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Editorial Board

Correspondence to be addressed to:

Dr. Sophie Gitonga

The Editor-in-Chief

East and Central Africa Journal of Otolaryngology,

Head and Neck Surgery

P.O. Box 29784 Nairobi, Code 00202 Kenya

Email: editor.ecajohns@gmail.com/sereyans@gmail.com

Tel: 0722 867302

EAR AND HEARING CARE IN KENYA. WHERE ARE WE? WHERE DO WE NEED TO BE?

Hearing loss currently affects more than 1.5 billion people worldwide, of whom 430 million have moderate or higher levels of hearing loss in the better hearing ear, and are more likely to be adversely affected unless the condition is addressed in a timely manner[1]. Two thirds of the burden of hearing loss lies in Low and Middle Income Countries (LMIC) where access to Ear and Hearing Care (EHC) services is often limited[2]. The World report on hearing 2021 identifies the priority interventions that are necessary in achieving universal access to quality ear and hearing care across the life course. These interventions are:- Hearing screening and intervention; ear disease prevention and management; access to technologies; rehabilitation services; improved communication; noise reduction and greater community engagement. Sixty percent of the causes of hearing loss are avoidable using preventive strategies which have been found to be both successful and cost-effective[2].

Hearing loss that is not addressed can have a significant negative impact on communication, speech and language development in children, cognition, education, employment prospects, social well-being and economic independence of individuals. Hearing loss often remains undetected due to its invisible nature and for this reason, it is important that screening for hearing loss be conducted across the different stages of the life course. The target age groups mostly at risk for hearing loss include: newborns and infants, school children especially pre-schoolers, individuals who are exposed to noise, ototoxic medications and chemicals, and older adults[3].

Kenya faces several challenges common to other LMIC in the provision of EHC services. These include inadequate EHC professionals such as doctors, clinical officers, audiologists and speech and language therapists; coupled with inadequate infrastructure, equipment and medical supplies. In addition assistive hearing devices are costly and currently only available in private health facilities. It is against this backdrop that the National Strategy for Ear and Hearing care was developed in 2016[4]. The strategy provides leadership, coordination and prioritization of EHC services, mobilization of resources and effective use of the scarce resources. Since inception, the National EHC strategy has had several achievements which include: the development of a scheme of service for Audiology and Speech and Language cadres; provision of hearing aids and cochlear implants through the National Health Insurance Scheme; inclusion of EHC medications in the essential drug list; development of infrastructure for EHC by the counties through sponsoring the training of ENT surgeons, ENT clinical officers, Audiology and Hearing Care Technology professionals and speech and language therapists. The strategy has helped to facilitate the integration of EHC into the Universal Health Coverage (UHC) and the health care system. Along with this National strategy for EHC, policy guidelines and protocols on establishment and management of EHC were developed to enable health care workers at various levels of service delivery to diagnose, manage and refer patients appropriately[5].

The next steps for EHC in Kenya will include the formation of a National Committee which will spearhead the review of the National Strategic plan for EHC for the next five years (2021-2025) and ensure its implementation. The committee will have a multisectoral representation drawn from the Ministry of Health (MOH), Ministry of Education, the Council of Governors, Non-Governmental Organisations and Faith Based Organisations providing EHC services, Deaf societies, training institutions, professional societies, among others. One of the key outputs of this committee will be to have a key indicator in the DHIS2 system which will monitor EHC within the health systems. The guidelines for assessment and categorisation of disabilities currently being undertaken by the MOH will benefit all persons with disabilities in Kenya.

In conclusion, there is need to take advantage of the UHC implementation in Kenya as an opportunity to improve access and reduce the burden of ear diseases and hearing loss. Rolling out universal hearing screening, ear disease prevention, management and rehabilitation services across the life course will enable achievement of this goal. To improve awareness on EHC, all counties should mount activities to celebrate the World Hearing Day on the 3rd of March every year.

Ndegwa SN, Department of Surgery (ENT), College of Health Sciences, University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya. Email: serahndegwa8@gmail.com

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"WE ARE WHAT WE REPEATEDLY DO. EXCELLENCE, THEN, IS NOT AN ACT BUT A HABIT". ARISTOTLE.

We are delighted to be back to work, back to operating and back to reconnecting with each other. Am delighted we have a volume 5 no. 2 issue, with articles from Kenya, Ivory Coast and Zimbabwe. Whilst still in the midst of the COVID 19 pandemic, restricted travel abroad has resulted to either online training or postponement of specialized medical training or fellowships for some. We have been fortunate to have monthly Continuous Medical Education (CMEs) amidst the pandemic. The scope of CMEs have indeed evolved over the years from clinical updates to personal development CMEs which target social and managerial development skills, leadership and communication, research and scientific writing, to multidisciplinary patient care and now more recently to virtual CMEs.

Evidence-based studies suggests that no practitioner can hope to remain competent for more than a few years after graduating without a program of active learning. As such a system of life-long learning must be followed. The health goal (SDG 3) is to ensure healthy lives and promote wellbeing for all at all ages. The SDG declaration emphasizes that to achieve the overall health goal universal health coverage and access to quality healthcare must be achieved. "No one must be left behind". That said, Africa accounts for 29% of the global health burden with only 3.5% of healthcare professions. According to the WHO global health workforce statistics, both Kenya and Zimbabwe have 0.2 physicians per 1000 people[1].

At the start of the millennium, Zimbabwe underwent both political and economic upheaval which resulted in reduction of government funding of health institutions and State Universities. Subsequently, there was an exodus of Academic Faculty with many leaving the country for better remuneration elsewhere[2]. With hyperinflation, there has been a reduction in patients seen in the public hospitals which has subsequently reduced clinical exposure for medical trainees[2]. Therefore in order to achieve the goals of SDG3 it is imperative that a collaboration between the private and public sector be forged to ensure quality and accessible healthcare for all is achieved.

A Complete Blood Count (CBC) is routinely carried out before during and after cancer treatment. The CBC roughly estimates the patient's anaemic, nutrition, inflammatory, and immunologic status. Results from a cross- sectional case control study done in Kenya, showed that patients with mucosal head and neck squamous cell carcinoma had significantly lower levels of haemoglobin and mean corpuscular volume, which was directly proportional to the stage of cancer[3].

The WHO describes probiotics as live micro-organisms, which when administered in adequate amounts confer a health benefit to the host. They are mainly consumed in fermented foods such as cheese and yoghurt. Their inherent biological feature enables them to predominate and prevail over potential pathogenic microorganisms. Probiotics that have been tailored to treat atopic diseases are growing in the market. A review of literature using PubMed search engines to determine the contribution of probiotics in the management of chronic rhinosinusitis showed no consensus on the sinus microbiome, due to the imbalance of bacteria species in the sinuses. *Lactobacilli* strains have been the most widely used probiotics and its administration via nasal route has been effective both in adjuvant therapy and prevention of chronic rhinosinusitis[4].

I hereby invite you to read the articles with a sense of critique and I will be glad to publish any letters that will emerge from this issue. I wish you all an enjoyable reading.

Dr. Sophie Gitonga
Editor-in Chief

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PRE-TREATMENT RED BLOOD CELL INDICES IN MUCOSAL HEAD AND NECK SQUAMOUS CELL CANCERS AT THE KENYATTA NATIONAL HOSPITAL, NAIROBI, KENYA

Bonko NM[1,2], Mugwe P, [2,3], Yuko E[2,3]

[1]Faculty of Health Sciences, University of Buea, South West Region, Cameroon
[2]Department of Surgery (ENT), School of Medicine, University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya
[3]Kenyatta National Hospital, Nairobi, Kenya

Address for correspondence: Dr. Bonko N. Mengjo, Faculty of Health Sciences, University of Buea, Cameroon. Email: nevillemenchs@gmail.com

ABSTRACT

Background: There has been a growing interest in the pathologic, diagnostic, and prognostic utility of haematologic parameters in the management of Mucosal Head and Neck Squamous Cell Carcinoma (HNSCC).
Objective: This study sought to compare pre-treatment red blood cell indices of mucosal HNSCC to that of the general population and to correlate these with cancer characteristics of the study population.
Design: This was a cross-sectional case control study.
Methods: The study was conducted at the Kenyatta National Hospital (KNH), Nairobi, Kenya. Cases were patients aged 18 years and above, presenting with a histological diagnosis of mucosal HNSCC. Controls were healthy individuals, aged 18 years or above who were not being followed up regularly for any disease conditions. Complete blood count was analysed with an automated analyser (SYMEX™, MODEL: XN500). Comparative analysis of quantitative data was achieved with Student's T test whereas qualitative data was evaluated by using Chi-square and Fishers exact tests. Normally distributed data was analysed with one- way ANOVA test. A two tailed P-value of <0.05 was our cut-off for statistically significance.
Results: A total of 122 participants (61 cases and 61 controls) met the inclusion criteria. Males constituted 67.2% (41) of each study arm. The mean age for cases was 45.30±17.17 years and 43.00±15.45 for controls, (P=0.44). Laryngeal carcinoma was the most common cancer (31.1%) among our participants. Most participants (91.8%) were at advanced stage (T3 and T4) at the time of recruitment into the study. There was a significant difference in haemoglobin levels (12.5±2.5 vs 14.5±1.8, P<0.001), mean corpuscular volume (85.4±8.7vs91.6±6.3, P < 0.001), red cell distribution width (14.8±3.5 vs 13.8±1.2) and total platelet counts (409.5±139.7 vs 247.8±76.1) between HNSCC and the general population. Lowest levels of Hb and MCV were observed with more advanced tumours in terms of nodal staging, (P=0.01).
Conclusion: Mucosal HNSCC is significantly associated with lower values of Hb and MCV compared to the general population. The more advanced the disease, the lower the Hb and MCV values. Patients in this setting therefore need close follow up in terms of nutrition and clinical evaluation for optimal treatment outcomes.

Key words: Inflammation, Red blood cell, Red cell distribution width, Haemoglobin, Mucosal head and neck squamous cell carcinoma, Kenyatta National Hospital

INTRODUCTION

Recently, the relationship between cancer and haematologic markers have become a growing field of research. Interest in the pathologic, diagnostic, and prognostic utility of haematologic parameters has expanded the understanding of the vital role they play in cancer treatment and outcomes. Changes in the haematological profiles have shown association with incidence of both pre-cancerous and malignant lesions of the head and neck region[1]. Anaemia is known to engender radio-resistance and pre-treatment Hb is an important factor determining treatment outcomes in cancers of the head and neck and other regions[2]. The pathologic mechanism relates to tissue hypoxia which directly bears upon haemoglobin as the major oxygen transfer molecule to tumour cells. Studies have shown that anaemic head and neck cancer patients tend to have low oxygen partial pressures within the primary tumours and neck node metastasis, which invariably leads to poor response to radiation therapy and poor treatment outcomes[3]. Aetiologies of anaemia in

mucosal head and neck cancer patients revolve around iron deficiency due to poor food intake, absorption and other tumour induced metabolic abnormalities. Iron is an essential micronutrient for human health due to its vital role in many metabolic processes. Variations in the levels of serum iron may be reflected as changes in parameters such as mean haemoglobin (Hb), Mean Corpuscular Volume (MCV), Mean Cell Haemoglobin (MCH), and Mean Corpuscular Haemoglobin Concentration (MCHC) and changes in Red Cell Distribution Width (RDW). Positive correlations have been shown between serum iron levels and cancer incidence and treatment outcomes in previous studies[4]. The red cell distribution width is a measure of the variation in the sizes of red blood cells (Anisocytosis). RDW is an important prognostic marker in various malignancies including HNSCC, partly because of its role as a marker of inflammation and also because it correlates with the nutritional state of these patients[5]. All these indices can be extracted from the complete blood count, which is a performed investigation worldwide for a variety of clinical conditions. To the best of our knowledge, there have been no studies in our setting, assessing the pre-treatment levels of red blood cell indices in HNSCC. Our aim was to compare the pre-treatment levels of red blood cell indices in mucosal HNSCC patients to those of the normal population. This study will provide a basis for establishment of baseline values for these haematologic parameters and provide insight into the active use of the same in monitoring and follow up of patients in our setting undergoing treatment for mucosal HNSCC.

MATERIALS AND METHODS

This was a cross-sectional case control study conducted at the Kenyatta National Hospital (KNH), Nairobi Kenya. This study was approved by the ethics and research committee of the University of Nairobi/ Kenyatta National Hospital, protocol number P34/01/2019. Data collection tool was a specially designed questionnaire that captured demographic characteristics of the study population, cancer characteristics and the complete blood count result slip. Cases were patients aged 18 years and above, presenting with a histological diagnosis of mucosal HNSCC. Controls were healthy individuals, aged 18 years or older who were not being followed up regularly for any disease conditions. They were sampled among blood donors who had undergone assessment for fitness to donate and individuals with conditions like refractive errors or cataract followed up at KNH. They were matched with cases based on gender and age ranges established on 10 years interval. We excluded patients who have had or are currently on treatment for mucosal HNSCC such as surgery, radiotherapy, or chemotherapy and participants with diagnosed cancers of other body regions apart from mucosa of the head and neck region. Individuals with history of long-term steroid use were also excluded. Complete blood count was analysed with an automated analyser (SYMEX™, MODEL: XN500).

Data was expressed as mean, standard deviation and 95% Confidence Interval (CI). Comparative analysis of quantitative data was achieved with Student T test whereas qualitative data was evaluated by using Chi-square and Fishers exact tests. Normally distributed data was analysed with one- way ANOVA test. A two tailed P-value of <0.05 was our cut-off for statistically significance.

RESULTS

A total of 122 participants (61 cases and 61 controls) met the inclusion criteria. Males constituted 67.2% (41) of each study arm. The mean age for cases was 45.30±17.17 years and 43.00±15.45 for controls, (P=0.44). The age distribution of the study population is depicted in Figure 1, and the gender distribution is presented in Table 1.

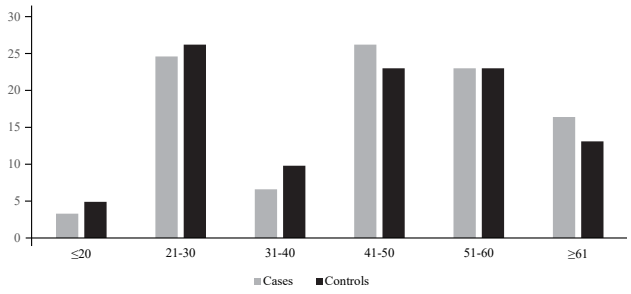

Figure 1: Age distribution of the study population

Table 1: Gender distribution

Characteristic	Case	Control	P-value
Gender			
Male	41(67.2%)	41(67.2%)	1.00
Female	20(32.8%)	20(32.8%)	
Age (years) Mean	45.30±17.17	43.00±15.45	0.44

Laryngeal carcinoma was the most common cancer (31.1%) among our participants (Figure 2). Most participants (91.8%) were at advanced stage (T3 and T4) at the time of recruitment into the study. Early stage presentations were relatively rare. Cervical nodal stage, N2, disease was the most encountered (49.2%) in our population. Distant metastases were found in only seven (11.5%) of participants. Well differentiated squamous cell carcinomas were seen in 31(50.8%) patients (Table 2).

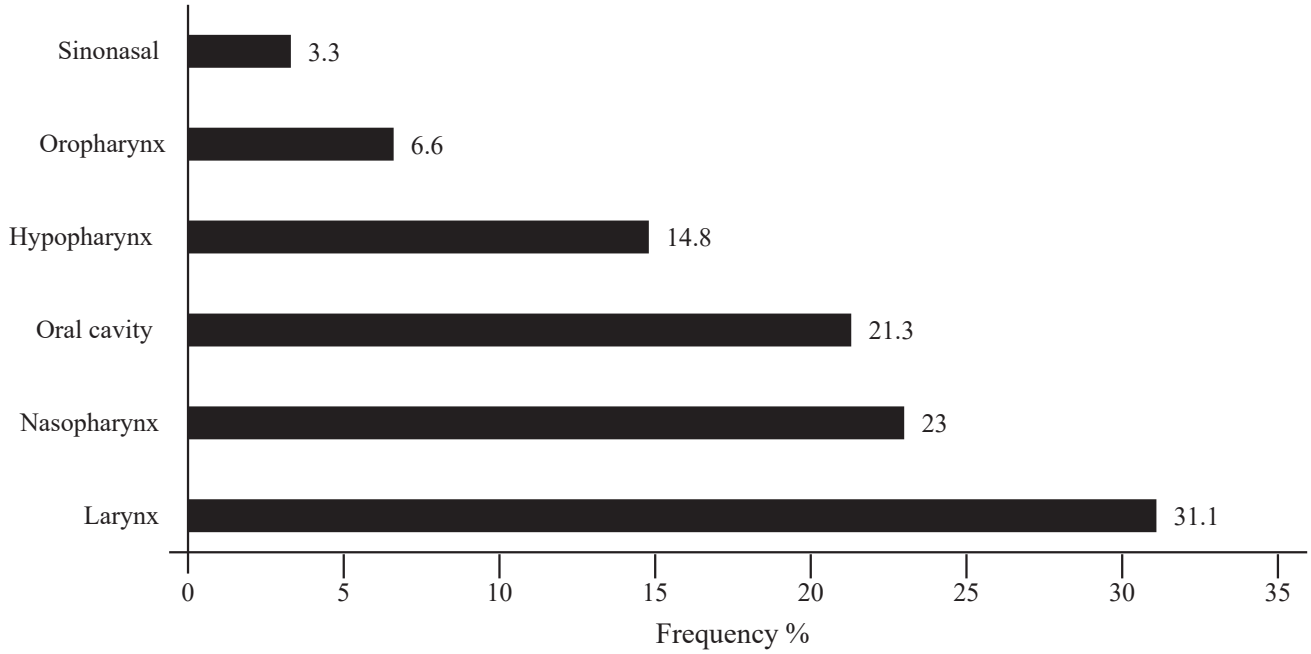

Figure 2: Distribution of cancers based on anatomical location

Table 2: Cancer characteristics

Characteristics		Frequency (%)
Location	Nasopharynx	14 (23)
	Sinonasal	2 (3.3)
	Oropharynx	4 (6.6)
	Oral cavity	13 (21.3)
	Hypopharynx	9 (14.8)
	Larynx	19 (31.1)
T-stage	T1	1 (1.6)
	T2	4 (6.6)
	T3	13 (21.3)
	T4	43 (70.5)
N-stage	N0	13 (21.3)
	N1	6 (9.8)
	N2	30 (49.2)
	N3	12 (19.7)
M-stage	M0	54 (88.5)
	M1	7 (11.5)
Histological grade	Grade 1	31 (50.8)
	Grade 2	16 (26.2)
	Grade 3	2 (3.3)
	Grade 4	11 (18.0)

Table 3: Red blood cell indices

Parameter	Normal values	Cases	Controls	P-values
Total red cell count		4.5±0.8	4.8±1.1	1.34
Haemoglobin		12.5±2.5	14.5±1.8	<0.001
Mean corpuscular volume		85.4±8.7	91.6±6.3	<0.001
Mean corpuscular hemoglobin concentration		32.1±1.9	31.9±1.7	0.58
Red cell distribution width (RDW)	11.6-14.8	14.8±3.5	13.8±1.2	0.04
Platelets	142 -424	409.5±139.7	247.8±76.1	<0.001

There was a significant difference in haemoglobin levels (12.5±2.5 vs 14.5±1.8, P < 0.001), mean corpuscular volume (85.4±8.7vs 91.6±6.3, P < 0.001), red cell distribution width (14.8±3.5 vs 13.8±1.2) and total platelet counts (409.5±139.7 vs 247.8±76.1) between HNSCC and the general population (Table 3). Lowest levels of Hb and MCV were observed with more advanced tumours in terms of nodal staging, (P=0.01) (Table 4).

