

**Original article**

## **Clinical Presentation and Factors Leading to Complications of Deep Neck Space Infections at CHUK**

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### **Abstract**

#### **Background**

Deep neck space infection (DNSI) mostly arise from the local extension of dental, tonsils and parotid gland infections. Early diagnosis and management is the key to avoid associated complications.

#### **Objective**

Our study aimed at evaluating the clinical presentation and factors related to complications of DNSIs at the University Teaching Hospital of Kigali.

#### **Methods**

This cross-sectional study was conducted at the University teaching hospital of Kigali from September 2017 to November 2018. It enrolled 66 participants. Patient information was recorded using a questionnaire and analyzed using Epidata 3.1 software. The data were processed using SPSS 16.0. Comparison of categorical variables were performed using the chi-square test. Associations with  $p$ -values=0.05 were considered statistically significant.

#### **Results**

Males accounted for 35 (53%) of DNSIs. The majority (97%) presented with neck pain and 21% with a history of tooth extraction. The submandibular space was the most involved in 33 (50%) cases. The average duration of symptoms at presentation was 11 days. Delayed consultation and advanced age (>40years) were associated with complications and hospital stay with ( $p$  value=0.022) and ( $p$ =0.015) respectively.

#### **Conclusion**

Neck pain on background of tooth extraction is the most common presentation of patients with DNSIs. Delayed presentation and advanced age are central factors for complications and longer hospital stay.

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**Keywords:** Deep neck space infections, presentation, complications.

## Background

Deep neck space infections (DNSIs) are defined as infections in potential spaces and fascial planes of the neck, characterized by rapid progression and life-threatening complications.[1–4]

The fascial planes are of two types: superficial and deep layers. According to the relationship with the hyoid bone, deep neck spaces are classified as follows: There are spaces localized above the hyoid bone level including the peritonsillar, submandibular, parapharyngeal, buccal, parotid and masticatory spaces. There are also spaces that involve the entire circumference of the neck and these include the retropharyngeal, danger, prevertebral and carotid sheath, and the anterior or pre-tracheal visceral spaces below the hyoid bone.[5–7]

Globally, the incidence of DNSIs decreased significantly following the widespread use of antibiotics for infection, development of new diagnostic modalities and improvement in oral hygiene.[8] However, DNSIs continue to be a significant health problem in developing countries, resulting in significant morbidity and mortality.[7,9,10]

The common etiological factors of DNSIs are dental infections, pharyngotonsillar infections, salivary

gland infections, trauma to the aerodigestive tract, and benign and malignant neck tumors. Dental infections are associated with the majority of DNSIs while the etiology of DNSIs is not identified in 20-50% of cases.[6] Clinical presentation of DNSIs vary according to the neck space involved. Common symptoms include dysphagia, odynophagia, pain, neck swelling, respiratory difficulties, fever and features of inflammation on physical examination.[11,12] Medical history may reveal comorbidities such as previous dental diseases or procedures, upper respiratory tract infections (URTIs), maxillofacial or neck trauma, immunosuppressive drug intake (steroids, chemotherapy), HIV, Diabetes and Tuberculosis.

The presence of comorbidities predispose to complications of DNSIs.[3,13–15] and delayed consultation predisposes to complications and high morbidity and mortality rate.[7,11,15]

Diagnosis of DNSIs is based on clinical assessment. Needle aspiration (proof puncture) is a useful and cost efficient diagnostic tool as it helps to differentiate an abscess from cellulitis. Furthermore, proof puncture has been reported as an effective initial treatment for pediatric neck abscesses.[16] Microbiology reveals mixed bacterial flora including gram positive

organisms (streptococcus viridans, staphylococcus aerius) and gram negative organisms (Escherichia coli, haemophilus influenza). Anaerobic germs are responsible for fulminating necrotizing fasciitis which is severe complication of DNSIs.[5]

Imaging helps in delineating the exact anatomical extent of DNIs and detecting complications.[7] Ultrasonography is useful as initial or alternative modality for evaluation of abscess collection or cellulitis and assist in drainage by good localization of the abscess. However the exact localization of the infections focus is often difficult with this modality.[9] The CT scan with contrast is a modality of choice as it helps in identifying the extent of the infections and differentiates cellulitis from abscess.[7] The role of MRI in DNSIs is limited by long acquisition times, high cost, unavailability in most places and the unstable general status of these patients.

The treatment of DNSIs consists mainly of IV antibiotics, incision and drainage of the abscess and airway maintenance.[9,13] Delays in diagnosis and treatment can result in life-threatening complications, namely, airway compromise, necrotizing fasciitis, mediastinitis and sepsis.[17] Elderly patients, delayed consultation, associated comorbidities, odontogenic infections

and inappropriate management have shown to be the factors leading to complications.[10,12,16] There are very few studies published on DNSIs in sub-Saharan Africa.[18–20] yet it is the region of the world where poor oral hygiene and other social economic factors contributing to the development of DNSIs are identified. There is no published data about deep neck spaces infections (DNSIs) in Rwanda nor the East African region. The aim of the study was to evaluate the clinical presentation and factors related to the complications of deep neck space infections at CHUK.

