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A study on presentation, etiology, complications and management of deep neck space infections: our experience

Pradip Khokle[1]*, Vaibhav J. Lahane[2], Swati Mishra[3], Moinnudin Choudhary[1]

Department of ENT, [1]Government Medical College, Latur, Maharashtra, [2]Government Medical College, Nagpur, Maharashtra, [3]KKR institute, Chennai, Tamil Nadu, India

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***Correspondence:**
Dr. Pradip Khokle,
E-mail: pdkhokle@gmail.com

ABSTRACT

Background: To analyze our experience in presentation, etiology, complications and difficulties encountered in diagnosis and management of deep neck space infections.
Methods: 52 cases of deep neck space infections were analyzed within the period of November 2013 to November 2015 in ENT OPD at GMC Latur. Patients with airway compromise or in failures were managed with intubation or tracheostomy. All patients were investigated with detail history, hematological and radiological investigations like X-Ray, USG or CT scan. Although all patients were treated with intravenous antibiotics, surgical drainage was the definitive management.
Results: Study includes 29 males and 23 females. Neck pain was most common presentation in 90.38% with airway compromise being most common complication. Submandibular (34.61%) and peritonsillar (21%) space were commonly involved with odontogenic and upper airway infections being leading causes. Diabetes was common comorbidity found among patients. *Staphylococcus aureus* being common isolate (*Klebsiella* in diabetics). Surgical drainage with antibiotics as per culture sensitivity was treatment modality of choice.
Conclusions: Early diagnosis and appropriate management is key for better outcome. Odontogenic etiology being most common correlates well with poor oral hygiene and tobacco chewing. Surgical drainage and antibiotics are the treatment modalities. Complications and associated comorbidities affect the course of DNSI and hence require appropriate management.

Keywords: Deep neck space abscess, Submandibular space, Tonsillar infection, Parapharyngeal space

INTRODUCTION

Deep neck space infections (DNSI) affect fascial compartments in head and neck and their contents leading to either abscess formation or cellulitis. Deep neck spaces are classified as:

1. Spaces localized above hyoid level: peritonsillar, submandibular, parapharyngeal, buccal, parotid, masticatory /temporal.
2. Spaces involving entire circumference of neck: retropharyngeal, prevertebral and carotid.
3. Anterior or pretracheal visceral space below hyoid.

For centuries, complex anatomy of deep neck spaces and its infections have challenged physicians and surgeons. Common primary sources are infections of dentine, tonsils and salivary glands, esophageal or hypo-pharyngeal malignancies and foreign bodies. Rare causes include branchiogenic cysts instrumentation, spread of superficial infections, IV drug use while some cases remain idiopathic. This condition is commonly

polymicrobial and *Streptococci, Peptostreptococcus spp, Staphylococcus aureus,* and anaerobes are most commonly cultured organisms.[1,2] Although widespread usage of antibiotics reduced prevalence, fatality remains high if not timely diagnosed, accurately localized and promptly incised and drained. Involvement of vital structures in neck spaces may complicate the condition. Literature had mentioned various life-threatening complications such as airway compromise, jugular vein thrombosis, mediastinal involvement, pericarditis, pneumonia, and arterial erosion.[3,4] Modern imaging techniques have led to early and definite diagnosis of complications. Infections in immunocompromised patients like diabetes, HIV may have unusual presentation and bacteriology leading to diagnostic and treatment difficulties. Treatment principally comprises airway management, antibiotic therapy and surgical intervention. Thorough knowledge of presentation, proper diagnosis and prompt management can effectively overcome the disease and provide cure without any complication.

This study aims at analyzing our experience about the presentation, etiology, complication and management of various deep neck space infections presenting to ENT OPD and comparing it with existing literature.

METHODS

This study involved 52 cases presenting to ENT OPD and Casualty with complaints suggestive of deep neck space infection were studied between period of November 2013 to November 2015 in ENT OPD at GMC Latur.