Table 4: Relationship between cancer characteristics and red cell indices

Characteristic		Mean Hb ± SD	P-value	Mean MCV±SD	P-value	Mean RDW (CV) ±SD	P-value	Mean MCH-C±SD	P-value
Tumour location	Nasopharynx	11.9±2.2	0.32	82.3±8.6	0.05	15.3±3.2	0.55	31.4±1.8	0.58
	Sinonasal	13.3±2.3		80.6±4.6		12.2±0.5		33.5±0.6	
	Oral cavity	11.9±3.5		85.6±12.0		15.8±5.9		32.3±2.5	
	Oropharynx	10.9±2.1		78.4±4.4		15.2±1.2		32.9±3.5	
	Hypopharynx	13.6±2.6		84.2±9.1		15.1±3.3		32.1±0.7	
	Larynx	13.0±1.6		90.0±4.4		13.8±1.5		32.3±1.6	
T-stage	T1	13.7±2.1	0.93	91.0±7.1	0.41	12.7±3.0	0.68	32.3±0.1	0.19
	T2	12.6±3.1		80.5±8.0		15.9±3.5		30.4±1.3	
	T3	12.7±2.0		88.0±7.8		14.0±1.4		32.8±2.3	
	T4	12.3±2.6		84.9±9.0		15.0±4.0		32.1±1.8	
N-stage	N0	12.5±3.1	**0.01**	85.6±6.3	**0.01**	15.2±5.0	0.35	32.2±2.1	0.61
	N1	14.8±1.5		93.3±7.9		13.4±1.4		32.3±1.4	
	N2	12.7±2.0		86.0±7.0		13.4±2.4		32.4±1.9	
	N3	10.8±2.3		79.5±10.2		16.2±4.5		31.5±1.9	
M-stage	M0	12.7±2.4	0.10	85.8±8.3	0.31	14.5±3.1	0.06	32.3±1.9	0.15
	M1	11.0±2.2		82.2±12.1		17.2±5.8		31.2±1.6	
Histological grade	Grade 1	12.3±2.1	0.71	86.4±10.0	0.30	15.0±3.4	0.91	32.2±2.0	0.91
	Grade 2	13.0±3.0		86.2±6.3		14.7±4.4		32.1±1.8	
	Grade 3	13.1±2.1		75.9±2.9		13.3±2.1		31.4±3.6	
	Grade 4	12.0±2.2		83.0±8.00		14.7±2.3		31.9±1.7	

DISCUSSION

This study sought to compare the pre-treatment red blood cell indices in mucosal HNSCC patients to that of the healthy population. There was predominantly male population which is consistent with the worldwide gender specific incidence rates of mucosal HNSCCs showing highest values among males than females. This is mainly attributable to cigarette smoking and alcohol consumption behaviours which are more prevalent among males than females though this trend is changing in recent years[6].

The most prevalent subtype of mucosal HNSCC was laryngeal cancer. This finding is supported by the findings of Onyango *et al*[7] in the same study setting. This is however different from other settings especially in Asia pacific region where oral cavity cancers are the most frequently encountered[6]. The difference is mainly related to the variances in risk factor exposures, where betel quid chewing is the most common form of tobacco exposure contrary to our setting where cigarette smoking predominates. Late presentation to hospital in mucosal HNSCCs is common in our setting. Our findings are similarly reported by Onyango *et al*[8] and Oburra[9] in which studies, late presentation stemmed from misdiagnosis at primary health care settings and the inefficiency of the referral system in the most part. However, presentation to health facility of mucosal HNSCCs is variable with respect to the subsite involved. Oral cavity (tongue) and glottic carcinomas generally cause early symptoms whereas pharyngeal and supraglottic tumours usually present at an advanced stage nonetheless differences in presentation times still exist from region to region.

The present study showed an extremely significant difference in haemoglobin levels and mean corpuscular volume between HNSCC and the general population[10]. Lower values of haemoglobin and MCV in head and neck cancer may suggest that iron deficiency is the underlying derangement in this population of individuals. This may implicate nutritional deficiency as the primary aetiology of anaemia as mucosal HNSCC may have a toll on food intake. However, anaemia in HNSCC may be due to variety of reasons which may or may not be related to the cancer[5]. Erythropoietin deficiency due to poor marrow function, myelofibrosis, myelonecrosis and poor dietary intake due to debility of disease may all contribute to anaemia in HNSCC. Increased RBC loss from haemorrhage or RBC destruction by haemolysis in HNSCC have been previously reported[11]. The most probable explanation for the decrease in Hb, RBC count and MCV observed in the present study is the presence of tumour induced haemolysis which in turn is related to the advanced and aggressive nature of the disease[12]. Lowest levels of Hb and MCV were observed with more advanced tumours in terms of nodal staging. These findings are important in terms of treatment of these malignancies in our setting. It has been shown that Hb level is an independent predictor of outcome of HNSCC managed with radiotherapy[13]. Negative impact of low haemoglobin levels upon response rates, local control, and survival in head and neck cancer patients treated with definitive radiation therapy have been established[13]. It is therefore imperative to optimise these group of patients prior to commencement of definitive therapy to maximise outcomes in this setting.

In conclusion, mucosal HNSCC is significantly associated with lower values of Hb compared to the general population. The more advanced the disease, the lower the Hb and MCV values. Patients in this setting therefore need close follow up in terms of nutrition and clinical evaluation for optimal treatment outcomes.

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PATTERNS OF CERVICAL LYMPH NODE METASTASIS AMONG LARYNGEAL CANCER PATIENTS AT THE KENYATTA NATIONAL HOSPITAL, NAIROBI, KENYA

Got GA[1], Mugwe P[1], Irungu C[1], Murayi H[2]

[1]Department of Surgery, School of Medicine, College of Health Sciences, University of Nairobi, P.O. Box 19676-00202, KNH Nairobi, Kenya
[2]Department of Diagnostic Radiology and Imaging, Kenyatta National Hospital, P.O. Box 20723 -00202, Nairobi, Kenya

Address for correspondence: Dr. Got George Akuno, Department of Surgery, School of Medicine, College of Health Sciences, University of Nairobi, P.O. Box 19676-00202, KNH Nairobi, Kenya Email: akuno.md@gmail.com

ABSTRACT

Background: Cervical lymph node metastasis is common in laryngeal carcinoma and is the most important prognostic factor of the disease. In patients with histologically confirmed head and neck cancer including cancer of the larynx, the presence of an ipsilateral metastatic cervical node reduces the 5-year survival rate by 50%. Presence of bilateral metastatic cervical nodes reduces the 5-year survival rate further to 25%. Ideally, cervical lymph node metastasis is confirmed by Fine Needle Aspirate Cytology (FNAC), however, in routine clinical practise, evaluation by palpation of the nodes and a Contrast-enhanced CT scan of the neck is acceptable for decision making.
Objective: To determine the patterns of cervical lymph node metastasis among laryngeal cancer patients presenting for treatment at the Kenyatta National Hospital (KNH).
Design: A hospital based descriptive cross-sectional study.
Methods: Seventy nine patients with a pre-treatment histological diagnosis of laryngeal cancer were examined for presence and patterns of cervical lymphadenopathy. Data on their direct laryngoscopy examination findings was also collected. Primary and nodal disease stage was confirmed by a contrast-enhanced CT scan of the neck.
Results: Trans-glottic cancer was 81.0%, subglottic 10.1% and glottic 8.9%. N+ neck nodes status was 54.6% and N0 status 45.6%. T4 primary cancer and poor grade of differentiation on histology were significantly associated with N+ neck node status P=0.001 and P=0.010 respectively.
Conclusion: Locally advanced primary cancer and poor grade of histologic differentiation are significantly associated with N+ neck node status, while glottic primary is significantly associated with N0 status.

Key words: Cervical lymph nodes, Laryngeal cancer, Kenyatta National Hospital

INTRODUCTION

Cancer of the larynx is one of the commonest head and neck cancers in Kenya and globally[1]. Onyango *et. al.*[2,3] reported a prevalence of 39% of laryngeal cancer among patients with head and neck cancer while Sandabe *et. al*4] reported a prevalence of 20% of all head and neck cancers. It is predominantly a disease of the elderly male in their 7th decade of life with a male to female ratio varying from 5.2:1 to 24:1[2,4-7]. Among patients with head and neck cancer, lymph node metastasis is one of the most important prognostic factors. In patients with histologically proven head and neck cancer, including cancer of the larynx, the presence of an ipsilateral metastatic cervical node reduces the 5-year survival rate by 50%, whereas the presence of bilateral metastatic nodes reduces the 5-year survival further to 25%[8].

Advanced laryngeal cancer may involve multiple anatomic subsites but the disease progression is predictable based on the presence of natural barriers and pathways which may prevent or facilitate the spread of the cancer as depicted on Figure 1[9].

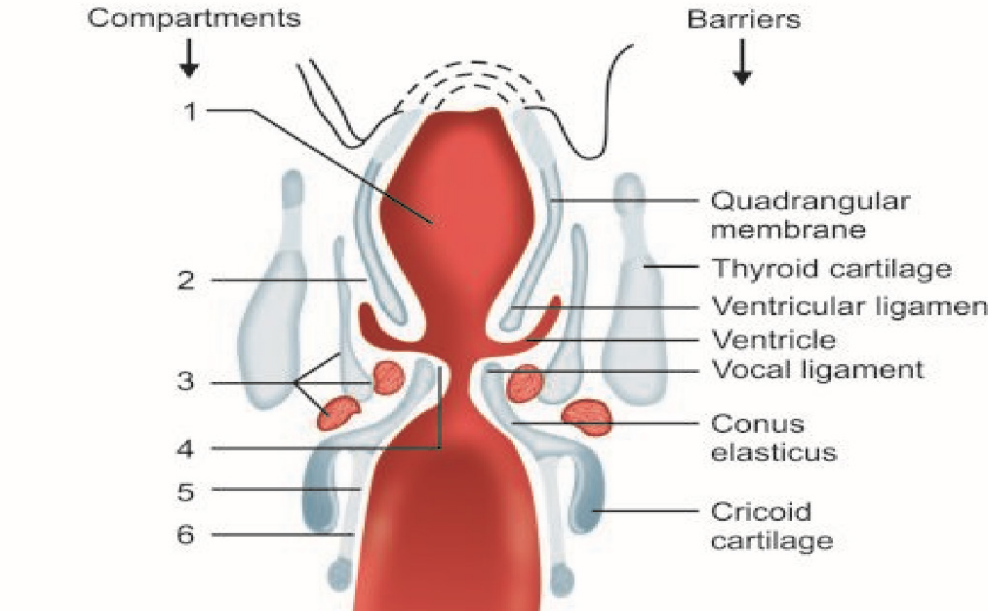

Figure 1: Coronal view of the larynx

Coronal view of the larynx demonstrating the natural barriers to spread of laryngeal tumours along with spaces through which tumours can spread. (i) Supraglottis, (ii) Portion of the pre- epiglottic space continuous with the PGS, (iii) PGS, (iv) Reinke's space, (v) Subglottis, (vi) Cricoid area[9].

Some of the natural barriers which limit the spread of laryngeal cancer include: the thyroid and cricoid cartilages, the hyoepiglottic ligament, the conus elasticus, the quadrangular membrane, the thyrohyoid membrane and the cricothyroid membrane[9].

There are also natural pathways within the larynx that facilitate the spread of laryngeal cancer within and without the larynx. The thyroepiglottic ligament and the anterior commissure provide minimal if any resistance to tumour spread thus allowing cancers of the anterior commissure to invade the thyroid cartilage due to a deficiency of the thyroid perichondrium at the insertion of the anterior commissure.

The pre-epiglottic and paraglottic spaces provide pathways of spread of laryngeal cancer within the laryngeal framework. Cancers that involve the infrahyoid epiglottis will almost always invade the pre-epiglottic space. Laterally, the pre-epiglottic space is continuous with the paraglottic space on either side providing a pathway for cancer to spread submucosally to involve the glottis and subglottis. Spread of cancer through the pre-epiglottic space also predisposes to cancer spread into the soft tissues of the neck via the superior laryngeal neurovasculature.

The paraglottic space binds the laryngeal ventricles bilaterally and its medial limit is the quadrangular membrane, the ventricles and the conus elasticus. Laterally, the paraglottic space is bound by the thyroid cartilages and the piriform sinus mucosa. Invasion of laryngeal cancer into the paraglottic space can lead to the spread of the cancer into the extra-laryngeal soft tissue and the thyroid gland by penetrating through the cricothyroid membrane[9,10].

Save for some little variations; the lymph fluid is drained along relatively predictable and constant lymph vessels into certain lymph node groups. This forms the basis for dividing lymph nodes in the head and neck region into groups. In the year 2002, The American Head and Neck Society committee neck dissection issued an updated classification which has aided and improved assessment of lymph nodes by regions and improved the nomenclature of selective neck dissection as summarized in Table 1[11].

Table 1: American Head and Neck Society (2002 Updates) classification of neck nodes

Level	Lymph node group	Boundaries of neck levels
IA	Submental	Between
IB	Submandibular	Between the boundaries of the anterior belly of the digastric muscle, the stylohypoid muscle and the mandible
II	Upper jugular	Includes nodes located around the upper third of the internaljugular vein and spinal accessory nerve.This extends from the skull base above to the inferior border of hyoid bone below.The anterior boundary is the stylohyoid muscle, and the posterior boundary is the posterior border of sternomastoid muscle
IIA		anterior to the vertical plane defined by thespinalac-cessory nerve
IIB		posterior to the vertical plane defined by the spinal accessory nerve
III	Middle jugular	Includes nodes located around the middle third of the internaljugular vein extending from the inferior border of the hyoid bone above to the inferior border of cricoid cartilage below. The anterior (medial) boundary is the lateral border of the sternohyoid muscle,and the posterior (lateral) boundary is the posterior border of sternocleidomastoid muscle
IV	Lower jugular	Includes nodes located around the lower third of internal jugular vein extending from the inferior border of the cricoid cartilage above to the clavicle below
V	Posterior triangle	Includes nodes located along the lower half of the spinal accessory nerve and the transverse cervical artery.The supraclavicular nodes are also included in the posterior triangle group. The superior boundary of this level is the apex formed by convergence of sternomastoid and trapezius muscles
VA		Above a horizontal plane marking the inferior border of the anterior cricoid
VB		Below a horizontalplane markingthe inferior border of the anterior cricoid
VI	Anterior compartiment	includes pre and paratrachealnodes,precricoid (Delphian node),and the perithyroidal nodes including the nodes along the recurrent laryngeal nerves.The superior boundary is the hyoid bone,the inferior boundary is the suprasternal notch. The lateral boundaries arethe common carotid arteries.

Every effort should be made to accurately evaluate and stage regional lymph nodes as they bear a great prognostic significance. While performing a pre-therapeutic evaluation for lymph node metastasis, clinical palpation remains the basic method applied [12]. Palpation criteria to consider a node metastatic include: a firm to hard consistency of the lymph node, size more than 10mm and fixation to underlying structures[12].

The sensitivity of exclusive inspection and palpation in detecting cervical lymph nodes ranges from 60% - 70%[12]. Application of CT scanning and MR Imaging is complementary with sensitivity ranging from 65% - 88% in literature[13].

Globally, the most significant procedure currently used to detect lymph node metastasis is B mode ultrasonography combined with ultrasound guided node aspiration cytology[13]. Based on a comparative meta-analysis, this modality has a sensitivity of 80% and a specificity of 98% and is superior to both CT scanning and MR imaging[13]. However, this technique is time consuming and suffers from wide inter-operator variability making its clinical use difficult. To forestall the difficulties associated with ultrasonography and ultrasound guided FNAC, CT scanning and MRI are more commonly used in pre-treatment staging of nodal disease.

Contrast-enhanced CT scanning of the neck has found wide and practical use in the radiological staging of both the primary cancer of the larynx and metastasis to regional cervical lymph nodes and even distant metastasis. CT scanning eliminates inter-operator variability which affects Ultrasound guided FNAC.

Contrast enhanced CT scans allow for characterization of the cervical nodes in detail. The CT scan criteria used to define a node as metastatic include: nodes with central necrosis regardless of size in the absence of clinical infection, heterogeneous density of the node, aggregation of lymph nodes, evidence of extra capsular spread as shown by irregular borders, presence of contrast material surrounding the node. Size criterion may vary from 10-15mm. Computed tomography has improved the accuracy of diagnosis of cervical metastasis. It has limitations of being expensive and has hazards of radiation exposure[13].

Pathologic or metastatic lymphadenopathy is radiologically defined as a node greater than 10mm in its transverse diameter or one that contains central necrosis[13,14]. Central nodal necrosis has been variously proven to be the most accurate marker of metastatic lymphadenopathy with up to 100% sensitivity and specificity on CT and ultrasound examination when compared against histological examination of the lymph nodes[15-17].

MATERIALS AND METHODS

The study was designed to determine the patterns of cervical lymph node metastasis among laryngeal cancer patients presenting for treatment at the Kenyatta National Hospital (KNH). The specific objectives were: to determine the distribution of sub-sites of the larynx from which primary cancer of the larynx arose, to determine the correlation between the sub-site(s) of origin of primary laryngeal cancer and level(s) of metastatic cervical nodes involved on CT scan, and to determine the correlation between the histological type and grade of the primary cancer of the larynx with the metastatic cervical nodes detected on CT scan.

