UNIVERSITY of RWANDA
College of Medicine and Health Sciences

Department of ENT, Head and Neck Surgery

Presentation, management and outcome of deep neck space infections at University Teaching Hospital of Kigali

A dissertation submitted in partial fulfilment
of the requirements for the award of the Degree of
Master of Medicine in ENT, Head and Neck Surgery
of the University of Rwanda

By Dr MUNEZERO Eric

Supervisor: Dr NCOGOZA Isaie

Kigali, August 2019

DECLARATION

Researcher:

I hereby declare that the dissertation titled: *"Presentation, management and outcome of deep neck space infections at University Teaching Hospital of Kigali"* is my own work and has not been submitted to any university in Rwanda for the award of any degree.

Signed…… Date…….……

Dr Munezero Eric

Supervisor:

I hereby declare that this dissertation has been submitted with my approval as the supervisor.

Signed……Date……..

Dr NCOGOZA Isaie

DEDICATION

To my beloved wife MUKESHIMANA Justine,

To our children Munezero Louange, Mahoro Munezero Ange and Munezero Angelo,

This work is dedicated.

ACKNOWLEDGEMENTS

It is with gratitude that I am first and foremost thankful to my supervisor Dr NCOGOZA Isaie for his acceptance to lead this important work.

I would also like to thank all my teachers and mentors Dr Ncogoza Isaie, Dr Kaitesi Batamuliza Mukara, Dr Rajab Mugabo, Dr Tuyishimire Gratien, Dr Nyabyenda Victor , Dr David Shaye, Dr Rogers Nuss, who fed my enthusiasm of becoming an ENT Surgeon and taught me so many of the secrets of this specialty. I recognize and appreciate their efforts, their time and advice to make this work feasible.

A special reserve of gratitude is also owed to the German team for their invaluable devotion to support our training from its beginning to date.

Last but not least I wish to thank my colleague residents, dear nurses, friends and whoever has contributed to the completion of this work.

Dr Munezero Eric

ABSTRACT

Background: Deep neck space infection (DNSI) refers to the infection in the potential spaces and fascial planes of the neck with abscess formation or cellulitis. Delayed consultation of these infections can cause life-threatening complications with significant morbidity and mortality.

Objective: The current study aimed at evaluating the clinical presentation, predisposing factors, management and outcome of deep neck space infections at University Teaching Hospital of Kigali.

Materiel and methods: The current research was cross-sectional study, conducted at CHUK/ ENT department. It included patients, who consulted with confirmed DNSIs from September 2017 to February, 2019. The information about sociodemographic characteristics, history, clinical presentation, co-morbidities, diagnosis, treatment option, complications, and outcome was recorded using a pre-established data collection tool.

Results: 66 patients were included in the study. 53% of participants were males with a male-to-female ratio of 1.13. The age ranged from 0 to 75 years with the predominant age group of 0-15 years. The history of previous tooth extraction/ infection was found in (33%) and delayed consultation with average of 10.82±7.69 days. The complications represented 21% and were mainly necrotizing fasciitis (66.7%) and airway obstruction (50%). Factors significantly associated with complications included parotid (p=0.008) and para-pharyngeal (p=0.032) involvement and duration of symptoms (p=0.022). The mean hospital stay was 10.23 days and it was significantly associated with the presence of complications (p=0.022). Patients with complete resolution at discharge were 80% while the mortality rate was 5%.

Conclusions: DNSIs are common and have significant morbidity and mortality. Early recognition, diagnosis and management may prevent life-threatening complications and poor outcome.

Key words: Deep neck space infections, risk factors, clinical presentation, complications.

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

CHUK: University teaching hospital of Kigali

CMHS: College of medicine and health sciences

CT: Computed tomography

DNSIs: Deep neck space infections

DHs : District Hospitals

E-coli: Escherichia coli

ENT: Ear Nose and Throat

GP: General Practitioner

HCs: Health centers

HIV: Human immunodeficiency virus

I&D: Incision and drainage

ICU: Intensive care unit

IRB: Institutional review board

IV: Intravenous

MRI: Magnetic resonance imaging

PICU: Pediatric intensive care unit

SD: Standard deviation

URTIs: Upper respiratory tract infections

Table of Contents

Chapter I. GENERAL INTRODUCTION

I.1. Introduction

Deep neck space infection (DNSI) refers to the infection in the potential spaces and fascial planes of the neck resulting in cellulitis or abscess formation(1–4). These infections are potentially life-threatening disease and require immediate diagnosis and aggressive management (5,6).

Compared with infections elsewhere in the body, deep neck infections pose complicated problems, due to numerous portals of entry of infection, complex anatomy and proximity to vital strictures(7).

Globally, the incidence of deep neck space infections decreased significantly following antibiotic discovery , development of new diagnostic modalities (CT scan, MRI) and improvement in oral hygiene (8).

However, significant morbidity and mortality from DNSIs continue to be common in developing countries where late presentation and diagnosis is common (7,9). Associated comorbidities and risk factors such as Diabetes mellitus, immunosuppression (HIV, chemotherapy,..) and advanced age increase severity of deep neck space infections especially in adults (10).

In Rwanda there is no published data about presentation, management and risk factors for complications of DNSIs.

I.2. Literature review

1.2.1. Location of DNSIs

Fascial spaces of the neck are subdivided into two main layers: superficial and deep layers. Additionally, according to the relationship with hyoid bone, deep neck spaces are classified as follows: spaces localized above the hyoid bone level (per tonsillar, submandibular, para

pharyngeal, buccal, parotid, masticatory (masseteric, pterygoid and temporal); spaces that involve the entire circumference of the neck (retropharyngeal, danger, prevertebral and carotid); and the anterior or pre-tracheal visceral space, below the hyoid bone (11–13). The type of deep neck space infections depend on its location (retropharyngeal abscess, para pharyngeal abscess etc.)

In three studies conducted by Lee et al (8), Ridder et al(14) and Panduranga et al(7), the findings showed the same first three locations of deep neck space infections as para pharyngeal space(56.3% ,59% and 48%), submandibular(35.4%,18% and 31%) and retropharyngeal(20.9% , 6.4% and 24%) respectively.

