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Original Article

Clinical Types and Infective Pattern of Pyogenic Neck Abscess in Diabetic Patients

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Abstract:

Background: *Complex anatomy of neck makes the diagnosis and treatment of the neck abscess challenging. Diabetic patients especially with poorly controlled are more susceptible for such infection and faces virulent pyogenic bacteria. The course of the disease may be more rapidly progressive and serious. Some fatal complications may occur like airway obstruction, pneumonia, lung abscess, mediastinitis etc. We aimed to detect the bacteria causing different clinical types of pyogenic neck abscess and their antimicrobial sensitivity in diabetic patients.*

Methods: *It is a prospective observational type of study carried out in the Department of Otolaryngology and Head Neck Surgery of BIRDEM General Hospital, Dhaka from 1st December, 2019 to 31st May, 2020. Total 50 cases of diabetic patients having neck abscess were selected by purposive consecutive sampling. Then history taking, clinical examinations, relevant investigations along with antibiogram were done in all cases. Afterwards data were collected in a preformed data collection sheet. Then data were analysed with Statistical Package for the Social Sciences (SPSS) V 22.0.*

Results: *Among the 50 cases 30 were male and 20 were female. Age ranges from 32 to 83 years and mean age was 55.28 years. The commonest symptom was neck swelling 47 (94%). Other symptoms were neck pain 46 (92%), fever 42 (84%), difficulty in swallowing 15 (30%), difficulty in mouth opening 14 (28%), toothache 7 (14%), H/O tooth extraction 6 (12%), H/O neck surgery 3 (6%) and respiratory difficulty 1 (2%). On clinical examination commonly 47 (94%) patients had neck swelling which was subsequently followed by pyrexia 36(72%), trismus 16 (32%), dental caries 14 (28%) and halitosis 13 (26%). Commonest aetiology was dental origin. Most common pyogenic abscesses were involved in the anterior triangle of the neck 15 (30%) followed by Ludwig's angina 12 (24%), submandibular abscess 10 (20%), abscess in the posterior triangle 7 (14%), parotid abscess 4 (14%), retropharyngeal abscess 1 (2%) and parapharyngeal abscess 1 (2%). Bacteria isolated from pus culture revealed Klebsiella pneumoniae 23 (46%), Staphylococcus aureus 6 (12%), Pseudomonas 5 (10%), Acinetobacter 4 (08%), E.coli 1 (2%), Proteus 2 (4%), MRSA 1 (2%), Beta haemolytic streptococcus 1 (2%). All the organisms were mostly sensitive to Meropenem, Colistin, Netilmicin, Gentamicin, Amikacin, Piperacillin+Tazobactum. But Acinetobacter was highly sensitive to only Colistin.*

Conclusion: *Neck abscess in diabetic patients occurred commonly in male with lower middle socio-economic class. The virulence of organism is more in case of uncontrolled diabetes. Abscess in the anterior triangle was the commonest type of neck abscess and Klebsiella pneumoniae was the most frequently isolated organism. Empirical antibiotic treatment must cover gram positive, gram negative and anaerobic pathogens. Early surgical intervention can reduce the complications.*

Keywords: *Pyogenic neck abscess, clinical types, Diabetes mellitus, antibiogram.*

Background:

Neck abscess constitutes a surgical emergency. The clinical presentation and severity of neck abscess varied according to different age groups, different anatomical location of the infection and higher incidence of comorbidity especially in diabetic patients.[1] The number of diabetic patients is now increasing very rapidly and with it the diabetic related complications are also in rise. Patients with poorly controlled diabetes mellitus are more prone for such infection and faces virulent pyogenic bacteria.[2] Hyperglycemia suppresses the host's immune functions such as neutrophil function (including phagocytic and bactericidal activity, chemotaxis, and respiratory burst), cellular immunity and complement activation.[3] Infections in diabetic patients result in extended hospital stays and additional financial burden.[4]

The incidence of neck abscesses was higher in the pre-antibiotic era but remains as an important problem in third world countries leading to morbidity and mortality.[4,5] In that era, 70% of deep neck infection resulted from pharyngo-tonsillar infections whereas today they are mostly caused by dental infections.[5] The common clinical types of neck abscess are submandibular abscess, peritonsillar abscess, Ludwig's angina, parotid abscess, retropharyngeal abscess, parapharyngeal abscess, abscesses in the anterior and posterior triangle.[5] A deep neck abscess can lead into serious fatal complications such as airway obstruction, pneumonia, lung abscess, mediastinitis, pericarditis.[6,7] Fatal pyothorax, due to secondary involvement of pleura following mediastinitis in a case of massive acute retropharyngeal abscess, has also been reported.[8] Complications like cavernous sinus thrombosis have been reported in patients with parapharyngeal abscess.[8] Further spread of infection into the mediastinum can occur via the carotid sheath (Lincoln

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Highway).[9] If the predisposing factors of complicated deep neck infections are identified, appropriate treatment can be provided as soon as possible in order to prevent the complications.

