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A study of head and neck space infections and their sensitivity pattern at tertiary care hospital

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ABSTRACT

Background: Head and neck space infections including submandibular, buccal, diffuse neck space, peritonsillar, parapharyngeal, parotid, submental, retropharyngeal, result in frequent hospital visits. Infection can be mild or severe life threatening infection.
Methods: 40 patients with head and neck space infections were considered. Pus samples were collected with aseptic precautions and sent to department of microbiology for culture and antibiotic sensitivity.
Results: The most common head and neck space infections are submandibular followed by buccal, diffuse neck abscess, peritonsillar, parapharyngeal, parotid, submental and retropharyngeal. Incidence of aerobic growth is 60%, fungal 10%, anaerobic 7.5%, tubercular 7.5% and no growth 15%. Predominant aerobes are *Staphylococcus aureus*, *Pseudomonas aeruginosa*, Methicillin Resistant *Staphlococcus aureus*, *Klebsiella* species and anaerobes are Peptostreptococcus and bacteroides and fungal species is *Candida*. Aerobic organism showed maximum sensitivity to Amikacin, Vancomycin, Linezolid, Piperacillin+Tazobactum, Clindamycin, Erythromycin, Cefoperazone, Ceftriaxone and maximum resistant to Levofloxacin, Cefoperazone, Ceftriaxone, Meropenem. Anaerobic bacteria showed sensitivity to Clindamycin, Metronidazole and Colistin and resistance to Vancomycin.
Conclusions: Bacteriological examination and culture of head and neck abscesses helps to identify causative organisms. It helps to isolate even rarest of organisms and by knowing their sensitivity pattern we can detect specific therapy against them. Thus it helps in more effective treatment and fast recovery.

Keywords: Head and neck space infections, Microorganisms, Culture sensitivity, Antibiotic sensitivity and resistance

INTRODUCTION

Deep neck abscesses are less common today than in the past. The impact of antibiotic treatment and improved dental care are the most likely reasons for this change. In spite of widespread use of antibiotics, deep neck infections do not disappear and remain one of the difficult emergencies encountered in daily clinical practice.

Maxillofacial deep space head and neck infections of odontogenic origins have afflicted mankind for all recorded history. Odontogenic infections are most frequently occuring infectious process known to both antiquity and present day health practice.[1,2] Odontogenic infections range from periapical abscesses to superficial and deep infections in the neck.[3] Deep neck space infections pose various challenges to the treating surgeon. The abscess lie deep in the neck and in close proximity to the neurovascular structures, mediastinum and skull

base.[4] Most odontogenic infections are readily resolved by removal of the source with or without antibiotic therapy. However the few that involve deep neck spaces can become life threatening. Prompt airway management, surgical drainage in an operating room (OR) setting, removal of source, and systemic intravenous (IV) antibiotics all play a critical role to these patients.[5]

Deep neck infections of odontogenic origin are polymicrobial in nature.[6-9] The study of microbiologic flora and antimicrobial susceptibility will help clinician to establish the efficacy of any particular antibiotic to combat orofacial infections of odontogenic origin. The knowledge of common pathogens and their resistance status guide the clinician towards appropriate selection of empirical antibiotics.[10] Pencillin still remains the empirical drug of choice for odontogenic infections because of its effectiveness, minimal side effects, low cost, patient tolerability and ready availability.

Patients at risk of neck abscesses include immunocompromised patients, HIV, chemotherapy, diabetes, malnutrition.[11]

The objectives of the study were to identify specific microorganisms causing the infection and to evaluate the resistance of antibiotics used in the treatment of these infections.

METHODS

40 patients who reported to Department of ENT, Guru Gobind Singh Medical College, Faridkot from time period of 6months i.e. October 2017 to March 2018; with complaint of swelling in the maxillofacial region, trismus, dysphagia and dyspnoea; and hence diagnosed to have neck space infections aged between 10-60 years and irrespective of their sex were selected for the study.

Descriptive statistics, for example frequency and percentage, were used.

Inclusion criteria

Inclusion criteria were patient aged between 10 to 60 years; patient with any head and neck swelling.

