Original Article

Bacteriological Study and Antibacterial Susceptibility in Ludwig's Angina in a Tertiary Level Hospital in Dhaka, Bangladesh

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ABSTRACT

Background: *The knowledge of the local pattern of infection and antibacterial sensitivity in Ludwig's angina is essential to enable efficacious treatment for it.*

Objective: *To find out the pattern of bacteria responsible for developing Ludwig's angina and their antibacterial susceptibility.*

Methods: *It is a prospective, observational type of study carried out in the Department of Otolaryngology & Head-Neck Surgery, Dhaka Medical College Hospital, Dhaka and Department of Clinical Microbiology, ICDDR,B, Dhaka, Bangladesh, between April and September of 2016. A total of 100 patients were included in this study.*

Results: *This study was done among 100 patients. In this study 42 cases (42%) were in the 31-45 years age group. The male patients were 60 (60%) and female were 40 (40%). Majority of patients 70(70%) came from poor class family with educational level up to HSC (75%), maximum 35(35%) patients use meswak to clean teeth, 70 (70%) patients came from rural area, 70 (70%) patients had dental infection, 25 (25%) patients had diabetes mellitus, all the cases (100%) presented with swelling in the floor of the mouth and neck, pain and tenderness and fever. The major complication was necrotizing fasciitis 8 (8%), 36 (36%) patients were discharged within 1-2 weeks after treatment, Streptococcus 40 (40%) was the most common organism and most effective antibiotic was Ceftriaxone (65%).*

Conclusion: *The most frequently isolated organism in Ludwig's angina is Streptococcus and sensitivity results showed majority of isolates is susceptible to Ceftriaxone.*

Keywords: *Ludwig's angina, microorganism, antibiogram, antibiotics.*

Mugda Med Coll J. 2023; 6(2): 71-76

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INTRODUCTION

Ludwig's angina is a rapidly progressive, potentially fulminant cellulitis of the submandibular space. It is named after the German physician Willhem Frederick von Ludwig, who first described the condition in 1836. The word 'angina' comes from the Greek *ankhon* meaning 'strangling'.[1] It is manifested by swelling of the floor of the mouth, tense edema and induration of submental soft tissues and elevation and posterior displacement of tongue. The pain and trismus, along with swelling of the oral and cervical tissues and tongue displacement, create a severely compromised airway.[2] Grodinsky developed strict criteria for the diagnosis of Ludwig's angina. According to him the disease can be recognized by five identifying characteristics: (1) the infection is a cellulitis of the submandibular space, not an abscess; (2) it never involves only one space, and it is usually bilateral;