1.2.2. Etiology

The most common primary sources of deep neck infections are the dentition, tonsils, salivary glands, foreign bodies and malignancy(15). Thiago et al(3) have found that tonsillitis was the predominant source of infection (31%), followed with odontogenic origin (23.7%). Other causes were URTIs, lymphadenitis, foreign body ingestion and tuberculosis (3). Panduranga et al(7) found that in the majority of cases the etiology couldn't be established.

1.2.3. Clinical presentation

Clinical manifestations of DNSIs depend on the spaces involved. Panduranga et al(7) have found that the symptoms presented by patients were odynophagia/dysphagia (66%), neck pain (59%), neck swelling (59%) and fever(48%). Signs were swelling in the neck (79%), oropharyngeal abnormalities (62%), trismus (21%) and dental abnormalities (21%). On the contrary Paul et al have found that fever was the most frequent symptom(75%), followed by sore throat(54%) and neck mass/swelling(42%)(16). Weiqiang et al(2) have found that the most common symptoms of DNSIs in children (<16 years) were fever (93.2%), trismus (61.4%) and neck pain (54,5%) while in adults they were neck pain(74.4%), odynophagia(66.3%) and trismus (61.6%)(2). The infants group is of particular importance as symptoms such as sore throat, odynophagia, voice changes

and other common subjective complaints that play a prominent role in DNSIs diagnosis are not easy to evaluate.

Working on patients with Ludwig's angina(submental+ submandibular+ submaxillary), V Ugboko et al (17) have found that the symptoms ranged from one day to three weeks, mean+SD; 6.4+4.9 days of the onset of illness .Delayed consultation predisposes to complications and high morbidity and mortality10, 16, 21).

1.2.4. Comorbidities and risk factors

The presence of comorbidities predisposes to patients with DNSIs to complications and higher morbidity and mortality rates (3,20–23).

Increased age and diabetes mellitus are two important risk factors of deep neck infection (20,24,25). In the study by Panduranga et al(7), they found that comorbidities were smoking, drug use, hypertension, diabetes mellitus, obesity, hypothyroidism, hepatitis C and HIV. Adults patients present with more comorbidities than children and it is easier to have multiple space involvement (2,3). This can justify why adults patients with DNSIs tend to develop complications and have high morbidity and mortality rates(26).

1.2.5. Diagnostic modalities

1.2.5. a. Imaging

The diagnosis of DNSIs is based on clinical assessment however the extent of the disease is assessed by imaging which delineates the anatomical extent of DNSIs (11,27).

Ultrasonography is useful as initial or alternative modality for evaluation of abscess collection or cellulitis. On top of that, ultrasonography may also assist in drainage by good localization of the abscess. However the exact localization of the infections focus is often difficult with this modality(13). Ultrasound is cheap, simple, quick and less likely to cause any harm to the patient.

Lateral neck radiography can reveal the soft tissue swelling in the prevertebral region, radio opaque foreign body, subcutaneous air fluid levels and erosion of vertebral bodies. Chest radiography can help in evaluating the mediastinum when complications are suspected (e.g. mediastinitis, aspiration pneumonia, etc.)(28). However this modality has been progressively replaced by CT scan even in developing countries.

Computed tomography (CT) scan with contrast is the modality of choice to diagnose DNSIs. In case of PPS, anterior visceral, danger and prevertebral space which extend into the mediastinum, it is important to include sections of the mediastinum. It helps in identifying the extent of the infections and differentiates cellulitis from abscess (26). CT scan with contrast represents 95% sensitive and 53% specific for distinguishing a drainable fluid collection. However, when CT scan findings are associated with clinical findings, sensitivity remains 95% but specificity raise to 80%(11)

The role of Magnetic Resonance Imaging (MRI) in the diagnoses of DNSIs is limited by long acquisition times, high cost, unavailability in many low resource settings, and the unstable general status of these patients (2,13,16,24,29).

Dental radiography is useful in identifying odontogenic sources of infections(26).

Needle aspiration is a valuable diagnostic tool especially when accessibility is easy (29)

1.2.5. b. Bacteriology

Microbiology reveals mixed bacterial flora including gram positive organisms (streptococcus viridans, staphylococcus aureus) and gram negative organisms (Escherichia coli, haemophilus influenza) (30). Anaerobic germs are responsible for fulminating necrotizing fasciitis, a severe complication of DNSIs(5)

Panduranga et al found that of the 29 patients, 26 had positive cultures. 20 of them revealed multiple organisms while only 6 were pure culture (7). Lee et al found that only 46.2% of patients had positive bacterial cultures. Klebsiella pneumoniae was the most common pathogen

with 13.7%, followed with Streptococcus viridans (12.3%) , streptococcus aureus(11%) and alpha hemolytic streptococcus(8.2%)(8).

Although culture-guided antimicrobial therapy was advocated, initial treatment almost always depend on empirical antibiotics (8). The evolutions of the disease and bacteriology findings determine the second option of antibiotic administration.

1.2.6. Management

The treatment consists mainly of intravenous antibiotics, surgical and airway maintenance (9). Antibiotics are given empirically immediately after admission. The antibiotic therapy must cover common pathogens including gram+, gram- and anaerobes. The most commonly used antibiotics are ampicillin, metronidazole and cephalosporin(6). In the study of Larawin et al, they found that 82% of patients with DNSIs were treated with surgery and antibiotics while 21% were treated with antibiotics alone(31).

Needle aspiration under guidance of ultrasound may be performed also to treat deep neck space abscess collection (32).

Additional options of treatment are used for management of complications. Kataria et al(1) and Brito TP et al (3) performed emergent tracheostomy in 5.26% and 7.8% respectively for urgent airway secure. Alise et al(22) have found that 6.10% of patients were admitted in ICU for better management

1.2.7. Complications and outcomes

1.2.7. a. Complications

Delays in diagnosis and treatment can result into life-threatening complications, namely, airway compromise, jugular vein thrombosis, necrotizing fasciitis, mediastinitis, pericarditis, pneumonia, emphysema, arterial erosion, sepsis, septic shock, intracranial complications or osteomyelitis(26,33,34). In their study of 76 patients, Kataria et al (1) found 4 patients with upper airway obstruction, three cases of septic shock, two with jugular vein thrombosis, two cases of skin necrosis and one had mediastinitis. In their series of 234 patients, Ridder et al (14)

found complications in 36 patients with 13 cases with mediastinitis, 6 patients each with sepsis and pneumonia and 5 cases of thrombosis of the internal jugular vein.

