

DEEP NECK SPACE INFECTION: AN ANALYSIS OF AETIOLOGY AND RISK FACTORS FOR COMPLICATIONS.

Sunil Kumar K. ^{P1}, Surendran K. ^{M2}, Sebina Francis³, S. Muneeruddin Ahmed⁴

¹Professor, Department of ENT, Government Medical College, Kozhikode.

²Assistant Professor, Department of ENT, Government Medical College, Kozhikode.

³Senior Resident, Department of ENT, Government Medical College, Kozhikode.

⁴Professor and HOD, Department of ENT, Kannur Medical College, Kannur, Kerala.

ABSTRACT

BACKGROUND

Infection of the deep neck spaces is a common and potentially devastating ENT disease sometimes requiring interdisciplinary team approach. Present study evaluates the clinico-epidemiological aspects of deep neck space infection and the risk factors for complication. Except a few all the patients had to be managed surgically. Immunosuppression, addictions and multispace involvement are major risk factors for developing complications.

AIMS OF THE STUDY

To study and analyse the aetiopathology of deep neck space infections and resulting complications.

MATERIALS AND METHODS

In this prospective study, 40 patients diagnosed to have deep neck space infection were included; among them 15 patients with parapharyngeal, 13 patients with retropharyngeal, 10 patients with Ludwig's angina, and anterior visceral space and visceral vascular space involvement in one patient each.

OBSERVATIONS AND RESULTS

Patients were aged between 3 and 76 years with a mean age of 44.1. Majority of them were between 31 to 70 years. 25/40 (62.5%) were males and 15/40 (37.5%) were females with an M: F of 1.6:1. 27.5% (11) patients had odontogenic aetiology, followed by foreign body & its impaction and quinsy with 7 (17.5%) patients each. Fish bone was a common F.B {6 out of 7 cases (85.71%)}. 37.5% of patients underwent external drainage and 22.5% endoscopic. Intraoral drainage was in 20% of the patients. Diabetic ketoacidosis was found in 5 patients, Complications like descending necrotising mediastinitis in 8 and acute renal failure in 7 encountered.

CONCLUSIONS

Infection of the deep neck spaces is a common and potentially life threatening ENT disease and requires an interdisciplinary approach. Tooth infections and foreign body impaction are the commonest causes of these infections. Diabetes Mellitus is an important predisposing factor. Complications such as mediastinitis, septic shock and pleural effusion are possible, hence the surgeon should be cautious.

KEYWORDS

Deep Neck Space, Parapharyngeal, Retropharyngeal, Ludwig's Angina, Mediastinitis, Neck Abscess

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INTRODUCTION

Infection of the deep neck spaces remains a common, yet potentially devastating otolaryngology process that requires an interdisciplinary approach. Even after the introduction of modern antibiotics, deep neck space infections remain life threatening. Delay in the diagnosis or inadequate or inappropriate treatment can lead to dire complications with significant mortality. The fascia of head and neck has been the subject of great controversy since it was first described by

Burns in 1811. A basic understanding of head and neck anatomy and lymphatic drainage routes can provide insight into the patterns of spread and clinical presentation of deep neck space infections. The important deep neck spaces are retropharyngeal space, danger space, prevertebral space, visceral vascular space/carotid space, lateral pharyngeal/parapharyngeal space, submandibular space and anterior visceral space. The primary foci of infection can be odontogenic, tonsillitis, sialadenitis, foreign body impaction or malignancy; it can be iatrogenic in some cases and idiopathic also. We can arrive at a proper diagnosis and rule out complications by the use of modern imaging modalities like USG, CT and MRI. The combination of accurate early diagnosis, effective broad spectrum antibiotic therapy, airway maintenance, and prompt intensive surgical debridement will lead to a good prognosis. This study was conducted to evaluate the clinico-epidemiological aspects of deep neck space infection and the risk factors for complication.

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Corresponding Author:

Dr. Sunil Kumar K. P,

Professor, Department of ENT,

Government Medical College, Kozhikode.