(3) the cellulitis causes gangrene with sero-sanguineous infiltration and very little or no frank pus; (4) the cellulitis attacks the connective tissue, fascia, and muscles, but not the glandular structures; and (5) the cellulitis spreads by tissue continuity, not by the lymphatics.[3] Over 80 percent of patients have a dental infection and the rest usually have an upper respiratory tract infection.[1]The most common predisposing factors for the development of Ludwig's angina are carious and abscessed teeth, periodontal disease and extractions of the lower molars. Other etiology includes floor of the mouth trauma, mandibular fractures, peritonsillar abscess and sialdadenitis.[4] The second and third mandibular molars have roots which lie at the level of the mylohyoid muscle either adjacent to or below the submandibular space. Abscesses of these lower molar may perforate the mandible and spread into the submandibular and submental spaces, leading to Ludwig's angina.[5]Mixed infections involving both aerobes and anaerobes are common. Streptococcus viridans is the most common pathogen followed by Staphylococcus epidermidis, Staphylococcus aureus and Escherichia coli.[1] Pseudomonas spp,Bacteroides spp.,Fusobacterium spp., Actinomyces spp. and Haemophilus influenzae are also identified.[3] A study identified Sterptococcus (40.62 %), Staphylococcus (18.75 %), E.Coli (12.5 %), Pseudomonus (9.37%), Proteus (2%), Klebsiella (1%) among the 12 most common pathogens.[6] All age groups may be affected. Patients are often elderly and young. There is trismus and excessive salivation. The swelling is diffuse, and there is erythema and cellulitis of the skin. The floor of the mouth appears oedematous, brown in colour with the tongue pushed upwards and back which can cause a potential airway obstruction.[1] Patients have neck swelling, pain, and elevation of the tongue, malaise, fever, dysphagia and stridor. The submandibular area can be indurated, sometimes with palpable crepitus.[7,8] The diagnosis and treatment of deep neck space infections have challenged physicians and surgeons. The complexity and the deep location of this region make diagnosis and treatment of infections in this area difficult. The diagnosis is based on the history and examination and made on clinical grounds. The white cell counts and the inflammatory markers, such as ESR and CRP, are usually raised. The ultrasound or CT scan will delineate the abscess and confirm diagnosis, although abscess formation is rare if initial antibiotic therapy is targeted at gram-positive, gram negative organisms and oral cavity anaerobes. Empirical therapy with IV penicillin G, clindamycin or metronidazole is recommended before culture report is available. Antibiotic treatment before hospital admission often results in sterile cultures. Intravenous steroids can be given for 48 hours & it can decrease edema and cellulitis and thus help maintain the integrity of the airway and enhance antibiotic penetration.[8] Usually this illness is associated with other comorbid conditions. It is very important to identify and address these comorbidities. Diabetes mellitus is an important comorbid condition which should be checked for. Proper handling of diabetes is also an important part of comprehensive treatment. Complications includes airway obstruction due to laryngeal edema or swelling or pushing back of tongue, extension to mediastinum causing mediastinitis, sepsis and septicemia, pleural empyema, pericarditis, and pericardial tamponade and even may result in the death of the patient.[4]

This study will predict the microorganisms responsible for Ludwig's angina and their antibacterial susceptibility and help the ENT and Head Neck surgeon to diagnose and manage patients of Ludwig's angina in Bangladesh thereby decreasing mortality and morbidity of the patient.

METHODS

This prospective, observational type of descriptive study was conducted in the Department of Otolaryngology & Head-Neck Surgery of Dhaka Medical College Hospital, Dhaka and Department of Clinical Microbiology of International Centre for Diarrheal Disease Research, Bangladesh, (ICDDR,B), Dhaka, Bangladesh, between April and September of 2016. Our study population included all the patients of different age, sex admitted into the Department of Otolaryngology & Head-Neck Surgery with Ludwig's angina. However, a total of 100 patients were finally included in the study based on our inclusion and exclusion criteria. We adopted a nonrandom, convenient, purposive sampling technique.

Inclusion criteria:

1. All the diagnosed cases of Ludwig's angina in whom incision and drainage were done to obtain pus which was sent for culture and sensitivity
2. All the diagnosed case of Ludwig's angina who gave consent willingly to take part in the study.

Exclusion criteria:

1. All cases of Ludwig's angina treated conservatively.
2. All the diagnosed cases of Ludwig's angina who will not give consent willingly to take part in the study.

Informed written consent was taken from the patient or the legal guardian of the patient. Patient personal history, medical history and records, clinical examination findings, culture and sensitivity report of the pus collected were recorded in a structured questionnaire data sheet. Thus, our data sheet was prepared including patient questionnaire, examination findings and investigation results. Wound swab or pus was collected by dry swab stick according to standard method and the sample was sent to the designated lab immediately for culture and antibiotic sensitivity. The culture and sensitivity tests were done in the Department of Clinical Microbiology of ICDDR,B, Dhaka. The swab was first moistened by sterile normal saline and then inoculated on blood agar, MacConkey agar and chocolate agar media. The plates were incubated aerobically at 37^0C for 18-24 hours. Antibiotic sensitivity testing was done by Kirby Bauer disc diffusion method. Susceptibility to antibiotic reports were reported as per CLSI (Clinical and Laboratory Standards Institute) guidelines of 2020. Following antibiotics were considered for sensitivity testing:

Amikacin, Amoxiclav, Ampicillin, Azithromycin, Cefixime, Ceftazidime, Ceftriaxone, Ciprofloxacin, Cloxacillin, Cotrimoxazole, Doxycycline, Gentamicin, Levofloxacin, Penicillin G &Vancomycin.

