

An analysis of postoperative complications and associated risk factors in the surgical management of oral and maxillofacial tumors and tumor-like lesions at a Tanzanian tertiary referral center

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Abstract

Introduction

Surgical management is the primary treatment for many pathological lesions of the orofacial region. Despite advances in technique and perioperative care, postoperative complications remain a major determinant of treatment outcomes. This study assessed the incidence, characteristics, and risk factors for postoperative complications among patients undergoing surgery for oral and maxillofacial tumors and tumor-like lesions in a tertiary hospital in Tanzania.

Methodology

This was an analytical prospective hospital-based study carried out at the Muhimbili National Hospital (MNH) between April 2022 and March 2023. It included all patients managed surgically for the tumor and tumor-like lesions involving the oral and maxillofacial region.

Results

A total of 132 patients, with 29 different types of tumors and tumor-like lesions, were managed during the study period. Most procedures (56.8%) were non-ablative. Immediate, intermediate, and late post-operative complications occurred in 67.2%, 12.1%, and 10.6% of patients, respectively. Male patients had higher odds of immediate complications, whereas female patients had increased odds of late complications. Malignancy (AOR = 26.44; 95% CI 2.71–258.2; $p = 0.005$) and operative duration exceeding 2 hours (AOR = 6.62; 95% CI 1.26–34.88; $p = 0.026$) were independently associated with intermediate complications.

Conclusion

Immediate post-operative complications are the most

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common following head and neck surgery, while intermediate and late complications are less frequent. Patient sex influenced the development of immediate and late complications, whereas malignancy and prolonged operative duration were key predictors of intermediate post-operative complications.

Introduction

Numerous anatomical structures, comprising both hard tissues (bones, cartilage, dentition) and soft tissues (neurovascular bundles, glands, musculature), are found in the oral and maxillofacial region of the body. [1] Consequently, this region is prone to a broad spectrum of pathological conditions arising from any of these structures, ranging from neoplasms (benign and malignant) to tumor-like lesions, such as cysts and inflammatory conditions (osteomyelitis, sialadenitis, etc). [1,2]

The primary management of these pathological lesions in the oral and maxillofacial region often requires a surgical intervention. [3] While surgical results are generally predictable, procedures in the oral and maxillofacial region inherently carry a higher risk of complications due to the anatomical complexity and high density of functionally significant structures. [1,4] Despite meticulous technique and surgeon expertise, postoperative complications remain a significant factor that influences surgical outcomes subsequently.

Surgical complications may occur either at the time of surgery or in the post-operative period; they may be progressive or may occur during days, weeks, months, or even years after surgery. [1] Some of the documented complications of oral and maxillofacial surgeries in the literature include bleeding, pain, surgical site infection (SSI), aspiration pneumonia, swallowing and breathing difficulties, nerve injuries, post-operative vomiting, wound dehiscence, etc. [1,4–7] The established factors linked with post-operative complications include; smoking, combined organ resection, older age, medical comorbidities, and longer duration of surgery. [6–9]

Post-operative complications are a significant concern because they negatively impact both the quality of surgical care and patient safety. These events may require repeated interventions, extend hospital stays, increase healthcare costs, and potentially result in long-term disability or death. [10] Hence, understanding the common post-operative complications and the factors influencing their occurrence prepares the surgeon well for adequate and timely management of these complications, therefore enhancing survival and improving the quality of life of patients post-operatively. [7] Furthermore, a comprehensive understanding of potential risks for developing complications is essential for providing effective preoperative patient counseling. [7] Therefore, this study aimed to investigate the incidence, nature, and risk factors of postoperative complications in oral and maxillofacial surgeries among patients managed for tumors and tumor-like lesions in a tertiary health facility in Tanzania.

Methodology

Study design and area

This was an analytical prospective hospital-based study carried out at the Muhimbili National Hospital (MNH) between April 2022 and March 2023. A convenient sampling technique was used, where all patients who were managed surgically for oral and maxillofacial tumors and tumor-like lesions under general anesthesia during the study period were included. Patients with oral and maxillofacial tumors and tumor-like lesions managed conservatively or under local anesthesia were excluded from the study.