The study was carried out at the ENT and Radiology Departments between October 2018 and June 2019. Seventy-nine patients were recruited by consecutive sampling. The inclusion criteria included patients with confirmed laryngeal carcinoma on histology, had radiological imaging, and gave written consent to participate. Neck node status was determined by clinical palpation and confirmed by contrast-enhanced CT scan of the neck. The exclusion criteria were patients who did not have a histological confirmation of laryngeal carcinoma, patients who had undergone any form of treatment whether curative or palliative for the disease, and patients who declined to give a written consent.

The sample size was determined using Fisher's formula with finite population correction taking an estimate of 60.0% as expected proportion of patients with cervical node metastases in laryngeal cancer patients[14].

Approval to conduct the study was obtained from the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee.

The principal investigator did a complete ENT examination on all the study subjects. All direct laryngoscopy examinations were either done by the principal investigator or fellow ENT surgery residents in the department who completed a standard reporting form provided by the principal investigator. All the patients had a contrast-enhanced CT scan of the neck done and reported within 6 weeks. All the CT scans were reported by one consultant radiologist at the hospital for consistency.

The incidence of cervical lymph node metastasis was determined by calculating the proportion of laryngeal cancer patients in the sample with confirmed metastatic node involvement on CT scan of the neck. Frequencies and percentage showing Nodal (N) staging of cancer of larynx were also calculated. The Chi squared and Fisher's exact tests were used to determine the association between the primary tumour sub-site and level(s) of cervical nodes involved, and in determining the association between the histologic grade of cancer and radiological N stage of the disease. All analyses were performed with Statistical Package for Social Sciences (SPSS) version 22, and P-values of <0.05 were considered statistically significant.

RESULTS

Males constituted 98.7% of the patients with females accounting for 1.3%. Most of the patients were in the 7th decade of life accounting for 45.6% (Table 1).

Table 2: Demographic characteristics of the study patients

Characteristic	No.	(%)
Age (years)		
31 – 40	1	1.3
41 – 50	11	13.9
51 – 60	17	21.5
61 – 70	36	45.6
71 – 80	8	10.1
81 – 90	6	7.6
Sex		
Male	78	98.7
Female	1	1.3

The examination and imaging findings are displayed in Figure 2.

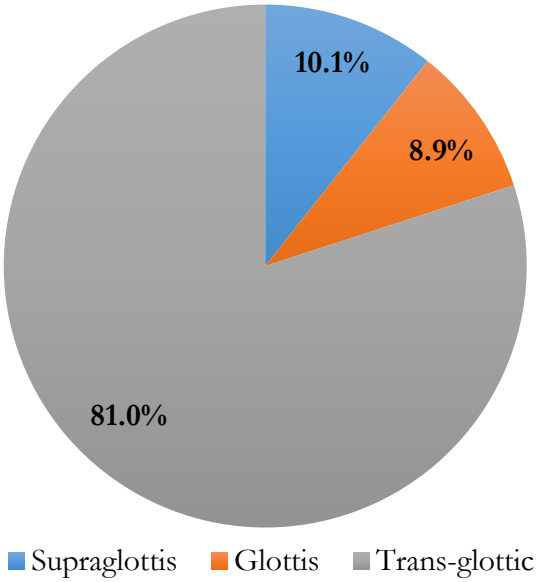

Figure 2: Percentage distribution of laryngeal cancer by subsites

Multiple subsite involvement was predominant with both clinically and radiologically trans-glottic cancers accounting for 81.0% of all the patients.

Table 3: Overall clinical and radiological nodal stage of the patients

Stage	No.	(%)
N0	36	45.6
N1	9	11.4
N2a	5	6.3
N2b	8	10.1
N2c	13	16.5
N3	8	10.1

Overall, 36 patients had no cervical nodes detected either on clinical examination or on CT scan, thus, patients with N0 nodal status accounted for 45.6% of the patients. Forty-three patients had cervical nodes detected either clinically or on imaging, thus, patients with N+ nodal status accounted for 54.4% (Table 3).

Table 4: Association of laryngeal subsite of primary cancer and the cervical nodal status

Subsite	Total	N+	N0	P-value
Supraglottic	8 (10.1)	6 (14.0)	2 (5.6)	0.280
Glottic	7 (8.9)	0 (0.0)	7 (19.4)	**0.003**
Clinical Transglottic	60 (75.9)	33 (76.7)	27 (75.0)	0.857
Transglottic with subglottic extension	4 (5.1)	4 (9.3)	0 (0.0)	0.121

All the patients with the glottis as the origin of their primary cancer had an N0 neck and the difference observed in this subsite was statistically significant (p=0.003) (Table 4).

Table 5: Subsite of primary cancer versus the level of cervical nodes detected

Cervical node group(s) & Cancer subsites	Total	II	II, III	II, III, IV	III	III, IV	IV	P-value
Supraglottic	6	4	0	1	1	0	0	0.179
Clinical Transglottic	33	4	9	5	10	2	3	0.067
Radiological Transglottic	4	2	1	1	0	0	0	0.688
Total for node groups	43	10	10	7	11	2	3	-
Percentage	100.0	23.3	23.3	16.3	25.6	4.6	6.9	0.204

For Patients with N+ cervical nodal status, all the nodes were detected at levels II, III, and IV. On testing for the association between the sub-site of origin of the primary cancer of the larynx and the predilection to any specific levels of cervical nodal groups, the differences noted were not statistically significant, with p-values of 0.179, 0.067 and 0.688 for supraglottic as well as clinical and radiological trans-glottic cancers respectively. There was no significant differences for the combination of patterns of nodal level distribution (p=0.204). In this study there was no involvement of level I, V, or VI cervical nodes detected.

Table 6: Association between laryngeal primary site and laterality of neck nodes

Subsite of primary cancer	Total	Ipsilateral	Bilateral	P-value
Supraglottic	6	4	2	0.699
Clinical transglottic	33	17	16	0.728
Radiological transglottic	4	2	2	1.000

Among patients studied with N+ neck node status, 53.5% had ipsilateral lymphadenopathy while 46.5% had bilateral cervical lymphadenopathy. Zero percent had contralateral cervical lymphadenopathy. There was no significant association between the subsite of primary laryngeal cancer to either a predilection to ipsilateral or bilateral cervical lymphadenopathy. However, the finding that as high as 46.5% of patients who had N+ neck nodes status had bilateral cervical lymphadenopathy is clinically significant in the care of these patients.

Table 7: Overall clinical and radiological T stage of primary laryngeal cancer

Stage	No.	(%)
T1	5	6.3
T2	2	2.5
T3	30	38.0
T4a	36	45.6
T4b	6	7.6

In the study, 53.2% of patients presented with T4 primary laryngeal cancer. Patients with locally advanced primary disease at T3 and T4 accounted for 91.2% of all patients in the study.

Table 8: Association between primary stage of laryngeal cancer and neck node status

	Total	N+	N0	P-value
T1	5 (6.3)	1 (2.3)	4 (11.1)	0.110
T2	2 (2.5)	0 (0.0)	2 (5.6)	0.117
T3	30 (38.0)	12 (27.9)	18 (50.0)	0.044
T4	42 (53.2)	30 (69.8)	12 (33.3)	0.001

T4 primary laryngeal cancer accounted for 69.8% of all N+ neck disease and 33.3% of N0 neck disease (p=0.001). T3 primary laryngeal cancer accounted for 27.9% of all patients with N+ neck disease and 50.0% of all the patients with N0 neck disease (p=0.044) (Table 8).

Table 9: The T stage of primary cancer versus cervical nodal stage

T stage of primary cancer	Total	N1 (%)	N2/N3 (%)	P-value
T1	1	1(11.1)	0 (0)	0.209
T3	12	5(55.5)	7(20.6)	0.088
T4	30	3(33.3)	27(79.4)	0.014

Patients with T4 primary laryngeal cancer constituted 79.4% of those who presented with advanced cervical lymph node metastasis N2/N3 nodal stage and 33.3% of those with early cervical lymph node metastasis N1 nodal stage (p=0.014) (Table 9). Advanced primary laryngeal cancer at stage T4 is significantly associated with advanced cervical lymph node metastasis of the disease (Table 10).

Table 10: Grade of differentiation of primary cancer

Grade of cancer differentiation	No.	(%)
Grade 1: Well differentiated SCC	24	30.4
Grade 2: Moderately differentiated SCC	41	51.9
Grade 3: Poorly differentiated SCC	14	17.7

All patients in this study (100.0%) had squamous cell carcinoma of the larynx. There were 51.9% who had moderately differentiated grade, 30.4% with well differentiated, and 17.7% who had the poorly differentiated grade. There was no patient with grade 4 (undifferentiated) laryngeal carcinoma (Table 11).

Table 11: Association between grade of differentiation of primary cancer and nodal status

	Total	N+	N0	P-value
Grade 1: Well differentiated	24 (30.4)	14 (32.6)	10 (27.8)	0.645
Grade 2: Moderately differentiated	41 (51.9)	17 (39.5)	24 (66.7)	0.016
Grade 3: Poorly differentiated	14 (17.7)	12 (27.9)	2 (5.6)	0.010

Patients with a poorly differentiated squamous cell carcinoma of the larynx accounted for 27.9% of all the N+ cervical nodal status and 5.6% of all the N0 cervical nodal status (p=0.010), while those with moderately differentiated squamous cell carcinoma of the larynx accounted for 39.5% of the N+ cervical nodal status and 66.7% of the N0 cervical nodal status (p=0.016). Those patients with well differentiated carcinoma of the larynx accounted for 32.6% of the N+ cervical nodal status and 27.8% of the N0 cervical nodal status (Table 11).

Table 12: Grade of differentiation versus cervical nodal stage

Grade & Nodal stage	Total	N1	N2/N3	P-value
Grade 1: Well differentiated	14	1	13	0.045
Grade 2: Moderately differentiated	17	7	10	
Grade 3: Poorly differentiated	12	1	11	

Among the patients with N+ neck node status, 9 (20.9%) had early nodal/ regional disease N1, while 34 (79.1%) had late/ advanced nodal disease N2/ N3. Overall, when this observation was tested against the grade of differentiation of primary laryngeal carcinoma, it was statistically significant (p= 0.045) (Table 12). Thus, a worsening grade of histology of primary laryngeal cancer may be a significant predictor of a more advanced cervical nodal diseases.

DISCUSSION

Cancer of the larynx is the most common head and neck cancer whose incidence ranges from 20% to 40%[2,4]. It predominantly affects the male gender with the male to female ratio varying from 5.2:1 to 24:1, and the peak age is in the 7th decade of life[2,4,5]. This heavy male preponderance is comparable to studies elsewhere since males tend to consume more alcohol and smoke cigarettes more than females as was found also in a Kenyan survey[6]. In the survey, 2% of women used tobacco in its various forms, whereas 1% smoked cigarettes which may explain the low prevalence of laryngeal squamous cell carcinoma in the females. Studies in other centres have shown up to 100% prevalence of laryngeal squamous cell carcinoma among males[7].

In this study, 81.0% of the patients had multisite primary laryngeal cancer being trans-glottic in origin, 10.1% had isolated supra-glottic carcinoma and 8.9% isolated glottic cancer. Overall, subglottic cancer was observed in 4 out of the 79 patients (5.06%), however, this sub-site was not involved in isolation, but as part of the trans-glottic malignancies of which it constituted 6.3%. The finding differs slightly with those in the study by Sandabe *et al*[4] who reported the sub-site distribution as 43% trans-glottic, 37.6% supra-glottic, 9.7% glottic and 9.7% sub-glottic in the sub Saharan Africa population. This difference may be explained by the fact that the patients in our study presented late and thus a clear delineation of the exact sub-site of origin of primary cancer was difficult.

The sub-site of origin of the primary laryngeal cancer has also been postulated to have an association with the cervical nodal status of the patients. In this study, patients with isolated supra-glottic carcinoma of the larynx were 10.1% while isolated glottic carcinoma patients made up 8.9% of all the patients. An overwhelming majority had laryngeal cancer of trans-glottic origin indicating that multisite involvement of the primary carcinoma is more common. Isolated cancer of the subglottic larynx was not observed.

Trans-glottic cancer of the larynx (multisite) was associated with a 76.6% detectable cervical nodal metastatic rate. This compares with the results in the studies by *Ahsan et al*[18] and Kirchner[19] who reported 72% and 65% incidence of detectable cervical nodal metastasis respectively. Isolated carcinoma of the sub-glottis was not observed in this population; however, 4 patients out of 64 with trans-glottic laryngeal cancer had sub-glottic involvement of the primary cancer. All patients who had sub-glottic extension of the primary laryngeal cancer also had positive neck node metastasis, thus 9.3% of all N+ patients were patients with sub-glottic extension of laryngeal cancer. This finding differs with the findings by Ahsan *et al*[18] and Kirchner[19] who both reported 0% incidence of neck node metastasis in sub-glottic laryngeal cancer. The methodology in this study and that of both Ahsan *et al*[18] and Kirchner[19] were similar and, therefore, the difference in the findings may warrant further research involving a larger population of patients.

In this study, carcinoma of the glottis was significantly associated with lack of cervical nodal metastasis (N0 nodal status), p=0.003. This finding significantly differs with those of Ahsan *et al*[18] who found 30% N+ neck node status and Kirchner[19] who found a 25% N+ neck node status. The methodology of this study was comparable to that by Ahsan *et al*[18] and Kirchner[19] and therefore, the marked difference may be explained by racial and regional variation in the populations that may need to be investigated in a larger study.

The stage of primary laryngeal cancer (T stage) has also been postulated to be associated with presence or absence of cervical lymph node metastasis. In this study, 6.3% of patients presented with stage T1 disease, 2.5% with stage T2 disease, 38.0% stage T3 disease and 53.2% stage T4 disease. This compares with the findings of the studies by Luca *et al*[20] and Wenyue *et al*[21] especially for T1, T3 and T4 stages. However, in this study, stage T2 patients only accounted for 2.5% of

the patients which was significantly much lower than the 31% -60% reported by Luca *et al*[20] and Wenyue *et al*[21], this difference may be due to a subjective definition for T2 laryngeal cancer which leads to lack of uniformity in staging.

It was also observed in this study that T3 laryngeal cancer accounted for 27.9% of all patients with N+ cervical nodal status while T4 laryngeal cancer accounted for 69.8% of N+ cervical nodal status. Both T3 and T4 primary laryngeal cancer were significantly associated with presence of cervical lymph node metastasis (p=0.044 and 0.001 respectively). This observation compares with those by Wenyue[21] who documented 38.0% N+ status for T3 and 25% N+ status for T4 laryngeal cancer. Nevertheless, these findings are much lower than the metastatic rates reported by Ahsan[18] at T1 14.3%, T2 41.2%, T3 81.8% and T4 100%. Attempts have also been made to establish the association between the sub-site of origin of primary laryngeal cancer and the level(s) of metastatic cervical nodes. In this study, only levels II, III and IV were detected to have metastatic disease. However, when statistical test of association was done, this association between sub-site of origin of laryngeal primary cancer and the levels of cervical neck node metastasis was insignificant. In spite of this, the observation is still comparable to the findings by Ahsan *et al*[18], Akhter *et al*[22] and Luca *et al*[20] who all demonstrated a predilection of levels II, III and IV cervical nodes to be the ones involved in loco-regional metastasis of laryngeal cancer.

All the patients in this study (100%) had squamous cell carcinoma of the larynx. This finding is in keeping with multiple studies that have found that squamous cell carcinoma constitutes over 95% of all head and neck cancer histology including cancer of the larynx[22]. The study has also demonstrated a statistically significant association between poorly differentiated histology of the primary cancer with the presence of cervical neck node metastasis. There has also been a statistically significant association demonstrated for the moderately differentiated squamous cell carcinoma histology. Though, this study was a cross-sectional descriptive hospital-based study, its findings are comparable to several other retrospective studies[23-25] which also found some association. Kowlasky *et al*[24] for example in his study demonstrated an Odds Ratio of 4 showing that grade 3 (poorly differentiated) laryngeal cancers were four times more likely to manifest with cervical nodal metastasis which is both clinically detectable as well as occult than grade 1 (well differentiated) cancer.

CONCLUSIONS

(i) Laryngeal cancer patients presenting at the Kenyatta National Hospital predominantly have trans-glottic primary disease.
(ii) A majority of these patients present with T4 primary laryngeal cancer and the advanced primary disease is significantly associated with presence of detectable cervical lymph node metastasis.
(iii) Grade 3 poorly differentiated laryngeal squamous cell carcinoma is significantly associated with presence of detectable cervical lymph node metastasis.
(iv) Glottic laryngeal cancer is significantly associated with N0 neck node status.
(v) For patients with N+ neck node status, advanced grade of differentiation of primary laryngeal cancer is associated with more advanced cervical nodal disease N2/ N3.
(vi) For N+ neck node status, levels II, III and IV neck nodes were detected to be the sites of cervical metastasis, however, there is no significant association between the sub-site of primary laryngeal cancer to metastasis to any cervical lymph node level or groups of node levels.

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RESEARCH ARTICLE

VASCULAR ANATOMICAL VARIANTS OF THE TEMPORAL BONE AS DEPICTED ON HIGH RESOLUTION TEMPORAL BONE CT SCANS DONE IN NAIROBI, KENYA

Onyango S[1], Mugwe P[1], Thinwa J[2]

[1] Department of Surgery (ENT), University of Nairobi, Kenya
[2] Department of Radiology, Kenyatta National Hospital, Nairobi, Kenya

***Address for correspondence**:* Dr. Stephen Onyango, Department of Surgery (ENT), University of Nairobi, P. O. Box 19676– 00202, Nairobi, Kenya. Email: dronyango@gmail.com

ABSTRACT

Background: The temporal bone is the center of otology practice thus understanding its anatomy and variations is important for diagnosis, treatment and planning surgeries in ear pathology. Vascular variants may present with pulsatile tinnitus and pose high haemorrhagic risk during ear surgery.
Objective: To determine the patterns and prevalence of vascular anatomical variations in temporal bone anatomy as depicted on High Resolution Computed Tomography (HRCT) scans.
Design: A descriptive cross-sectional study.
Methodology: The study was carried out on 100 participants (182 radiologically normal temporal bones) who underwent HRCT of the temporal bone at the Kenyatta National Hospital and Plaza Imaging Solutions, both centres are located in Nairobi, Kenya.
Results: The age range was 2-74 years with a mean of 31.6±16.5 years and a male:female ratio of 1:1.1. The vascular variants noted included prominent sigmoid sinus (70.3%), lateral sigmoid sinus (22.5%), lateral internal carotid artery (12.6%), high jugular bulb (11.5%), anterior sigmoid sinus (8.8%), dehiscent jugular bulb (6.6%), anomalous transpetrous venous channel (1.6%) and petrosquamous sinus (1.1%). There were higher paediatric rates of lateral sigmoid sinus at 60% versus adults'16.6% (p= 0.001), sigmoid sinus dehiscence at 12% versus adults'10.2% (p= 0.02) and high jugular bulb at 16% versus adults' 10.8% (p=0.048). No gender predilection for anatomical variants was noted. Data analysis was conducted using SPSS version 22.
Conclusion: There was a high prevalence of vascular variants with significant disparity between age groups and individuals. These variants should be actively sought when reviewing patients' scans.