Factors related to complications are old age, delayed consultation, associated comorbidities, infections of odontogenic origin and inappropriate management(26).

1.2.8. b. Outcome

These complications result into high morbidity such as prolonged hospital stay and disability (e.g. limited mouth opening)(15). Severe complications are associated with high mortality rate(31). In the study done in Nigeria, Otasowie et al(35) have found the mortality rate of 4.6%. The outcome was satisfactory with complete resolution in 48.8% of cases while resolution with some morbidity (limitation of opening the mouth, orocutaneous fistula and progression to necrotizing fasciitis) accounted for 46.3% of cases. Additionally, authors found that the outcome was significantly associated with the presence of underlying systemic conditions, duration of symptoms at presentation and age.

Lee et al(8) found that hospital stay ranged from 3 to 70 days with average of 14.1 days.

1.3. PROBLEM STATEMENT, STUDY JUSTIFICATION AND OBJECTIVES.

1.3. 1. Problem statement

Deep neck infections are characterized by their rapid progression and life-threatening complications. The diagnosis and treatment have been challenging always due to their deep location and complex anatomy of this region. Worldwide, the incidence of DNSIs have been decreasing with wide spread of antibiotics and improvement in mouth care and hygiene. However this medical condition still continues to be a health problem in developing countries where it causes more morbidity and mortality (7,25,36).

Delayed consultation or referral result into life-threatening complications and disabilities(18–20). Associated comorbidities such as diabetes mellitus, previous tooth extraction or infection,

immunosuppression and cardiovascular diseases are risk factors for complications of DNSIs among adult patients(26).

Factors determining the hospital stay were studied and they vary from one center to another though some were found to be common. Osunde et al(35) found that outcome of DNSIs was significantly Associated with presence of underlying systemic condition, period of symptoms at presentation and age.

1.3. 2. Study justification

The delay in consultation (or referral) can be the cause of life threatening complications with significant mortality and morbidity that are very often observed in patients with DNSIs. These delays may be due to clinicians who are not familiar with this medical condition. Few studies on DNSIs are found in sub-Saharan Africa yet it is in this region of the world where oral hygiene and other social economic factors contributing to the development of DNSIs are identified.

No research done on DNSIs in Rwanda in general and no data published from the 4 referral hospitals of the country in particular. CHUK/ENT is one of the main referral hospitals which receive complicated URTI and post dental infection from different district hospitals and private clinics with diagnostic tools and expertise in the management of DNSIs.

This study aimed to evaluate the clinical presentation, predisposing factors, management and outcome of DNSIs at CHUK .It will help to bring awareness to the community and health care providers on this condition. The findings from this research would serve also as a baseline for other studies in Rwanda, Africa or elsewhere in the world.

1.3.3. Objectives

1.3.3.1. General objective

To evaluate the clinical presentation and management of deep neck space infections at University Teaching Hospital of Kigali.

1.3.3.2. Specific objectives

1. To identify sociodemographic distribution of DNSIs at CHUK
2. To describe the clinical presentation of DNSIs at CHUK
3. To identify the most common predisposing factors of DNSIs at CHUK
4. To evaluate the management of DNSIs at CHUK
5. To evaluate the outcome of DNSIs at CHUK

Chapter II. METHODOLOGY

2.1. Study design, place and duration of the study

The current research was cross-sectional study. It enrolled all patients who consulted the department of ENT / CHUK with confirmed DNSIs during 18 months, from September 2017 to February 2019.

2.2. Sample size

DNSI is a rare disease and there are no global estimates on its prevalence. According to data found in hospitalization of ENT department at CHUK From January 2015 to December 2016, 62 patients consulted and were admitted for deep neck abscess in a total population of 1438 patients giving a prevalence of 4,31%. Sample size calculation was based on these data and it was calculated using Fisher's formula:

$$n = \frac{\alpha^2 \cdot P \cdot Q}{E^2} = \frac{(1.96)^2 \cdot 0.0431 \cdot (1 - 0.0431)}{(0.05)^2} = \mathbf{63\ patients}$$

Where N: Sample's width

p: Estimated prevalence (estimated at 4.31%)

q:1-p

i: Precision of estimate set at 5%

∈:α-related error risk (∈ is equal to 1.96)

A total number of 69 patients have been registered in ENT department during the period of study as Deep neck space infections. 3 patients of them have been excluded. One patient had refused

the proposed treatment and decided to get treatment elsewhere. Two patients had incomplete collected data and have been excluded. Our sample was made of 66 patients.

2.3. Inclusion criteria.

The current research included all patients with confirmed DNSIs who consulted ENT/CHUK from September 2017 to February 2019. ENT department could be consulted from other department (Accident and Emergency or Stomatology Departments) or from home. As usual, the resident on call received, evaluated and made the diagnosis in collaboration with the ENT Surgeon on call. Once the diagnosis of Deep Neck Space Infections was made, the patient could be included in our study after consent. Patients of all ages were included.

2.4. Exclusion criteria

We excluded from this study all patients who could not consent and those who refused treatment. Patients who had undergone elective surgeries complicated with wound infection were also excluded from the study.

2.5. Data collection

Data have been recorded on a data collection tool that had been pre-established and filled throughout the course of admission of the patient by the researcher. Whenever a patient who fulfilled the inclusion criteria came, the investigator has been informed and started data collection. The diagnosis was by clinical, radiological and surgical findings. Immediate management consisted on empirical antibiotics administrations and schedule for surgical incision and drainage was arranged if abscess was confirmed.