Exclusion criteria

Exclusion criteria were patients below 10 years and above 60 years of age (both genders); patients who are hypersensitive to antibiotics; patients who gave history or those on examination were diagnosed to be immuno-compromised (systemic disease or metabolic disorder, congenital defects or primary immunodeficiencies); pregnant patients; patients who gave history of prior antibiotic medication; those who are not willing to participate in the study and have not given written consent.

After taking detailed history each patient was thoroughly examined. The pus was collected from space infection before commencement of antibiotic therapy. The extra oral sites were prepared with germicidal soap, alcohol, povidine iodine or a combination of these. Intra oral sites were prepared with chlorhexidine. Disposable syringes (5ml) with disposable needle of 18 gauges were used to aspirate the pus from the abscess. The aspirated syringes with needle were immediately taken to Department of Microbiology for culture and sensitivity, fungal smear and ZN staining.

RESULTS

In the present study, 40 patients with neck abscesses were considered. The most commonly involved age group was between 40-50 years, 28 (70%) cases were males while 12 (30%) cases were females; showing males were more prone to oro-facial odontogenic space infections as compared to females.

In our study submandibular was seen in 15 (37.5%) cases, followed by diffuse neck abscess in 9 (22.5%), peritonsillar in 5 (12.5%), parapharyngeal in 4 (10%), submental in 3 (7.5%), parotid in 2 (5%) and retropharyngeal in 2 (5%).

Table 1: Distribution according to types of isolate.

Isolates	Frequency	Percentage (%)
Aerobic	24	60
No growth	6	15
Fungal	4	10
Anaerobic	3	7.5
Tubercular	3	7.5

The present study has microbiological isolates including both aerobes and anaerobes. In addition we also isolated tubercular bacilli in 3 cases (7.5%), fungi in 4 cases (10%) and no growth was detected in 6 cases (15%). Of the total 40 isolates, 24 (60%) were aerobes and 3 (7.5%) were anaerobes.

Table 2: Number and types of aerobic bacteria.

Organisms	No. of isolates	%
Staphylococcus aureus	10	41.7
Pseudomonas aeruginosa	8	33.33
Methicillin resistant *Staphylococcus Aureus*	3	12.5
***Klebsiella* species**	3	12.5

The predominantly isolated microorganisms amongst aerobes were *Stapylococcus aureus* (41.7%) followed by *Pseudomonas aeruginosa* (33.33%), methicillin resistant *Staphylococcus aureus* (12.5%), *Klebsiella* species (12.5%).

The predominant anaerobic flora isolated was *Peptostreptococcus* in 2 (66.67%) and *Bacteroides* species in 1 (33.33%). The only fungal organism isolated was *Candida albicans*.

Table 3: Antibiotic sensitivity pattern of aerobic strains (n=24).

Antibiotics	Sensitivity	%	Resistance	%
Erythromycin	6	25	3	12.5
Amikacin	14	58.33	6	25
Vancomycin	9	37.5	0	0
Linezolid	9	37.5	0	0
Clindamycin	6	25	0	0
Levofloxacin	4	16.67	11	45.83
Cefoxitin	0	0	3	12.5
Cefoperazone	5	20.83	10	41.67
Ceftriaxone	5	20.83	6	25
Meropenem	0	0	6	25
Piperacillin+ Tazobactam	7	29.17	2	8.33
Imipenem	3	12.5	6	25
Ceftazidine	2	8.33	2	8.33
Polymyxin B	2	8.33	0	0
Ciprofloxacin	2	8.33	4	16.67
Cefoxidine	0	0	3	12.5
Sulbactam+ Cefoperazone	3	12.5	0	0

Aerobic bacteria were sensitive to Amikacin, Vancomycin, Linezolid, Piperacillin+Tazobactam, Clindamycin, Erythromycin, Cefoperazone, Ceftriaxone, Levofloxacin, Sulbactam+Cefoperazone. Aerobic bacteria were least sensitive to Cefoxitin, Meropenem, Cefoxidine. Antibiotic resistance seen in aerobic bacteria was for Levofloxacin, Cefoperazone, Ceftriaxone, Meropenem, Imipenem, Ciprofloxacin.

Table 4: Antibiotic sensitivity pattern of anaerobic strains (n=3).

Antibiotics	Sensitivity	%	Resistance	%
Clindamycin	3	100	0	0
Metronidazole	3	100	0	0
Colistin	3	100	0	0
Vancomycin	2	66.67	1	33.33

Among the anaerobic bacteria it was found that most of the organisms were sensitive for Clindamycin, Metronidazole, Colistin, Vancomycin. Antibiotic resistance seen in anaerobic bacteria was for Vancomycin.

