

# Indications and Predictors of Early Complications among Patients Undergoing Open Tracheostomies at a Tertiary Hospital, Northwest Tanzania

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## Abstract

**Background:** Tracheostomy is a lifesaving procedure used globally. As with other surgeries open, surgical tracheostomies do not go without risks and complications. The aim of this study was to determine the common indications and predictors of early complications among patients undergoing open tracheostomies. **Methods:** This was a prospective cross sectional study that included 56 patients who underwent open tracheostomy at Bugando Medical Centre from January to July 2019. After tracheostomy, characteristics were determined, and patients were followed up for seven days to determine complications. Univariate logistic analysis followed by multivariate logistic regression analysis was performed to determine predictors of early complications. **Results:** The age ranged from 14 days – 80 years, and median 40 years. Male were 41 (73.2%) and 15 (26.8%) females. About 31 (55.4%) had elective tracheostomy. The commonest indications were upper airway obstruction 27 (48.2%), prolonged intubation 19 (33.4%), adjunct to major head and neck surgery 7 (12.5%) and airway protection 3 (5.4%). The complications rate was 32% and recorded tracheostomy tube blockage 9 (42.8%), false tracheostomy 3 (14.3%), wound infection 3 (14.3%), surgical emphysema 2 (9.5%), apnea 2 (9.5%), haemorrhage 1 (4.8%) and tube dislodgement 1 (4.8%). Increased age (OR 1.3; 95% CI 1.00 - 1.06; p = 0.048) was the only significant factor. Overall, 3.6% tracheostomy related mortality was recorded. **Conclusion:** The most common indications are upper airway obstruction followed by prolonged in-

tubation, adjunct to head and neck surgery and lower airway protection. The most common complications were tracheostomy tube blockage, false tracheostomy and wound infections. Increased age was the only significant predictor.

## Keywords

Tracheostomy, Early Complications, Predictors

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## 1. Introduction

Tracheostomy is a surgical procedure aimed at establishing an alternative airway by creating a surgical opening in the anterior wall of the trachea and maintaining it with a tube [1]. Tracheostomy has frequently been used for airway intervention [2] [3]. It is one of the oldest medical procedures known. The history of tracheostomy goes as back as first century BC [4] [5], in which it was used to treat diphtheria patients with dyspnea. Early 1970s, tracheostomy was commonly indicated in patients with acute obstructive upper airway infections but lifestyle of humans across the globe has led to revolution of the indications [6]. The use of tracheostomy since then is on rise with broader indications ranging from the need for temporary to permanent use [1]. The evolution of indications is due to changes in the epidemiology of infectious diseases, early diagnosis, adequate use of antibiotics, advances in critical care and the improvement in the capabilities of medical technology [2] [7] [8]. Moreover, the trend of tracheostomies indications in recent times is toward upper airway trauma [9]. The common indications of tracheostomy include upper airway obstruction, prolonged mechanical ventilation, lower airway protection or elective tracheostomy for major head and neck surgery, respiratory failure and removal of retained secretions [9]-[17].

Globally, the prevalence of tracheostomy complications ranges from 6 to 66% [6] [18]. However, in developed countries has been reported to range from 5% to 40% of tracheostomies depending on study design, patient follow-up, and the definition of the different complications [19]. In developing countries, especially Africa, prevalence of tracheostomy complications differs from place to place. In Nigeria and Kenya, for example, the prevalence of open tracheostomy complications was 15% [9] and 33.3% [20] respectively. In Tanzania, a study done at BMC reported a prevalence of 21.5% [11]. This study aimed at assessing the indications and predictors of early complications of patients undergoing open tracheostomies.