Key words: Vascular variants, Temporal bone, HRCT and prevalence

INTRODUCTION

Anatomical variations are the normal flexibilities or differences in topography and morphology of body structures usually of embryonic or genetic origin[1]. The variations clinically influence predisposition to certain illnesses, symptomatology, clinical findings, investigation findings and patient management especially in surgical procedures[2]. Vascular anatomical variants in the temporal bone may clinically simulate or result in pathology for example pulsatile tinnitus by aberrant Internal Carotid Artery (ICA) and sigmoid anomalies and otoscopic resemblance to glomus tumour or high haemorrhagic risk during ear operations by persistent stapedial artery and aberrant ICA[3-6] . There are significant differences in temporal bone by gender and age where by age, below 10.8 years, the temporal bone may be considered immature by bone density[7] thus paediatric-type and this immaturity may account for the higher prevalence of anatomical variants in the paediatric age group. This study aimed at determining the patterns and prevalence of vascular anatomical variations of the temporal bone in patients evaluated by temporal bone HRCT in two Nairobi based centres: Kenyatta National Hospital (KNH) and Plaza Imaging Solutions.

MATERIALS AND METHODS

Study procedure

This was a descriptive cross-sectional study conducted after approval by the local ethics and research committee. The study population consisted of patients independently referred by their physicians for HRCT of temporal bone to either study centre. The sample size of 100 participants was calculated using a World Health Organization formulae for the "safest choice" of prevalence as 50%[8]. Participants were recruited by convenience sampling. Their demographic data was entered into a data collection sheet. Their HRCTs were

stored in a compact disc and subsequently evaluated by the principal researcher and one (the same) consultant radiologist. Temporal Bones (TBs) with pathology obscuring visualization of and/or erosion of major landmarks and anatomical features were excluded from the study but the normal contralateral ear was included as an unpaired TB thus 18 unpaired TBs and 82 paired TBs totaling 182 radiologically normal TBs were studied. The anatomical variations were recorded in the data collection sheet. The diagnostic criteria for the vascular anatomical variants are shown in Table 1.

Equipment

The CT scan machine at KNH was a Philips 16 slice Brilliance machine that took standard axial scans by helical technique (140kV, 250mA, rotation time of 0.75 seconds, section thickness of 0.6mm). The CT scan machine at Plaza Imaging Solutions was Aquilion One Toshiba 320 slice machine that took standard axial plane scans by helical technique (135kv, 200mA, rotation time of 1.5 seconds, slice thickness of 0.5mm). To standardize image evaluation, RadiAnt Dicom viewer version 5.5.0 was utilized.

Table 1: Diagnostic criteria for vascular variants

	Vascular anatomical variations	Description on HRCT
1.	Aberrant ICA	An internal carotid artery that is laterally displaced into the middle ear cavity and no carotid canal, best seen in axial view
2.	Lateral ICA	An internal carotid artery with a dehiscent lateral bone cover, adjacent to the middle ear cavity, in at least one axial and one coronal view (orthogonal plane)
3.	Persistent stapedius artery	Soft tissue density at the cochlear promontory with expansion of the tympanic facial canal, obliteration of the stapes obturator foramen and the absence of the foramen spinosum in axial view
4.	Anterior Sigmoid Sinus (ASS)	Sigmoid sinus whose anterior sigmoid plate is ≤9mm from the posterior EAC bony wall when seen in axial view
5.	Lateral Sigmoid Sinus (LSS)	Sigmoid sinus that is laterally placed compared to the contralateral side or the lateral distance to the outer cortex is less than the thickness of the cranium taken at the ipsilateral occipitomastoid suture in axial view at the level of EAC
6.	Prominent Sigmoid Sinus (PSS)	Sigmoid with a significant lateral indentation on the sigmoid plate relative to the contralateral sigmoid or ≥33.3% protrusion of the sigmoid sinus diameter into the mastoid seen in axial view at EAC level
7.	Sigmoid sinus dehiscence	A defect in the bony sigmoid plate with direct exposure of the sigmoid sinus to the mastoid airspaces
8.	High Jugular Bulb (HJB)	A jugular bulb that is seen at the same level as the IAC in axial or coronal view
9.	Dehiscent jugular bulb	The absence of bony covering on the jugular bulb with its direct exposure to the middle ear cavity when seen in axial and coronal views
10.	Sigmoid diverticulum	Isolated sigmoid projection into the mastoid aircells through sigmoid sinus dehiscence
11.	Large mastoid emissary vein	A prominent mastoid emissary vein with its width being ≥33.3% of the ipsilateral sigmoid diameter in axial view
12.	Petrosquamous sinus	An aberrant vascular channel seen as a linear hypodensity in a bony canal from the mastoid roof draining to the sigmoid sinus and running in an anteroposterior direction

Abbreviations: EAC = External Auditory Canal; ICA = Internal Carotid Artery

Data analysis

Data analysis was performed using IBM SPSS statistical software (Version 22) and correlations analyzed using Fisher's exact test.

Study limitations

The clinical indications for the HRCTs were not captured thus minimal direct clinicoradiological correlations could be deduced.

RESULTS

Temporal bone HRCT scans of 100 participants (182 normal temporal bones) were examined as 82 paired TBs and 18 unpaired TBs.

Demography

The participants' ages ranged from 2-74 years. The mean age was 31.8±16.5 years. The males were 7 (47%) and females 53 (53%). The paediatric group (≤11 years) consisted of 14 participants (14% of study group) where 25 TBs were evaluated. The comparative demographics by age, gender and central tendencies are contrasted in Table 2.

Table 2: Age and gender of participants

Tendencies → / Group ↓	Study size	Range (years)	Mean age	Median age	Mode	M:F
Paediatric group	14(14%)	2-10	6.4	7.5	2	1.3:1
Adult group	86(86%)	12-74	35.9	36	48	1:1.2
Overall group	100(100%)	2-74	31.8	32	48	1:1.1

Variant anatomy of temporal bone

The overall vascular variants observed included Prominent Sigmoid Sinus (PSS) at 70.3%, Lateral Sigmoid Sinus (LSS) 22.5%, Lateral ICA 12.6%, High Jugular Bulb (HJB) 11.5%, Anterior Sigmoid Sinus (ASS) 8.8%, dehiscent jugular bulb 6.6%, anomalous transpetrous venous channel 1.6% and petrosquamous sinus 1.1%. No aberrant ICA, persistent stapedial artery or jugular diverticulum were observed.

There were higher paediatric rates of LSS at 60% versus adults' 16.6% (p= 0.001), sigmoid sinus dehiscence at 12% versus adults'10.2% (p= 0.02) and HJB at 16% versus adults' 10.8% (p=0.048). The overall prevalence and age contrasted prevalence of variants are summarized in Tables 3 and 4.

Table 3: Summary of overal vascular variations in temporal bone HRCTs

Variations		Rt n=89 (48.9%)	Lt n=93 (51.1%)	Total n=182 (100%)	Comments
1.	Aberrant ICA	00	00	00	1 case LICA protrusion
2.	Lateral ICA	13	10	23(12.6%)	
3.	Persistent stapedius rtery	00	00	00	
4.	Anterior sigmoid sinus	6	10	16(8.8%	
5.	Lateral sigmoid sinus	21	20	41(22.5%)	
6.	Prominent sigmoid sinus	68	60	128(70.3%)	3 cases sigmoid diverticula
7.	Sigmoid sinus dehiscence	12	7	19(10.4%)	
8.	High jugular bulb	14	7	21(11.5%)	
9.	Dehiscent jugular bulb	7	5	12(6.6%)	
10.	Jugular diverticulum	00	00	00	
	Mastoid type				
	Hans 1	10	13	23(12.6%)	
	Hans 2	19	11	30(16.6%)	
	Hans 3	12	13	25(13.7%)	
	Hans 4	40	47	87(47.8%)	
11.	Sclerosed	8	9	17(9.3%)	
12.	Petrosquamous sinus	1	1	2(1.1%)	

Table 4: Prevalence of vascular variation by age groups

Variations		Paediatric group n=25(100%)	Adult group n=157(100%)	Overall group n=182(100%)	P-value
1.	Aberrant ICA	00	00	00	-
2.	Lateral ICA	00	23(14.6%)	23(12.6%)	0.54
3.	Persistent stapedius rtery	00	00	00	-
4.	Anterior sigmoid sinus	4(16%)	14(1.6%	16(8.8%	0.27
5.	Lateral sigmoid sinus	15(60%)	26(16.6%)	41(22.5%)	0.001
6.	Prominent sigmoid sinus	17(68%)	111(70.7%)	128(70.3%)	0.62
7.	Sigmoid sinus dehiscence	3(12%)	16(10.4%)	19(10.4%)	0.02
8.	High jugular bulb	4(16%)	17(10.8%)	21(11.5%)	0.048
9.	Dehiscent jugular bulb	00	12(7.6%)	12(6.6%)	1.00
10.	Jugular diverticulum	00	00	00	-
11.	Mastoid type				
	Hans 1	7(28%)	16(10.2%)	23(12.6%)	0.11
	Hans 2	6(24%)	24(15.9%)	30(16.6%)	0.31
	Hans 3	3(12%)	22(14.0%)	25(13.7%)	1.00
	Hans 4	7(28%)	80(50.9%)	87(47.8%)	0.35
	Sclerosed	2(8%)	15(9.6%)	17(9.3%)	1.00
12.	Petrosquamous sinus	1(4%)	1(0.6%)	2(1.1%)	0.14

Lateral ICA was the only arterial variant observed in this study with a prevalence of 12.6% and 38.5% bilaterality. Lateral Sigmoid Sinus (LSS) prevalence was 22.5%, sigmoid sinus dehiscence was 10.4% and Anterior Sigmoid Sinus (ASS) was the least common sigmoid variation at 8.8%. Large emissary vein was noted in 5.5% TBs with no bilaterality (Figure 1).

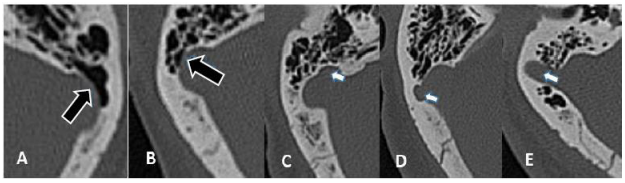

Figure 1: Axial views of sigmoid dehiscence (white hollow arrows)-A/B and sigmoid diverticula (white solid arrows)-C/D/E

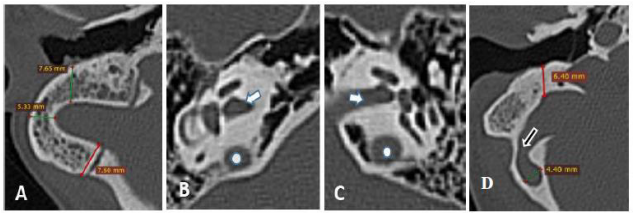

Figure 2: Axial views of concurrent ASS/ LSS/ PSS-A, bilateral HJB-B/C (white spots- jugular bulb / white solid arrows- IAC both seen at the same level) and Rt ASS/LSS with a large emissary vein-D (white hollow arrow)

Subarcuate canal was seen in 122/182 (67.0%) of TBs with 71.4% bilaterality. The subarcuate canals that were prominent totaled 13/122 (10.7%). Jugular foramen symmetry was also assessed in the 82 paired TBs (Figure 3). Asymmetrical jugular foramen was seen in 33/82 (40.2%) of paired TBs against n=49/82 (59.8%) with symmetrical foramina.

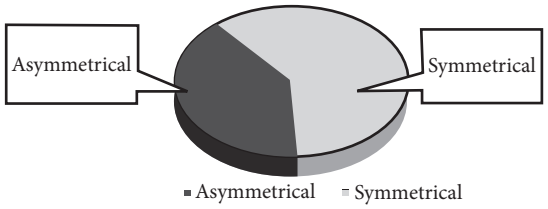

Figure 3: Jugular foramen symmetry

Aberrant soft tissue density, possibly an anomalous venous channel, was observed in three TBs as noted in Figure 4 . The channel was medial to the superior semicircular canal running in an anteroposterior course to drain into the superior petrosal sinus.

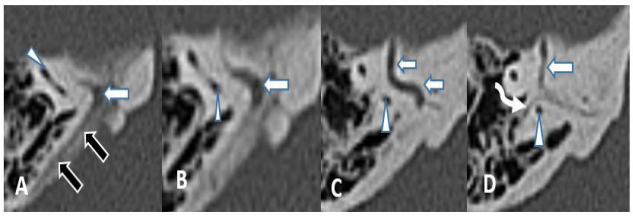

Figure 4: Anomalous venous channel (white solid arrow) from middle cranial fossa to the superior petrosal sinus is seen craniocaudally from A-D. Superior petrosal sinus (white hollow arrows, superior semicircular canal (white arrow head) and subarcuate canal (curved white arrow) are seen

Mastoid pneumatization was classified as sclerosed (9.3%) and pneumatized, where pneumatization was graded according to Han's classification[9]. The classes were Hans 1= poor pneumatization (12.6%), 2= moderate pneumatization (16.5%), Hans 3= good pneumatization (13.7%) and Hans 4= very good pneumatization (47.8%) (Figure 5).

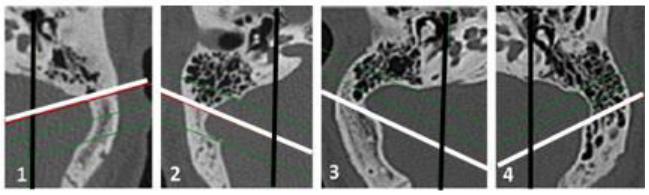

Figure 5: Scans showing mastoid pneumatization Hans types 1-4 respectively (axial cut at level of incudomalleor joint with black lines in the anteroposterior plane while white and green lines are at 40-45^0 consistent with Hans classification)

On correlations, Hans 4 mastoid pneumatization was significantly associated with PSS (p= 0.001) while sclerosed mastoid was associated with both ASS (p= <0.04) and LSS (p= <0.005). LSS was associated with both sclerosed and lower mastoid pneumatization (Hans 1 and 2) than higher mastoid pneumatization (p=<0.005).

DISCUSSION

Arterial variants in the temporal bone especially the aberrant internal carotid artery and persistent stapedial artery are extremely rare. These variants were not observed in this study and several others[6,10,11]. Lateral ICA was noted to be the highest occurring arterial variant with a prevalence of 12.6% in this study and 2-3.4% in others[6,12]. Injury to the lateral ICA and other arterial variants can result in catastrophic intraoperative haemorrhage[6] thus a cautious low threshold for diagnosis is recommended.

The sigmoid sinus, jugular bulb and mastoid emissary vein comprise the most significant venous structures in the temporal bone. The ASS prevalence was 8.8% and fell within the range of 1.1-34% prevalence by other studies[6,10-13]. The LSS prevalence of 22.5% resonates with ranges by others studies, 8.3- 28% [6,13]. Anteriorly and laterally placed sigmoid sinus significantly increase the difficulty of mastoidectomy, risk of haemorrhage and the overall operative time especially if concurrent with other variants for example low lying tegmen[6,15]. Sigmoid sinus dehiscence was noted in 10.4% TBs differing from Koesling's 1%[13]. HJB prevalence was 11.5% which was in tandem with prevalence of 6-32% given by other studies[6,12,13]. Jugular bulb dehiscence was noted in 6.6% of TBs which is slightly higher than the 1- 4% prevalence reported in other studies[6,10,11,13]. HJB and jugular bulb dehiscence have been associated with significant haemorrhage during middle ear exploration and manipulation and can similarly be confused for a glomus tumour radiologically and during otoscopy especially in jugular diverticulum[4,5,6].

The mastoid emissary veins are usually <1mm but higher mean sizes have been reported[15,16]. In this study, the prevalence of large emissary vein was 5.5% without bilaterality and the veins ranged 2.3- 4.7mm in diameter where all the sizes were ≥33.3% of the ipsilateral sigmoid sinus diameter. Large mastoid emissary veins may result in significant venous haemorrhage in extended mastoidectomies and retrosigmoid approach procedures[17]. Mastoid emissary can also be a source of retrograde infection from the neck to the sigmoid, transverse, superior petrosal and even to the cavernous sinus[17].

Jugular foramen was asymmetrical in 40.2% of paired TBs resonating with Koesling's 42% prevalence but contrasting Tomura's 4%[10,13]. Asymmetrical jugular foramen could be a normal variant but it could also indicate lesions causing expansion of the foramen for example glomus jugulare or schwannomas. No lesion was noted as the cause of jugular foramen asymmetry in this study. Subarcuate canal was noted in 67.0% of TBs whereas Koesling noted it in 93% of cases[13]. Subarcuate canal is also called the petromastoid canal and runs from the medial anteromedial margin of the cephalad petrous and passes between the limbs of the superior semicircular canal. It was very prominent in 10.7% of cases and could easily be mistaken for a temporal bone fracture[5].

Petrosquamous sinus (Figure 6) was observed in 1.1% of TBs that was similar to Koesling's low prevalence of 1.4% but significantly differed from Pawel's 6.9% observation[6,13]. This sinus denotes the persistence of embryonic vascular channel, possibly the lateral capital vein, that runs in an anteroposterior direction usually on the bony roof of the mastoid cavity and drains into the sigmoid sinus[6,18]. It is directly associated with mastoidectomy related bleeding which could be profuse and confused for sigmoid sinus bleeding[6,18].

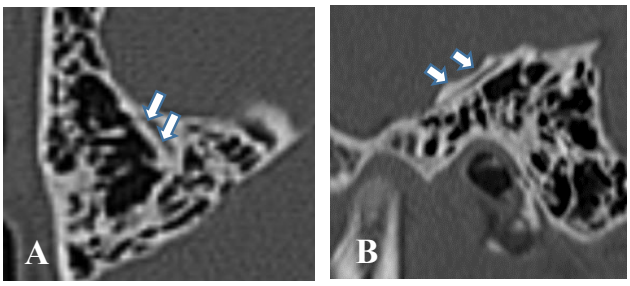

Figure 6: Petrosquamous sinus in axial- A and sagittal- B views

Several anomalous and aberrant venous channels in the temporal bone have been described[19,20]. These have been attributed to persistence of embryonic vasculature especially of the lateral capital vein also called the primary head sinus[19,22]. The anomalous channel seen unilateraly in 3 cases (1.6% of TBs) were consistently anterior to the superior semicircular canal thus may be an aberrance, persistent lateral capital vein or a transpetrous vein[18,20].