For outpatients, initial data collection has been done after treatment. The patient has been seen one week after initial treatment for follow up. The following characteristics have been recorded:

sociodemographic characteristics including age, sex, social economic category, antibiotics and admission history, comorbidities and risk factors (recent history of dental manipulations, diabetes, HTN,..), symptoms and signs(duration of symptoms, Fever ,neck swelling, neck pain, trismus….), site(submandibular, Para pharyngeal, parotid, buccal, masticator, retropharyngeal, prevertebral, pretracheal), laboratory investigations (pus culture), diagnostic modalities(CT scan, ultrasound, needle aspiration, x ray), treatment option(antibiotics with or without incision and drainage , treatment of complications, complications(Necrotizing fasciitis, airway obstruction, septic shock), hospital stay duration and outcome(good improvement, improvement with disability and death. There was no additional cost to patients who were enrolled in our study. In Rwanda we have 4 social economic categories. The higher the category, the better is social economic status. Category 1 and 2 are considered as low social economic status while category 3 and 4 are considered as high social economic status. Categories are defined as follows:

Category 1: They don't have a house and can hardly afford basic needs

Category 2: They have a house or able to rent one but don't have fulltime jobs

Category 3: They have their jobs or farmers produce a surplus which can e sold. Those who have Small or medium enterprises are found here.

Category 4: Those with large scale business, working with international organizations and industries.

The patient was discharged when he was doing well and can continue management at nearest health facility without further complications are expected.

2.6. Data management

Data have been recorded using Epidata 3.1 software. The data processing and statistical analyses have been performed using SPSS 16.0. Comparisons of categorical variables have been performed using the chi-square test. The limit of significance have been established at $p = 0.05$. Microsoft Word and Power Point have been useful in drafting, final writing and presentation of the study.

2.7. Ethical consideration

This study has been carried out with approval by the Department of ENT and the Research Ethics Committee of CHUK and CMHS Institutional Review Board (IRB). Patients were enrolled into the study after giving their written informed consent. A parent or guardian was requested to consent for minors (<18 years). The children above 7years had to give also their assent while parents were giving consent. The data collection tool was in English and Kinyarwanda. For illiterate patients the data collector had to read for him/her before consenting. The consent was given by signature or fingerprint for illiterate patients. All questions from the patients or next of kins were to be answered. All data collected was treated with confidentiality. No cost was added to the bill of the patient in the purpose of implementing the current project.

2.8. Study limitations.

There are some limitations to our study including:

There was no culture of anaerobic germs in laboratory of CHUK during the period of study due to lack of appropriate materials. This could results into false negative results of bacteriology.

Our sample was made of patients coming mainly from North and Ouest. A great number of patients of South are sent to University Teaching Hospital of Butare while those from Est are sent to Rwanda Military Hospital according to referral system. This would make difficult to generalize our findings to the whole population of Rwanda.

Chapter III. PRESENTATION OF RESULTS/FINDINGS

A total of 66 patients with deep neck space infections consulted University Teaching Hospital of Kigali over the period of study. 64(97%) patients were found to have abscess collection while 2(3%) patient was diagnosed of cellulitis.

3. 1. Social demographic characteristics

Table 1: Gender, age and social economic distribution

Variables		N	%
Gender	**Male-to-female ratio: 1.13**		
Male		35	53
Female		31	47
Economic status			
Class One		2	3
Class Two		40	60.6
Class Three		24	36.4
Age range (in years)			
0→10		22	33.30%
11→20		9	13.60%
21→30		11	16.70%
31→40		8	12.10%
41→50		4	6.10%
>50		12	18.20%

Table 1 shows the frequency of gender, economic status and age ranges. Our sample accounted for 35(53%) males and 31(47%) females with a male-to-female ratio of 1.13.

The predominant age group was the 0-10 years accounting 33.3%, followed by the group of more than 50 years (18.2%). Social economy category II was predominant with 40 (60.6%) cases.

3.2. Clinical presentation

Table 2: Symptoms, signs and location of DNSIs

Variable		N	%
Symptoms			
Pain		64	97.00%
Swelling		63	95.50%
Fever		48	72.70%
Odynophagia		29	43.90%
Duration of symptoms:	**11(±8, 2-45) days**		
Signs			
Tenderness		64	97.00%
Fluctuation		61	92.40%
Trismus		26	39.40%
Fistula with pus discharge		21	31.80%
Location			
Submandibular		33	50%
Ludwig's Angina		9	13.63%
Peritonsillar		9	13.63%
Sub mental		8	12.13%
Para pharyngeal		6	9.09%
Parotid		5	7.57%

Above table represents the distribution of symptoms and signs of DNSIs distribution. The majority of patients presented with severe pain in 97%, neck swelling in 95.5% and fever in 72.7%. The mean period of time since the onset of symptoms was 10.82 ±7.69 days with a minimum of 2 days and maximum of 45 days. Physical exam showed tenderness in 64(97.0%) cases, fluctuation in 61(92.4%) cases, oropharyngeal swelling in 30(45.5%), trismus in 26(39.4%) cases and fistula with pus discharge in 21(31.8%) cases. The submandibular space accounted for 50% of the cases followed by peritonsillar and Ludwig's angina with 13.63% for each.

3.3. Predisposing factors

Table3. Predisposing factors of DNSIs

Variable	N	%
Tooth extraction/ infection	14	21.21%
Tonsillitis/Pharyngitis	9	13.63%
Diabetes	4	6.06%
HIV	3	4.54%
Congenital cysts	2	3.03%
Tuberculosis	2	3.03%

The above table shows predisposing factors of DNIs. Tooth extraction/infection was the most prevalent with 14(21.21%) cases followed by tonsillitis or pharyngitis in 9(13.63%). Diabetes was found in 4 (6.06%).

3.4. Management of DNSIs

3.4.1. Diagnostic modalities

Table4. Diagnostic modalities

Variable	N	%
Diagnostic modalities		
Needle aspiration	50	75.80%
Ultrasound	11	16.70%
CT scan	8	12.10%
X ray	2	3.00%
Bacteriology		
Pus sample collection	27	40.90%
Positive culture	6	22.20%
Staph. aureus	5	18.51%
E-coli	1	3.70%

Table 4 shows the distribution of diagnostic modalities. It shows that in majority of cases (70.4%), the diagnosis was made by needle aspiration (proof puncture) followed by neck ultrasound (15.5%) and CT scan in11.3%. Positive pus culture was found in 6 cases (22.2%) and staphylococcus aureus isolated in 18.5%.