Inclusion criteria

Inclusion criteria were patients with complaints suggestive of deep neck space infections like neck pain, swelling, odynophagia/dysphagia, fever, pus in mouth etc.

Exclusion criteria

An exclusion criterion was malignant conditions.

Detailed history including onset, duration, progression; local examination including inspection, palpation; detailed ENT and systemic examination were carried out. History of diabetes, HIV, Steroid or immunosuppressant therapy, trauma and foreign body were noted. All patients were subjected to X-ray neck AP and lateral view and ultrasonography. Those suspected of retropharyngeal or parapharyngeal infection and complications were advised CT neck-chest. Required hematological investigations were undertaken.

RESULTS

Study included 52 patients in the age group 4-74 years with mean age of 38.8 with maximum patients in the group of 41-50 years. Out of total, 29 (55.76%) were males and 23 (44.23%) were females. 80.76% patients belonged to rural area whereas 19.23% to urban. When enquired into associated comorbidities, 5 (9.61%) patients were diabetic, 2 (3.84%) were HIV, 1 (1.92%) was suffering from chronic renal failure due to congenital posterior urethral valve and 1.92% (1) from chronic alcoholic liver failure. Tobacco chewing (57.69%) was most common addiction found amongst study cases, 50% of which were also smokers.

Neck pain was most common presenting complaint, found in 47 (90.38%) cases followed by neck swelling in 45 (86.53%). Other symptoms like dysphagia (78.84%), toothache (57.69%), fever (51.92%), trismus (34.61%) and torticollis (3.84%) were also noted (Table 1).

Table 1: Symptoms of deep neck space infection.

Symptom	No. of cases	Percentage (%)
Neck pain	47	90.38
Neck swelling	45	86.53
Dysphagia/odynophagia	41	78.84
Toothache	30	57.69
Fever	27	51.92
Trismus	18	34.61
Airway compromise symptoms	4	7.69
Torticollis	2	3.84

Table 2: Complications of deep neck space infection.

Complications	No. of patients	Percentage (%)	Outcome
Airway compromise	4	7.69	Survived
Skin necrosis	3	5.76	Survived. 1 patient with required skin grafting
Sepsis	2	3.84	1 patient died
Mediastinitis	1	1.92	Died
Pneumonitis	1	1.92	Died
Subcutaneous emphysema up to upper chest	1	1.92	Recovered and survived.

Out of 52, 11 patients presented with complications; stridor and respiratory distress being most common (7.69%) followed by overlying skin necrosis and defect with pus oozing out of it in 5.76%. In 1 patient, progressive necrotizing fasciitis was noted over cheek skin (underlying masticator space abscess) which required extensive debridement. Other complications encountered; sepsis in 2 cases (3.84%), mediastinitis and

pneumonitis in 1 case (1.92%) each. Patients with airway compromise and severe sepsis were managed by intubation or tracheostomy. Emergency tracheostomy was done in 2 cases. 3 cases died with cause of death being sepsis, mediastinitis and pneumonitis (Table 2).

Table 3: Physical findings of deep neck space infection (n=52).

Finding	No. of patients	Percentage (%)
Neck swelling	45	86.13
Tenderness	45	86.13
Frank fluctuations	39/45	86.66
Dental caries	30	57.69
Halitosis	30	57.69
Pus in oral cavity	23	44.23
Trismus	18	34.61
Skin necrosis	3	5.76
Swelling over posterior pharyngeal wall	2	3.84
Bulge and congestion over anterior pillar tonsillar hypertrophy (R>L)	7	13.46
Bulge and congestion over anterior pillar tonsillar hypertrophy (L>R)	4	7.69
Subcutaneous emphysema	1	1.96

Details of physical examination documented in Table 3. Neck swelling (86.13%) was most common finding encountered. Moderate to severe grade tenderness was elicited in all swellings. Out of 45 swellings, frank fluctuations were elicited in 86.66% cases. Oral cavity examination revealed trismus in 18 (34.61%) cases with 6 cases having severe trismus. 30 (57.69%) cases having dental caries, 16 cases had carious lesions of various grades and 14 had periodontal disease with marked tenderness. Posterior pharyngeal wall bulge was seen in 2 cases whereas bulge over anterior pillar with congestion and pus point suggestive of peritonsillar collection were evident in 11 (21%) cases.