## 2. Methods

This was a hospital based cross sectional study for six months between January 2019 and July 2019, conducted at BMC; the tertiary care and teaching hospital for the Catholic University of Health and Allied Sciences (CUHAS)-Bugando. All patients of either sex and of any age who underwent tracheostomy and voluntarily

gave consent or their parents or care taker gave assent for them to participate in the study. This included all patients admitted in Adult Intensive Care Unit (AICU) or ENT Department. The demographic data, clinical presentation, surgery details and early complications information filled into data collection form designed for the study. Elective patients were recruited before tracheostomy and for emergency patients, recruitment was done immediately after tracheostomy was performed. The assessment for early complications occurrence such as primary and reactional haemorrhage, tracheostomy tube dislodgement, tracheostomy tube obstruction by mucous plug, tissue pneumatosis and false tracheostomy was done on daily basis up to seven days of follow up by filling a designed follow up assessment form. Haemorrhage was considered if 4 partially stained gauzes or 1 fully soaked gauze (20 mls of blood is lost).

Continuous variables were summarized using mean  $\pm$  standard deviation (SD) or median with interquartile range, whereas categorical variables were summarized using proportion (percent). To determine the predictors of early complications of open tracheostomy, univariate followed by multivariate logistic regression was performed. Predictors with a p-value less than 0.2 on univariate logistic regression were subjected to multivariate logistic regression analysis. Predictors with a p-value less than 0.05 deemed statistically significant predictors of open tracheostomy.

### 3. Results

A total of fifty six (56) patients were recruited and gave consent for the study during the study period. In all patients, forty one (73.2%) were males and fifteen were females (26.8%). Male to female ratio was 2.7:1. Age ranged from fourteen days to eighty years with a median age of 40 (24 - 68) years. Most of the patients were between the second to the third decade. Urban residents were 41 (73.2%) and the other 15 (26.8%) residents came from rural areas. Of all the patients who underwent tracheostomy 12 (21.4%) had pre-existing medical conditions. **Table 1** summarizes the sociodemographics.

**Table 1.** Social demographic data distribution.

Variable	Number (n)	Percent (%)
Age in years		
0 - 20	10	17.8
21 - 40	19	34
41 - 60	15	26.8
61 - 80	12	21.4
Sex		
Male	41	73.2
Female	15	26.8
Residence		
Urban	41	73.2
Rural	15	26.8

**Continued**

Pre-existing medical illness		
Yes	12	21.4
No	44	78.6
Department first Presented		
Otorhinolaryngology	20	35.7
Emergency Department	24	42.9
Dental/Maxillofacial	3	5.3
Internal Medicine	3	5.3
Oncology	1	1.8
Paediatrics	3	5.4
Cardiothoracic	2	3.6

n = number of patients in that category. SD = standard deviation, IQR = interquartile ratio, Total number of patients = 56.

Upper airway obstruction accounted for 48.2% (n = 27) of patients. 34% (n = 19) had prolonged intubation as an indication, 5.4% (n = 3) of tracheostomies were inserted due to depressed level of consciousness to protect airway by facilitating tracheobronchial toilet and 4% (n = 4) for adjunct of major head and neck surgery (**Table 2**).

**Table 2.** Indications of open tracheostomies.

Indication	Medical Condition	Frequency	Percent
		27	48.2
	Trauma	3	11.1
	Cut Throat	2	3.6
	Subglottic stenosis	1	1.8
	Neoplasm	18	66.7
	Laryngeal tumour	6	10.7
	Hypopharyngeal tumour	2	3.6
	Tonsillar tumour	2	3.6
	Thyroid tumour	1	1.8
Upper Airway Obstruction	Nasopharyngeal Carcinoma	2	3.6
	Base of tongue tumour	2	3.6
	Neck Lymphoma	2	3.6
	Oesophageal Tumour	1	1.8
	Infections:	3	11.1
	Ludwig Angina	1	1.8
	JRRP	2	3.6
	Neuromuscular disorder (Vocal Cords Paralysis)		
		3	11.1