3.4.2. Treatment of DNSIs

Table5. Treatment

Treatment	N	%
Immediate treatment		
Incision and drainage with antibiotics	60	90.90%
Antibiotics only	6	9.10%
Treatment of complications		
Debridement	8	12.12%
ICU/PCU management	6	9.10%
Tracheostomy	5	7.57%
Skin graft	3	4.50%
Pedicle flap	1	1.50%

As shown by above table 5, the majority of our patients were managed by incision and drainage with antibiotics with 60 (75.9%) cases and only 6(7.6%) were treated with antibiotics only. Treatment of complications included debridement in 8 (12.12%) cases, tracheostomy in 5(7.57%) and ICU/PCU management in 6(9.10%) cases.

3.5. Complications, hospital stay and outcome of DNSIs

Table6. Complications, hospital stay and outcome

Variables	N	%
Complications	14	21.20%
Septic shock	2	16.70%
Necrotizing fasciitis	8	66.70%
Upper airway obstruction	6	50.00%
Hospital stay Mean: 10.23 (SD ±11,64; range0-60) days		
Short term (<7days)	34	51%
Long term (>7days)	30	45.50%
Outcome		
Complete resolution	53	80.30%
Resolution with disability	10	15.15%
Mortality rate	3	5%

As it is shown in table 6 above, 14 (21.2%) had complications of deep neck space infections and Necrotizing fasciitis represented the majority with 8(66.70%) cases, followed with upper airway obstruction with 6(50.00%) and septic shock with 2(16.7%).

The mean hospital stay duration was 10.23 days (SD±11.64, range 0-60) and prolonged hospital stay (>7days) was observed in 30(45.5%) cases. The majority of the patients were doing well at discharge with 53(80.30%) cases, while 10(15.5%) cases had disability. The mortality occurred in 3(5%) cases.

3.6. Factors associated with complications of DNSIs.

Table7. Factors associated with complications of DNSIs.

	Complications			
	Yes	No (%)	Chi-Square	P value
Duration of symptoms				
<7 days	3 (9.7%)	28 (90.3%)	5.234	**0.022**
≥7 days	11 (33.3%)	22 (66.7%)		
Age				
<40 years	7 (14.6%)	41 (85.4%)	5.973	**0.015**
≥40 years	7 (43.8%)	9 (56.3%)		
Diabetes				
Yes	2(5%)	2(5%)	1.108	0.293
No	8(22%)	23(36%)		
HIV				
Yes	2(5%)	1(3%)	2.467	0.116
No	8(22%)	25(69%)		
Fistulized wound				
Yes	6(9%)	13(20%)	1.489	0.222
No	8(12%)	37(58%)		
Parotid				
Yes	3(5%)	1(2%)	7.046	**0.008**
No	11(17%)	49(76%)		
Para pharyngeal				
Yes	3(5%)	2(3%)	4.613	**0.032**
No	11(17%)	48(75%)		
staphylococcus				
Yes	0	4(15%)	1.342	0.247
No	6(22%)	17(63%)		
Tooth extraction/Infection				
Yes	5(14%)	9(25%)	0.719	0.396
No	5(14%)	17(47%)		

Table 7 shows the relationship complications of DNSIs with different clinical characteristics. Delayed consultation (>7 days) is significantly associated to the presence of complications (P=0.022). Advanced age (>40 years) is a significant risk factor of complications of DNSIs (P=0.015). Abscess in parotid and Para pharyngeal spaces are significantly associated with complications with respectively p=0.008 and p=0.032 P.

3.7. Factors associated with hospital stay.

Table8. Factors associated with hospital stay

	Hospital stay			
	<7 days	≥7 days	Chi-Square	P value
Duration of symptoms				
<7 days	21 (65.6%)	11 (34.4%)	4.158	**0.007**
≥7 days	11 (32.4%)	23 (67.6%)		
Age				
<40 years	29 (60.4%)	19 (39.6%)	4.099	**0.043**
≥40 years	5 (31.2%)	11 (68.7%)		
Complications				
Yes	3 (21.4%)	11 (78.6%)	9.461	**0.022**
No	28 (56.0%)	22 (44.0%)		
Comorbidities				
Yes	16 (44.4%)	20 (55.6%)	1.151	0.472
No	16 (53.3%)	14 (46.7%)		

Table8 shows factors affecting hospital stay. Duration of symptoms, age and the presence of complications are significantly associated with prolonged hospital stay.

Chapter IV. DISCUSSION OF FINDINGS

This study was conducted at University Teaching Hospital of Kigali which is one of the two public referral hospitals in Kigali where diagnosis and management of DNSIs is performed.

Our research included 66 patients with DNSIs. The majority of our participants had deep neck abscess (97%) while cellulitis represented 3%. There were 35(53%) males and 31(47%) female with male to female ratio of 1.13. This is consistent with what have been found by Kataria et al and Joon-Kyo Lee et al.(1)(26) who found respectively male to female ratio of 1.23 and 1.29.

Patients' ages ranged from 0 to 75 years with mean of 25.17±21.35 years. DNSIs were predominant in young age group of 1-10 years, followed with >50 years representing respectively 33.3% and 18.20%. This is consistent with what have been found by Yang et al(2) who found that the predominant age group was that from birth to 10 years. In India, Thimmapa, TD, et al(37) have shown that the majority of patients with deep neck infections were coming from low social economic group. Our study has shown that category II of social economic status, which is a low social economic status, was the most prevalent with 60.6%.

The average duration since the onset of symptoms was 10.82 days (SD±7.69, range 2-45 days) This finding is consistent with what has been published in Brazil(8 days) (3) and in India(15 days) (41). The delay for consultation could be due to lack of awareness by the community or improper diagnosis by health professionals at lower levels.

The symptoms at arrival were by descending order neck pain (97%), swelling (95.5%) and fever (72.7%). This is consistent with what have been found by Joon-kyo Lee, et al (26)who found respectively neck swelling (74.7%), neck pain (41.1%) and fever (14.6%).