Among *Staphylococcus aureus* most of the organisms were most sensitive to amikacin and showed no sensitivity to meropenam. They showed maximum resistance to levofloxacin.

Table 5: Antibiotic sensitivity pattern of *Staphylococcus aureus* (n=10).

Antibiotic	Sensitivity	%	Resistance	%
Erythromycin	6	60	0	0
Amikacin	10	100	0	0
Vancomycin	6	60	0	0
Linezolid	6	60	0	0
Clindamycin	6	60	0	0
Levofloxacin	4	40	6	60
Cefoxitin	0	0	3	30
Cefoperazone	1	10	3	30
Ceftriaxone	1	10	3	30
Meropenem	0	0	3	30
Piperacillin+ Tazobactam	3	30	0	0
Sulbactam+ Cefoperazone	1	10	0	0
Imipenem	1	10	0	0

Table 6: Antibiotic sensitivity pattern of *Pseudomonas aeruginosa* (n=8).

Antibiotic	Sensitivity	%	Resistance	%
Cefoperazone	4	50	4	50
Ceftazidine	2	25	2	25
Amikacin	2	25	6	75
Piperacillin+ Tazobactam	4	50	2	25
Imipenem	2	25	6	75
Levofloxacin	0	0	2	25
Polymyxin B	2	25	0	0
Ceftriaxone	4	50	0	0
Ciprofloxacin	2	25	4	50
Cefoperazone+ Sulbactam	2	25	0	0

Among pseudomonas most of the organisms were most sensitive to cefoperazone, piperacillin- tazobactum and ceftriaxone and showed no sensitivity to levofloxacin. They showed maximum resistance to amikacin and imipenam.

Table 7: Antibiotic sensitivity pattern of *Klebsiella* species (n=3).

Antibiotic	Sensitivity	%	Resistance	%
Cefoperazone	0	0	3	100
Ceftriaxone	0	0	3	100
Amikacin	2	66.67	0	0
Piperacillin+ Tazobactam	2	66.67	0	0
Levofloxacin	0	0	3	100
Meropenem	0	0	3	100

Among *Klebsiella* most of the organisms were most sensitive to amikacin, piperacillin- tazobactum. They

showed maximum resistance to cefoperazone, ceftriaxone, levofloxacin and meropenam.

Table 8: Antibiotic sensitivity pattern of Methicillin Resistant *Staphylococcus aureus* (n=3).

Antibiotic	Sensitivity	%	Resistance	%
Vancomycin	3	100	0	0
Linezolid	3	100	0	0
Cefoxidine	0	0	3	100
Erythromycin	0	0	3	100

Among MRSA all of the organisms were sensitive to vancomycin and linezolid. They showed full resistance to cefoxidine and erythromycin.

Table 9: Antibiotic sensitivity pattern of *Peptostreptococcus* (n=2).

Antibiotic	Sensitivity	%	Resistance	%
Clindamycin	2	100	0	0
Metronidazole	2	100	0	0
Colistin	2	100	0	0
Vancomycin	1	50	1	50

Among *Peptostreptococcus*, 100% sensitivity was seen with clindamycin, metronidazole, colistin. They showed maximum resistance to vancomycin

Table 10: Antibiotic sensitivity pattern of *Bacteroides* (n=1).

Antibiotic	Sensitivity	%	Resistance	%
Clindamycin	1	100	0	0
Metronidazole	1	100	0	0
Colistin	1	100	0	0
Vancomycin	1	100	0	0

Among *Bacteroides*, 100% sensitivity was seen with clindamycin, metronidazole, colistin and vancomycin.

DISCUSSION

Neck space infections are typically polymicrobial. The pathogenesis of odontogenic infections is dependent on a synergistic relationship between aerobic and anaerobic bacteria. The severity of these infections is far greater than in the past, demanding swift recognition of the disease followed by prompt, and more aggressive treatment. Failing to identify and treat these infections promptly may result in disastrous outcomes.