The sensitivity patterns of the isolates were categorized as 'Sensitive' and 'Resistant'.

Collected data were coded, kept confidential and processed and analyzed using computer software SPSS (Statistical Package for Social Sciences) version 20.0. The test statistics used for analysis of data were t-test (for comparison of data presented in quantitative scale). For any analytical test the level of significance was 0.05 and $p<0.05$ was considered statistically significant.

The study was approved by the Ethical Review Committee of Bangladesh College of Physicians and Surgeons (BCPS), Dhaka, Bangladesh.

RESULTS

Most of the patients (42%) were in the 31-45 years age group (Table-I). Among the participants, 60% was male and 40% was female. Male-female ratio was 1.5:1. Most of the patients (35%) used meswak to clean their teeth (Fig.1). 70% of the cases presented with dental infection followed by history of tooth extraction (10%) (Fig. 2). 25% of the cases presented with diabetes mellitus, while 15% presented with isolated diabetes mellitus (Table-II). Table-III shows that all of the cases (100%) presented symptoms of swelling in the floor of the mouth and neck, pain and tenderness and fever followed by dysphagia (80%) and dental infection (70%). However, more than one symptom was present in all patients. Major complications observed among the patients were necrotizing fasciitis and septicemia (30.8%) followed by mediastinitis (23.1%) (Fig. 3). Most of the patients (36%) were discharged from hospital within 1-2 weeks (Fig. 4). Table-IV shows that Streptococcus (40%) was the most common organism followed by Staphylococcus aureus (23%). However, no organism was found in 5% cases. Mixed organisms were responsible for most of the infections in 30% cases (Table-V). Table-VI shows that most effective antibiotic was Ceftriaxone (65%), followed by Ceftazidime (58%).

Table-I: *Age distribution of patients (n=100)*

Age group (in years)	No. of cases	Percentages
1-15	5	5
16-30	15	15
31-45	42	42
46-60	34	34
>60	4	4
Total	100	100

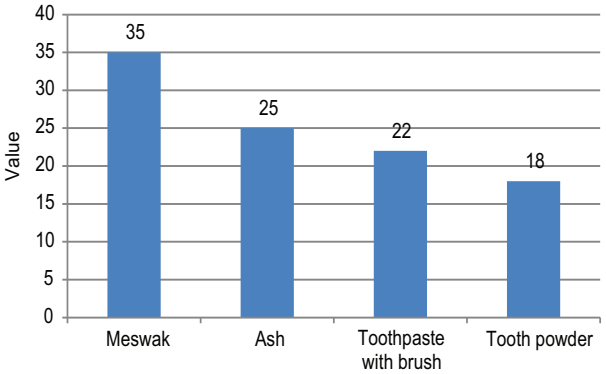

Fig. 1: *Distributions of patients by personal tooth cleaning habits (n=100)*

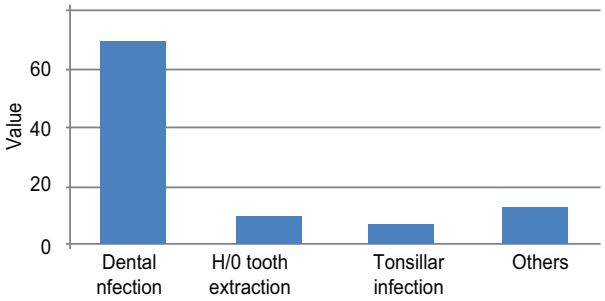

Fig. 2: *Distribution of the patients based on aetiological factors (n=100)*

Table- II : *Comorbidities among patients (n=100)*

Aetiological factors	Number of cases	Percentages
Isolated Diabetes mellitus	15	15
Diabetes mellitus with aetiological factors	10	10
No Diabetes Mellitus	75	75
Total	100	100

Table- III : *Distribution of the patients by clinical presentation (n=100)*

Symptoms	Number of cases	Percentages
Swelling in the floor of the mouth and neck	100	100
Pain and tenderness	100	100
Fever	100	100
Dysphagia	80	80
Dental infection	70	70
Trismus	15	15
Foul smell	24	24
Respiratory distress	3	3
Muffled voice	10	10