**Continued**

		19	33.9
	Severe tetanus	9	16.1
	Haemorrhagic stroke	2	3.6
	Ischaemic stroke	1	1.8
Prolonged Intubation	Polytrauma	1	1.8
	Embryonal Rhabdomyosarcoma	1	1.8
	Diabetic Ketoacidosis	1	1.8
	Traumatic brain injury	1	5.3
	Uncontrolled Diabetic Mellitus	2	3.6
	Strangulated Rectal Prolapse	1	1.8
	Air way protection /Tracheobronchial toilet	3	5.4
	Severe head injury	1	1.8
	Pulmonary embolism	1	1.8
	Respiratory failure	1	1.8
Adjunct to Head and Neck Surgeries		7	12.5
	TMJ Ankyloses	3	5.5
	Dermoid Cyst	1	1.8
	Chronic Osteomyelitis of mandible	2	3.6
	Dental Abscess	1	1.8
<b>Total</b>		<b>56</b>	<b>100%</b>

Most of these open tracheostomies were done in theater 33 (58.9%) and the rest 23 (41.1%) done in AICU. Majority 31 (55.4%) were elective procedures. Fresh tracheostomies 52 (92.9%) and only 4 (7.1%) were re-tracheostomies. Those who underwent tracheostomy under local anaesthesia were 42 (75%) and the other 14 (25%) under general anaesthesia. Residents performed most of these tracheostomies 52 (92.9%), whereas specialist performed 4 (7.1%) of them. Surgical techniques assessed involved type of skin and tracheal incisions of which vertical incision was most preferred 49 (87.5%) over 7 (12.5%) with horizontal incision. For tracheal incisions vertical slits were 28(50%), while 26 (46.4%) opted for Y and 2 (3.6%) for T incision (**Table 3**).

In this study, early complications related to open tracheostomy occurred in 18 patients (32%), of which 3 (17%) developed complications intraoperatively (one patient developing two complications) and the other 15 (83%) patients developed complications postoperatively within seven days of follow up (See **Table 4** below). Morbidities included tube blockage 9 (42.8%), false tracheostomy and wound infection each 3 (14.3%), surgical emphysema and apnea 2 (9.5%) each, and lastly

tube dislodgement and haemorrhage recorded one 1 (4.8%) each (See **Table 4** and **Table 5** below). Two patients died due to tracheostomy leading to tracheostomy related mortality (3.6%). One of the deaths was on the table and the other occurred some few hours post tracheostomy due to cardiac arrest, all two incidents followed apnea.

**Table 3.** Characteristics of surgery.

Variable	Number (n)	Percent (%)
Setting of Tracheostomy		
Theater	33	58.9
AICU	23	41.1
Frequency of Tracheostomy		
Re-tracheostomy	4	7.1
Fresh Tracheostomy	52	92.9
Timing of Tracheostomy		
Elective	31	55.4
Emergency	25	44.6
Type of Anaesthesia		
Local Anaesthesia	42	75
General Anaesthesia	14	25
Type of skin incision		
Horizontal incision	7	12.5
Vertical incision	49	87.5
Type of tracheal incision		
Y incision	26	46.4
Vertical slit	28	50
T incision	2	3.6
Rank of Operating Surgeon		
Resident	52	92.9
Specialist	4	7.1

n = number of patients in that category. Total number of patients = 56.

**Table 4.** Early Complications of open tracheostomy.

Complications	Number (n)	Percentage
Haemorrhage	1	4.8
Tube blockage	9	42.8
False Tracheostomy	3	14.3
Tube dislodgement	1	4.8
Surgical Emphysema	2	9.5
Wound infection	3	14.3
Apnea	2	9.5
Total	21	100

n = number of patients in that category. Total number of complications = 21.

**Table 5.** Early (Intraoperative vs Post-operative) complications of open tracheostomy.

Complications	Number	Percentage
Intraoperative complication		
Apnea	1	4.8
Haemorrhage	1	4.8
False Tracheostomy	1	4.8
Surgical emphysema	1	4.8
Post-operative early complications (up to day seven)		
Tube blockage	9	42.8
False Tracheostomy	2	9.4
Tube dislodgement	1	4.8
Surgical Emphysema	1	4.8
Wound infection	3	14.2
Apnea	1	4.8
Total	21	100