E-mail: sidhusunil@gmail.com

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MATERIALS AND METHODS

The present prospective study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery, Govt. Medical College, Kozhikode. The materials for this study were collected from patients who attended the outpatient department and casualty department during the period from March 2014 to August 2016. The aim of the study is to analyse the age and sex incidence of deep neck space infections, its clinical presentation, the possible aetiological factors and to assess the efficacy of diagnostic investigations, to assess the different treatment modalities, to study the complications and their management. An attempt is made to find the risk factors for complication and their predictors. 40 patients with a diagnosis of deep neck space infection were included and evaluated in the study. They included patients with parapharyngeal abscess - 15, retropharyngeal abscess - 13, Ludwig's angina - 10, anterior visceral space infection - 1, visceral vascular space infection - 1.

Inclusion Factors

1. All those patients diagnosed and treated as deep neck space infections.
2. All the age groups were included.

Exclusion Factors

Patients with superficial infections, limited intraoral abscesses, peritonsillar abscesses or cervical necrotising fasciitis alone, infections due to penetrating neck trauma and head and neck malignancies and their treatment complications. Detailed proper history and clinical examination were carried out as per the proforma attached for all patients. Special attention was given to the presenting complaints, any precipitating factors like toothache, quinsy, any history of foreign body ingestion, any recent iatrogenic trauma like endoscopic procedure, tooth extraction, a/c tonsillitis or parotitis, any relevant past history like recurrent toothache, chronic tonsillitis and history of conditions of immunosuppression like diabetes mellitus, chemotherapy, steroid treatment, chronic renal failure or chronic liver failure. Also history of any intake of antibiotics was also noted. A careful clinical examination was carried out to locate the site of infection and for any features of complication. The investigations carried out were blood investigations including complete blood count, ESR, random blood sugar, renal function test, serum electrolytes, liver function test, blood grouping and screening. Diabetic patients were daily evaluated with fasting and postprandial blood sugar values for proper control. Radiological evaluation was done according to the clinical scenario. In most of the patients, X-ray of soft tissue of neck lateral view and chest X-ray PA view were taken. In some patients, it was diagnostic. For further evaluation USG neck or contrast-enhanced CT neck and thorax or both to localise and assess the extent of abscess and to rule out complications was undertaken. All patients with history of toothache were subjected to dental evaluation. In most of the cases, pus was sent for bacteriological examination. Microbiologic studies were done for both routine culture and anaerobic culture. The treatment policy in each case was individualised depending on the space involved and the extent of involvement. All patients were put on empirical broad-spectrum antibiotics including anaerobic coverage. Patients were managed conservatively if there is no frank abscess on radiological investigation and without any evidence of complication. If there is no

improvement with medical management within 24 hrs. or if there is a definite abscess, or with any evidence of complication, the patients are managed surgically with intraoral/endoscopic/external drainage. The evaluation of results was done keeping in mind the aims of the study. The age and sex incidence of deep neck space infections, the clinical presentation, the possible aetiological factors, diagnostic investigations, the different treatment modalities, the complications and their management, and the risk factors for complications and their statistical significance were analysed. Written consent was obtained from all the patients and the study received ethical clearance from the institution's ethics board. After constructing the data base in Microsoft excel, it was imported to SPSS software for analysis. Chi square test was used to analyse two variables. P value less than 0.05 was considered as significant. All patients were reviewed for followup 1 week after discharge, then 2 weeks, 1 month and 3 months. It was not possible to follow up all the 40 patients in this study as planned owing to noncompliance. However, all patients came for followup at first week.