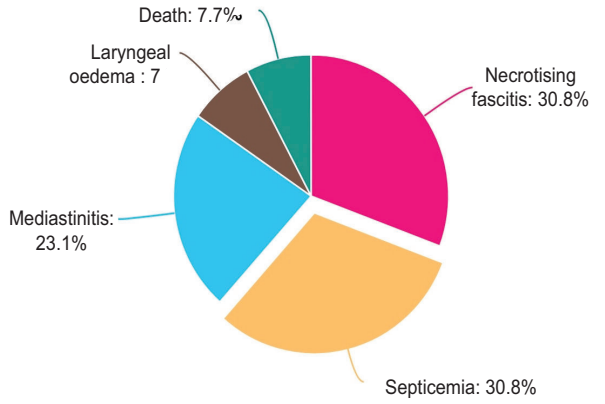

Fig. 3: *Complications observed among the patients (n=100)*

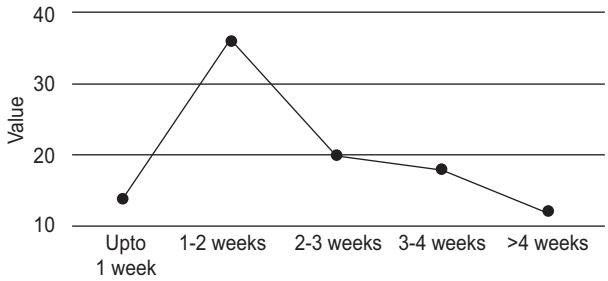

Fig. 4: *Duration of hospital stay among the patients (n=100)*

Table-IV : *Identification of causative microorganisms in the pus of Ludwig's (n=100)*

Strains	Number of cases	Percentages
Streptococcus viridans	40	40
Staphylococcus aureus	23	23
Coagulase negative staphylococcus	20	20
Escherichia coli	13	13
Pseudomonas	12	12
Proteus	11	11
Klebseilla	16	16
No organism	5	5

Table-V: *Identification of causative microorganisms in the pus of Ludwig's angina: Isolated and mixed microorganism (n=100)*

Strains	Name of organism	Number of cases	Percentages
Isolated	Streptococcus viridans	25	25
	Staphylococcus aureus	15	15
	Coagulase negative staphylococcus	10	10
	E coli	10	5
	Pseudomonas	5	3
	Proteus	3	5
	Klebsiella	2	2
Mixed		30	30
No organism		5	5
Total	100	100	

Table-VI: *Identification of isolated microorganism and their antibiotic sensitivity (n=95)*

	Antibiotics								
	Strep (25)	Staph (15)	CNS(10)	E. coli(5)	Pseud(3)	Prot(2)	Kleb(5)	Mixed(30)	Total(95)
Amikacin	9	5	5	4	2	2	4	11	42
Amoxiclav	18	12	8	2	1	1	2	6	50
Ampicillin	18	10	5	2	0	0	1	5	41
Azithromycin	20	8	2	2	1	2	5	0	40
Cefixime	15	8	7	3	1	1	4	11	50
Ceftazidime	17	10	9	4	2	2	4	10	58
Ceftriaxone	19	11	8	4	3	2	4	14	65
Ciprofloxacin	16	10	8	4	2	2	4	10	56
Cloxacillin	20	12	8	1	0	1	2	0	44
Cotrimoxazole	13	9	7	3	1	1	3	5	42
Doxycycline	8	7	5	4	2	2	4	8	40
Gentamicin	7	5	5	5	2	2	4	11	41
Levofloxacin	15	7	6	2	1	1	2	6	40
Penicillin G	18	8	6	2	0	0	1	6	41
Vancomycin	21	13	8	2	1	1	2	4	50