## **Material and Methods**

This was a cross-sectional study conducted at the University Teaching hospital of Kigali (CHUK) from September 2017 to February 2018. It was approved by the Research Ethics Committee of CHUK and CMHS-IRB. Patients were enrolled into the study after giving their written informed consent. The study enrolled 66 patients who consulted the department of Otorhinolaryngology at CHUK with confirmed deep neck space infections (DNSIs).

The data was collected using a pre-established questionnaire. The following information was recorded: demographic characteristics including age, gender, comorbidities, risk factors, clinical symptoms and

signs, timing of consultation, microbiology results, diagnostic modalities, treatment options, complications and hospital stay. Time for consultation was classified into three categories: Early (<3days), intermediate (3-7days) and delayed consultation (>7days). Data was recorded using Epidata 3.1 software. Data processing and statistical analyses were performed using SPSS 16.0. Comparisons of categorical variables were performed using the chi-square test. The limit of significance was established at  $p \leq 0.05$ .

## Results

The distribution of demographic characteristics is shown (Table 1). Males accounted for 35(53%) and females 31(47%). The predominant age group was 0-10 years accounting for 33.3% of all DNSIs, followed by the group of more than 50 years (18.2%). The majority of cases were from rural areas.

**Table 1. Demographic characteristics**

<b>Variables</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Gender</b>		
Male	35	53
Female	31	47
<b>Age range (in years)</b>		
0-10	22	33.3
11-20	9	13.6
21-30	11	16.7
31-40	8	12.1
41-50	4	6.1
>50	12	18.2
<b>Origin</b>		
Rural	51	77.3
Urban	15	22.7

Table 2 shows clinical presentation, timing for consultation, complications and hospital stay of patients of DNSIs. The majority of patients with DNSIs 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  $10.82 \pm 7.69$  days with a minimum of 2 days and maximum of 45 days. The majority (40.9%) presented after 7days of onset of symptoms while only 25.8% consulted for features of DNSIs <3 days after onset of symptoms. Physical findings were neck tenderness in 64(97.0%) cases and fluctuation on palpation in 61(92.4%) cases. The submandibular space were the site more involved in 50% of the cases followed by peritonsillar space in 13.63% and

Ludwig’s angina was found in 13.63%.

Tooth extraction or infection was the most prevalent of predisposing factors in 21.21% cases followed by tonsillitis or pharyngitis in 9(13.63%). In the majority of cases (70.4%) the diagnosis was made by needle aspiration and imaging was done by using ultrasound (15.5%) and contrast CT scan (11.3%). Needle aspiration and CT scan were used together in 4% and the majority of patients were treated by incision and drainage with antibiotics in 60(90.9%) cases.

Out of 66 cases of DNSIs, 14 (21.2%) had complications and Necrotizing fasciitis represented the majority with 8 out of 14 cases (66.7%), followed by upper airway obstruction in 4 out of 14 cases (28.6%). 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. (Table 2).

**Table 2. Presentation, timing for consultation, complications and hospital stay**

<b>Variables</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Symptoms</b>		
Pain	64	97
Swelling	63	95.5
Fever	48	72.7
Odynophagia	29	43.9
<b>Signs</b>		
Tenderness	64	97
Fluctuation	61	92.4
Trismus	26	39.4
Pus discharge	21	31.8
<b>Location</b>		
Submandibular	33	50
Ludwig's Angina	9	13.63
Peritonsillar		
space	9	13.63
Parapharyngeal		
space	8	12.13
Others	7	10.6
<b>Timing for presentation</b>		
Early presentation (<3days)	17	25.8
Intermediate (3 - 7 days)	22	33.3
Delayed presentation (> 7days)	27	40.9
<b>Complications</b>		
Septic shock	2	14.3
Necrotizing Fasciitis	8	57.1
Upper airways obstruction	4	28.6
<b>Hospital stay</b>		
Shorter (<7days)	36	54.5
Longer(≥days)	30	45.5

Factors associated with occurrence of complications of DNSIs are shown in table 3. Delayed consultation (>7days) was significantly associated to the presence of complications (p=0.022).

The advanced age (>40 years) was a significant factor of complications of DNSIs (p=0.015).