OBSERVATIONS AND RESULTS

A prospective clinical study of suppuration of deep spaces of neck was undertaken after obtaining the ethical clearance from the Government Medical College, Kozhikode. The demographic observations, aetiological profile, clinical presentation, radiological observations, bacteriological study and the management aspects are depicted. Parapharyngeal abscesses were found to be the commonest deep neck space infection in this study; next common was the retropharyngeal, then the Ludwig's angina. Anterior visceral space and visceral vascular space were primarily involved in one case each. The age distribution ranged from 3 years to 76 years with a mean age of 44.1. Majority of the cases were between 31 to 70 years. In the paediatric age group, only the retropharyngeal and the parapharyngeal spaces were involved. The incidence in males was (62.5%) 25/40 and in females it was 15/40 (37.5%) with a male to female ratio of 1.6:1. The most common presenting symptom was dysphagia and odynophagia and more than half of them had fever. Next common complaint was neck swelling. 17 (42.5%) patients had neck pain and difficulty for opening mouth. Throat pain was present in 14 cases. Change in voice was present in 12 (30%) patients in the form of hoarseness or "hot-potato" voice and breathlessness in 8 (20%) patients. 4 (10%) patients presented with respiratory obstruction and stridor. Other symptoms like foreign body sensation throat, haemoptysis, cough; vomiting, earache and swelling in the cheek were present in few cases. On evaluating the precipitating factors, it was found that majority of the patients had odontogenic origin - 11 patients (27.5%). Next common aetiology was accidental ingestion of foreign body and quinsy with 7 (17.5%) patients each. Among the foreign bodies, fish bone was the commonest (6 out of 7 cases (85.71%) and one case of chicken bone impaction. 3 (7.5%) patients of acute tonsillitis progressed to deep neck space infection in this study. 3 (7.5%) patients were with iatrogenic trauma. One patient developed abscess 4 days after Oesophagoscopy was performed for foreign body removal. One patient had prior flexible endoscopy for evaluation of acid peptic disease and another had a tooth extraction before presenting with neck space infection. One case of parotitis later presented with deep neck space infection. In 8 (20%) patients, we could not find out

any specific precipitating factor. On further evaluation, it was found that submandibular space infection is common in the toothache group (8 cases); retained foreign body causing infection in the retropharyngeal space mainly (6 out of 7 cases). There were 7 patients with peritonsillar abscess which had extended to the parapharyngeal space. The case of an isolated visceral vascular space abscess was found out to be a tuberculous abscess on evaluation and one case of thyroid abscess progressed to involve the anterior visceral space. In the past history, history of immunosuppression was present in half of our cases, in the form of DM, chronic renal failure, chronic liver disease, steroid therapy, malnutrition and one patient had multiple myeloma and was on chemotherapy. In our study, 13 patients had multiple comorbidities. 14 patients were diabetic, with uncontrolled blood sugar levels; among them, 2 patients were newly detected diabetic patients. 5 patients were hypertensive. History of recurrent toothache was present in 14 of our patients in the past. Chronic tonsillitis was present in 8 patients, Malnutrition was present with features of anaemia and vitamin deficiency in 3 patients, 2 with bronchial asthma and one with COPD on steroid treatment was present. 2 patients of chronic renal failure, one case of recurrent parotitis, one case of chronic liver disease, two cases with coronary artery disease, one case with history of CVA, and one case with psychiatric illness were also present in the study. 3 of our patients were without any comorbidity. Considering the addictions, 18 of our patients were addicted to smoking, alcohol or tobacco or in combination. On clinical examination, tachycardia was present in half of the patients when they first presented to us. 5 patients were presented with hypotension. Detailed ENT examination revealed restriction of mouth opening, poor dental hygiene, and bulge in the oropharynx, swelling in the neck with skin erythema and absent cricovertebral crepitus (positive Bocca's sign) in 21 (52.5%) of our cases. Total WBC count was elevated in majority of the patients - 26 (65%). 23 (57.5%) of our patients were anaemic with an Hb level <13 mg% in males and 12 mg% in females. 1 ESR was also elevated in majority of our patients. Admission random blood sugar was elevated in 22 patients with a value >201 mg% in 13 patients. The renal function tests were elevated in 9 patients. Electrolyte abnormality was present in 4 patients in the form of hyponatraemia and hyperkalaemia. X-ray soft tissue neck showed evidence of abscess in 13 cases with retropharyngeal abscess. 3 cases showed foreign body also. Further evaluation was done with USG or contrast-enhanced CT neck with or without thorax or both. Nearly (27) 67.5% of the patients had multiple space involvement. Involvement of submandibular space was seen in 10 (25%) patients, retropharyngeal space in 13 (32.5%) patients, parapharyngeal space in 17 (42.5%) patients, anterior visceral space in 6 (15%), visceral vascular space in 3 (7.5%), masticator space in 5 (12.5%) and parotid space in 2 (5%) patients. In our study, descending necrotising mediastinitis was present in 8 (20%) patients, foreign body was present in 6 (15%) patients with retropharyngeal abscess (P value 0.004). Bacterial culture and sensitivity showed growth of MRSA and mixed flora in equal no. of patients 13 (32.5%) each. Streptococcus & Acinetobacter were present in 11 (27.55%) patients. One patient of lymphadenitis with Mycobacterium tuberculosis was present which had progressed to cold abscess involving the visceral vascular space. In majority of patients, surgical intervention could be undertaken within 24 hrs. 3

