection of an abscess.
[Table/Fig-8]: Dimensions and depth of an abscess. (Images from left to right)



[Table/Fig-9]: Air foci in an abscess.
[Table/Fig-10]: Cervical lymphadenopathy in an abscess. (Images from left to right)

In a CECT scan, an abscess demonstrates a central area of hypodensity with a characteristic rim enhancement of its wall with air being a strong predictor. Compromised images due to the presence of metal materials, radiation exposure in serial scans, contrast dye or iodine allergies and inability to use in patients with impaired renal functions are some of its noteworthy limitations [8,23]. MRI provides superior soft tissue differentiation but high cost and contraindication in patients with metal or electrical implants and dyspnoea are its constraints [24].

Management includes control of the airway, effective antibiotic therapy, timely aspiration or surgical intervention. The most crucial step is to protect airway as hypoxia and asphyxia remain the primary causes of mortality. First line airway management includes oxygenated face tent with cool mist humidity, intravenous steroids and nebulised epinephrine to reduce mucosal edema. Endotracheal intubation, awake fiberoptic intubation or tracheostomy are other options if the need arises [25].

Medical management includes an empiric broad spectrum antibiotic coverage reflecting the clinical scenario. Penicillin in combination with or without a beta-lactamase-resistant antibiotic (amoxicillin/clavulanate) or second/third generation cephalosporins along with a drug effective against anaerobes like metronidazole or clindamycin can be used. Eikenella corrodens seen in odontogenic infections respond to fluoroquinolones but should not be used in pregnancy or children. Parenteral antibiotics is to be continued after surgical drainage until patient is afebrile for 48 hours, and then switched to an oral agent for two weeks [6,8,17].

The main goals of surgical treatment are to provide sample for tissue staining and culture, therapeutic irrigation of infected body cavity and a stable external drainage pathway to prevent reaccumulation of an abscess. Various modalities are needle aspiration, transoral incision and drainage and conventional surgical drainage. Ultrasound-guided aspiration of pus in deeper collections merited a 41% cost reduction, shorter duration of hospital stay, no difference in treatment efficacy or complication rates [17,26]. Also, aspiration helps in increasing the isolation of anaerobes and reduces the detection of potential skin contaminants when compared to swabs [6].

Surgical intervention usually follows a period of conservative management of 24-48 hours in stable patients if there is a clinical failure to respond. Location of incision is dictated by excellent anatomic exposure and cosmetic healing with minimal risk to vital structures following the shortest route from outside or over maximum area of fluctuation or induration. The abscess wall is curetted and any loculations between adjacent and communicating neck spaces are broken down. The space is thoroughly irrigated and larger wounds needing debridement will remain open and packed with antimicrobial iodoform to allow healing by secondary intention [6,8,27,28].

Complications are common in cases of delayed diagnosis and in immunocompromised hosts with co-morbid conditions and include pneumonia, carotid artery aneurysm and rupture, IJV thrombosis with septic emboli or Lemierre's syndrome, necrotising fasciitis, vocal and facial palsies, skin fistulae and defects, Horner's syndrome, descending mediastinitis, upper gastrointestinal bleeding, iatrogenic bleeding following tracheostomy insertion, sepsis, cavernous sinus thrombosis, disseminated intravascular coagulopathy, multi-organ failure and death [6,29,30].

CONCLUSION(S)

The DNSI can affect patients of all ages with or without pre-existing co-morbid conditions. In this series, the first case was of dental origin, second case was due to suppurative lymphadenitis in an elderly patient with co-morbidities and the reason for the third case was not apparent. All the patients recovered in a week's time. Skin loss in the second case took nearly a month to heal by secondary intention probably owing to the patient's advanced age and diabetes. Without an impending airway compromise, surgical intervention usually follows a period of conservative management of 24-48 hours. Though all patients were stable, incision and drainage was done on the first day allowing for greater availability of medications in pus-filled spaces limited by poor vascularity. Ultrasound as the radiological modality and surgical drainage on day one led to a faster recovery of patients. Dictated by the clinical scenario, it can be advocated as a preferred management option, thus saving resources and time along with a shorter duration of hospital stay in the management of DNSI.

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