Patient recruitment and data collection tool

The principal investigators identified patients who were scheduled for surgeries for orofacial tumors and tumor-like lesions under general anesthesia. All patients were managed according to standard treatment guidelines of the MNH. Post-operative assessments were carried out on day 1, day 3, day 7, the 2nd week, the 4th week, and then once every month until the end of the 3rd post-operative month. The patients were informed in detail about the aim of the study, and informed consent was sought before collecting information from them.

A predesigned questionnaire was used to collect data from patients. The information collected included the sociodemographic characteristics of the patients, clinical findings, and the diagnosis of the tumors and tumor-like lesions. Other data collected included the laboratory investigations findings from the full blood count i.e, hemoglobin, neutrophils, lymphocytes and platelets count,

the complications patients experienced from day 1 post-operatively to 3 months post-operatively. A pilot study was carried out involving 15 patients who were managed under local anesthesia to ensure clarity of the questionnaire and common understanding among all those responsible for data collection.

Patients were interviewed regarding subjective complications on scheduled assessment days. Clinical assessments were conducted, and appropriate management strategies were provided. Patients were asked about the persistence of complications during each recall visit. These complications encompassed various symptoms such as pain, painful swallowing, painful urination, numbness, coughing, difficulty in chewing, etc.

Data handling and statistical analysis

The Statistical Package for Social Sciences software (SPSS) for Windows (version 29, Armonk, New York: IBM Corp) was used to code and analyze the data. For descriptive analysis, standard error of the mean (SEM), median, interquartile range (IQR), and proportion were used.

The postoperative complications were grouped into three groups: immediate post-operative complications (complications occurring within the first 72 hours post-operatively), intermediate post-operative complications (those complications which had developed between the third day and second week post-operatively), and late complications (those which occurred beyond 2nd week post-operatively).

The participants' age was categorized as pediatric patients (<18 years) and young adults (18-35 years), middle aged adults (36-59 years) and elderly (>60 years). The tumors and tumor-like lesions were grouped into four categories (benign, malignant, inflammatory, and cyst) for descriptive purpose, and for analytical purpose into 3 categories (benign tumors, malignant tumors and tumor-like lesions). The tissues affected were grouped as soft tissues (salivary gland, muscles, fat tissues, neurovascular tissues, etc) and hard tissues (mandible, maxilla, palatal bone, etc.). Surgical procedures were grouped as ablative (when there was compromise tissue continuity e.g. mandibulectomy, sialoadenectomy, wide tumor excision) and non-ablative (when there was preservation of tissue or continuity of normal tissue e.g. tumor/cyst enucleation, marginal resection). The neutrophil to lymphocyte ratio (N/L ratio) was calculated and the results were classified as normal (≤ 3) and high (> 3). Duration of surgery were dichotomized into ≤ 2 hours and > 2 hours.

For the univariate analysis, a Chi-square test or Fisher's exact test was used, wherever appropriate, to assess factors associated with the occurrence of postoperative complications. The probability level of $\alpha < 0.05$ was selected for statistical significance. Multivariate logistic regression was used to assess the strength of the association between the predictor variables and the occurrence of post-operative complications. All predictor factors with a p-value of < 0.1 on univariate analysis, were included in the multivariate logistic regression model. The p-value and 95% confidence interval (CI) for the adjusted odds ratio (AOR) or unadjusted odds ratio (UOR) were used to confirm the significance of the association.

Ethical considerations

Ethical clearance was sought from Muhimbili University of Health and Allied Health Sciences (MUHAS) (Ref.No.DA. 282/298/01.C/1113) and permission to conduct the study was obtained from Muhimbili National Hospital (MNH/TRCU/ Perm/2023/123). Participation was voluntary, and refusal to participate or withdraw from the study did not compromise the management of the patient. All eligible patients presenting at MNH were enrolled after obtaining a signed informed consent from the patient or their guardians. Patients who were unable to give informed consent were excluded from this study. Numbers were used instead of names to hide the patient's identity. Acquired information was coded and stored on a computer only accessible to the investigators.