patients were managed medically including one patient of tuberculous abscess. There was death in 1 patient before any intervention.

Approach	No. of Cases	Percentage
External	15	37.5%
Endoscopic	9	22.5%
Intraoral	8	20%
External & Endoscopic	3	7.5%
Intraoral & External	1	2.5%
Nil	4	10%

Table 1: Showing the different Approaches to Drain the Deep Neck Spaces (n=40)

Anterior visceral space was primarily infected in one patient with thyroid abscess and as an extension of infection from other spaces in 5 other patients. All the patients were drained externally. Thyroid abscess resulting in a deep neck space infection in patient of a haemorrhagic nodule was an uncommon occurrence, rarely reported in English literature. Tracheostomy was done in 3 of our patients, two patients of retropharyngeal abscess and one patient of anterior visceral space infection. Suppurative arthritis of temporomandibular joint was present in a case of Ludwig's angina, which was spontaneously relieved with surgical and medical management. One patient of osteomyelitis of clavicle with involvement of sternoclavicular joint following an anterior visceral space infection responded well after repeated debridement and sensitive antibiotics. 2 out of 3 patients of internal jugular vein thrombosis and one patient of carotid artery thrombosis with multispace infection were relieved symptomatically after prompt surgical and medical management. Radiological imaging was not repeated once the patient was symptomatically improved. One patient succumbed to death following multispace involvement and Lemierre's syndrome. Two patients with pleural effusion were put on intercostal drainage.

Complications	No. of Cases
Diabetic Ketoacidosis	5
Descending Necrotising Mediastinitis	8
Acute Renal Failure	7
Upper Airway Obstruction	3
Electrolyte Imbalance	4
Septic Shock	4
Pleural Effusion	4
Lemierre's Syndrome	3
Atrial Fibrillation	2
Pneumonia	2
Pericardial Effusion	2
Suppurative Arthritis(TMJ & SCJ)	2
Seizure	1
Carotid Artery Thrombosis	1
Respiratory Failure	1
Dilated Cardiomyopathy	1
Empyema	1
Osteomyelitis (Clavicle)	1
Death	5

Table 2: Showing the Complications Encountered (n=40)

Regarding complications, 16 (40%) patients showed single or multiple complications. Complications were common in elderly age group (P value 0.04). No sex predilection observed for development of complication. Duration of symptoms was also not statistically related to complications. Use of antibiotics soon after the onset of symptoms had decreased the incidence of complications (P value 0.048). On evaluating the symptoms, patients presenting with breathlessness, noisy breathing and neck swelling were more prone for developing complications. History of immunosuppression and patients with addictions had a definite relation with the development of complications (P value 0.009, 0.047) but multiple comorbidities had no statistically significant correlation. On clinical examination, tachycardia, hypotension and hyperthermia were important predictors of underlying complication (P value 0.009, 0.00012, 0.022). Bulge in the posterior or lateral pharyngeal wall, tender neck swelling and absent cricovertebral crepitus clinically correlate complications (P value 0.012, 0.001, 0.003). Among the routine blood investigations, total count was a significant predictor of complication. Elevated RBS, abnormal RFT and electrolyte values also implied underlying complication (P value <0.05). On imaging, involvement of multiple spaces was related to complicated neck abscess (P Value 0.022). In our study, the sub-mandibular space extending to anterior visceral space and the retropharyngeal space infections were the most common spaces prone for developing complications especially the mediastinitis (P value 0.001). Foreign body impaction was not a statistically significant aetiology for complication. Bacteriological evaluation showed that patients with MRSA had developed more complications (P value 0.018). All complicated abscesses were managed with combined medical and surgical method. One patient expired before any surgical intervention and 4 cases succumbed to death even after surgical and medical treatment. The duration of hospital stay ranged from 3 to 31 days with an average of 7.525 days.