Pus in oral cavity in gingivobuccal sulcus was seen in 23 (44.23%) cases. 3 cases had evidence of overlying skin necrosis of which 2 had underlying parotid abscess and 1 masticator space abscess.

All patients were investigated in details with USG and X-ray neck AP and lateral. USG was helpful in diagnosing extent of abscess in cases of submandibular, parotid, Ludwig's and masticator. CT scan was performed in patients with suspected retropharyngeal or para-pharyngeal abscess, multispace involvement and complications. With high clinical suspicion but non-contributory imaging, needle aspiration and surgical exploration were undertaken.

Most of DNSI were odontogenic (53.84%) in origin with tosnsillo-pharyngitis (17.30%) being 2nd most common cause. Etiology was unknown in 10% case (Figure 1). Odontogenic etiology was seen commonly among cases with poor oral hygiene and tobacco chewers whereas preceding episode of tonsillo-pharyngitis was common in pediatric age group. Neglected foreign body (fish bone) was cause of peritonsillar abscess in 3.84%. One case of temporal space abscess was noted secondary to otitis media.

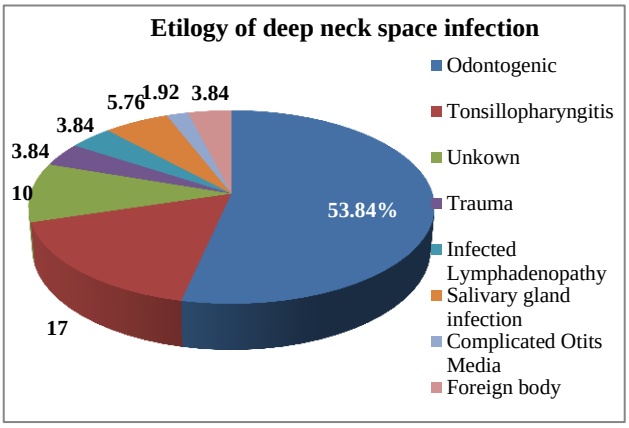

Figure 1: Etiologies of deep neck space infections.

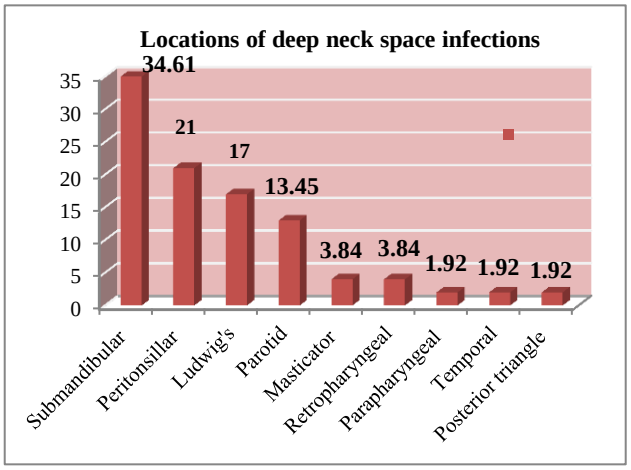

Figure 2: Locations of deep neck space abscess.

Submandibular space (34.61%) being the most common space involved in our study followed by peritonsillar (21%), Ludwig's (17%), parotid (13.45%), retro-pharyngeal (3.84%), masticator (3.84%), parapharyngeal (1.92%), temporal space (1.92%), posterior triangle of neck (1.92%). Involvement of more than 2 spaces was termed as multi-space lesion. 7 cases had multispace involvement out of which 4 had origin in submandibular, 2 in peritonsillar and 1in retropharyngeal space (Figure 2).