Generative AI tool (Grammarly) was used to aid in grammar correction and language enhancement during the manuscript's preparation.

Results

Sociodemographic characteristics

A total of 230 patients were surgically managed under general anesthesia during the study period, with 132 (57.39%) presenting with oral and maxillofacial tumors or tumor-like lesions. The age range of patients was between 11 months and 86 years, with the mean age of 34.69 years (SEM=1.55) and a median age of 32 years (IQR 22.25-48.00). Young adults (n=58, 43.9%) constituted most of the patients. The male-to-female ratio was 1:1.06. Most patients neither smoked nor consumed alcohol (Table 1).

Table 1: Sociodemographic characteristics of study participants

Demographic Characteristics		Frequency (n)	Percentage (%)
Age group	Pediatric	19	14.4
	Young adults	58	43.9
	Middle-aged adults	41	31.1
	Elderly	14	10.6
Sex	Male	64	48.5
	Female	68	51.5
Residence	Urban	64	84.2
	Rural	12	15.8
Smoking	No	123	93.2
	Yes	9	6.8
Alcohol	No	122	92.4
	Yes	10	7.6

Diagnoses and nature of disease

A total of 29 different types of tumors and tumor-like conditions were managed surgically during the study period. Most cases were benign tumors (n=84, 63.8%) followed by malignant tumors (n=25, 18.9%). The tumor-like conditions included cysts (n=16, 12.1%) and inflammatory conditions (n=7, 5.3%).

The most common benign tumors were ameloblastoma (n=37, 44.0%) and ossifying fibroma (n=21, 25.0%). Squamous cell carcinomas were the most prevalent malignant tumors managed surgically (n=11, 44.0%), followed by sarcomas, including osteosarcoma, rhabdomyosarcoma, and fibrosarcoma (n=10, 40%). Most of the malignant tumors were stage III (n=16, 64.0%), followed by stage IV (n=8, 32.0%).

The majority of tumors and tumor-like lesions affected hard tissues (n=100, 75.8%), and 32 (24.2%) affected the soft tissues. The mandible was more affected than the maxilla in a ratio of 2:1. Most of the patients (n=100, 75.8%) had a normal preoperative neutrophil to lymphocyte ratio with the rest having a higher ratio.

Regarding the nature of surgical procedures carried out, most procedures were managed in a non-ablative manner (n=75,

56.8%). Most surgical procedures (n=74, 56.1%) were carried out in ≤ 2 hrs.

Post-operative complications following surgical management of tumors and tumor-like lesions

Immediate post-operative complications

The immediate post-operative complications were noted in 92 (69.7%) patients, of which the frequent complications were surgical site pain (n=55, 59.8%), edema (n=24, 26.1%), and odynophagia (n=23, 25.0%). There was one case of cardiac arrest (Figure 1).

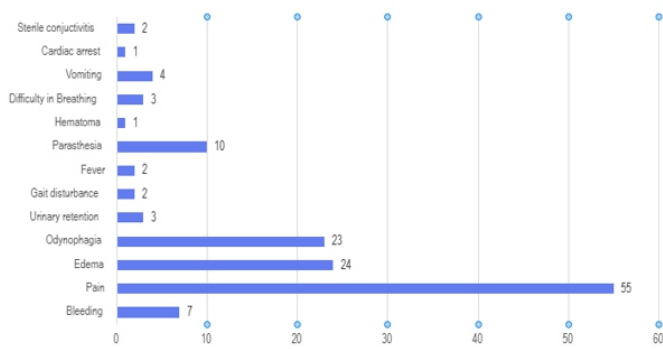


Figure 1: Frequency distribution of patients according to immediate post operative complications

Intermediate post-operative complications

Only 12.1% (n=16) of patients had intermediate post-operative complications following surgical management of tumors and tumor-like lesions. These included surgical site infection (n= 2, 12.5%), wound dehiscence (n= 13, 81.2%), and facial disfigurement (n=2, 12.5%).