In recent years, several reports have described changing trends in deep neck space abscess over time.[10] Differences in incidence, age at presentation, sex, anatomical location are commonly noted. Common organisms of neck abscess include *Staphylococcus aureus, Streptococcus, Klebsiella, Pseudomonas, E. colli* etc[11]. The most crucial issue is perhaps increasing microbial resistance. To get an effective antibiotic against the isolated organism, it is necessary to do culture and sensitivity of pus.

Treatment of all these diabetes associated head and neck infections is quite challenging and patients need long term hospitalization for anti-microbial therapy and better glycemic control1.[2] Because of long term hospitalization incurs greater treatment cost and increased absence from work place which in turn causes huge financial burden to the family[1]. Nevertheless, if a prompt diagnosis of a major life-threatening infection is made at an earlier stage, one can avoid the onset of major complication which in turn can reduce overall morbidity and mortality.[1]

Compared with infections elsewhere in the body, deep neck infections pose complicated problems due to the numerous portals of entry of infection and proximity to vital structures. These infections may result in life-threatening complications such as upper airway obstruction, descending mediastinitis, thrombosis of the jugular vein, venous septic emboli, rupture of the carotid artery, adult respiratory distress syndrome, pericarditis, septic shock, and disseminated intravascular coagulopathy. Anatomical variation of different clinical types of neck abscess makes the treatment difficult for the physicians and surgeons. The increasing prevalence of patients with immunodeficiency like diabetes may result in unusual clinical presentations and pathogens. By isolation and identification of common organisms, proper antibiotics can be selected and this may alleviate the different complications. So, this study will be helpful for the future generation regarding clinical management of pyogenic neck abscess especially in the diabetic patients.

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Methods:

This non-randomized, prospective, cross sectional, observational study was conducted among the indoor and outdoor patients of Department of Otolaryngology and Head Neck Surgery, BIRDEM General Hospital, Dhaka, Bangladesh from December, 2019 to May, 2020 for a period of six months. Purposive consecutive type of nonprobability sampling method was applied.

Diabetic patients diagnosed with pyogenic neck abscess who were willing to participate were included in the study. Patients with neck abscess without diabetes mellitus, tubercular neck abscess, abscesses on the malignant lesion of the neck and patients and/or attendants not willing to give consent were excluded from the study. At first the patients were enrolled in the study by purposive consecutive type of sampling. A data collection sheet and a consent form were prepared. The patients were stated regarding the study. Informed written consent was taken. The patients were assessed biochemically due to diabetic conditions. As a result, FBS with 2HABF and HbA1c were done. After proper clinical evaluation like history taking and proper clinical examinations more relevant investigations like CBC, serum creatinine, and local part x-ray was done.

Only clinically confirmed cases of abscesses were included in the study. Incision and drainage was done at the earliest stage. Pus was sent for culture and sensitivity analysis prior to the start of antibiotic treatment. Empirical antibiotic was started if considered emergency. The antibiotics were modified, based on culture sensitivity reports or clinical unresponsiveness. Supportive therapy, in the form of intravenous fluids, analgesics, antipyretics, antiemetics, mouthwashes, etc., were given. All patients were kept under observation for any possible respiratory distress. Radiology and dental referrals were sought in appropriate cases. All results were compiled and analyzed by using SPSS 22.0 and expressed in tables or figures.

Statistics: After collection of all the required data, they were checked, verified for consistency and then tabulated into the computer using the SPSS v22. Statistical analyses were carried out by using the Statistical Package for Social Sciences version 22.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Variables were expressed as frequencies and percentages.

Results:

Total 50 cases of diabetic patients having neck abscess were included in this study. Most of the patients (30%) belonged to the age group 51-60 years, with a mean age of 55.28 years. Out of 50 patients, 30 (60%) and 20 (40%) were male and female respectively. The male to female ratio was 3:2. Out of 50 patients, 29 (58%) belonged to lower middle-class group.