Management

Patients with airway compromise were managed by intubation or tracheostomy. Emergency tracheostomy was done in 2 (3.84%) cases. Both were cases of

Ludwig's angina. Adequate hydration was maintained by IV fluids. All patients were started with injection amoxyclav or piperacillin+taxobactum, amikacin and metronidazole initially with shifting to antibiotics of choice according to culture sensitivity. Drainage of the pus was definite management in our study. Interventions undertaken to drain the pus were; USG guided needle aspiration, intraoral incision and drainage, surgical neck exploration and drainage, wound debridement.

USG guided needle aspiration was favored in well defined, small swelling (less than 30 mm), deep sited parotid space infections and unfit patients. Average 3-4 aspirations were required. All peritonsillar abscess were managed intraorally which were dilated twice daily till no pus drained out. Retropharyngeal abscess was also managed intraorally however one case with extensive retropharyngeal collection was managed by neck exploration during repair of C4-C5 disc prolapse. Temporal abscess was managed with drainage and mastoidectomy. External drainage was done through adequate skin incision with wide access, blunt dissection and good control over neurovascular structures. After drainage abscess cavities were cleaned with normal saline, betadine and hydrogen peroxide mixture. Cavities after external drainage were packed with gauge piece soaked in same mixture and changed once daily till healthy tissue appeared after which calendula ointment was used to fill cavity till healing ensued. Secondary suturing was done when required. Dental extraction was done after adequate mouth opening had achieved. All cases of peritonsillar abscess and dental caries were advised betadine gargles. Patients with airway obstruction, sepsis, mediastinitis and pneumonitis were managed in ICU.

Table 4: Microbiology of deep neck space infection.

Bacteria	No. of patients	Percentage (%)
Staphylococcus aureus	13	25
***Streptococcus milleri* group**	9	17.30
Streptococcus viridans	8	15.38
Streptococcus pyogenes	7	13.46
Bacterioides species	5	9.61
Klebsiella pneumonia	6	11.53
Peptostreptococcus species	5	9.61
Fusobacterium	2	3.84
No growth	07	13.46

*Polymicrobial in 11 cases, aerobic in 30, anaerobic 20, negative culture 7 cases.

Management of systemic comorbidities was done with physician advice. Diabetic patients were given subcutaneous insulin in required doses whereas patients with renal failure were managed by dialysis and diuretics. Blood sugar and urea/nitrogen were monitored in respective cases.

HIV patients were already on antiretroviral therapy which was continued with CD4 count monitoring. Patients' hospital stay ranged from 8 to 17 days with mean of 11.57. Patients with diabetes, HIV and multispace abscess had longer stay. All patients were discharged after stable status except three who succumbed.

Microbiological examination was done in all cases (Table 4). 11 patients had polymicrobial culture results. 20 patients grew aerobic bacteria, while 14 patients grew anaerobic bacteria. No growth was observed in 7 cases (13.46%) after 48 hours of incubations. Among aerobic, *Staphylococcus aureus* was most common in 25% cases followed by *Streptococcus milleri* whereas *Bacterioides* species being most common in 9.61% cases among anaerobic. Among cases with odontogenic etiology, *Streptococcus milleri* and *viridans* were common isolates whereas with tonsillopharyngitis, staphylococcus aureus and *Klebsiella pneumoniae* were common. Diabetic patients had *Klebsiella pneumoniae* as a common microorganism.

When analyzing the course of disease and outcomes during treatment, various prognostic factors were concluded. Patients with late presentations, low socioeconomic status, poor oral hygiene fever, multi-space abscess like submandibular-parapharyngeal-mediastinal or retropharyngeal-mediastinal, associated comorbidities like diabetes, renal failure, HIV, old age and complications like tissue necrosis, airway compromise, mediastinitis were associated with poor prognosis in terms of late recovery and increased hospital stay.

DISCUSSION

Our study results showed interesting similarities and differences with literature.