Late post-operative complications

Fourteen (10.6%) patients had late complications following surgical management of oral and maxillofacial tumors or tumor-like lesions. These included: occlusal derangement (n= 9, 64.3%), oro-antral communications (n=4, 28.6%), facial disfigurement (n= 1, 7.14%), hypertrophic scar (n= 1, 7.14%), and facial nerve palsy (n= 1, 7.14%).

Factors associated with the development of post-operative complications

Table 2 summarizes the association between various factors and the development of immediate, intermediate, and late post-operative complications. Risk factors assessed included: patient-related factors (age group, sex, cigarette smoking, and alcohol consumption), disease-related factors (classification of the lesions, nature of primary tissue affected, and neutrophil-lymphocyte ratio), and the surgical-related factors (nature of surgical procedure and duration of surgery).

Table 2: Factors associated with the occurrence of post-operative complications in patients managed by ORIF

Associated factor		Immediate complication		Intermediate complication		Late complication	
		No	Yes	No	Yes	No	Yes
Age group	Pediatric	5 (33.3%)	14 (73.7%)	17 (89.5%)	2 (10.5%)	17 (89.5%)	2 (10.5%)
	Young	17 (29.3%)	41 (70.7%)	51 (87.9%)	7 (12.1%)	54 (93.1%)	4 (6.9%)
	Middle aged	14 (34.1%)	27 (65.9%)	37 (90.2%)	4 (9.8%)	34 (82.9%)	7 (17.1%)
	Elderly	4 (28.6%)	10 (71.4%)	11 (78.6%)	3 (21.4%)	13 (92.9%)	1 (7.1%)
p-value		0.924		0.706		0.491	
Sex	Female	28 (41.2%)	40 (58.8%)	61 (89.7%)	7 (10.3%)	57 (83.8%)	11 (16.2%)
	Male	12 (18.8%)	52 (81.3%)	55 (85.9%)	9 (14.1%)	61 (95.3%)	3 (4.7%)
p-value		0.005		0.507		0.046	
Smoking	No	38 (30.9%)	85 (69.1%)	110 (89.4%)	13 (10.6%)	109 (88.6%)	14 (11.4%)
	Yes	2 (22.2%)	7 (77.8%)	6 (66.7%)	3 (33.3%)	9 (100%)	-
p-value		0.722		0.078		0.596	
Alcohol	No	39 (32.0%)	83 (68.0%)	109 (89.3%)	13 (10.7%)	109 (89.3%)	13 (10.7%)
	Yes	1 (10.0%)	9 (90.0%)	7 (70.0%)	3 (30.0%)	9 (90.0%)	1 (10.0%)
p-value		0.281		0.103		1.000	
Classification of lesion	Benign	26 (31.0%)	58 (69.0%)	80 (95.2%)	4 (4.8%)	75 (89.3%)	9 (10.7%)
	Malignant	8 (32.0%)	17 (68.0%)	16 (64.0%)	9 (36.0%)	21 (84.0%)	4 (16.0%)
	Tumor-like	6 (26.1%)	17 (73.9%)	20 (87.0%)	3 (13.0%)	22 (95.7%)	1 (4.3%)
p-value		0.885		<0.001		0.429	
Tissues affected	Soft	8 (25.0%)	24 (75.0%)	27 (84.4%)	5 (15.6%)	31 (96.9%)	1 (3.1%)
	Hard	32 (32.0%)	68 (68.0%)	89 (89.0%)	11 (11.0%)	87 (87.0%)	13 (13.0%)
p-value		0.453		0.485		0.186	
N/L ratio	Normal	31 (31.0%)	69 (69.0%)	86 (86.0%)	14 (14.0%)	89 (89.0%)	11 (11.0%)
	High	9 (28.1%)	23 (71.9%)	30 (93.8%)	2 (6.3%)	29 (90.6%)	3 (9.4%)

The immediate post-operative complication had no statistically significant association with any of the factors, with the exception of the sex of the patient. Male patients were about 3 times more likely to present with immediate post-operative complications compared to the females [AOR= 2.84, 95%CI 1.28-6.33, $p=0.01$].