CONCLUSION AND RECOMMENDATION

There is a high prevalence rate of vascular temporal bone variations in this study. This may suggests a reciprocal predisposition to surgical complications or suggestive symptomatology. The differences in the prevalence rates of the vascular variants between this study and others, may imply that vascular variants differ based on geographical region and may have a genetic element. It is prudent for the otolaryngologists and radiologists to actively seek these variations on a case by case basis during temporal bone HRCT evaluation to reduce pitfalls in diagnosis of ear pathology, planning and undertaking otologic procedures.

Declaration of interest: The authors report no conflicts of interest.

Ethical approval: Ethical approval was given by KNH/UoN Ethics and Research Committee.

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PRE-TREATMENT HAEMATOLOGIC MARKERS OF INFLAMMATION IN MUCOSAL HEAD AND NECK SQUAMOUS CELL CARCINOMA AT THE KENYATTA NATIONAL HOSPITAL, NAIROBI, KENYA

Bonko MN[1,2], Mugwe P[2,3], Yuko E[2,3]

[1]Faculty of Health Sciences, University of Buea, Cameroon
[2]Department of Surgery, School of Medicine, University of Nairobi, Kenya
[3]Kenyatta National Hospital, Nairobi, Kenya

Address for correspondence: Dr. Bonko N. Mengjo, Faculty of Health Sciences, University of Buea, Cameroon. Email: nevillemenchs@gmail.com

ABSTRACT

Background: Head and Neck Squamous Cell Cancers (HNSCC) are among the commonest cancers encountered in clinical practice, constituting a significant public health problem. Diagnosis, and management of these cancers remains challenging to clinicians especially in resource limited settings. Use of simple and affordable biomarkers of inflammation like the Neutrophil Lymphocyte Ratio (NLR), Platelet Lymphocyte Ratio (PLR) and the Red Cell Distribution Width (RDW) may highlight the role of inflammation in patients with mucosal HNSCC in this setting.
Objective: The aim of this study was to investigate the effect of mucosal HNSCC on the levels of haematologic markers of inflammation viz, NLR, PLR and RDW, at the Kenyatta National Hospital (KNH), Nairobi, Kenya.
Design: This was a cross-sectional case control study.
Methods: The study involved 61 mucosal cancer patients and 61 gender-matched and age-matched controls at KNH. Convenience sampling technique was used to recruit participants. Our data collection tool captured the demographic, clinical and disease specific characteristics of the respondents. The NLR, PLR, and RDW were computed from the Complete Blood Count (CBC) result slips.
Data management and analysis: Data was expressed as means and standard deviations. Differences between variables in case and control groups were analysed using the Pearson's Chi-squared test and mean levels of PLR, NLR and RDW were correlated with clinico-demographic variables by one-way analysis of variance (ANOVA). A two tailed P-value of <0.05 was our cut off for statistical significance.
Results: A total of 61 cases and 61 controls were recruited into this study. Males constituted 41 (67.2%) of both study arms. The mean age for cases was 45.30±17.17 years and 43.00±15.45 for controls. Mean values of NLR between cases and controls were 4.1±4.8 and 1.3±0.7 respectively (P<0.001). Values of PLR for cases and controls were 238.4±138.5 and 117.8±44.0 (P<0.001). Similarly, cases had a higher RDW (CV) value compared to controls, 14.8±3.5 and 13.8±1.2 respectively, p= 0.04. When values of NLR and PLR were dichotomized, the odds ratio for having mucosal HNSCC and having a raised NLR, PLR and RDW were 5.55 (CI: 2.60-11.85, P<0.001), 3.25 (CI: 2.01-5.25, P<0.001) and 1.57(CI: 0.89-2.74, p=0.08) respectively. There was a non-significant increase of NLR with T-stage of mucosal HNSCC.
Conclusion: The NLR, PLR and RDW levels are significantly higher in mucosal HNSCC patients than in healthy individuals. We recommend appropriate studies to correlate these indices with treatment outcomes, mortality, and prognosis of mucosal HNSCC in this setting.

Key words: Haematologic markers, Complete blood count, Neutrophil lymphocyte ratio, Platelet lymphocyte ratio, Red cell distribution width

INTRODUCTION

Mucosal HNSCCs (HNCs) are cancers arising within the mucosal surfaces of the hypopharynx, nasal cavities and sinuses, nasopharynx, larynx, and oral cavity, the most common histological variant being squamous cell carcinoma[1]. HNCs are the fifth most common cancers globally and are responsible for more than 600,000 new cases diagnosed yearly and more than 300,000 deaths per year[2]. Recently, there have been many studies exploring the relationship between inflammation and carcinogenesis [3-8]. Markers of inflammation and immunity such as Neutrophil-to-Lymphocyte Ratio (NLR) and the Platelet-to-Lymphocyte Ratio (PLR) have been found useful as prognostic indicators in patients with HNCs. The red cell distribution width, a reliable marker of chronic inflammation in malnourished patients[8,9], has

been associated with poor outcomes in patients with malignancies and has shown positive correlation with cancer stage in patients with lung cancer[10].

Use of NLR, PLR, and RDW, which could all be drawn from the Complete Blood Count (CBC), could be an affordable approach in deciding on patient management, monitoring response to treatment and for prognostication in patients with mucosal HNSCCs. The full blood count is routinely performed before, during and after treatment of many disease conditions in clinical practice including mucosal HNSCCs. This investigative modality roughly estimates the patient's anaemic, inflammatory, immunologic, and nutritional status and could therefore provide benefit in this subset of patients. The main objective of the present study was to investigate the effect of mucosal HNSCCs on the levels of NLR, PLR and RDW among patients. Determination of pre-treatment levels of NLR, RDW and PLR will provide useful information for establishment of reference values for these parameters in evaluating the extent of mucosal HNSCC patients. This will also form a substantive basis for the use of these markers in monitoring of treatment response and for prognostication in our patients. These parameters may also aid in deciding on the therapeutic choices in mucosal HNSCC patients and will form a basis for further research on the applicability of inflammation in designing therapies for cancers.

MATERIALS AND METHODS

This was a cross-sectional case control study conducted at the Kenyatta National Hospital, Nairobi Kenya. This study was approved by the ethics and research committee of the University of Nairobi/ Kenyatta National Hospital, protocol number P34/01/2019. Data collection tool was a specially designed questionnaire that captured demographic characteristics of the study population, cancer characteristics and the complete blood count result slip. Cases were patients aged 18 years and above, presenting with a histological diagnosis of mucosal HNSCC. Controls were healthy individuals, aged 18 years or older who were not being followed up regularly for any disease condition. They were sampled among blood donors who had undergone assessment for fitness to donate and individuals with conditions like refractive errors or cataract followed up at KNH. They were matched with cases based on gender and age ranges established on 10 year intervals. We excluded patients who have had or are currently on treatment for mucosal HNSCC such as surgery, radiotherapy, or chemotherapy and participants with diagnosed cancers of other body regions apart from mucosa of the head and neck region. Individuals with history of long-term steroid use were also excluded. Complete blood count was analysed with an automated analyser (SYMEX™, MODEL: XN500).

Data was expressed as mean, standard deviation and 95% Confidence Interval (CI). Comparative analysis of quantitative data was achieved with Student T test whereas qualitative data was evaluated by using Chi-square and Fishers exact tests. Normally distributed data was analysed with one- way ANOVA test. Dichotomization of markers of inflammation to high and low values was based on the following cut offs; NLR-<3.5 and ≥3.5, PLR-≥350 and <350, RDW-≥15 and <15. A two tailed P-value of <0.05 was our cut-off for statistical significance.

RESULTS

A total of 122 participants (61 cases and 61 controls) met the inclusion criteria. Males constituted 41 (67.2%) of each study arm. The mean age for cases was 45.30±17.17 years and 43.00±15.45 for controls, (P=0.44). The age distribution of the study population is depicted in Figure 1 and the gender distribution is presented in Table 1.

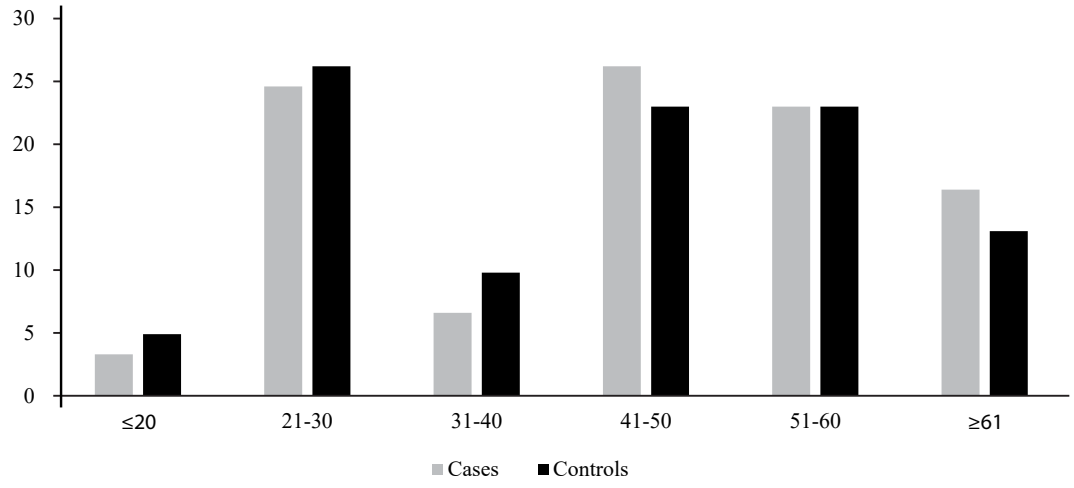

Figure 1: Age distribution of the study population

Table 1: Gender distribution

Characteristic	Case	Control	P-value
Gender			
Male	41(67.2%)	41(67.2%)	1.00
Female	20(32.8%)	20(32.8%)	
Age (years) Mean	45.30±17.17	43.00±15.45	0.44

Laryngeal carcinoma was the most common cancer (31.1%) among our participants (Figure 2). Most participants (91.8%) were at advanced stage (T3 and T4) at the time of recruitment into the study. Early stage presentations were relatively rare. Cervical nodal stage, N2, disease was the most encountered (49.2%) in our population. Distant metastases were found in only seven (11.5%) of the participants. Well differentiated squamous cell carcinomas were seen in 31 (50.8%) patients (Table 2).

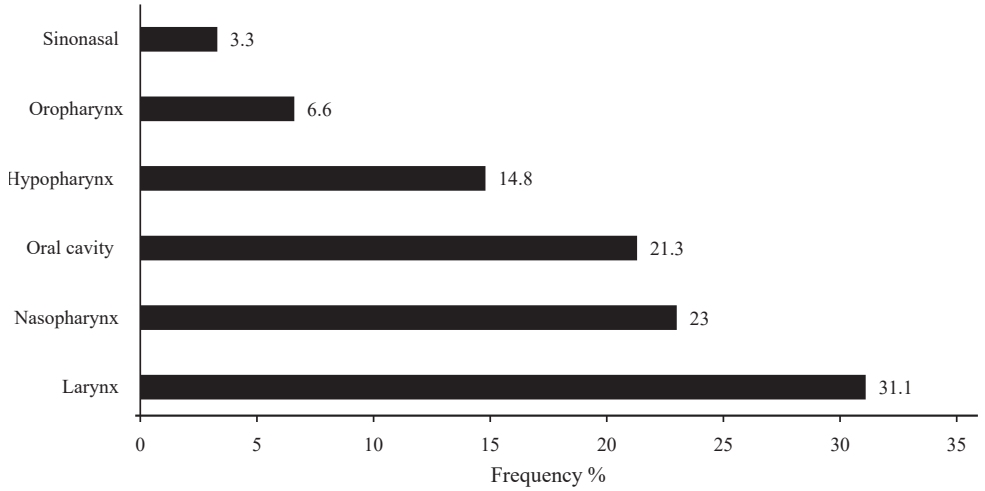

Figure 2: Distribution of cancers based on anatomical location

Table 2: Cancer characteristics

Characteristics		Frequency (%)
Location	Nasopharynx	14 (23)
	Sinonasal	2 (3.3)
	Oropharynx	4 (6.6)
	Oral cavity	13 (21.3)
	Hypopharynx	9 (14.8)
	Larynx	19 (31.1)
T-stage	T1	1 (1.6)
	T2	4 (6.6)
	T3	13 (21.3)
	T4	43 (70.5)
N-stage	N0	13(21.3)
	N1	6 (9.8)
	N2	30 (49.2)
	N3	12 (19.7)
M-stage	M0	54 (88.5)
	M1	7 (11.5)
Histological grade	Grade 1	31 (50.8)
	Grade 2	16 (26.2)
	Grade 3	2 (3.3)
	Grade 4	11 (18.0)

The complete blood count and markers of inflammation

Total white blood cell counts were significantly higher in mucosal HNSCC patients than the general population (10.0±8.31 vs 5.5±1.5 respectively, P<0.001). Differential neutrophil counts likewise were significantly higher in cases than in controls (7.1±8.1 vs 2.7±1.1 respectively, P<0.001). Lymphocyte counts however were higher among controls than cases (2.2±0.6 vs 1.7±0.6, P=0.02). Significant differences were also observed in total platelet counts between cases and controls (409.5±139.7 vs 247.8±76.1 respectively, P<0.001). Significantly higher values of the red cell distribution width coefficient variation value were observed in cases than in controls (14.8±3.5 vs 13.8±1.2 respectively, P=0.03).

Markers of inflammation were similarly higher in head and neck mucosal squamous cell carcinoma patients than in the general population. Mean values of NLR between cases and controls were 4.1±4.8 and 1.3±0.7 respectively (P<0.001) likewise, values of PLR for cases and controls were 238.4±138.5 and 117.8±44.0 (P<0.001).

When values of NLR and PLR were dichotomized, the odds ratio for having head and neck mucosal squamous cell carcinoma and having a raised NLR, PLR and RDW were 5.55 (CI: 2.60-11.85, P<0.001), 3.25 (CI: 2.01-5.25, P<0.001) and 1.57(CI: 0.89-2.74, p=0.08) respectively (Table 3).

Table 3: The complete blood count and markers of inflammation

Parameter	Normal values	Cases	Controls	P-values
WBC	4.6 -10.2	10.0±8.31	5.5±1.5	<0.001
Neutrophils	2 -6.9	7.1±8.1	2.7±1.1	<0.001
Lymphocytes	0.6 -3.4	1.7±0.6	2.2±0.6	0.02
Platelets	142 -424	409.5±139.7	247.8±76.1	<0.001
RDW (CV)	11.6-14.8	14.8±3.5	13.8±1.2	0.04
NLR		4.1±4.8	13.8±1.2	<0.001
PLR		238.4±138.5	117.8±44.0	<0.001

Correlations between markers of inflammation and clinicodemographic parameters

Higher values for NLR were found among male cases than female cases**,** 4.7±5.6 vs 3.1±2.4 but similar in controls across both gender categories. This relationship was not however significant, P=0.28. On the contrary, among the cases, females had higher values of PLR and RDW than males, 242.7±107 and 15.2±3.6 vs 236.2±152.7 and 14.6±3.4 for controls, females had higher values for PLR than males, 127.8±44.2 vs 113.0±42.6 but similar values for RDW, 13.8±1.4 vs 13.8±1.0. The relationship between PLR and RDW with gender was not significant, P=0.64 and P=0.52, respectively. The NLR, PLR and RDW were therefore, similarly distributed across both gender categories (Table 4).

Table 4: Correlation between gender and markers of inflammation

Characteristics	Gender	Case	Control	P-value
NLR	Male	4.7±5.6	1.3±0.8	0.28
	Female	3.1±2.4	1.3±0.5	
PLR	Male	236.2±152.7	113.0±42.6	0.64
	Female	242.7±107	127.8±44.2	
RDW	Male	14.6±3.4	13.8±1.4	0.52
	Female	15.2±3.6	13.8±1.0	

Highest values for NLR were recorded in the 31-40-year age group for both cases and controls, 5.5±7.2 and 1.9±1.7, respectively, P=0.92. There was no predictable relationship between PLR, RDW and age and no statistical differences existed between both groups.

Table 5: Correlation between markers of inflammation and age of participants

Marker	Ages (years)	Case	Control	P-value
NLR	≤20	5.0±1.6	0.7±0.3	0.92
	21-30	3.4±2.8	1.1±0.4	
	31-40	5.5±7.2	1.9±1.7	
	41-50	4.0±2.3	1,4±0.4	
	51-60	5.1±8.6	1.3±0.4	
	≥61	3.4±2.6	1.2±0.4	
PLR	≤20	362.7±39.8	117.9±36.7	0.30
	21-30	216.1±119.8	103.0±41.8	
	31-40	260.8±98.6	139.9±72.9	
	41-50	297.8±203.3	124.0±35.0	
	51-60	220.4±70.8	119.9±38.0	
	≥61	168.3±98.4	116.7±60.6	
RDW	≤20	16.2±1.7	12.7±1.4	0.55
	21-30	15.8±4.6	13.7±1.1	
	31-40	13.4±1.8	13.5±1.3	
	41-50	15.7±4.9	13.6±1.4	
	51-60	15.6±4.9	14.7±3.6	
	≥61	14.4±0.9	14.0±1.1	

There was a non-significant increase of NLR with T-stage of mucosal HNSCC. Oral cavity and oropharyngeal tumours had the highest levels of NLR. This relationship was however not significant. Highest levels of PLR were found in oropharyngeal cancers and oral cavity tumours had the highest values of RDW. None of these were statistically significant. T4 cancers had higher levels of NLR and PLR than the other stages. There were no predictable associations between N-stage, M-stage and histological differentiation of mucosal HNSCCs and the markers of inflammation (Table 6).