Male preponderance over females in present study has similar results with studies by Wang et al and Eftekharian et al while several reports in west showed equal distribution.[3-6] Diabetes was a systemic comorbidity in 9.61% cases in our study which correlates well with study by Kataria et al where it was 10.52% but very low when compared with Huang et al which reported 30.3% patients.[2,7] In present study**,** HIV has been found in 3.84% cases where it was 3.75% and 7% in studies by Suehara and Parhiscar et al respectively.[8,9] 57.69% patients were addicted with tobacco chewing which results in poor oral hygiene and is reported to affect host's vulnerability to systemic diseases by formation of subgingival biofilms acting as reservoirs of Gram-negative bacteria and through periodontium acting as a reservoir of inflammatory mediators.[10] In our prospective study we have correlated well between chewing habits, poor oral hygiene and deep neck space infection. Similar association was correlated well by Kataria et al.[7]

Clinical presentation in our patients was more or less same as compared to other literature done on DNSI, which showed that for infection in head and neck spaces, usual presentation was same i.e., neck swelling, neck pain, odynophagia, dysphagia, or systemic manifestation such as fever, malaise, or symptoms of airway obstruction, skin necrosis, mediastinitis with differences in most common symptom. Neck pain was most common symptom seen in 47 (90.38%) patients which was similar to that demonstrated in other studies.[7,8,11,12] In a study by Kamath et al**,** dysphagia or odynophagia was most common symptom present in 66% followed by pain in neck in 59%.[13]

Etiology of deep neck space infections varies depending upon the space involved. In present study, submandibular space was the most common space involved. Submandibular space involvement was attributed to dental infection. Root apex proximity of mandibular molars to submandibular space was the reason for majority of infection. Odontogenic infection can spread laterally into buccal space, posteriorly either side of mandible into masticator space, further medially into lateral pharyngeal space or lingually into sublingual space. In present study, submandibular abscess was followed by Ludwig's angina, masticator abscess and parapharyngeal abscess which can be correlated well with odontogenic spread. Similar findings were reported by study of Meher et al**,** Zamiri et al, Rega et al and Kataria et al.[12,14-16] Second most common cause was tonsillopharyngeal infection and was found to be more common in pediatric age group. Dental infection followed by tonsillar infection, as a cause of deep neck space infection, later being common in pediatrics, was reported by many studies.[8,9,17-20]

Peritonsillar abscess or cellulitis secondary to acute tonsillitis may penetrate buccopharyngeal fascia directly or extend by retrograde thrombophlebitis to involve parapharyngeal space. The carotid sheath, which traverses parapharyngeal space can get involved and provide a pathway of spread to mediastinum. Mosher named this potential avenue of infection as "Lincoln's Highway" of neck.[21]

Submandibular, masticatory, and parotid space also communicates with parapharyngeal space and infection in these spaces can spread to parapharyngeal spaces. And hence, on contrary to submandibular space involvement, many literatures had reported parapharyngeal space as most commonly involved.[4,9,17,22]

Retropharyngeal space could get infected secondary to spread to pus along fascial planes or secondary to trauma. Retropharyngeal lymph nodes which are found in greater number in children and may become abscessed secondary to a primary focus in nose, paranasal sinuses, pharynx, middle ear and eustachian tube, leading to a prevertebral space infection.[13] In our study, retropharyngeal space involvement was secondary to trauma in one case and in other cause was pus spread along fascial plane from submandibular region.

Trauma and foreign body in upper digestive tract were documented in literature as causes of DNSI.[13,21]

Other causes; salivary gland infection both submandibular and parotid, infected lymphadenopathy in case of posterior triangle abscess and chronic otitis media in case of temporal space abscess.

Etiology was unknown in 10% cases in present study which was much lower to those reported by Kamath et al and Lee.[13,17] Unknown etiology was probable because of inciting infection can precede deep neck infection by weeks.