Table-I: Distribution of patients according to symptoms (N=50)

Clinical features	Frequency (%)
Neck swelling	47 (94%)
Neck pain	46 (92%)
Fever	42 (84%)
Difficulty in deglutition	15 (30%)
Difficulty in mouth opening	14 (28%)
Toothache	7 (14%)
H/O tooth extraction	6 (12%)
H/O neck surgery	3 (6%)
Respiratory difficulty	1 (2%)

Most common symptoms were neck swelling (94%), neck pain (92%) and fever (84%) (table I). A swollen neck with raised temperature was the most common sign among patients (table II).

Table-II: Distribution of patients according to clinical signs (N=50)

Clinical features	Frequency (%)
Neck swelling	47 (94%)
Raised temperature	36 (72%)
Dental caries	14 (28%)
Trismus	16 (32%)
Halitosis	13 (26%)
Floor of the mouth oedema	4 (8%)
Lymphnode enlargement	6 (12%)
Bulging of the posterior pharyngeal wall	1 (2%)
Wound infection	3 (6%)

Table III: Possible source of infection of pyogenic neck abscess (N=50)

Possible source of infection	Frequency (%)
Odontogenic	18 (36%)
Upper respiratory tract infection	8 (16%)
Skin infection	8 (16%)
Parotitis	4 (8%)
Surgical wound infection	3 (6%)
Foreign body(digestive tract)	2 (4%)
Unknown	7 (14%)

Table-III shows that among the 50 cases of pyogenic neck abscess, most common possible source of infection was dental in origin (36%). *Klebsiella pneumoniae* was the most common organism isolated (46%), followed by *Staphylococcus aureus* (12%) and *pseudomonas* (10%) (table IV).

Table IV: Organisms isolated from culture of pus drained from the neck abscesses (N=50)

Name of organism	Number of cases	Percentage
Klebsiella	23	46
Staphylococcus aureus	06	12
Pseudomonas	05	10
Proteus	02	04
Acinetobacter	04	08
MRSA	01	02
E. coli	01	02
Beta haemolytic streptococcus	01	02
No growth	07	14
Total	50	100

Table-V: Variation in different types of organisms isolated from pus for C/S from different types of pyogenic neck abscess in diabetic patients (N=50)

Types of abscess (n)	Bacteria isolated	Frequency (%)
Submandibular abscess (n=10)	*Klebsiella pneumonia*	4 (40%)
	Staphylococcus aureus	3 (30%)
	Proteus	1 (10%)
	MRSA	1 (10%)
	No growth	1 (10%)
Ludwig's angina (n=12)	*Klebsiella pneumonia*	3 (25%)
	Pseudomonas	2 (17%)
	***β**-hemolytic streptococci*	1 (8%)
	Acinetobacter	1 (8%)
	No growth	5 (42%)
Anteior triangle abscess (n=15)	*Klebsiella pneumonia*	9 (60%)
	Pseudomonas	2 (13%)
	Acinetobacter	2 (13%)
	Staphylococcus aureus	2 (13%)
Posterior triangle abscess (n=7)	*Klebsiella pneumonia*	4 (58%)
	Staphylococcus aureus	1 (14%)
	Acinetobacter	1 (14%)
	No growth	1 (14%)
Parotid abscess (n=4)	*Klebsiella pneumonia*	2 (50%)
	Proteus	1 (25%)
	E. Coli	1 (25%)
Retropharyngeal abscess (n=1)	*Pseudomonas*	1 (100%)
Parapharyngeal abscess(n=1)	*Klebsiella pneumonia*	1 (100%)

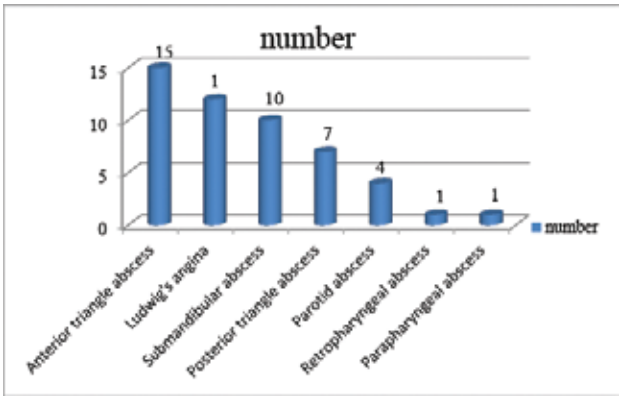

Figure 1: Distribution of patients according to the anatomical location of neck abscess (N=50).