Table 6: Correlation between cancer characteristics and markers of inflammation

Characteristic		Mean NL-R±SD	P-value	Mean PLR±SD	P-value	Mean RD-W(CV) ±SD	P-value
Tumour location	Nasopharynx	4.3±2.9	0.35	274.6±92.3	0.59	15.3±3.2	0.55
	Sinonasal	3.0±1.7		257.7±54.8		12.2±0.5	
	Oral cavity	6.1±8.6		204.3±98.8		15.8±5.9	
	Oropharynx	6.0±3.4		322.8±333.1		15.2±1.2	
	Hypopharynx	5.0±4.7		246.7±134.4		15.1±3.3	
	Larynx	2.4±2.0		213.7±146.5		13.8±1.5	
T-stage	T1	2.7	0.62	242.9	0.30	12.7	0.68
	T2	2.6±1.4		216.2±106.3		15.9±3.5	
	T3	3.2±3.2		176.3±93.7		14.0±1.4	
	T4	4.8±5.4		260.2±151.0		15.0±4.0	
N-stage	N0	5.3±8.9	0.71	175±89.4	0.05	15.2±5.0	0.35
	N1	2.7±1.0		151.0±33.0		13.4±1.4	
	N2	3.8±3.2		266.8±140.6		13.4±2.4	
	N3	5.1±3.0		283.6±177.9		16.2±4.5	
M-stage	M0	4.3±5.1	1.00	236.7±147.3	0.71	14.5±3.1	0.06
	M1	4.3±1.4		257.8±53.5		17.2±5.8	
Histological grade	Grade 1	3.6±2.5	0.65	235.7±170.3	0.46	15.0±3.4	0.91
	Grade 2	5.5±8.3		207.6±99.8		14.7±4.4	
	Grade 3	3.7±0.5		263.0±47.3		13.3±2.1	
	Grade 4	4.4±3.2		293.4±92.9		14.7±2.3	

DISCUSSION

Mucosal HNSCCs constitute a growing problem worldwide with heavy burden in terms of morbidity and mortality especially in developing countries. In this study, we sought to compare the pre-treatment levels of haematologic markers of inflammation in mucosal HNSCC patients to that of the healthy population.

This study had a predominantly male population which is consistent with the worldwide gender specific incidence rates of mucosal HNSCCs showing highest values among males than females. This is mainly attributable to cigarette smoking and alcohol consumption behaviours which are more prevalent among males than females[11].

The most prevalent subtype of mucosal HNSCC was laryngeal cancer. This finding is supported by the findings of Onyango *et al*[12] in the same study setting. This is however different from other settings especially in Asia pacific region where oral cavity cancers are the most frequently encountered[11]. The difference is mainly related to the variances in risk factor exposures, where betel quid chewing is the most common form of tobacco exposure contrary to our setting where cigarette smoking predominates. Late presentation to hospital in mucosal HNSCCs is common in our setting. Our findings are similarly reported by Onyango *et al*[12] and Oburra[13] in which studies, late presentation stemmed from misdiagnosis at primary health care settings and the inefficiency of the referral system in the most part. However, presentation to health facility of mucosal HNSCCs is variable with respect to the subsite involved. Oral cavity (tongue) and glottic carcinomas generally cause early symptoms whereas pharyngeal and supraglottic tumours usually present at an advanced stage nonetheless differences in presentation times still exist from region to region[15]. Despite advanced tumour stage and lymph node metastasis at diagnosis, distant metastasis at presentation is generally uncommon as shown in our population.

Neutrophil-lymphocyte ratio and platelet-lymphocyte ratios were significantly higher in mucosal HNSCC patients compared to healthy individuals. This finding has been reported similarly by Kuo *et al*[16]. These markers generally reflect the balance between pro-tumour inflammation and host immunity. High levels therefore suggest that mucosal HNSCCs in this study setting engender higher levels of peritumoral inflammation than can be surmounted by host immunity. Seetohul *et al*[17] showed among 170 cases of mucosal HNSCC patients and 80 controls, that the NLR and the PLR were significantly higher in the cases than the controls (2.76 ± 1.82 and 113.20 ± 60.36, P=0.005 vs 2.15 ± 0.90 and 91.41 ± 38.62, p=0.030) respectively. These values are lower than those in this present study. The difference is mainly because most of our cases presented at an advanced stage contrary to their study in which a majority of were early cancers (T2, N0). In their study among 65 laryngeal cancer patients and 42 controls, laryngeal cancer patients, Duzlu *et al*[18] demonstrated a statistically significant difference (p = 0.004) in NLR between larynx carcinoma (2.70 ± 1.25) and control group (2.04 ± 0.90). Similarly, Ciftci *et al*[19] showed among 53 laryngeal cancer patients and 50 controls, the median NLR was higher in the malignant group (1.9455) compared to the control group (1.5404) and the difference was statistically significant (p = 0.01). Rasoulli *et al*[20] showed that head and neck squamous cell carcinoma patients with higher values of these inflammatory markers have increased mortality and an associated increased incidence of recurrent disease. Furthermore, Sun *et al*[21] and Turri-Zanoni *et al*[22] showed that nasopharyngeal cancer patients with high pre-treatment levels NLR and PLR had shorter overall and disease-free survival and these findings have been similarly reported in sinonasal carcinoma.

Red cell distribution width (coefficient of variation) levels was significantly higher in mucosal HNSCC patients than healthy individuals. Peri-tumoral inflammation has been shown to disrupt the maturation process of red blood cells through membrane disruption leading to high RDW[23]. The magnitude of this disruption therefore mimics the level of systemic inflammatory response. Bozkurt *et al*[24] found that patients with laryngeal cancer had higher pre-treatment levels of RDW and this subgroup of patients had poorer survival and a higher incidence of locoregional recurrence. Though the relationship between RDW and cancer progression, treatment and outcomes is still poorly understood, inflammation and nutritional factors may be implicated as RDW has been shown to be elevated in malnutrition.

Contrary to Rassouli *et al*[20] who found significant increase in NLR and PLR with advancing T stage, our study did not find any significant relationship between clinicodemographic parameters and levels of inflammatory markers. The differences may be attributed to differences in study designs and sample sizes. Rassoulli *et al*[20] conducted a retrospective cohort study in 319 head and neck mucosal cancer patients while the present study was a case control study and comparably had a smaller sample size. Nevertheless, the findings in this present study are in keeping with other studies by Seetohul *et al*[17] and Duzlu *et al*[18].

CONCLUSIONS

We have shown in this case control study design that the NLR, PLR and RDW levels are significantly higher in mucosal HNSCC patients than in healthy individuals. There was no significant relationship between the pre-treatment levels of these markers and other clinicodemographic variables explored in this study.

RECOMMENDATION

Appropriate studies are recommended to correlate these indices with treatment outcomes, mortality, and prognosis of mucosal HNSCC in this setting.

Conflict of interest: The authors declare no conflict of interest related to this work

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CHRONIC RHINOSINUSITIS AND PROBIOTICS: A REVIEW

Mobio NMA, Nasser D, Adagra KM, Yavo-Dosso KN, Dibi K X C, Yotio A, Koffi-Aka V

ENT Department Treichville CHU 23 BP 3861 Abidjan 23, Côte D'Ivoire

Address for correspondence: Dr. Mobio N'kan Max Ange, Félix Houphouët Boigny University in Cocody, Head and Neck Department, Abidjan 23 Côte D'Ivoire. Email: mobiomax@yahoo.fr

ABSTRACT

Background: Probiotics are already used for the treatment of certain functional disorders. Despite a well-conducted medico-surgical treatment, the proportion of chronic sinusitis remains important.
Objective: To determine the contribution of probiotics in the management of chronic rhinosinusitis from a review of the literature.
Data source: We carried out a two-step bibliographic search, covering English-language publications from 2014 to 2015, using the Pubmed engine. In the first step, the key words were "probiotics" and "chronic rhinosinusitis". For the second step, the key words were "sinus microbiome", "probiotic's mechanism action" or "probiotic's study". We retained 17 publications out of 119.
Data synthesis: There is no consensus on the sinus microbiome. The *lactobacillus* strains were the most tested. Probiotics used for prevention or adjuvant treatment mainly through the nasal route appear to be more effective.
Conclusion: The efficacy of nasal probiotics has been demonstrated in adjuvant therapy and prevention.

Key words: Probiotics, Rhinosinusitis, Chronic

INTRODUCTION

Probiotics are living microorganisms which, when given in adequate quantities, produce a health benefit for the host[1]. They would help to eliminate the responsible germs and stimulate the useful germs. Probiotics that would help restore the bacterial ecosystem are already used for the treatment of certain functional disorders in gastroenterology, gynaecology and dermatology[2,3]. In ENT, we could compare the cases of imbalance of the bacterial ecosystem (dysbiosis) favoring chronic rhinosinustitis. Indeed, the passage to chronicity of rhinosinusitis despite a well-conducted medico-surgical treatment would be due to a significant inflammatory phenotype. This phenotype, expression of persistent inflammation, affects approximately 30% of patients[4,5]. Would probiotics, supposed to restore the bacterial ecosystem, be useful in the treatment of chronic rhinosinusitis? Based on a review of the literature, this work aims to respond to these concerns.

DATA SOURCE

We carried out a two-step bibliographic search, covering English-language publications from the year 2014 to 2015, using the Pubmed engine. The first step consisted of searching for publications using the keywords "probiotics" and "chronic rhinosinusitis". We obtained 14 publications of which nine were selected because they answered the appropriate combination "probiotics and chronic rhinosinusitis". The bibliographic search covered both clinical and laboratory studies, in humans as well as in animals. In the second stage, the bibliographic search consisted of consulting on Pubmed the 110 bibliographic references of previously selected publications. A reference was chosen when the terms "sinus microbiome", "probiotic's mechanism action" or "probiotic's study" were found. We therefore retained eight other publications, for a total number of 17 publications out of 119.

DATA SYNTHESIS

Sinus microbiome

There is no consensus on the exact make up of the sinus microbiome. It is polymicrobial and essentially composed of *pseudomonas, staphylococcus*, and *streptococcus*[6]. Other bacteria such as f*irmicutes* (*Lactobacillus, actinobacteria) propionibacterium*, and b*acteroidetes* have been reported[7,8]. These saprophytic bacteria can under certain conditions become pathogenic. The diversity of the microbiome prevents the proliferation of a group of bacteria that later become pathogenic. The microbiome stimulates baseline immunity by interacting with the epithelium maintaining baseline inflammatory activity[9].

Mechanism of action of probiotics

Probiotics modulate the immune system through an anti-inflammatory effect and inhibit pro-inflammatory

cells[10]. Gram-positive probiotics *lactobacilluslactis* have an anti-inflammatory effect through Interleukin 10 and inhibit pro-inflammatory cells globally (nuclear factor)[10]. On the other hand, *staphylococcus aerius* has a dependent bacterial load effect. In small amounts, it has a strong anti-inflammatory effect and inhibits pro-inflammatory cells. It behaves like a saprophytic germ which stimulates immunity. In large quantities, it has the opposite effect[10]. Probiotics produce antimicrobial agents. They promote pH variation. Probiotics compete to avoid colonization of the sinus by a pathogenic species and for receptor binding. *Lactobacillus reuteris* are produced by the protein euterin. It induces oxidative stress in competing proteins[11]. *Lactobacillus spp.* produces acetic and lactic acid thus reducing the pH, thus inhibiting the growth of acid-intolerant taxa[12-14]. *Lactobacillus johnsonii* competes at the receptor level (asialo-GM1) with *pseudomonas aeruginosa*, *haemophilus influenzae* and *Staphylococcus aureus*[15].

Clinical tests

Habermann *et al*[16] reported a multicenter double-blind study involving 157 patients. It was based on oral administration of *enterococcus faecalis* in 20 drops to 30 drops three times a day for six months. This study observed a significant reduction in sinusitis attacks with a decline of eight months after treatment. The probiotic *enterococcus faecalis* has been used as an adjuvant in 204 children with recurrent sinusitis[17]. The children were treated with amoxicillin and a nasal decongestant for seven days. Then *enterococcus faecalia* was administered at the rate of 20 drops three times a day orally for eight months. This study demonstrated a regression in the frequency and duration of attacks.

A randomized clinical test involving 77 patients by Mukerji *et al*[18] evaluated the efficacy of oral administration of probiotics in patients with chronic rhinosinusitis. *Lactobacillus rhamnosus* was administered in tablet form (containing 500 million active strains) twice a day for four weeks. The condition of the patients did not improve compared to the control group. Martensson *et al*[19] performed a randomized, double-blind study of 21 patients with chronic non-polyp rhinosinusitis. They studied the effect of nasal (spray) administration of *lactobacillus* from bees for two weeks. They concluded that there was good tolerance without any impact on the severity of the symptoms, nor of the microbial flora as well as of the local anti-inflammatory activity[19]. Roberta *et al*[20] carried out a study on 20 healthy people on the administration by the nasal route (spray) of a mixture of *streptococcus salivarius* 24SMBc and *streptococcus oralis* 89 for one week each morning after visiting the toilet. They observed a week after the end of the treatment a significant increase in 2 germs and a significant regression of *staphylococcus aureus* in the nasal secretions of healthy people. The comparison of the bacterial species in the nasal mucosa of healthy people before and after one month of treatment showed the reduction of the bacterial species in relation with a proliferation of pathogenic bacterial germs[20]. Uehara *et al*[21] found a low incidence of colonization of *staphylococcus aureus* in the nasal vestibules of 156 patients carrying c*orynebacterium tuberculostearicum*. Nasal administration of *corynebacterium tuberculostearicum* in patients with *staphylococcus aureus* resulted in the eradication of *staphylococcus aureus* in 71% of cases[21]. Abreu *et al*[7] studied the microbiome of patients suffering from chronic rhinosinusitis to identify the most common pathogenic bacteria. In a second step, they tested the efficacy of a bacteria against them using mice as a human mode of rhinosinus infection. They first studied the microbiome of patients (n=10) with chronic rhinosinusitis and healthy people (n = 10). They noted a predominance of c*orynebacterium tuberculostearicum* in patients with chronic rhinosinusitis. The abundance of c*orynebacterium tuberculostearicum* correlated with the severity of chronic rhinosinusitis. Second, the mouse (n = 20) was used as a model for rhinosinus infection to test the efficacy of *lactobacillus sakei* against c*orynebacterium tuberculostearicum*. The simultaneous administration in mice (previously treated with antibiotic therapy) of *Lactobacillus sakei* and c*orynebacterium tuberculostearicum* by the intranasal route compared to the single administration of *corynebacterium tuberculostearicum* made it possible to demonstrate a significant reduction in *corynebacterium tuberculostearicum* in the group having received the probiotic and the pathogen[7]. This would suggest a competitive inhibition of the proliferation of *corynebacterium tuberculostearicum* by l*actobacillus sakei*.

Cleland *et al*[22] studied the administration of *staphylococcus aureus* and *staphylococcus epidermis* intranasally in 20 mice divided into two groups[22]. *Staphylococcus aureus* and *staphylococcus epidermis* were administered in one group and single administration of *staphylococcus aureus* in the other group. They found a significant reduction in *staphylococcus aureus* in the group of mice receiving

the two germs. This suggests the probiotic potential of *staphylococcus epidermis* vis-à-vis *staphylococcus aureus* which is a recalcitrant germ in chronic sinusitis[22].

CONCLUSIONS

The exact composition of the sinus microbiome is not known. But the imbalance of bacterial species in the sinuses is a characteristic feature of chronic bacterial rhinosinusitis. Probiotics oppose pathogenic bacteria by two mechanisms. The first is competition for sinus space and receptors. The second is the secretion of antimicrobial substance. Lactobacillus strains have been the most widely used probiotics. Their administration by the nasal route was the most favoured. Probiotics used for prevention or as an adjuvant have proved more effective than using them alone to treat chronic bacterial rhinosinusitis.

The efficacy of probiotics has been demonstrated in the adjuvant therapy and prevention of chronic bacterial rhinosinusitis. *Lactobacillus* strains have been the most tested probiotics; the nasal route is thought to be the most favoured.

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MANAGEMENT CHALLENGES IN A PATIENT PRESENTING WITH PENETRATING EXTERNAL LARYNGEAL TRAUMA AT UNIVERSITY HOSPITAL OF TREICHVILLE, COTE D'IVOIRE: CASE REPORT

Mobio NMA, Bazilid T, Dosso-Yavo N, Nasser D, Yotio A, Adagra KM, Dibi KXC, Koffi-Aka V

Félix Houphouët Boigny University, Cocody, Head and Neck Department, 23 BP 3861 Abidjan 23, Côte D'Ivoire

Address for correspondence: Dr. Mobio N'kan Max Ange. Email: mobiomax@yahoo.fr

ABSTRACT

Penetrating external laryngeal trauma exposes the risk of laryngeal stenosis and speech dysfunction. Our objective was to present the difficulties of reconstructing the larynx after penetrating neck injury in our practice conditions. This was a 31-year-old adult without particular antecedent treated for external cervical trauma following attempted suicide. The lesion assessment revealed a loss of more than the average 1/3 of the thyroid cartilage associated with laryngeal and pharyngeal mucosal lesions. The lesions to the larynx were sutured; stenting of the larynx was made possible by placement of a nasotracheal tube. The suture and the nasotracheal intubation tube were not the best means for this situation. The poor economic condition of our patient and the lack of technical equipment couldn't allow the use of another option. Pharyngoplasty was performed using vicryl 3/0. Specialized psychiatric care was provided. The immediate post-operative period was marked by the persistence of the pharyngo-cutaneous fistula treated by maintaining the nasogastric tube. The nasotracheal tube was removed after 11 days. Resumption of speech and oral feeding was possible after 4 months. In conclusion, this laryngeal reconstruction inspired by our practice conditions proved to be effective.

Key words: External trauma, Larynx, Nasotracheal tube

INTRODUCTION

Trauma to the larynx is rare. It represents 1 case per 30,000 emergency cases in the USA and the second leading cause of death in cases of head and neck injuries[1]. Penetrating external laryngeal trauma is an emergency. Insufficient care exposes complications such as laryngeal stenosis. It can be prevented by airway stents if there is a large mucosal lesion or an unstable laryngeal fracture. The exclusive laryngeal stenting procedures are made using rolled Silastic® sheets, a Silastic® tube or a finger cot filled with gauze or sponge[2]. We are reporting a case of penetrating external laryngeal trauma following an attempted suicide by stabbing. The management required laryngeal reconstruction with limited technical equipment. The objective was to expose the difficulties of laryngeal reconstruction during management under our practice conditions.