**Table 6.** Univariate logistic regression for Predictors of early complications of open tracheostomy.

Variables	Early Complications			OR [95%CI]	P value
	Yes	No	n		
Demographic characteristics					
Age				1.03 [1.00 - 1.06]	0.048
Gender					
Female	3	12	15	1.0	
Male	15	26	41	2.31 [0.56 - 9.51]	0.247
Residence					
Rural	3	12	15	1.0	
Urban	14	26	41	2.31 [0.56 - 9.51]	
Characteristics of Surgery					
Setting of Tracheostomy					
AICU	7	16	23	1.0	
Theatre	11	22	33	1.14 [0.36 - 3.59]	0.819
Frequency of Tracheostomy					
Re-Tracheostomy	0	4	4	1.0	
Fresh Tracheostomy	34	18	52	2.66 [0.314 - +inf]	0.401
Timing of Tracheostomy					
Emergency	9	16	25	1.0	
Elective	9	22	31	0.73 [0.24 - 2.24]	0.579

**Continued**

Type of Anesthesia					
General Anesthesia	3	11	14	1.0	
Local Anesthesia	15	27	42	2.04 [0.49 - 8.46]	0.327
Type of skin incision					
Horizontal incision	0	7	7	1.0	
Vertical incision	18	31	49	5.28 [0.73 - +inf]	0.018
Type of tracheal incision					
Vertical incision	10	18	28	1.0	
Y incision	7	19	26	0.37 [0.02 - 6.72]	0.5
T incision	1	1	2	Omitted	
Duration of surgery					
≤15 minutes	4	13	18	1.0	
>15minutes	14	24	38	0.48 [0.13 - 178]	0.279
Rank of operating Surgeon					
Specialist	0	4	4	1.0	
Resident	18	34	52	2.66 [0.31 - +inf]	0.401

n = number of patients in the specific category with complication; n = total number of patients = 56, OR = odd ratio; 95% CI = 95% confidence interval; ref = reference category.

On univariate logistic regression analysis, the predictors for occurrence of early complications of open tracheostomy were analyzed. The predictors included age of the patients, gender, setting of tracheostomy, tracheostomy freshness, timing of tracheostomy, type of anesthesia, surgical techniques (skin incision and tracheal incision) and rank of surgeon. Only age (OR 1.3; 95% CI 1.00 - 1.06; p = 0.048) was statistically significant (**Table 6**).

Following univariate logistic regression analysis, the predictors age and type of skin incision had p value <0.2 and were analyzed for multivariate logistic regression. Age was statistically significant, and type of skin incision was omitted in the output due to co linearity dependence (**Table 7**).

**Table 7.** Multivariate logistic regression for Predictors of early complications of open tracheostomy.

Variables	OR [95% CI]	P value
Age	1.04 [1.00 - 1.07]	0.027
Type of skin incision	1.00 (omitted)	

n = total number of patients in the category; OR = odd ratio; 95% CI = 95% confidence interval.

## 4. Discussions

Tracheostomy is a lifesaving procedure widely performed throughout the world

with the history being drawn from the first century BC [4]. In this study, the highest incidence of performing tracheostomy was the third decade, which falling to the age group 21 - 40 years (40%). Similar findings of majority of patients in the same age group were reported in Sudan [21]. Male preponderance of 73% was reported. A similar demographic picture was captured in similar studies [8] [11] [21] [22]. The preponderance of male gender can be explained by high incidence of head and neck malignancies especially laryngeal tumour in men.

Literature review shows the prevalence of tracheostomy related complications to range from 6 to 66 with mortality rate of <2% [10] [23]. The results of our study revealed a tracheostomy related complication rate to be 32%, which is within the reported range worldwide. Also, the complication rate is almost similar to the study done by Karuga [20] at Kenyatta hospital of 33.3% and 29.81% in rural India [17]. However, this is higher compared to another retrospective study that was done in the same setting Mwanza, Tanzania some years back which was 21.5% [11]. This difference of complication rate of this study to the previous one can be explained by the fact that other study was retrospective therefore there is a possibility of missing information and the fact that majority of tracheostomies were done by residents affected the results of the study. Tracheostomy related mortality of 3.6% is higher than previous the study in the same setting where no tracheostomy related death occurred.