Table-VI: Antibiotic sensitivity pattern of klebsiella, Pseudomonas, Acinetobacter, Proteus, E. coli with commonly used antibiotics (N=50)

Antibiotics with sensitivity (%)	*Klebsiella* (n=23)	*Pseudomonas* (n=5)	*Acinetobacter* (n=5)	*Proteus* (n=2)	*E.coli* (n=1)
Ceftriaxone n (%)	16 (70%)	1 (20%)	0 (0%)	2 (100%)	0 (0%)
Ceftazidime n (%)	16 (70%)	5 (100%)	0 (0%)	2 (100%)	0 (0%)
Cefixime n (%)	16 (70%)	3 (60%)	0 (0%)	2 (100%)	0 (0%)
Ciprofloxacin n (%)	15 (65%)	3 (60%)	1 (20%)	2 (100%)	0 (0%)
Netilmicin n (%)	23 (100%)	5 (100%)	2 (40%)	2 (100%)	1(100%)
Colistin n (%)	23 (100%)	3 (60%)	5 (100%)	1 (50%)	1(100%)
Meropenem n (%)	23 (100%)	5 (100%)	1 (20%)	2 (100%)	1(100%)
Amoxycillin+Clavulanic acid n (%)	14 (61%)	1 (20%)	0 (0%)	1 (50%)	0 (0%)
Gentamicin n (%)	23 (100%)	5 (100%)	1 (20%)	2 (100%)	1(100%)
Amikacin n (%)	22 (96%)	5 (100%)	1 (20%)	2 (100%)	1(100%)
Piperacillin+Tazobactum n (%)	22 (96%)	4 (80%)	1 (20 %)	2 (100%)	1(100%)
Aztreonam n (%)	22 (96%)	5 (100%)	0 (0%)	2 (100%)	0 (0%)

Table VII: Antibiotic sensitivity pattern of Staphylococcus Aureus and β- hemolytic Streptococcus with commonly used antibiotics (N=50)

Antibiotics with sensitivity (%)	Staphylococcus Aureus (n=6)	β- hemolytic Streptococcus (n=1)
Ampicillin n (%)	—	1(100%)
Amoxycillin+Clavulanic acid n (%)	5 (83%)	—
Cefotaxime n (%)	—	1(100%)
Ceftriaxone n (%)	—	1(100%)
Cephalexin n (%)	6 (100%)	1(100%)
Chloramphenicol n (%)	—	1(100%)
Clindamycin n (%)	4 (67%)	1(100%)
Ciprofloxacin n (%)	2 (33%)	—
Cotrimoxazole n (%)	4 (67%)	1(100%)
Erythromycin n (%)	4 (67%)	1(100%)
Gentamicin n (%)	6 (100%)	0 (0%)
Levofloxacin n (%)	—	1(100%)
Linezolid n (%)	—	1(100%)
Moxifloxacin n (%)	—	1(100%)
Oxacillin n (%)	5 (83%)	1(100%)
Penicillin G n (%)	—	1(100%)
Rifampicin n (%)	6 (100%)	1(100%)
Tetracyclin n (%)	—	1(100%)
Vancomycin n (%)	6 (100%)	1(100%)

Table VIII: Frequency of complications in diabetic patients with pyogenic neck abscess (N=50)

Complications	No. of patients	Frequency (%)
Nil	44	88%
Mediastinitis	01	02%
Skin loss	03	06%
Sepsis	01	02%
Facial Palsy	01	02%

Discussion:

Neck infections continue to be seen despite the wide use of antibiotics. These infections follow along fascial planes to create deep neck space abscess.[12] Patients with diabetes mellitus have higher risk of such infection. Diabetes leads to abnormal phagocytosis, persistent reduction of blood flow and abnormal cell mediated immunity[13]. Infections are usually severe and invasive such as pyogenic bacterial infection, necrotizing infections, candida infection or other fungi infections[14]. The risk of mortality related to infection in a diabetic adult patient is greater than that of a cardiovascular diseases patients[15]. So, isolation and identification of common organisms responsible for neck abscess in such patients can help in selection of proper empirical antibiotics and better treatment.