CASE REPORT

This was a 31-year-old male patient residing in Ayahou (Aboisso region) with an unspecified history. He was referred to our department for penetrating neck injury following an attempted suicide with a bladed weapon (machete). The incident reportedly occurred at approximately 4 am on the same day. The patient reportedly presented with severe bleeding, prompting his evacuation to the regional hospital (Aboisso). After a compression bandage and an administration of anti-tetanus serum, he was sent to us the same day at 9 pm. On admission, the patient was conscious, restless, dysphonic with no evidence of respiratory distress or subcutaneous emphysema. His conjunctivae were pale. His blood pressure was 110/60mm of Hg and his respiratory rate was 19 cycles/minute and pulse rate 110 beats/mn. He received a 500ml blood transfusion, parenteral administration of amoxicillin-clavulanic acid 1g twice daily, methylprednisolone 120mg per day and paracetamol 1g three times daily. Isthmic tracheotomy and an initial assessment of the wound under general anaesthesia was performed. The patient was intubated first. Further surgical exploration nor debridement of damaged and infected tissue could not be completed due to the patient's haemodynamic instability. The lesion assessment revealed a decaying penetrating wound in zone II measuring 8cm diameter by 5cm. There was no active bleeding but there was presence of saliva and air bubbles. A guedel cannula was present within the wound. The damaged tissue consisted of a section of the muscles under hyoid bone, a loss of more than the average 1/3 of the thyroid cartilage, a section of the aryepiglottic folds, ventricular bands, lesions of the laryngeal mucosa and an opening of the left piriform sinus producing a pharyngostoma (Figure 1).

Figure 1: Wound in zone II of the cervical

Subsequently, a pharyngoplasty with vicryl 3/0 and insertion of a nasogastric tube was performed. A second surgical exploration under general anaesthesia 2 days after admission was performed. It made it possible to remove all damaged or infected tissues. The attempt to bring together the fragments of thyroid cartilage was made a bit under tension with a significant risk of laryngeal stenosis. We performed a laryngeal stenting using a nasotracheal tube. It was introduced through the right nasal cavity to above the tracheostomy opening (Figure 2).

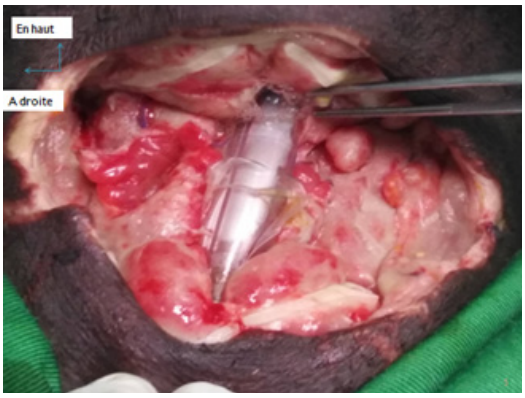

Figure 2: Laryngeal stenting using a nasotracheal intubation tube

The nasotracheal tube was attached to the right nostril wing using a 3/0 vicryl. Then a suture of the fragments thyroid cartilages under tension (Figure 3) and muscles under hyoid bone was performed using a 2/0 vicryl. The wound was sutured.

Figure 3: Suture of thyroid cartilage's fragments

On the fourth postoperative day, the patient presented with apharyngo-cutaneous fistula. Postoperatively, the medical treatment initiated was continued for 12 days. It had been combined with gentamicin for 5 days and local care for the pharyngo-cutaneous fistula. The nasotracheal tube was removed on the eleventh day postoperatively. Feeding was through a nasogastric tube. The patient was treated by the psychiatric department for delirium tremens. Closure of the pharyngo-cutaneous fistula and complete progressive decanulation of the tracheostomy cannula were achieved after 3 months as well as an improvement in his mental state. The patient resumed talking and eating. Follow-up nasofibroscopy revealed conservation of endolaryngeal structures and complete defect of the vocal cords (Figure 4).

Figure 4: conservation of laryngeal structure

DISCUSSION

The most frequently injured region of the neck is zone 2[3]. The vital structures of this affected area in our patient were the larynx and pharynx. This laryngeal injury was classified as stage IV according to the Schaefer – Fuhmann classification[4]. It is an anterior rupture of the larynx or unstable laryngeal fractures associated with massive edema, significant mucous lacerations, denudation of cartilage, laryngeal immobility, alteration of the respiratory tract of varying importance. It posed a problem of reconstruction of the laryngeal architecture while preserving the laryngeal functions. This injury assessment was obtained under general anaesthesia after nasotracheal intubation. Intubation should be preceded by assessing the integrity of the airways using fibre optic endoscopy. This prevents false-tract intubation, distortion of airway anatomy, disruption of soft tissue injury and respiratory arrest[5]. This was not possible under our working conditions because we did not have a fibre optic endoscopy in our possession. We might have exposed our patient to a worsening of his laryngeal injury. On the other hand,

other authors recommend a first attempt at intubation and recourse to tracheostomy if the latter fails[6].

In our situation, the reconstruction of the architecture required a tracheotomy to supplement the respiratory function of the larynx. For the repair of thyroid cartilaginous lesions, different means are used including sutures, steel threads, mini-plates and "APF" plates (adaptation flat fixation). The mini plates and "APF" plates provide immediate and lasting rigid stability of the laryngeal structure with restoration of the airway of the larynx[2,7]. They make it possible to reduce the calibration indications. The suture wasn't the best mean for this situation. But we used sutures that were available to us. The significant loss of part of the thyroid cartilage exposed the threads to tension with the risk of severing. The airway stents was indicated in our patient in agreement with the management based on the Schaefer – Fuhmann classification[8]. The endolaryngeal guardian wasn't available in our context. The low economic condition of our patient couldn't allow to buy it from a foreign country. It would take so much time to do it. In the absence of an endolaryngeal guardian, we have placed a nasotracheal tube to play this role. It stabilized the entire repaired laryngeal structure and prevented laryngeal stenosis. The duration of the maintenance of this probe was close to that recommended in the literature, ie no more than 15 days otherwise it could behave like a foreign body, promoting infection and granulation[9]. The delay in the management of pharyngeal lesions caused suppuration in our patient immediately after the operation. This suppuration could cause a section of the sutures of the thyroid cartilages. Indeed, Bladergroen *et al*[10] observed that surgical management of pharyngo-oesophageal trauma within 24 hours resulted in 92% survival. After 24 hours, the survival rate decreased to 67% and was not significantly influenced by the type of treatment. This observation is shared by Velmahos *et al*[11]. They reported no mortality directly related to the lesions in 108 patients operated on within 24 hours out of 119 patients presenting with traumatic perforations of the pharynx and esophagus. In contrast, among 11 patients taken more than 24 hours later, 4 of them (36%) had died from uncontrolled sepsis. In our case the mental state of the patient made it difficult to provide local care for the pharyngo-cutaneous fistula and asepsis essential for healing. This justified a hospitalization of 4 months. The evolution of the injury was marked by the resumption of the various laryngeal functions and that of the pharynx reflecting the conservation of the affected organs.

CONCLUSION

Penetrating laryngeal trauma presents a complex injury and requires high level of surgical expertise and resources. However, repair, reconstruction and good outcomes are possible in low resource settings using a firm foundation in surgical technique and locally available material.

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OSSICULAR CHAIN DISRUPTION DUE TO ROAD TRAFFIC ACCIDENT: CASE REPORT

Mwangi G[1], **Macharia I**[1,2]

[1]Nairobi ENT Clinic, Nairobi, Kenya
[2]Department of Otorhinolaryngology, Head and Neck Surgery, School of Medicine, University of Nairobi, Kenya

Address for correspondence: Dr. Grace N. Mwangi, Nairobi ENT Clinic, P.O. Box 29740-00200 Nairobi, Kenya. Email: dr.gmwangi@gmail.com

ABSTRACT

Road traffic accidents contribute to the majority of temporal bone trauma, with most been unilateral fractures. High index of suspicion is required during initial consultation, since otologic manifestations may not be overt in patients with multiple injuries. We present a case of overlooked temporal bone trauma at the initial stage of management in peripheral unit.

Key words: Temporal bone trauma, Ossicular chain, Hearing loss, Ossiculoplasty

INTRODUCTION

Most temporal bone trauma, up to 40-50% occur secondary to road traffic accidents**.** Road traffic injuries are the leading cause of death in children and young adults aged 5-29 years[1]. Men are three times more affected compared to women. Most are unilateral, with bilateral fractures occurring in 9% - 20% of the cases. Contributing factors locally include; alcohol intoxication, over speeding and lack off safety gear.

Clinical presentation may include facial nerve paralysis, hearing loss and CSF otorrhea. In a patient with multiple injuries, the otological manifestations of temporal bone trauma may be initially overlooked. We report a case of a patient who sustained multiple injuries including temporal bone trauma whose presentation to the otolaryngologist was markedly delayed.

CASE REPORT

We report a case of a 34-year-old male patient who presented in our clinic with right ear itchiness and was overly concerned as it was his only hearing ear. On further enquiry, the patient was involved in a road traffic accident 3 years ago and sustained head injury. He presented with loss of consciousness, left otorrhagia and left reduced hearing. Computed tomography scan of the brain was noted to be normal. No report of any ENT assessment was done. Two months later he noticed ipsilateral facial asymmetry and was reassured in a peripheral unit. There was no report of lacrimation or taste alteration.

On assessment, he had a left sided lower motor neuron facial nerve palsy, House Brackman grade II[2]. Video-otoscopy revealed a left step deformity of the posterosuperior canal wall with a thin and retracted tympanic membrane. Right ear had some waxy debris deep in the canal which was syringed out.

Figure 1: Right ear

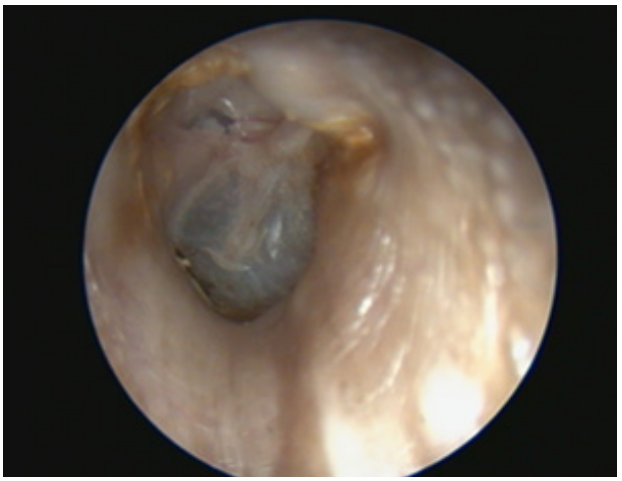


Figure 2: Left ear

Video otoscopic images of the ears

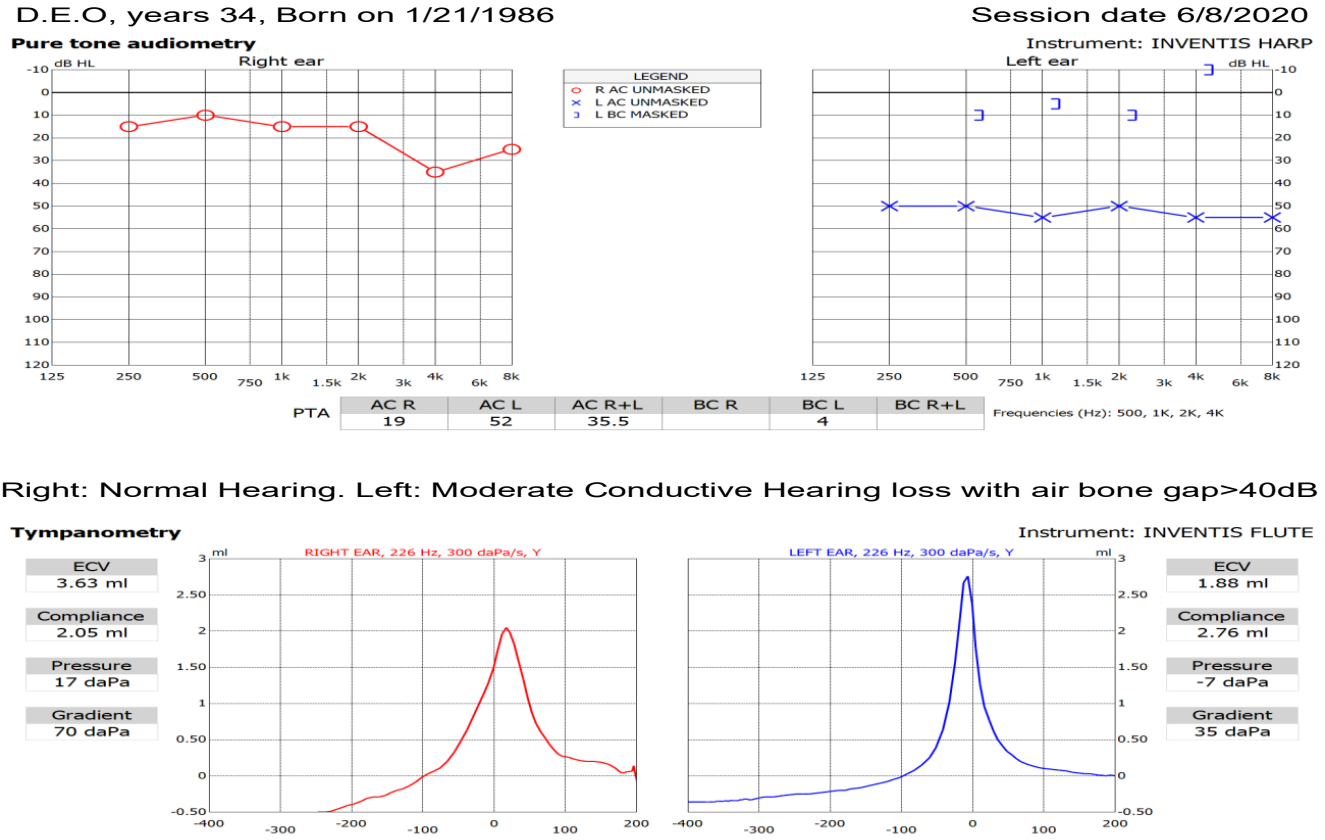


Figure 3: Pre-operative pure tone audiometry and tympanometry findings

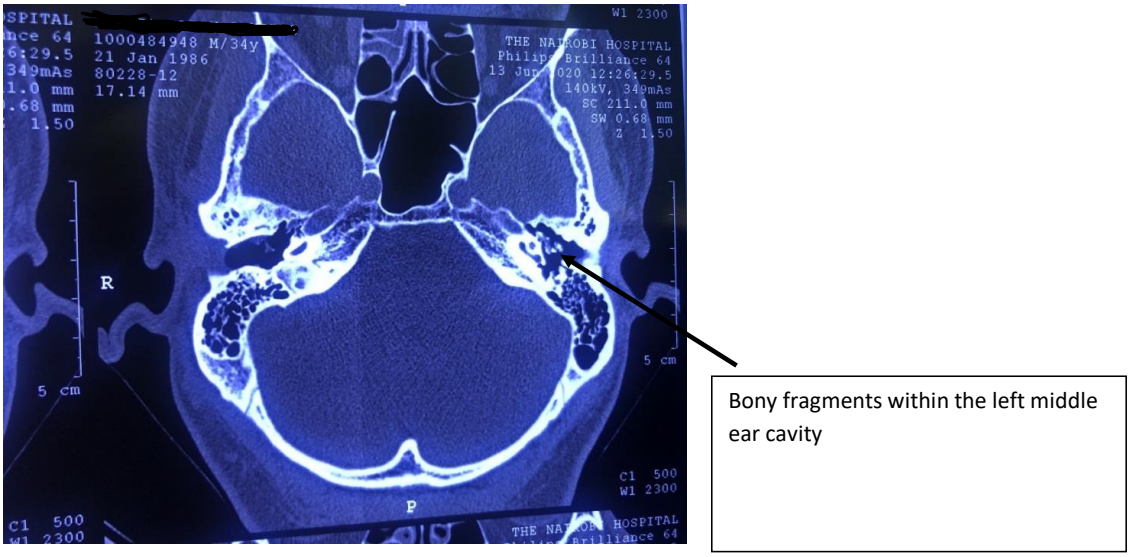


Figure 4: High resolution CT of temporal bone pre-operative findings

Ossicular discontinuity was thus suspected and patient underwent endoscopic left tympanotomy, middle ear exploration and ossicular chain reconstruction. In view of the Wallerian degeneration of the facial nerve that had occurred, facial nerve exploration was not done.

Salient intra-operative findings included; a fractured incus with the short arm extruded under the canal skin and which was what was responsible for the step deformity on otoscopy. The malleus and remnant incus were fused, with the stapes preserved in its original state.

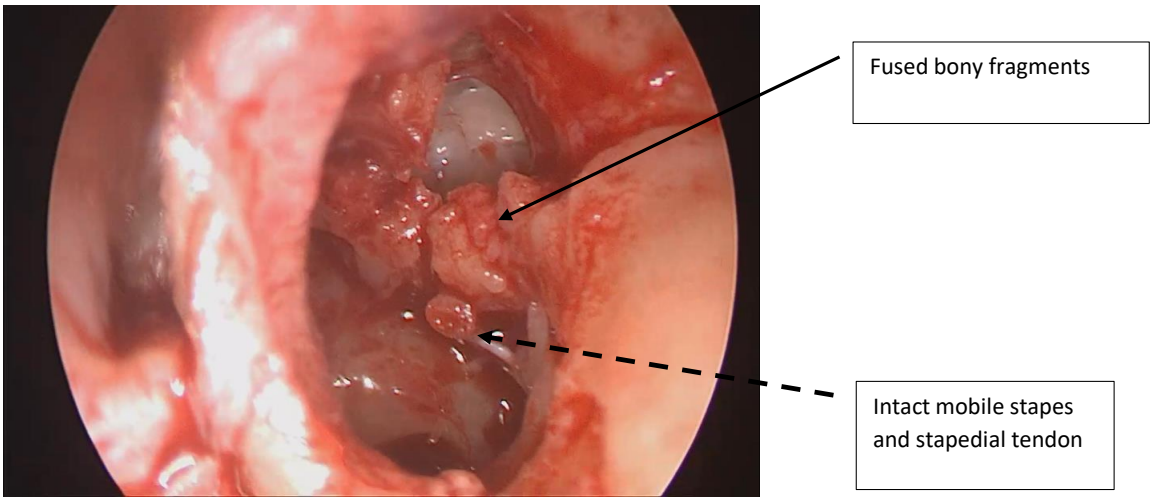


Figure 5: Intra operative findings

The fused bones were curetted out and the short process of the incus used as an inter-positional graft between the stapes and cartilage graft that was used as a buttress between the stapes and the thin tympanic membrane.