Most commonly isolated organisms are mostly part of normal oropharyngeal flora.[23] In our series, Staphylococcus aureus was most commonly isolated bacteria (25%), followed by *Streptococci milleri* (17.30%). A study by Suehara also had staphylococcus aureus as most common isolate. In our study, *Streptococcus milleri* and anaerobic bacteria were commonly isolated from odontogenic infections.[8] This predominance was also reported by Lee and Har-El.[17,22] Studies by Huang et al and Chen et al also reported *Klebsiella* as common isolate among diabetics.[2,24] Thus it is important to include antibiotics sensitive to *Klebsiella* in management of diabetic. No growth was observed in 7 cases (13.46%). This is probably due to the indiscriminate use of antibiotics prior to hospital admittance and the high doses of intravenous antibiotics before surgery.[18]

Evaluation of deep neck abscesses solely by clinical examination is inadequate as they can underestimate the extent of the disease in up to 70% of the patients**.**[25] As such, every patient in our center was assessed X ray neck, USG of neck, CT Neck and chest and invasive intervention. X neck and USG neck was primary investigations and CT Neck-chest was done in cases suspected of parapharyngeal, retropharyngeal, multispace involvement and complications which included 10 cases. Needle aspiration was done in cases where radiology was inconclusive and clinical suspicion was higher. Contrast enhanced CT scans are useful for diagnosis and identification of the spaces of infection for surgical drainage.[26,27] Studies by Mayor et al and Smith reported that USG also plays an important role in abscess.[28,29]

Patients with deep neck space abscess were admitted and started with intravenous antibiotics; IV amoxyclav or piperacillin+tazobatum, amikacin and metronidazole. Antibiotics were later changed according to culture report. Adequate hydration was maintained through IV fluids.

Intubation or tracheostomy was the options for airway management. Patients with inadequate mouth opening were kept on tracheostomy. Adequate tracheostomy care was taken to avoid its complications.

Table 5: Comparison of present study with other studies.

Headings		Present study	Kataria et al[12]	Huang et al[15]	Mumtaz[20]	Suehara[1]	Parhiscar et al[21]	Bakir[3]	Lee[32]
Symptoms	Neck pain	90.38%	89.87%	-	82.60%	98.75%	59%	m/c complaint	-
	Neck swelling	86.53%	85.52%	-	52.17%	-	59%	-	-
	Dysphagia / odynophagia	78.84%	82.89%	-	65.21%	11.25% / 23.75%	66%	-	-
Complications	Airway compromise	7.69%	5.26%	-	8.6%		-	-	-
	Skin necrosis	5.76%	2.63%	--	-		-	-	-
	Mediastinitis	1.92%	1.31%	-	-		-	-	-
	Pneumonitis	1.92%	-	-	-		-	-	-
	Sepsis	3.84%	3.94%	-	-		-	-	-
Comorbidities	Diabetes	9.61%	10.52%	30.3%	19.56%	23.75%	-	-	23.7%
	HIV	3.84%	-	-	-	3.75%	7%	-	5.1%
Addiction	Tobacco chewing	57.69%	36.84%	-	47.8%	-	-	-	
Etiology	Odontogenic	53.84%	34.21	53.2	26%	27.5	43%	48.6	16%
	Tonsillo-pharyngitis	17.30%	27.63	30.5	22%	22.5	6%	19.7	16%
	Unknown	10%	9.21	-	39%	25	-	-	42.7%
Space involved	Most common	Submandibular > peritonsillar	Ludwig's angina	Parapharyngeal space	Parapharyngeal space	Submandibular space	Parapharyngeal space	Submandibualr space	Multispace > Parapharyngeal space
Microbiology	Most common isolate	*Staph. aureus* 25%	*Streptococcus*	Strep. Viridans, K. pneumoniae	*Streptococcus*		Strept. viridans	-	*Klebsiella pneumonia*
	No growth	13.46%	16.17%	-	27.7%		-	-	-
Management	Surgical intervention	100% cases	77.63%	72.5%	78.26%		100%	59.5%	82.44%

What Mosher said about deep neck infections in 1929 still holds true, "Pus in the neck calls for the surgeon's best judgement, his best skill and often for all his courage".