DISCUSSION

Ludwig's angina is an infection of the submandibular region, manifested by swelling of the floor of the mouth and elevation and posterior displacement of the tongue.[6] In the pre-antibiotic era, Ludwig's angina was frequently fatal, antibiotics and aggressive surgical intervention have frequently reduced mortality.[17] Regarding age distribution our study showed maximum cases were in the 35-45 years age group (42%) followed by 46-60 years age group (34%). In this study, males were affected more than female. The male and female ratio was 1.5:1. De Best et al. also found male female ratio in their study 2:1.[9] In this study, most of the cases used meswak to clean their teeth (35%) followed by ash (25%). This poor tooth cleansing habit might explain their susceptibility to dental infection and subsequent development of Ludwig's angina. Another study done by Fakir et al. they found 41% patients used meswak and 20% used ash to clean their teeth.[6]

In this study, most of the clinical presentation of the patients were dental infection (70%) followed by a history of tooth extraction (in 10% patients). Lemonick et al. showed in their study dental infection was the prime cause in Ludwig's angina (63%).[14]

In comorbidity association we found in this study 25 % cases presented with diabetes mellitus, whereas Sakarya EU et al studied diabetic mellitus as comorbidity in ludwig's angina of 21%.[10]

In all the cases 100 (100%) presenting symptoms were swelling in the floor of the mouth and neck, pain and tenderness and fever. More than one symptom was present in all patients. Mahmud et al. and Fakir et al. showed in their study 90% and 87% cases clinical presentation were more than two feature respectively.[6,16]

In this study, most of the complications of Ludwig's angina were necrotizing fasciitis (8%) followed by septicemia (7%) and mediastinitis (6%). Two patients were died due to mediastinitis. Christian et al. found septicemia, necrotizing fascitis, mediastinitis as in 10%, 7% and 5% of the patients respectively.[11]

In the opresent study, most of the patients were discharged from hospital after adequate treatment within 1-2 weeks (36%). In this study, Streptococcus viridans 40 (40%) was the most common organism followed by staphylococcus aureus (23%), Coagulase negative staphylococcus (20%), Klebseilla (16%), Escherichia coli (13%), Pseudomonas (12%), Proteus (11%) cases. Mixed infection was found (30%) of cases. Maran et al. identified Streptococcus viridans (39%) was the most common pathogen followed by

Staphylococcus epidermidis (22%), Staphylococcus aureus (22%) and Escherichia coli.[1]Fakir AY et al. identified 50 Sterptococcus (40.62 %), Staphylococcus (18.75 %), E. Coli (12.5 %) were most common pathogen.[6] Another study in Bangladesh by Mahmud et al. identified. Klebsiella and pseudomonas were the most common pathogen.[16] Yang et al. identified the predominant aerobes were viridans streptococci, Klebsiella pneumoniae, and Staphylococcus aureus. The predominant anaerobes included species of Prevotella, Peptostreptococcus, and Bacteroides.[19]

Initial antibiotic therapy is targeted at gram-positive organisms and oral cavity anaerobes. Empiric therapy with IV penicillin G, clindamycin or metronidazole is recommended before culture report is available.[8] Alternative choices include Cefoxitin sodium or combination drugs such as Ticarcillin-Clavulanate, Piperacillin, Tazobactam or Amoxicillin-Clavulanate or Ceftriaxone and Metronidazole.[12,13] In this study, after incision and drainage pus was sent for culture and sensitivity. Empirical therapy was started with parental Ceftriaxone, Flucloxacillin and Metronidazole. When culture and sensitivity reports were available antibiotics were changed accordingly. In this study, most effective antibiotic was Ceftriaxone (65%) followed by Cetazidime (58%). Winters et al. and Rao et al. found ceftriaxone 55% and 62% effective, while, ceftazidime 60% and 59%, and Metronidazole 51% and 48% effective antibiotic respectively.[15,18]

Since the facility to culture and sensitivity test for anaerobic bacteria is not available in ICDDR,B and Dhaka Medical College, Dhaka, the possibility of Ludwig's angina due to anaerobic microorganisms could not be evaluated.

CONCLUSION

In Ludwig's Angina, Streptococcus viridans is the commonest pathogen and Ceftriaxone is the most sensitive antibiotic. Though some factors may vary in different situations, from this study it can be concluded that early diagnosis and immediate treatment is the key for successful management of Ludwig's angina which need to be evaluated for better management.

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