**Table 3. Factors associated with complications of DNSIs**

Variables	Complications		p value
	Any complication	None	
<b>Duration of symptoms</b>			
≤7 days	3 (9.7%)	28 (90.3%)	
>7 days	11 (33.3%)	22 (66.7%)	0.022
<b>Age</b>			
<40 years	7 (14.6%)	41 (85.4%)	
≥40 years	7 (43.8%)	9 (56.3%)	0.015

Factors associated with the duration of hospital stay of DNSIs are shown in Table 4. Delayed consultation (≥7days) and presence of complications were significantly associated with prolonged hospital stay with (p=0.007) and (p=0.022) respectively

**Table 4. Factors associated with the duration of hospital stay**

Variable	Hospital stay		p value
	<7 days	≥7 days	
<b>Duration of symptoms</b>			
<7 days	21 (65.6%)	11 (34.4%)	0.007
≥7 days	11 (32.4%)	23 (67.6%)	
<b>Age</b>			
<40 years	27 (54.0%)	23 (46.0%)	0.113
≥40 years	5 (31.3%)	11 (68.8%)	
<b>Complications</b>			
Yes	3 (21.4%)	11 (78.6%)	0.022
No	28 (56.0%)	22 (44.0%)	
<b>Comorbidities</b>			
Yes	16 (44.4%)	20 (55.6%)	0.472
No	16 (53.3%)	14 (46.7%)	

## Discussion

DNSIs represent medical and surgical emergencies with significant morbidity and mortality. We prospectively studied 66 patients with DNSI patients, their associated complications, risk factors, and outcomes at the University Teaching Hospital of Kigali. We found that DNSIs occur fairly evenly by sex, with males representing 35(53%) and females 31 (47%) and a male to female ratio of 1:1.3. This is consistent with other reports

showing male to female ratios of 1.23 and 1.29, respectively.[14,15] One third of all DNSIs occurred in patients aged 1-10 years, followed by 18.2% of DNSIs in the group of >50 years. These findings correspond to other reports in the literature.[2]

As this younger age group experiences more frequent URTIs, they may be predisposed to development of DNSIs. Congenital factors such as branchial cleft cysts may contribute as well. The average duration since the onset of

symptoms was 10.82 days (SD±7.69, range 2-45). Findings in Brazil demonstrated similar duration of onset, with an average of 8 days. Symptoms at arrival were neck pain (97%), swelling (95.5%) and fever (72.7%).[3] In a South Korea study findings were consistent, with symptoms of DNSIs were neck swelling (74.7%), neck pain (41.1%) and fever (14.6%).[21] Duration of symptoms being nearly 10 days implies a delay to access care. Exploring the reasoning for delay, either patient or health system factors would be an area of future research. Decreasing the time of onset to time to seek care would likely decrease complications, morbidity and mortality. Physical exam revealed that tenderness was the most common finding in 97% of patients with DNSIs, followed by fluctuation (92.40%). These findings are similar to what have been found in Brazil where the main physical finding of DNSIs were neck swelling(84.6%) and tenderness(76.9%).[5] Reports from India found that pus discharge in the oral cavity was 44.23% at arrival.[13] Initial physical exam findings should inform district level practitioners who can be aware of symptoms of DNSIs.

The submandibular space was the most common site involved in our study (50%) followed by the peritonsillar space (15%). This is

consistent with what have been found in Nigeria where submandibular location was the most prevalent with 43.9%. [10] The submandibular space is the first deep neck space to be affected by spread of infection of dental origin. This finding serves to emphasize the importance of dental hygiene, and DNSIs can be thought of as an extreme complication of poor oral hygiene.

Dental extractions or infections were the most common predisposing factor associated with DNSIs with 14(21.21%). Many studies identified odontogenic origins to DNSIs, citing odontogenic sources in 28%, 12%, 70.6%, and 92.7% of cases.[7,11,17,21] This is common for low income countries with inappropriate equipment for basic dental care, delayed extractions, a lack of dentists, and high numbers of patients with poor oral hygiene.

Contrast CT scan is the gold standard method of diagnosis for DNSIs. In our setting, needle aspiration was the predominant modality of diagnosis in 70.4%, while CT scan was used in only 11.3%. This may be a result of increased wait times for CT scan, higher associated cost, inability to acquire contrast, and the need for immediate diagnosis in patients with DNSIs. In fact, 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] A study done in South Africa has mentioned that needle aspiration can be used for both diagnosis and treatment of DNSIs.[22] Adoption of needle aspiration as the primary and immediate mode of diagnosis has assisted to increase speed of treatment, namely incision and drainage.

In our study, 14 (21.2%) of patients had complications and the majority of them were necrotizing fasciitis (57.1%), followed by airway obstruction (28.6%) and septic shock (16.70%). In Latvia, a study performed found 11.4% of complications with airway obstruction representing 27.9%.[17] Delayed consultation and advanced age were significantly associated with complications (p value=0.02 and 0.015 respectively). Patients in these age groups should warrant additional concern when presenting with DNSIs.

The mean hospital stay was 10.23 days (SD±11.64, range 0-60), which was in agreement with other reports in the literature. [7,21] The duration of symptoms prior to consultation and presentation of complications were significantly associated with hospital stay (p value=0.007 and 0.022 respectively). A study performed in Nigeria found that time

of presentation was significantly associated with duration of hospital stay (p value=0.027). [11] This is consistent with our findings whereby the delayed care influenced the occurrence of complications and longer hospital stay.

## **Conclusion**

Neck swelling and pain on background of tooth extraction are the most common risk factors for patients with DNSIs. Delayed presentation and advanced age are associated with higher levels of complications of DNSIs and prolonged hospital stay.

## **Conflict of interests**

No conflict of interests to declare.

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None

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