In our study of 40 patients with head and neck infections, male patients 28 (70%) were more common than females 12 (30%). In study by Santosh male patients 57 (63.33%) were more commonly involved than female patients 33 (36.66%).[12] This finding is also comparable to the sex distribution given by Rega where male patients were 54% and female patients were 46% and also comparable to sex distribution by Ahmad.[13,14] In study by Walia et al male patients were more commonly involved than female patients ;as in study by Goldberg, Kannangara males were more common than femlaes whereas females outnumbered males in the study conducted by Hunt DE.[15-18]

In our study, the maximum number of patients were in the age group of 40- 50 years. In study by Santosh, most commonly involved age group was between 29 to 39 years whereas in study by Ahmad, age group most commonly involved was in the third and fourth decades of life.[12,14]

In our study, patients with submandibular abscess were maximum (30%) followed by buccal (25%), diffuse neck abscess (22.5%), peritonsillar abscess (7.5%), parapharyngeal abscess (5%), parotid abscess (5%), submental abscess (2.5%) and retropharyngeal abscess (2.5%). In a study by Rega et al, most commom abscess is submandibular space (30%) followed by buccal (27%), lateral pharyngeal space (12.5%), submental space (7.5%).[19] In a study by Lin et al submandibular space (76.92%) followed by buccal (69.23%), submental (46.15%).[20] Our study is contadictory to the incidence documented by Storoe et al.[3] At the same time correlated with Walia et al.[15] In a study by Yang et al, submandibular space infection was most common (35%), parapharyngeal (20%), retropharyngeal (13%), peritonsillar (9%) and parotid (3%).[21] In a study by Walia et al, submandibular space infection (28.57%) was most common followed by buccal (21.42%), submental (7.14%).[15] In a study by Prakash et al most common neck space abscess was peritonsillar (20%), submandibular (16%), diffuse neck abscess (14%), parotid (10%), parapharyngeal (8%), retropharyngeal (4%), submental (4%).[22]

In our study, out of 40 cultures, 60% show aerobic organisms, 15% no growth, 10% fungal, 7.5% anaerobic, 7.5% tubercular. In a study by Walia et al, 70% were aerobes, 25% were anaerobes and 5% were fungal.[15] In a study by Yang et al, aerobes were 48%, mixed (36%), no growth (11%), 5% anaerobes.[21] In a study Ahmed et al, culture show aerobes (26%), anaerobes (29.5%) and mixed (44.5%).[14] In a study by Ye et al 57.85% were anaerobes and 42.08% were aerobes.[20]

In our study, out of 24 aerobes 41.7% were *Staphylococcus aureus*, 33.33% were *Pseudomonas aeruginosa*, 12.5% were *MRSA*, 12.5% were *Klebsiell*a species. In a study by Ye et al most commonly isolated organisms from aerobic bacteria were *Klebsiella* species (17.54%), *Staphylococcus aureus* (14.03%), *Streptococcus* species (4.38%), *Pseudomonas aeruginosa* (3.50%) and *Streptococcus mutans* (2.63%).[20] This finding was concurrent with that of Santosh et al. In a study by Santosh et al, most common aerobic organism were *Streptococcus viridans* (36.4%), *Klebsiella* (27.3%), *Pseudomonas aeruginosa* (18.2%), *Coagulase negative*

Staphylococci (9.1%), *Nisseria* (4.54%) and *Enterobacter* species (4.54%).[12] A high rate of Staphylococci was cultured from the total isolates, which may be due to contaminant of cultures from the skin or an actual finding. In a study by Walia et al, *S. aureus* was isolated in 17.50%, *Klebsiella* in 10%, *E. coli* in 10%, *Pseudomonas aeruginosa* in 5%[15]. In a study by Sia et al, *Klebsiella pneumoniae* (24.8%) was commonest bacteria, followed by *Staphylococcus aureus* (18.3%) and *Staphylococcus epidermidis* (9.2%).[23] The low percentage of *Streptococcus viridans* in this study is because of few odontogenic neck infection specimens collected. Srivanitchapoom et al reported *Streptococcus viridans* as the commonest bacteria, accounting for 46.9%, followed by *Klebsiella* species (9%) and *Staphylococcus spp*. (7.0%).[24] In a study Ahmed et al, *Staphylococcus Aureus* in 20%, *Pseudomonas aeruginosa* in 20%, *Streptococcus pyogenes* in 10%.[14] In a study by Shih-Wei Yang et al, most common aerobe was *Streptococci viridans*, the second and third ones were *K. pneumoniae* and *S. aureus*.[21]