The intermediate post-operative complications had a significant association with the classification of the lesions and duration of surgery. Upon performing multivariate analysis, the odds of intermediate complications following surgery of malignant tumors were about 26-fold higher than benign tumors [AOR= 26.44, 95%CI 2.71-258.2, $p=0.005$]. Also, the odds of intermediate post-operative complication increased by almost 7-fold when the duration of surgery was beyond 2 hours [AOR= 6.62, 95%CI 1.26-34.88, $p=0.026$].

Sex of the patient was the only factor that had a significant association with the occurrence of late post-operative complications following surgical management of oral and maxillofacial tumors and tumor-like lesions. Females were 4 times more likely to present with late post-operative complications than males [UOR= 3.92, 95%CI 1.04-14.79, $p=0.043$].

Discussion

Surgical complications, an inevitable part of surgical practice, are any undesirable and unintended effect of surgery that is generally detrimental to the patient, arising at the time of operation or during the post-operative period. [4] Despite the importance of understanding the post-operative complications and their associated factors for surgeons, in Tanzania, and probably elsewhere in Africa, the post-operative complications of oral and maxillofacial surgery are underreported. This paucity of information limits surgeons' ability to anticipate and manage complications promptly and hampers the provision of effective preoperative patient counseling. Therefore, this study reports on postoperative complications and risk factors in the management of oral and maxillofacial tumors and tumor-like lesions at a tertiary health facility in Tanzania.

Tumors and tumor-like lesions accounted for the majority of the cases operated on in the present study, similar to the findings from Nigeria, [11] but contrary to findings from Pakistan. [12] In the current study, 57.39% of the cases operated on were oral and maxillofacial tumors or tumor-like lesions. This was lower than 68.8% as reported by the previous study from the same setting, which reported on the six-year spectrum of oral and maxillofacial surgical

procedures [13] and recent reports on the establishment of oral and maxillofacial surgical services in a tertiary hospital. [2]

Most of the cases managed surgically in this survey were benign tumors, followed by malignant tumors. These findings are in concurrence with previous reports from Tanzania [2,13] and elsewhere in Africa. [11,14–16] The predominance of benign tumors is likely due to the wide range of conditions that fall under the category; contrarily, less malignant neoplasms were managed surgically since the majority of patients present with advanced disease characterized by significant morbidity, deformity, or metastasis, rendering them inoperable. [13]

Post-operative complications can be classified in various ways. They may be specific to the underlying surgical disease, comorbidities, anesthesia, or the surgical procedure itself. They may also be subjectively graded as mild, moderate, or severe; minor or major; or non-life-threatening or life-threatening. [10] Additionally, complications can be categorized based on the timing of their occurrence into immediate, intermediate, delayed, or prolonged post-operative complications. [4] In this study, we classified the complications by time of occurrence because it strengthens targeted follow-up strategies and counseling patients pre-operatively.