Neck abscess occurs in a wide spectrum of age group. In previous study of Khavdu P et al[11] revealed that highest percentage 31(25.8%) patients were between 51-60 years.[11] Our study also closely correlates with these studies. Neck abscess is commonly evident in male patients. In a previous Bangladeshi study 49 (67.12%) were male and 24 (32.87%) were female out of 73 respondents.[16] This study was very similar to our study findings.

Regarding economic class, in the study of Razib S F et al[17] revealed that 20 (66.6%) patients were from poor class and 7 (23.3%) patients were from middle class. Many possible factors may explain the associations of economic class with diabetic neck abscess including poorer overall health, increased number of comorbid conditions, lack of access to or underuse of health care services, and psychological factors.[17] Psychological factors including depression, anxiety, or emotional problems may influence overall health.[17] But in our study the highest sample size is in the lower middle class group. Economic factor is the reason behind this dissimilarity as the place of study is a paying hospital.

In earlier studies of Ahmad Showkat et al[18] showed that neck swelling (86%) was the commonest symptom which was followed by neck pain (75%), fever (60%). In our study most of the patients presents with neck swelling and neck pain (Table III). On clinical examination patient had neck swelling (88%) which was subsequently followed by oropharyngeal swelling (24%) and trismus (10%).[18] In our study clinical finding is also nearly similar with standard study.

Several previous studies showed common causes of neck abscess were odontogenic (40%), upper airway infection (20%), trauma from ingested foreign body (27%), skin infection (18%) and unknown (22%).[4,16] Our study also supports this.

Neck abscess usually occurred in relation to the space involved. Mazita A et al[19] described anterior triangle abscess and parapharyngeal abscess were the highest incidence in each (31%) and subsequently followed by submandibular abscess (17%), retropharyngeal (8%), posterior triangle abscess (8%) and submental abscess (5%).[19] In this study abscesses in the anterior triangle were highest incidence.

Infections of neck abscess in diabetic patients are usually of mixed microbiologic flora.[4] Sharma K et al[4] studied neck abscess among the diabetic patients. The study revealed the highest growth of bacteria from pus culture were *Klebsiella pneumoniae* (64.44%), *Streptococcus viridans* (22.22%), *Staphylococcus aureus* (6.67%) and MRSA (2.22%).[4] Huang TT et al[20] also analyzed the microorganism among the diabectis where *Klebsiella pneumoniae* was (56.1%) followed by *Streptococcus viridans* (17.1%), *Peptostreptococcus* (9.8%).[20] In the study of Rijal S et al[21] the Klebsiella pneumoniae was the highest isolated bacteria (13.04%) with subsequently *Streptococcus* (10.88%), *Staphylococcus aureus* (8.70%), and also sterile (35.51%).[21] Our study regarding bacteria is similar to these previous studies.

In the study of Jang J-W et al[2], microorganisms were identified in submandibular abscess showed clear domination of *Klebsiella pneumonia* (34.3%) followed by *Streptococcus viridans* (8.6%), *Streptococcus constellatus* (8.6%), *Staphylococcus aureus* (5.7%) and *Pseudomonas* (2.8%).[2] Commonly isolated microorganisms in Ludwig's angina include *Streptococcus viridans* (76.67%), *Staphylococcus aureus* (23.34%), E.coli (10%), *Pseudomonas* (6.67%) and *Klebsiella pneumonae* (3.34%).[17] The study of Mazita A et al[19] showed the isolated organisms were *Klebsiella, Acinetobacter, Staphylococcus* and *Pseudomonas* in the superficial neck abscesses in the anterior and posterior triangle. In the study of Nusem-Horowitz S et al[22], *Bacteroids* (5%), *Staphylococcus aureus* (5%) and *Klebsiella pneumoniae* (5%) were the isolated bacteria causing parotid abscess. Regarding retropharyngeal abscess in adult in the previous study among the four cases only one was cultured positive that was *Staphylococcus aureus* (25%).[23] In the study of Brook I et al, in parapharyngeal abscess predominant isolated bacteria were *Streptococcus pyogenes*, *Staphylococcus aureus, Haemophilus influenza* and *Peptostreptococcus*.[24] Previous study showed patients who are immunocompromised are prone to have *Klebsiella pneumonia* infection.[3,4,19] In our study *Klebsiella pneumonia* is the highest isolated bacteria in submandibular abscess, Ludwig's angina, anterior and posterior triangle abscess, parotid abscess and parapharyngeal abscess but in case of retropharyngeal abscess Pseudomonas is the causative organisms. Our study finding nearly correlates with the other studies. But in other study, Staphylococcus aureus was the isolated bacteria in retropharyngeal abscess. Kutty SR et al[5] found 30% of cases no growth of organism in culture. In the study of Khavdu PJ et al[11] there were 29.1% cases of negative