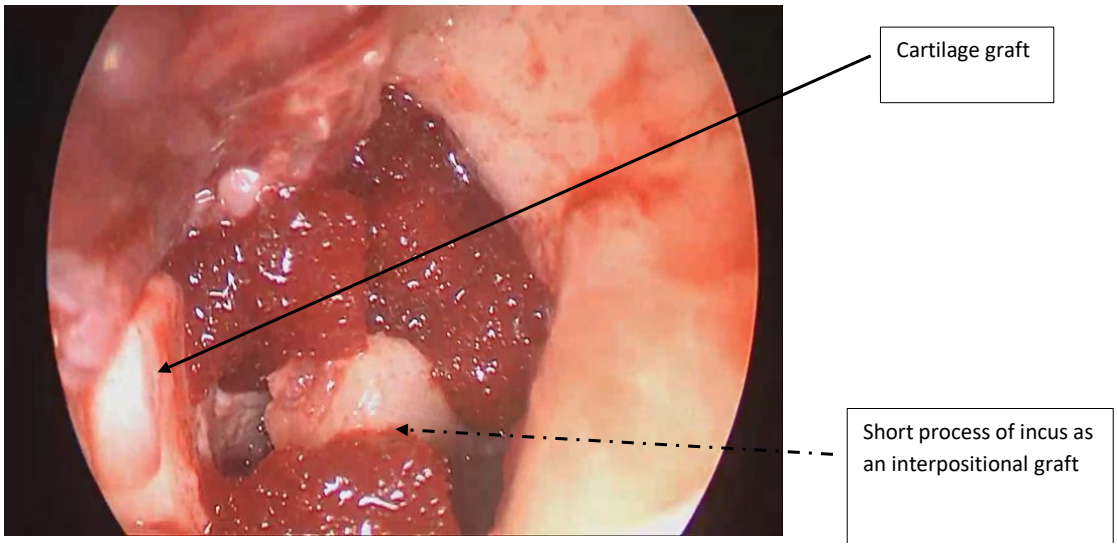
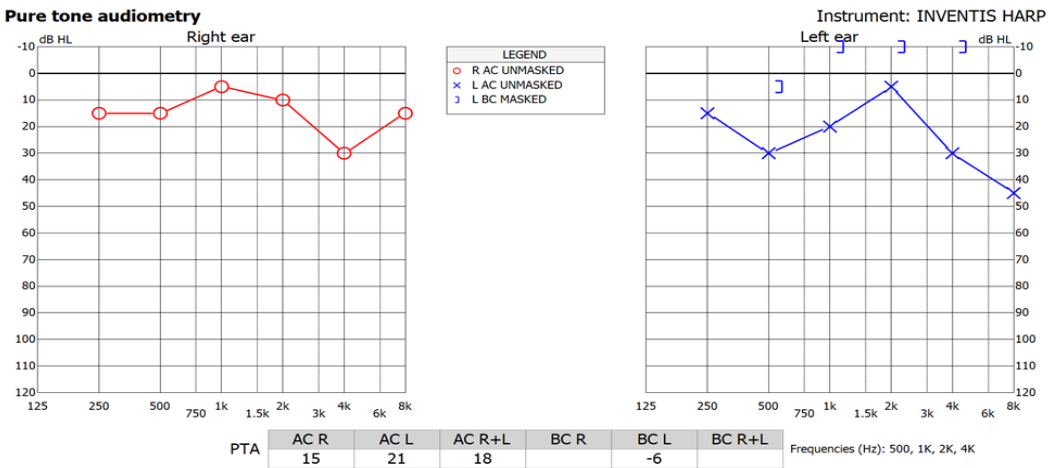


Figure 6: Ossicular chain restoration done

The ossicular chain reconstruction restored continuity and improved hearing both clinically and on audiogram.



Right ear normal hearing

Left ear mild conductive hearing loss

Figure 7: Six weeks post-operative pure tone audiometry findings

DISCUSSION

The temporal bone has vital structures that are at risk of injury and include; facial nerve, cranial nerves IX through XI, cochlea, labyrinth, ossicles, tympanic membrane, carotid artery and jugular vein. Its injury can lead to significant morbidity or mortality and knowledge of its pertinent anatomy, pathophysiology of injury and appropriate management strategies are critical[3].

Features of temporal bone trauma to look out for include:-

(i) Evidence of penetrating insult
(ii) Otorrhoea
(iii) Battle sign
(iv) LMN facial nerve paralysis
(v) Blood in external auditory canal
(vi) Step deformity along the external auditory canal
(vii) Haemotympanum
(viii) Tympanic membrane perforation
(ix) Tullio's phenomenon

Traditionally, temporal bone fractures were classified as either longitudinal or transverse relative to the plane of the petrous ridge[4]. However, this classification scheme did not provide useful prognostic information with regards to neurological deficits and majority had mixed fractures. An alternative classification based on the involvement of the otic capsule has gained popularity over the years as it gives some reliable prognostic information[5]. This case demonstrates an otic capsule sparing fracture as patient had a conductive hearing loss.

The ossicular chain consists of three bones; the malleus, incus, and stapes joined by two synovial joints, the incudomallear and incudostapedial joints. Together, they comprise the primary sound-conduction apparatus to transmit vibratory stimulus from the tympanic membrane to the oval window.

The ossicular chain in addition to conducting sound also amplifies it due to the compound lever effect of the ossicles and their natural resonance. Complete loss of this pathway would result in a conductive hearing loss of 50-60dB[6]. The commonly affected joint is the incudostapedial joint and more often with longitudinal fracture. However it is important to note that dislocation can occur with or without a temporal bone fracture[7]. Other injuries seen include incudomallear dislocation, stapediovestibular subluxation, luxation of the incus and incudomallear subluxation.

Following trauma, primary investigations are usually performed to rule out a more significant head injury. A CT head will normally be performed, and if a temporal bone fracture is present, it is important to note whether it is otic capsule-sparing or otic capsule-violating, as this is the most reliable predictor of underlying injuries to the middle and inner ear. An audiogram should be obtained as soon as possible to allow for a baseline measurement of hearing loss once the patient is stable. Any conductive hearing loss could be related to either ossicular disruption or hemotympanum, and it is challenging to differentiate between them at this point. Therefore, a repeat audiogram should then be performed at least 6 weeks following the injury by which time any hemotympanum should have resolved. Persistent conductive hearing loss or hearing loss greater than 25dB and an air bone gap present on audiometry of more than 40dB should raise suspicion of ossicular chain discontinuity. If there is a stapes dislocation, mixed hearing loss may be present with or without vertigo. For those with residual conductive hearing loss at 6 weeks post-injury, the likely cause is ossicular chain dislocation. Tympanometry may show increased compliance, suggesting discontinuity of the ossicular chain.

Middle ear exploration would then be performed under anaesthesia to identify the disrupted ossicular chain and perform ossiculoplasty. The presence of normal or minimally hypertrophied middle ear mucosa, patent eustachian tube orifice and mobile stapes footplate are prerequisites for ossiculoplasty. The materials used in ossiculoplasty can be autografts or homografts or of synthetic materials. The most commonly used autograft material has been the incus body, which is often reshaped to fit between the manubrium of the malleus and the stapes capitulum.

Cartilage osssiculoplasty is suited for atelectatic retraction problems; with no fear of extrusion. Autografts have several disadvantages, including lack of availability in chronically diseased ears, prolonged operative time to obtain and shape the material, resorption and/or loss of rigidity (especially with cartilage), and possible fixation to the walls of the middle ear. The presence of perichondrium with the graft helps to maintain nutrition, stiffness and the ossicular defects, with commendable hearing results. Because of the disadvantages of autograft materials and the potential risk of infection from homograft implants, alloplastic materials are the most commonly used materials for ossicular reconstruction. The synthetic prosthesis fulfilling criteria of biocompatibility gives most advantageous hearing results. Alloplastic materials includes metals

(titanium and gold), plastics (Plastipore, Proplast, Polyethylenes, Polytetrafluroethylene, or Teflon) and biomaterials (Ceramics and Hydroxyapatite)[7,8].

Ossiculoplasty results in hearing improvement in the majority of patients. Following surgery, an average closure of the air-bone gap of 35dB (range 8-60dB) has been reported. Over 70% of patients will have an air-bone gap of less than 20dB, and over 30% of patients will have an air-bone gap of less than 10dB[9-11].

Facial nerve injury is often due to fracture of the temporal bone with resultant compression of the nerve or complete transection. In cases where the nerve injury is incomplete or delayed, prognosis is excellent. When the facial nerve is completely transected, prompt surgical intervention is required for the best cosmetic outcome.

Electrodiagnostic testing, primarily electroneuronography (ENoG) as Fisch popularized, is the most accurate qualitative measurement[12]. A favorable prognosis is noted in patients with degeneration of less than 90% within 6 days or less than 95% within 14 days after their injury. Topognostic tests are used to localize the injury site. High Resolution Computed Tomography (HRCT) 1mm thin cuts of temporal bone is a useful diagnostic tool for traumatic facial nerve palsy, as it can visualize the fracture line and its relationship to the Fallopian canal[13]. Magnetic resonance imaging with contrast can reveal inflammatory facial nerve lesions and traumatic nerve injury. Enhancement of the distal intrameatal and labyrinthine segments is specific for facial nerve palsy[14]. Patients with total or immediate paralysis as well as those with poor prognostic audiometry results are good candidates for surgical repair while those with delayed onset facial weakness or incomplete facial weakness, conservative management with steroids and vasodilators is recommended. A typical course of high-dose prednisone is 1 mg/kg body weight for up to 10 days followed by a tapering dose regimen. Hematoma and impingement injuries are examples of what would result in a delayed manifestation. In cases of non-recovery or within six months after trauma late surgery may be recommended[13]. The surgical approach depends on the site of the injury to the nerve and hearing status. However, denervated muscle fibers architecture and end plate integrity can be maintained for up to 1 year and after 2 years, irreversible muscle fibrosis occur leading to permanent loss of functional muscle tissue[15,16]. Sensory function can be recovered even after muscle function is lost because sensory end organs such as Paccinian corpuscles and Merkel cells can last up to 2-3 years[17].

CONCLUSION

Temporal bone trauma can be overlooked in majority of multi trauma patients. High index of suspicion would ensure early diagnosis, prompt management and hence decreased morbidity or mortality. Ossiculoplasty results in hearing improvement in the majority of patients. The case by case selective approach in selection of ossiculoplasty technique would seem logical and optimum since there are varieties of ossiculoplasty techniques that exist. Outcome depends on the experience of the surgeon, graft material availability and instrumentation.

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TRAINING AND CAPACITY DEVELOPMENT IN HEALTHCARE: WHAT ROLE CAN THE PRIVATE SECTOR PLAY?: A CASE OF ZIMBABWE

Chidziva C[1,2], Soko ND [3]

[1]Department of Surgery, Faculty of Medicine, University of Zimbabwe, Harare, Zimbabwe
[2]Harare Eye, Ear, Nose and Throat Institute, 5 Weale Road, Milton Park, Harare
[3]Department of Biochemistry, Faculty of Science, University of Zimbabwe, Harare, Zimbabwe

***Address for correspondence*:** Dr. Clemence Chidziva, Harare Eye, Ear, Nose and Throat Institute, 5 Weale Road, Milton Park, Harare, Zimbabwe. Email: cchidziva@audiomaxclinic.com

ABSTRACT

Africa is disproportionately saddled with both poverty and disease. Africa accounts for 29% of the global disease burden while Africa has only 3.5% of global healthcare personnel, of which only 1.7% are doctors. In Zimbabwe, there are 1.6 physicians and 19.35 nurses for every 10,000 Zimbabweans[1], a far cry from the World Health Organisation's recommended 1 doctor per 1000 patients. The challenges of training healthcare personnel in Africa are well documented. They include poor human resource planning priorities, low funding, old and dilapidated infrastructure, old and outdated curricula, poor remuneration and a brain drain as trained personnel emigrate from Africa to more resourced and better compensating markets.

Dr. Margaret Mungherera speaking in her capacity as the World Medical Association president in 2007 said "the responsibility of ensuring that medical education is of the highest possible standards must be shared, however, between profession, training institutions and the government." It is our view that the time has come when all stakeholders in healthcare in African countries need to participate fully in the training and retention of healthcare personnel if there is to be marked improvement in healthcare personnel output and retention on the African continent.

The case of Zimbabwe

Traditional training of healthcare personnel in Zimbabwe lies squarely on the shoulders of the government of Zimbabwe. Competing priorities and socioeconomic and political uncertainties in the past two decades have greatly reduced government funding of both training institutions and government run health facilities. In response to the decline in economic output, funding of health from the fiscus decreased. In 2009, 12% of a 12.5 billion United States Dollar GDP was devoted to health, and this figure decreased to 7.46% in 2016[2]. Prior to the year 2000, government funding of public health institutions and training institutions was adequate. Zimbabwe had a single medical school at the University of Zimbabwe in Harare training doctors and several schools that trained nurses. During this period, hospitals were well equipped, staff adequately remunerated, and patients could afford services offered by the public health system. The training was of an adequate standard and was able to meet the needs of the communities and the nation at large. High end medical procedures like open heart surgery, cochlear implants, and separation of Siamese twins by locally trained paediatric surgeons all attest to the high standard of training prior to the brain drain and the decline in patients treated in public institutions. The overall output of healthcare training was a well-trained medical practitioner. Furthermore, retention of trained healthcare workers was met the needs of the population.

After the economic and political upheaval at the start of the millennium, a new reality set in affecting both healthcare provision and training institutions. The net effect of the deteriorating economic climate was a reduction in government investment in public health institutions and state universities. Consequently, retention of academic faculty began to decline as academics left public institutions. Many left the country in pursuit of better remuneration and working conditions. Deteriorating economic conditions reduced remuneration of healthcare practitioners. A natural brain drain followed with the majority of practitioners migrating to better resourced countries whilst those that remained entered private practice. Currently, health practitioners in state institutions dedicate more time to private practice where working conditions, infrastructure, and remuneration are higher. Cycles of hyperinflation have eroded disposable income in the general population and public institutions saw a decline in patient numbers. Patients who could afford to do so chose private health care over public health systems. Dwindling patient numbers at public institutions reduced clinical exposure for trainees at both undergraduate and postgraduate levels, and for faculty. This has been compounded by outdated and dilapidated infrastructure and ill equipped training institutions; and public healthcare systems are unable

to meet the standard of quality training required at both undergraduate and postgraduate levels.

However, despite deterioration in public health systems, private health systems in Zimbabwe tell a different story. Private health care in Zimbabwe is a robust industry. There is significant investment in infrastructure and remuneration of personnel, and has much higher staff retention than does the public health system. Accountability and transparency are higher in private; hence investors find the private healthcare system to be a lucrative investment opportunity. Activities in the private sector have therefore remained steady and robust.

However, private healthcare has benefited tremendously from the health training provided by the public health system and state training institutions, but has put very little back into the training system. It is our view that it is time for private-public synergies to be actively pursued to ensure the survival and resuscitation of quality training of health personnel in Zimbabwe.

In conclusion, training and capacity development should be an obligation of all players including the private sector.

Notes on contributors

Clemence Chidziva is an otorhinolaryngologist with nineteen years in clinical practice. He is part of the otorhinolaryngology faculty at the University of Zimbabwe. He is passionate about medical business models as well as training and capacity development in healthcare.

Nyarai D Soko holds a PhD in human genetics with a particular interest in human genetic disorders in Zimbabwe. She is involved in instruction of medical students including student training in medicine, dentistry, optometry, nursing sciences in human genetics, biochemistry related sciences.

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TEMPORAL BONE COURSE SUMMARY

Ayugi J

Lead Instructor, Temporal Bone Course 2021

We had a very successful temporal bone course held in Kenyatta National Hospital (KNH) Ear Nose and Throat (ENT) Department. This course was a collaboration between OED Netherlands, OED Kenya, KNH and University of Nairobi. The course was held from 1st to 6th February 2021. The attendees were postgraduate ENT master's students in 3rd and 4th years. There was a total of 13 students. Each student had two days of temporal bone drilling and lectures from both the international faculty and local faculty. Of note was that due to the COVID-19 pandemic, the international faculty were not able to physically attend the course. The course was thus run fully by local faculty for the very first time. The International faculty gave technical support and lectures through google meet and this was noted to be very successful.

The aim of the course was to give the students an understanding of the complex temporal bone anatomy, to teach them the basics of temporal bone drilling and surgical approach to various pathologies in the ear and temporal bone. They learnt how to do a canal wall up, canal wall down mastoidectomy, canaloplasty, facial nerve exploration, labyrinthectomy, posterior tympanotomy and some lucky ones got to do a cochlear implant using a dummy.

Much appreciation goes to the local faculty who helped with the training program including Dr. Elaine Yuko, Dr. Nicholas Ngugi and Dr. Stephen Onyango.

PEER REVIEWERS OF THE ISSUE

1. **Dr. Samuel Nyagah**, MBChB, MMed (ENT), Diploma Allergy, Kenyatta National Hospital and Nairobi ENT Clinic, Kenya
2. **Prof. Isaac Macharia**, MBChB, MMed (ENT), Senior Lecturer, University of Nairobi, School of Medicine and Nairobi ENT Clinic, Kenya
3. **Dr. Ian Macharia**, MBChB, MMed (ENT), Machakos Level 5 Hospital and Nairobi ENT Clinic, Kenya
4. **Dr. Samuel Okerosi**, MBChB, MMed (ENT), Machakos Level 5 Hospital, Kenya
5. **Dr. Peter Ochungo**, Assistant Editor, MBChB, MMed (ENT), Wote District Hospital and Hope ENT Centre, Kenya
6. **Dr. Samuel Gathere**, MBChB, MMed (ENT), Kenya Medical Research Institute, Nairobi, Kenya
7. **Dr. Wakisa Mulwafu**, PhD (University of Bergen), FCORL (SA), MBBS (Malawi), Associate Professor, College of Medicine, University of Malawi, Blantyre, Malawi
8. **Dr. Mukara Kaitesi**, MBChB, MMed (ENT)MSc (Audiology) . University of Rwanda, Humanhood Clinics Kigali, Rwanda
9. **Dr. Clemence Chidziva**, MBChB, FC ORl, Department of Surgery, Faculty of Medicine, University of Zimbabwe, Harare Eye, Ear, Nose and Throat institute (HEENT), Zimbabwe

Authors guidelines

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Submitted manuscripts should follow the guidelines below;

(i) Original research: Should follow the IMRAD format ie Abstract, Introduction, Methods, Results, Discussion. The abstract should be structured with the following sub-headings; Background, Objective(s), Design, Methods, Results, Conclusion(s). The manuscript should have about 3000 words and not more than 30 references.

(ii) Review articles: Should be written by an authority in a particular area. The abstract should be structured with the following sub-headings; Background, Objective(s), Data source, Data synthesis, Conclusion(s). The review should have about 5000 words with not more than 50 references.

(iii) Case reports: Should have a brief summary, introduction, case report description and a discussion. The case report should have not more than 2000 words and about 15 references.

Note that the submitted manuscripts should follow the Vancouver style and references should be numbered in order of appearance and only those cited should appear in the reference list.