Physical exam of our patients have shown that tenderness was the first finding with 97% followed with fluctuation (92.40%). These findings are similar to what have been found by Agricio, et al(11) who found that the main physical exam findings were Neck swelling(84.6%) and tenderness(76.9). We noticed fistula with pus discharge in 31.8%. Though not often published among DNSIs findings, fistulized neck abscess with pus discharge is one of the

features associated with delayed consultation. In India, Khole P, et al (39) found that pus discharge in oral cavity was 44.23% at arrival.

The submandibular space was far the most common site involved in our series with 65.5% followed by peritonsilar space with 15%. This is consistent with what have been found in Nigeria where submandibular location was the most prevalent with 43.9%(35).

Tooth extractions/infections was the most predisposing factor associated with DNSIs with 14(21.21%). Many authors identified odontogenic origin as the first cause. Panduranga. M, et al(7) , Joon-Kyo Lee, et al(26), Alise et al(22) and Otasowie (35) found that odontogenic causes were the most predominant with 28%, 12%, 70.6%, 92.7% respectively. This is consistent also with the Rwanda national strategic plan July 2014-June 2019 on non-communicable diseases (40)which stipulates that the burden of oral health is represented by dental caries and gum or periodontal diseases. It is highlighted in the same document that 60% of outpatients at CHUK have dental caries.

Diabetes used to be published in different literature as the first comorbidity for DNSIs. Kataria et al(1) have found 10.52% while Otasowie et al (35) have found 17.1%. In our series we have found that diabetes represented 6.06 %. This could be due to high proportion of young population in our sample. The predominance of young people in Rwanda compared to industrial countries could be the reason.

CT scan is the modality of choice in the diagnosis of deep neck space infections. It aids in identification whether there is pus collection or cellulitis, localization and extension of the infection and complication identification. Ct scan with contrast was the first modality of diagnosis in Iran(90.78%)(1) and in Brazil(71.2%) (3). Contrary to what have been published in literature, we have found in our series that needle aspiration was the predominant modality of diagnosis in 70.4%, followed with ultrasonography in 15%. CT scan was used in only 11.3%. Needle aspiration is rarely mentioned in the literature as a diagnostic modality of DNSIs. It is recalled as a modality of surgical treatment under ultrasound guidance (2). When it is used as diagnostic modality, it can underestimate the extent of the infection or predispose to injury of neurovascular strictures. However this can help in diagnosis of DNSIs. Fagan et al (29) has

mentioned that needle aspiration can be used for both diagnosis and treatment of DNSIs. It can hasten the diagnosis in a context with limited resources since it can be performed at the time of examination and does not rely on patient payment. Additionally the predominance of submandibular location, which is accessible space, can explain our relying on clinical diagnosis by needle aspiration for management of DNSIs.

Research has shown that DNIs results from polymicrobiological pathogens being aerobic and anaerobic. Sample collection for culture has been done for 27(40.9%). Positive culture has been found in 6 (22.2%) cases. Joon-Kyo Lee at al (26) found positive culture in 46.2% . A low proportion of positive cultures in our series may be due to previous antibiotics and failure to culture anaerobic germs in our institutions. Among 6 positive cases, 5 were staphylococcus aureus and 1 case of e-coli. This is consistent with what has been found by Pradip Khokle with his coworkers(39) who found out that staphylococcus isolation was the most predominant with 25%.

The main modality of immediate treatment was incision and drainage with antibiotics in 90.9% of DNSIs cases. This is consistent with the findings of Alise et al(22) of 96.3%. Antibiotic administration was presumptive, covering both aerobic and anaerobic germs. The large number of our patients received cephalosporin in 74.0% and metronidazole in 82.0%. Ampicillin was administered in 18%. This is contrary to what have been found in Iran (15) where authors found out that penicillin was the most preponderant by 67.7%, Metronidazole in 65.2% and clindamycin in 37.7%. The initial empiric antibiotic administration is given at accident and emergency and continued at arrival in ENT. Moreover, as we have a large number of patients who use antibiotics prior to ENT consult, the choice of antibiotics may consider more broad-spectrum antibiotics.

Special management was needed in patients with complications. Airway obstruction was treated with tracheostomy in 5(7.57%). This finding is in line with Kataria et al(1) and Brito TP et al(3) who reported tracheostomy in 5.26% and 7.8% of patients respectively. Admission in ICU has been done in 6(9.1%). Alise et al (22) and Marina et al (9) have found 6.10% and 2% respectively of patients who were admitted in ICU. Khokle P et al(39)have found that the reason to be admitted in ICU were sepsis, airway obstruction, mediastinitis and pneumonitis. Among

patients who have been admitted in ICU post incision and drainage, four had airway obstruction while 2 had septic shock. Debridement was needed in patients with necrotizing fasciitis (12.12%).

21.2% of our series had complications and the majority of them were necrotizing fasciitis (66.70%), followed by airway obstruction (50.00%) and septic shock (16.70%). In Latvia, Alise et al (22) found 11.4% of complications and airway obstruction was the most found with 27.9%. The duration of symptoms before consult and the age strongly influence the likelihood of complications (P value=0.02 and 0.015 respectively). Several authors have shown that multiple spaces involvement of DNSIs was associated with complications. Few studies had reported association of one single location and complication. The current study found out that parotid space and para pharyngeal space were significantly associated with complications (p=0.008 and p=0.032). The proximity of these spaces with vital strictures and propensity of rapid spreading can justify the severity of infections in these spaces. Contrary to what have been reported in other studies, diabetes was not found to be associated with complications. The predominance of young individuals without comorbidities like diabetes could be the particularity of our study. Moreover, gender, fistulised abscess, HIV and history of recent teeth extraction were not associated with occurrence of complications of DNSs.

The mean hospital stay was 10.23 days (SD±11.64, range 0-60). This is similar to what was found in the literature. Joon-kyo Lee(26) et al, Panduranga(7), and Alexander et al have found respectively14.1 days, 18 days, 13.3 days respectively. The duration of symptoms before consultation and presentation of complications were significantly associated with hospital stay (P value=0.04 and 0.02 respectively). However, the presence of comorbidities was not significantly associated to hospital stay in our series. Otasowie et al (35) have found that time of presentation was significantly associated with duration of hospital stay (P value=0.027) which is consistent with our findings. The mortality rate was noted in 3(5%) patients. These findings are consistent with those of Otasowie et al (35)who found the mortality rate of 4.9%.