In our study out of 3 anaerobes, 2 (66.7%) were *Peptostreptococcus* and 1 (33.3%) was *Bacteroids* spp. In a study by Santosh et al, the most common organisms isolated from anaerobic bacteria were *Peptococci* (58.9%), and *Peptostreptococci* (41.1%).[12] This study was compared with Rega in which *Streptococci viridans* were the predominant species followed by *Provetella*, *Staphylococci* and *Peptostreptococcus*.[13] In a study by Walia et al, the predominant flora isolated was P*eptostreptococcus* in 10%, *Bacteroides* in 12.5%.[15] In a study by Ye et al, Clostridium was mostly isolated in 14.03% followed by *Peptostreptococcus* in 7.01%, *Bacteroids* and *Streptococcus milleri* in 3.50%.[20] In a study Ahmed et al, anaerobic *Streptococci* were seen in 22.5% and *Bacteroids* were seen in 10%.[14] Similar to the study conducted by Labriola, Aderhold.[25,26]

In our study 4 cultures show candida growth (10%). In a study Ahmed et al, candida growth was seen in 2.5%.[14] In a study by Walia et al, Candida growth was seen in 5%.[15] The occurrence of candida in pus was consistent with the literature reported by Mcmanners et al.[27]

In our study aerobic bacteria were sensitive to erythromycin, clindamycin, cefoperazone, linezolid, amikacin, vancomycin, ceftriaxone, levofloxacin, sulbactam and were resistance to levofloxacin, cefoperazone, ceftriaxone, meropenem, imipenem, ciprofloxacin. Amongest the anaerobes clindamycin, metronidazole, colistin and vancomycin were found to be most sensitive. This was similar to study conducted by Bahl, Gupta, Kanwardeep et al which showed that aerobic organisms were 60% effective to erythromycin, 25% to cephalosporins, 70% to ciprofloxacin, 15% to gentamycin. Only 10% were sensitive to ampicillin. Sensitivity of anaerobic strains to metronidazole and clindamycin was 85% each. Metronidazole has been used as an empirical antibiotic for anaerobic cover.[28]

Parkash et al also showed similar results to our study with regard to the antibiotics linezolid, erythromycin, ciprofloxacin, gentamycin, cephalosporins which were sensitive to most aerobes and metronidazole, clindamycin effective against anaerobes.[22] Our study showed sensitivity of all anaerobes to Clindamycin and Metronidazole similar to the study conducted by Sutter, Fingegold which proved Clindamycin and Metronidazole to be effective against all anaerobes.[29] Yang et al concluded Metronidazole is active against all obligate anaerobes, including the genera *Peptostreptococcus*, *Bacteroides*, *Prrevotella*, *Fusobacterium*, and *Clostridium*, but it is not active against aerobes. When administered as an empiric antibiotic for deep neck abscess, metronidazole should be combined with antibiotics effective against aerobes to achieve broad coverage.[21] Walia et al concluded that antibiotic susceptibility of gram negative microorganisms was seen predominantly with Amikacin. *Klebsiella* was found to be 100% susceptible to amikacin whereas Pseudomonas was 100% resistant to Amikacin which was sensitive to Cephalosporins and Ciprofloxacin.[15]

In the study conducted by Ye et al, all anaerobic bacteria were 100% resistant to Ampicillin and Pencillin.[20] They were highly sensitive to Erythromycin (100%) followed by Clindamycin (98.48%), Cefoxitime (96.96%) and Amoxycillin (60.60%). At the same time it was less susceptible to Methicillin (22.72%) and Gentamycin (15.15%). Our study is also concurrent with Kuriyama et al, Flynn et al and Santosh et al.[9,12,30]

CONCLUSION

In nutshell we conclude that antimicrobial sensitivity for all head and neck infections is must, which will help in directing more effective treatment and hence achieving the faster cure rate. It will also help us to detect the rare causative organism and their sensitivity pattern. Although resistance to antimicrobial agents is developing worldwide, first line antibiotics still show significant therapeutic advantage in our settings. Judicious use of antibiotics shall be done in our general practices to prevent dreaded complications of infections by treating them at earlier stage and preventing its further spread.

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