DISCUSSION

In this clinical study of 40 patients with deep neck space infections, the commonest was the parapharyngeal abscess (37.5%), next being the retropharyngeal abscess (32.5%) and then was the Ludwig's angina in 25% of cases. Anterior visceral space and visceral vascular space were primarily involved in 2.5% of cases each. Jeffrey M. Blumberg et al in his review reported that parapharyngeal space is the second most common space involved in deep neck space infections next to peritonsillar space.² The age distribution was ranging from 3 to 76 years with an average age of 44.1. Majority of the cases were between 31 to 70 years. Regueiro Villarín S et al in his journal "Deep Neck Infections: Aetiology, Bacteriology, and Treatment" obtained an average age of 49 years.³ Male to female ratio was 5:3. Male predominance (63%), in our study is in accordance with others; 66% in Regueiro Villarín S et al.³ The duration of symptoms ranged from one to 14 days with an average of 5.95 days. In the present study, the most common aetiological factor was odontogenic (27.5%). In 20%, we could not pinpoint any aetiological factor. Other factors were accidental ingestion of foreign body and quinsy in 17.5%, acute tonsillitis and iatrogenic causes in 7.5% and parotitis in 2.5%. And there is statistically significant correlation between the type of abscess and aetiological factor with a P value of 0.013. Je-Shin Chang et al⁴ concluded that the prognosis of diabetic

patients was poorer than that of non-diabetic patients in secondary space infections. In this study, 50% of our patients had history of immunosuppression which included diabetes mellitus, chronic renal failure, chronic liver failure, steroid therapy, malnutrition and one case of multiple myeloma undergoing chemotherapy. Among them, 14 patients had diabetes including 2 newly detected cases? Longer hospital stay, increased risk of complications and repeated intervention were present in Immunosuppressed patients (P value 0.07, 0.009, 0.15 resp). Also we found that submandibular space, anterior visceral space, visceral vascular space and retropharyngeal space infections were common in patients with history of immunosuppression and parapharyngeal space infection was mainly seen in patients without immunosuppression (P value 0.046). Many of our patients with complicated multispace infections had multiple comorbidities, but there was no significant correlation. In this study, tachycardia was present in 50% and 5 patients presented with hypotension. 67.5% were febrile. Trismus was present in 55%, and it was more common in submandibular space infections (P value 0.012). Almost all patients had dental abnormalities with poor oral hygiene. In Ludwig's angina, patients had swelling in the floor of mouth of variable degrees and woody hardness over the submandibular region according to the classical description by Grodinsky.⁵ Oropharyngeal bulge in the lateral or posterior pharyngeal wall was present in 42.5% in case of parapharyngeal and retropharyngeal space involvement. Swelling in the neck was present in 65%; absent cricovertebral crepitus (Bocca's sign positive) was present in 40% (12/13 cases of retropharyngeal abscess). Clinical examination findings had statistically significant correlation with the diagnosis in our study (P value 0.032). Total count was elevated in 87.5% of our cases but no significant correlation was obtained with immunosuppression. 57.5% of our cases were anaemic. High ESR was obtained in almost all patients. Elevated total count was a predictor of mediastinitis (P value <0.05). Rapidly developing anaemia also suggests multispace involvement and complications like mediastinitis (P value 0.024, 0.016). Admission random blood sugar value was elevated in 55% with value >201 mg% in 32.5%. Renal function tests were altered in 22.5% and electrolyte abnormalities in 10%. Elevated RBS, RFT and abnormal electrolyte value can also be used as a predictor of underlying complication (P value <0.05). Srivanthapoom C et al⁶ states that elevated total count can be used as a predictor for multispace involvement and Hb level is a useful guide to locate the presence of complications.