culture. In our study culture was negative in 7 cases (14%), it may be because of improper use of antibiotics prior to presenting to our center. This dissimilarity with the previous studies occurred probably due to our small sample size. The treatment of abscess includes optimal abscess drainage, bacteria culture from pus and antibiotic sensitivity test. The results of this examination require a long time, so it needs antibiotics based on empirical data.[21] Antibiotic coverage should include gram negative, gram positive and anaerobic organisms.[5] A combination of third generation cephalosporins and metronidazole are good as empiric antibiotic coverage.[5] Previous studies showed *klebsiella pneumoniae* was highest sensitive to Meropenem (94.4%) followed by Gentamicin (87.3%), Amikacin (100%), Ceftriaxone (79.4%) Cefotaxime (76.9%), Ciprofloxacin (55%), Co-trimoxazole (50%) and Amoxycillin+Clavulanic acid (41.8%) 35,36. Trojan R et al's[25] study showed *Pseudomonas* was sensitive to Meropenem (80%), Netilmicin (80%), Piperacillin+Tazobactam (80%), Amikacin (80%), Gentamicin (60%), Ciprofloxacin (60%) and ceftriaxone (20%). In the previous study done by Fayyaz M et al[26], *Acinetobacter* was mostly sensitive to Doxycycline (45%) followed by Amikacin (15.6%), Piperacillin+Tazobactam (14.1%), Cotrimoxazole (11.6%), Meropenem (10.1%) and Ciprofloxacin (6.2%).

But in the study of Savanur S S[27], *Acinetobacter* was highly sensitive to Colistin (68%). In the previous studies *Proteus* was resistant to majority of the antibiotics.[27] But in this study, *Proteus* is found sensitive to the most of the antibiotics some geographical variation may be responsible for that. *E. Coli* was found sensitive to Colistin (97%), Meropenem (69%), Piperacillin+Tazobactam (47%), Amikacin (69%), Gentamicin (47%).[27] Our study result shows *Klebsiella pneumonae*, *Pseudomonas, Acinetobacter, Proteus* and *E.coli* all the organisms are mostly sensitive to Meropenem, Colistin, Netilmicin, Gentamicin, Amikacin and Piperacillin+Tazobactum. But *Acinetobacter* is highly sensitive to only Colistin. So, this result has similarity to the above-mentioned studies. In the study of Tiwari P et al[28] showed *Staphylococcus aureus* was highly sensitive to Vancomycin (100%) and subsequently to Clindamycin (87%), Oxacillin (75%), Erythomicin (55%) and Ciprofloxacin (11%). *Beta hemolytic Streptococci* were sensitive to penicillin G, erythromycin, co-trimoxazole and tetracycline in 95%, 98%, 89% and 77% of cases respectively.[29] In this study *Staphylococcus aureus* and *Beta hemolytic streptococcus* both are highly sensitive to Cephalexin, Rifampicin, and Vancomycin. So, our result also correlates with above study. In the study by DS Sethi et al[30], 19% of patients developed complications; six developed necrotizing cervical fasciitis. One had aspiration pneumonia, two developed acute myocardial infarction, and four patients developed septicemia and multiorgan failure.[30] In our study skin loss is the most common complication, subsequently followed by mediastinitis, sepsis and facial nerve palsy. These dissimilarities of complication are probably due to poor hygiene, malnutrition and delayed presentation.

Conclusion

Neck abscess in diabetic patients occurred commonly in male with lower middle socio- economic class. Abscess in the anterior triangle was the most common clinical types of neck abscess. In diabetic patients *Klebsiella pneumoniae* was the commonest organism causing pyogenic neck abscess. Identification of causative organisms and their sensitivity to antibiotics in different neck abscess is very crucial for the treatment of pyogenic neck abscess. For further recommendation, a multicentered study for longer duration in the tertiary hospitals of larger sample size can reveal the real picture of clinical types and infective pattern of pyogenic neck abscess in diabetic patients of Bangladesh.

Limitations

The study was conducted on only 50 patients and was done for 6 months only. A larger sample size and longer study duration would have been more acceptable.

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