In the current study, the immediate post-operative complications occurred in almost 70% of the patients, with intermediate and late complications occurring in less than 15% of the patients who underwent surgery. The immediate post-operative complications frequently noted were the surgical site pain, edema, and odynophagia. The immediate post-operative complications may be attributed to the effects of anesthesia and/or the body's inflammatory response to potential tissue damage during surgical procedures. Tissue injury causes cellular disruption, resulting in the escape of intracellular potassium ions and the release of inflammatory mediators, including bradykinin, serotonin, and prostaglandins, all of which are potent activators of the peripheral endings of nociceptive neurons; hence, pain. [1] Similarly, post-operatively, a cascade of inflammatory events begins, starting with microvascular changes such as vasodilation and increased blood flow. As the microvasculature becomes more permeable, protein-rich fluid leaks into the extravascular tissues. This loss of intravascular proteins reduces osmotic pressure within the vessels while increasing the osmotic pressure of the interstitial space, causing water and ions to move outward into the surrounding tissues, thus causing

causing edema. [1,17] Odynophagia may result from trauma to the laryngeal mucosa during laryngoscopy and the pressure exerted by the endotracheal tube. Some anesthesia-related immediate complications included fever, urinary retention, and vomiting.

In this study, it was found that the immediate post-operative complications had a significant association with patients' sex, where males had 3 times higher odds. While the exact reason for this association may not be clear, this may be explained by a combination of physiological differences, higher rates of comorbidities and risk behaviors, later presentation leading to more extensive surgery, and differential responses to pain, inflammation, and anesthesia in males.

The intermediate post-operative complications noted in the current study included surgical site infection, wound dehiscence, and facial disfigurement. Such complications have been reported in several studies [1,6,18–21] though with varying rates of occurrence, these differences are attributed to methodological, population, and sociodemographic differences.

The findings from the present study depicted that the chances of occurrence of intermediate post-operative complications increased by almost 7-fold when the duration of surgery was more than 2 hours. Similarly, studies [8,21] have found that the longer duration of surgery, more than 2 hours, increases the risk of overall complications, including reoperation, wound dehiscence, and surgical site infection. We also found that odds of complications after surgery of malignant tumors were 26 folds higher compared to benign tumors. This can be attributed to the fact that unlike in a benign tumor which may be managed by a non-ablative surgery, a malignant tumor requires wide excision for tumor free margins, hence more tissue resection and thus more risk of complications. [4]

The incidence of late post-operative complications in this study was 10.6% which included occlusal derangement, oro-antral communications, facial disfigurement, hypertrophic scar, and facial nerve palsy. Occlusal derangement can be attributed to an ablative surgical procedure that requires resection of the tooth-bearing bone, which subsequently affects the occlusion. Females were 4 times more likely to develop late post-operative complications. Loupatatzi et al.[22] similarly reported a higher predisposition among females to complications following head and neck surgeries, which may be related to women's typically greater bodily awareness and tendency to report physical symptoms and discomfort.

There are several weaknesses in the present study. Firstly, it was a single-centre study; as such generalizability of the findings is limited. Secondly, a small sample size reduced statistical power and limited the ability to detect smaller but clinically important differences in risk factors. Despite these limitations, this study provides significant information regarding the post-operative complications of oral and maxillofacial surgeries among patients managed for tumors and tumor-like lesions in Tanzania. The use of structured follow-up and multivariate analysis strengthens confidence in the observed associations.

Conclusion

In conclusion, immediate post-operative complications are the most common following oral and maxillofacial surgery, while intermediate and late complications are less frequent. Patient sex influenced the development of immediate and late complications, whereas malignancy and prolonged operative duration were key predictors of intermediate post-operative complications.

The clinical relevance

Scientific rationale for study

Evidence on post-operative complications following oral and maxillofacial tumor surgery in Tanzania is limited, despite surgery being the primary treatment modality. This study addresses this gap by identifying complication patterns and associated risk factors in a tertiary care setting.

Principal findings

Immediate complications were most common. Male sex was associated with immediate complications, while female sex predicted late complications. Malignancy and operative duration exceeding two hours were strong predictors of intermediate complications.

Practical implications:

Risk stratification, optimized surgical planning, and targeted follow-up may reduce complications and improve patient outcomes in similar resource-limited settings.

Conflict of interest

None

Funding

No funding source to be declared

Data availability

The data used and/or analyzed during the current study are available from the corresponding author on a reasonable request.

Study registration number

The clinical registration number of the study is MUHAS-REC-04-2022-1113.

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