Chapter V. CONCLUSIONS AND RECOMMENDATIONS.

5.1. Conclusions

This study aimed at evaluating the profile of DNSIs by determining its clinical presentation, predisposing factors, management and outcome at University Teaching Hospital of Kigali.

The researcher evaluated mainly comorbidity and etiology, symptoms and signs, site, diagnostic modality, treatment options, complications, hospital stay duration and outcome of DNSIs.

At the end of this study the following conclusions were developed:

- Patients of all ages are affected by DNSIs with male-to-female ratio of 1.13.
- The majority of patients with DNSIs were in social economic category 2 (60.6%).
- The main symptoms were neck pain (97%), neck swelling (95.5%) and fever (72.7%). The average duration of symptoms was 10 days.
- The main predisposing factors accounted were tooth extraction/infection (21.21%) and tonsillitis/pharyngitis (13.63%).
- Needle aspiration was the first diagnostic modality with 75.80%. Among 27 cases from whom pus sample collection have been done; only 6(22.2%) cases had positive culture.
- The main primary treatment was incision and drainage with antibiotic administration (90.9%).
- Of 14 patients who had complications of DNSIs, Necrotizing fasciitis was the most common with 66.7% followed with upper airway obstruction with 50%.
- The majority of patients have been discharged with complete resolution (80.3%) while mortality rate represented 5% with an average hospital stay of 10 days.
- The presence of complications was significantly associated with duration of symptoms (0.022), age (0.015), parotid location (0.008) and para pharyngeal location (0.032).
- Factors associated significantly with hospital stay were duration of symptoms (0.022) and presence of complications (0.022).

5.2. Recommendations

Relationship between complications of DNSIs and late clinical presentation and diagnosis requires actions at different health system levels to minimize poor outcome.

The following recommendations are formulated:

To Health professionals at Health centers and DH

- Transfer as soon as the patient is received with recent neck swelling, pain and tenderness for urgent investigations and management of DNSIs to the nearest ENT department.
- Increase the awareness on comorbidities of DNSIs among health professionals and community health workers especially on its comorbidities (tooth extraction/infection) and clinical presentations so that transfer can be made early once DNSIs is suspected.

To ENT department

- Share the knowledge of DNSIs with different health professionals (GPs, nurses, pediatricians) at HCs, DHs and private clinics through meetings, conferences and counter-referrals.
- Should increase the CT scan utilization as diagnostic modality of DNSIs for better determining the location and extent of the diseases especially when critical areas are suspected like para pharyngeal and parotid spaces

To dentists and dental surgeons

- Prevention and adequate management of dental infections.
- Early transfer to ENT department for management whenever odontogenic DNSIs is suspected.

To laboratory of CHUK

- Expand diagnostic capacity including gram-negative germs culture.

To researchers

- Conduct Multicenter study on DNSIs in Rwanda for better generalizing the finding

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APPENDIXES

Appendix1. Data collection tool

PRESENTATION, MANAGEMENT AND OUTCOME OF DEEP NECK SPACE INFECTIONS AT UNIVERSITY TEACHING HOSPITAL OF KIGALI

01	PATIENT'S ID	**……..**
02	AGE	……months/years
03	SEX	Male ☐ Female ☐
04	Social economic category	I ☐ II ☐ III ☐ IV ☐
05	Province	EST ☐ OUEST ☐ SOUTH ☐ NORTH ☐ KIGALI ☐
06	Onset duration	……..days
07	Previous admission	YES☐ NO☐
08	If yes which health facility	District Hospital ☐ Private clinic ☐ HC ☐ Others(specify)……..
09	Previous antibiotics(>24HRS)	YES ☐ NO☐
10	Comorbidities	DM ☐ HIV ☐ Smoking (duration) ☐ Dental disease ☐ Neck/Maxillofacial trauma ☐ Others (specify)……..

11	Symptoms	Fever ☐ Dysphagia/odynophagia ☐ Pain ☐ Swelling ☐ Aedema ☐ Toothache ☐ Respiratory difficulty ☐ Others(specify)……..
12	Signs	Fever(>37.5) ☐ Oropharyngeal abnomality ☐ Fluctuation ☐ Dental abnomality ☐ Tenderness ☐ Respiratory distress(Sa O2<90%) ☐ Trismus ☐ Others(Specify)……
13	Causes	Odontogenic ☐ Suppurative lymphadenitis ☐ Trauma ☐ Foreign body ☐ TBC ☐ Cancer ☐ Tonsillitis ☐ Parotitis ☐ URTI ☐ Others(Specify)…….
14	Site of DNIs	Submandibular ☐ Retropharyngeal ☐ Parotid ☐ Para pharyngeal ☐ Masticator ☐ Prevertebral ☐ Others (specify)……
15	Pathogens	Staphylococcus aureus ☐ Streptococcus viridans ☐ K. pneumonia ☐ Beta h. streptococcus ☐ Anaerobs ☐ AAFBs ☐ No growth ☐ Others (Specify)…….
16	Diagnostic modalities	Proof puncture ☐

		Ultrasound ☐ CT-Scan ☐ X-ray ☐ Others (Specify)……..
17	Treatment	I& D with antibiotics ☐ Antibiotics ☐ Tracheostomy ☐ ICU/HDU ☐ Others (Specify) ……
18	Type of antibiotics	Ampicillin ☐ Cephalosporin ☐ Metronidazole ☐ Gentamycin ☐ Others (Specify)……
19	Location after I &D	Ward ☐ ICU/ PCU ☐ HDU ☐ Home ☐
20	Complications	Septic shock ☐ Necrotizing fascitis ☐ Mediastinitis ☐ Upper airway obstruction ☐ Others(Specify)……
21	Complications management	Tracheostomy ☐ Debridement ☐ Thoracotomy ☐ Others (Specify)……
22	Hospital stay duration	……..days
23	Outcome	Discharge with complete resolution ☐ Discharge with disability ☐ Death ☐ Other(Specify)……

Appendix2. Consent form

Consent form in English

Title of the study: "PRESENTATION, MANAGEMENT AND OUTCOME OF DEEP NECK SPACE INFECTIONS AT UNIVERSITY TEACHING HOSPITAL OF KIGALI".