Multiple space involvement was present in 67.5%. We couldn't find any significant correlation between previously taken oral antibiotics and multiple space involvement. Multispace infections were common among anaemic patients (P value 0.024). According to our study, there is high chance of developing complications in case of multiple space involvement including mediastinitis (P value 0.007). Cai et al⁷ and Joon-Kyoo Lee et al⁸ had concluded that multispace infections might cause life threatening complications and significant morbidity. Descending necrotising mediastinitis was present in 20% of our cases. Microbiological evaluation showed MRSA and mixed flora in equal no. of cases (32.5%). Others include Streptococcus and Acinetobacter in few cases and one case of tuberculous lymphadenitis with cold abscess. Polymicrobial origin was documented by I Liao et al.⁹

Irrational use of oral antibiotics has led to increased chance of anaerobic infection according to Mamta Singh et al¹⁰ but we couldn't find any positive correlation between oral antibiotics and bacterial flora. In 90% of the patients, we proceeded with a combined medical and surgical approach. Among them, in most of the patients we could intervene before 24 hrs. All the patients were given multiple broad spectrum antibiotics. All the sub-mandibular space infections were drained with an external incision except one case in which abscess had burst out intraorally. Parapharyngeal space infections were drained mainly by external approach, and intraoral drainage was preferred in cases associated with quinsy. Retropharyngeal abscesses were approached endoscopically in majority of the patients. Anterior visceral space infections were also dealt with an external approach. Foreign body was present in 15%, mainly in the retropharyngeal space. Tracheostomy was done in 7.5%. Surgical intervention was a necessary part of treatment in 54% of cases in Regueiro Villarín S et al³ series. 93.62% underwent incision and drainage in Linjian Huang et al series.¹¹

All the patients with complications had combined treatment except one patient who expired before intervention. Pus in the superior mediastinum was cleared with finger dissection using the cervical approach. In a meta-analysis of mediastinitis, M J Corsten et al¹² described that retropharyngeal space, carotid space, danger space and pre-vertebral space were the common spaces progressing to mediastinitis. The predisposing factors obtained in this study were according to the findings in other studies (Joon-Kyoo Lee et al⁸, Linjian Huang et al¹¹ & X Cai et al⁷). There was a rare case of thyroid abscess, progressed to a complicated deep cervical infection with complications such as airway obstruction, mediastinitis, acute renal failure, atrial fibrillation, septic shock, bilateral pleural effusion with empyema, IJV thrombosis, pericarditis with effusion and dilated cardiomyopathy. In the literature, dilated cardiomyopathy is reported as a rare complication following certain viral infections like Coxsackie B virus, Enterovirus and Lyme's disease caused by the spirochete *Borrelia burgdorferi*¹³ but not a single case following deep neck space infection. However, in this case we are not sure whether it has developed as a complication of infection or due to longstanding thyroid disease.

CONCLUSION

Deep neck space infection is a life threatening disease even in the era of advanced diagnostic modalities and modern antibiotics. It mostly affects elderly males, commonly following a history of toothache. History of immunosuppression and addictions increases the morbidity and mortality. Tachycardia, hypotension and hyperthermia are important clinical predictors for impending complication. Elevated total count, rapidly developing anaemia, elevated blood sugar, and abnormal RFT and electrolyte values also points towards complication. Contrast-enhanced CT neck with or without thorax and ultrasound scan of neck are important diagnostic modalities for diagnosis and early recognition of complications like mediastinitis. Surgical intervention should be done in case of frank abscess, with evidence of complications clinically or radiologically, with impacted foreign body and in cases of failure of conservative management of 24 hours. Approaches of drainage included external, endoscopic, intraoral or

combined approaches according to the clinical scenario. Prompt management of complications can significantly decrease the mortality in case of complicated deep neck space infections.

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