Drainage of pus was treatment of choice in our study. Intervention undertaken to drain were; USG guided needle aspiration, intraoral incision and drainage, surgical neck exploration and drainage, wound debridement. Parhiscar et al reported surgical intervention in 100% cases similar to present study.[9] On contrary, studies by Mumtaz et al, Eftekharian et al and Har-El et al reported surgical intervention in approximately 78%, 79% and 90% of cases, respectively.[5,22,30]

USG guided drainage was undertaken in cases with well-defined small collection (<30 mm), deep sited parotid abscess without imminent complications and surgically unfit patients. With antibiotics coverage, USG guided aspiration found to be appropriate management. As per Haung et al therapeutic needle aspiration is effective in selective cases such as those with minimal abscess formation; but Ochi et al reported USG guided needle aspiration as less popular intervention.[2,31]

Peritonsillar and retropharyngeal (isolated) abscess were managed by intraoral incisions. Retropharyngeal abscess with multispace involvement required external approach.

For external approach, incision should give a wide access to the abscess with good control of adjacent neurovascular structures. Blunt dissection should be done in draining the abscess with great care to avoid injury to pharyngeal wall and neurovascular structures. Overlying skin necrosis required debridement.

Most common complication in our study was airway obstruction which was common in patients with floor of mouth and multispace involvement. This is similar to the Huang et al study.[2] Mu lti-space abscesses suggest a more severe form of infection, thus explaining the high rate of upper airway obstruction. Floor of mouth abscesses can cause rapidly progressive edema of soft tissues of the neck, floor of the mouth and pre-epiglottic space, thus leading to high rates of upper airway obstruction.[32]

In present study, we lost one patient each with mediastinitis, pneumonitis and sepsis. Mortality due to mediastinitis was documented in study by Kamath et al.[13] Sethi et al has quoted a mortality rate of 8%, with patients dying of necrotizing fascitis, multiorgan failure and cardiogenic shock.[18]

Similar to our study, Huang et al, reported diabetes mellitus (90.5%) was most commonly associated systemic disease.[2] Reduced polymorphonuclear leuko-cytes function, which plays key role in maintenance of gingival and periodontal health, has been found in patients with diabetes.[33] Furthermore, the control of these patients' blood glucose level plays a crucial role in the management of infection.[3] In this study, all diabetic patients' blood glucose level were closely monitored and kept below 140 mg/dl with insulin.

In our study, patients with late presentations, low socioeconomic status, poor oral hygiene, multi-space abscess like submandibular-parapharyngeal-mediastinal or retropharyngeal-mediastinal, associated comorbidities like diabetes, renal failure, HIV, old age and complications like tissue necrosis, airway compromise, mediastinitis were associated with poor prognosis in terms of increased interventions, late recovery, increased hospital stay and morbidity. This is well correlated with other studies.[7,8,17] Comparison of present study with other studies is shown in Table 5.

CONCLUSION

Early diagnosis and appropriate management with special attention to comorbidities is the need for preventing morbidity and mortality. Poor oral hygiene and tobacco chewing has led to increased prevalence. Odontogenic infection was leading cause of DNSI with *Staphylococcus aureus* being most common isolate. *Klebsiella pneumoniae* is common isolate amongst diabetics thus specific antibiotic coverage should be given to cover the same. All patients required empirical antibiotics with shift to antibiotic of choice as per culture report. Ultrasonography plays important role but CT scan is required in multispace abscess and complications. External Surgical drainage remains the treatment of choice with needle aspiration being effective in small abscess without complications. Comorbidities like diabetes, HIV and renal failure requires appropriate management. Late presentation, poor oral hygiene, multi-space abscess associated comorbidities, old age and complications like tissue necrosis, airway compromise, mediastinitis were associated with poor prognosis in terms of increased interventions, late recovery, increased hospital stay and morbidity.

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