Explanations to the participants

I am Dr Eric Munezero, Registrant in Ear Nose Diseases- Head and Neck Surgery, University of Rwanda, College of Medicine and Health sciences. I am conducting a study at University Teaching Hospital of Kigali/ ENT department for the degree of Master of Medicine in ENT-Head and Neck Surgery. The aim study is to evaluate the clinical presentation, management and outcome of Deep Neck Space Infections.

Despites international reports showing that this disease decreased significantly since the era of antibiotics, it is very common to see the patients with this condition and yet there is no data in our country defining its presentations and management. If not treated early, this disease is accompanied with very severe complications associated with high morbidity and mortality. The data from this project will help to raise awareness among health personal, public as well as to compare with international findings.

During the study, before enrollment, a consent form will be signed by the patient or guardian of the patients under 18 years or patients coma status. Children between 7 and 18years will give their ascent together with consent from their next of Kin. No direct benefit and no risks for the participant. There will be no additional cost for the patient.

All information obtained from this study will be handled in a confidential manner and be used only for research purposes.

If you have question about the study, please feel free to contact:

Eric Munezero on:

*Cell phone: 0788523500/0727523500

*E-mail: munezestudy@gmail.com

You can contact also CMHS Institutional Review Board for any additional comments or participants right violation on secretariat contacts:

*Cell phone: 0788563311

*Email:sundayfrax@gmail.com

CONSENT FORM

I,……confirm that the purpose of this study and my role have been well explained to me by Dr…….....I agree to the conditions explained and give consent that Mr/Miss…….....can be included in the study.

Patient's Signature…… Date……/……./…..…….

Next of Kin Names……..

Relationship…….Signature……

Date……/……/……...

Investigator's names/Representative……

Researcher's signature……

Date…../……. /……..

Consent form in Kinyarwanda

IBISOBANURO NO KWEMERA UBUSHAKASHATSI

Inyito y'ubushakashatsi

Inyito y'ubushakashatsi

"Ibiranga 'infection' z'imbere mw'ijosi, uko zimenyekana nuko zivurwa kubitaro bikuru bya Kigali (CHUK)".

Ibisobanuro

Jyewe MUNEZERO Eric, ukora ubushakashatsi, ndi umuganga wiga muri Kaminuza y'u Rwanda, ishami ry'ubuvuzi, aho niga ibijyanye no Kuvura indwara z' Amatwi, Amazuru, Umuhogo, umutwe n'ijosi.

Muri ubu bushakashatsi tuzareba abarwayi bagana ibitaro bikuru bya Kigali CHUK, servisi ivura amatwi, amazuru, umuhogo, umutwe n'ijosi bafite indwara za' infection' y'imbere mu ijosi, tugamije kureba uko igaragara, uko isuzumwa , uko ivurwa n'ubusembwa ishobora gusiga.

Nubwo imibare iva m'ubushakashatsi mpuzamahanga yerekana ko iyi ndwara yagabanutse cyane nyuma yaho imiti yo mubwoko bwa 'antibiotics'ivumburiwe, dukomeje kwakira abarwayi bayifite, rimwe na rimwe bakatugeraho barembye kubera gutinda kwivuza. Iyo itavuwe hakiri kare, iyi ndwara igira ingaruka nyinshi zirimo n'urupfu. Ubu bushakashatsi buzatuma abavuzi barushaho gusobanukirwa iyi ndwara n'uko murwanda ihagaze ugereranyije n'imibare mpuzamahanga.

Mbere y'uko umurwayi ashyirwa m'ubushakashatsi, agomba kubanza gusobanurirwa (cyangwa umurwaza k'umwana(munsi y'imyaka 18) cg indembe) ibijyanye n' ubu bushakashatsi , hanyuma agasinyira ko yemeye ko(umurwayi we) akorerwaho ubushakashatsi. Utazi gusoma azatera igikumwe nyuma yo gusomerwa ibijyanye n'ubu bushakashatsi. Abana bari hagati y'imyaka 7 na 18 bagomba nabo kwiyemerera ibijyanye n'ubu bushakashatsi hamwe n'abarwaza babo.

Mu kujya muri ubu bushakashatsi nta kiguzi cyangwa inyungu yihariye umuntu ku giti cye akuramo; ariko ibizavamo bishobora kugirira akamaro uwabugiyemo n' umuryango muburyo buziguye, abaganga ndetse n' igihugu muri rusange. Amakuru yose avuye ku murwayi azajya abikanwa ibanga kandi akoreshwe kumpamvu z'ubushakashatsi gusa.

Mugutangaza ibyavuye mubushakashatsi nta na hamwe hazagaragazwa amazina y' ababukoreweho.

Inyigo y' ububushakashatsi izasuzumwa kandi inemezwe na Komisiyo y' ubushakashatsi muri Kaminuza y'u Rwanda (CMHS IRB).

Ibibazo cyangwa ibindi bisobanuro, baza

Eric Munezero.

*Telefoni igendanywa: 0788523500

* E-mail: munezestudy@gmail.com

Hagize ibindi bitumvikanwaho hagati y'ukorerwaho ubushakatsi n'umushakashatsi, wahamagara umunyamabanga w'ikigigo cya Kaminuza gisuzuma ibijyanye n'ubushakashatsi (CMHS IRB) kuri:

*Telefoni: 0788563311

*Email:sundayfrax@gmail.com

<u>Kwemera kwinjira mu bushakashatsi ku bushake</u>

Njyewe ……, (imyaka……)
Nemeye ko nahawe ibisobanuro birambuye na Dr……kuri ubu bushakashatsi, mpabwa n'umwanya wogusobanuza. Mu gusinya, nemeye kubushake bwanjye nta gahato ko ubu bushakashatsi bunkorerwaho /bukorerwa kuri…..……..... (Imyaka……).

Umukono w'umurwayi……itariki……/……./……..

Uhagarariye umurwayi…….....Isano……..
Umukono cg igikumwe……Italiki……/……/…….

Ukora ubushakashatsi/Umuhagarariye…….....itariki……/… /……