Furthermore, mortality rate differs from place to place, for example, in Sudan 7.5% mortality was reported due to hair dye poisoning, a non tracheostomy related cause [21]. Mortality in this study is as well due to underlying medical conditions and therefore it cannot be confidently related to tracheostomy. This underlying complication was apnea. Of the two patients who died, developed hypovolemic shock and later cardiac arrest while the other had neck lymphoma.

There is a wide range of indications of tracheostomy and the literature has demonstrated a dynamic change of indications in the last two decades due to a number of reasons, including changes in the epidemiology of infectious diseases, early diagnosis, adequate use of antibiotics, advances in critical care and the improvement in the capabilities of medical technology [5] [8] [24] [25]. In this study, the most common indication was upper airway obstruction contributing to 48.2% mainly secondary to head and neck malignancies whereby laryngeal tumour 10.7% was leading from this major group. This finding is different from the previous results of the study done at the same setting [11], whereby upper airway obstruction due to trauma was leading. However, this finding is similar to a report from Pakistan 27% [23] and in Nigeria [9] recorded 28.9%. Upper airway obstruction in this study was followed by prolonged intubation 34% and adjunct to major head and neck surgery 12.5%. This trend of indications in this study is the same to the previous study in this setting [11]. Majority were Tetanus patients admitted in ICU, intubated and later warrant tracheostomy to prevent complications of prolonged intubation hence early weaning from mechanical ventilators. Among these nine patients with tetanus was a 14 days baby with neonatal tetanus.

The use of tracheostomy for adjunct to head and neck surgeries is on increase comparing to the last review where by 12.5% were recorded in this study that goes with an increase in the number of surgeries and surgeons. The setting was exclusively in theater and AICU (58.9%) similar to a study in Kenya 61% [20].

In our study, 56 tracheostomies were done as electives (55.4%) and 44.6% as emergencies comparatively the same to a study done in Rwanda [26].

Majority of the patients underwent tracheostomy under local anaesthesia 75%, with only 25% under general anaesthesia. Its only 7.1% patients whose tracheostomy was a repeat surgery and the rest 92.9% were fresh tracheostomies and none of the re-tracheostomy had complications.

Surgeons do differ in the preference of surgical techniques. The techniques start from skin incision, underlying tissue dissection to the incision of the trachea. In this study, vertical incision on the skin was the most preferred (87.5%), while for the trachea, Y incision 46.4%, T incision 3.6%, and vertical slit incision 50% were used. Vertical incision is a quick technique but has a poor skin cosmetic. In this study 7.1% of tracheostomies were performed by maxillofacial surgeon and all were due to adjunct of head and neck surgery and none had complications. The rest of tracheostomies 92.9% were performed by residents and recorded 32.1% complications. Low number of complications to tracheostomies done by specialists can be attributed by small number of cases and experience.

Tracheostomy tube blockage due to crusting (42.8%) was high among complications. This may be attributed by general tracheostomy care especially suctioning. There is no particular trend of complications. In the current study tother recorded complications were wound infections 14.3%, false tracheostomy 14.3%, surgical emphysema 9.5%, apnea 9.5%, haemorrhage 4.8% and tube dislodgement 4.8%.

It has been reported that high incidence of tracheostomy related complications is in paediatrics than in adults due to anatomical reasons. In this study, the trend is toward the older age.

This can be due to anatomical changes, mostly in patients with head and neck malignancies.

## 5. Limitations

The fact this was a single-centre design one cannot generalize its findings.

There was a possibility of selection bias based on the method used.

## 6. Conclusion

The commonest indications for open tracheostomy were upper airway obstruction followed by prolonged intubation, adjunct to head and neck surgery and lower airway protection. Most common complications were tracheostomy tube blockage, false tracheostomy and wound infections. Increased age was the only significant predictor.

## Recommendations

- Efforts should be invested to doctors and nurses to meticulously perform tracheotomies and on the care of tracheotomy respectively to mitigate the occurrence of complications
- Most complications were related to the underlining conditions, we recommend thorough review of the patients as to whether they need it.
- A longitudinal study with larger sample size and longer follow up period will widen our understanding of late complications.

## Ethical Approval

The study was approved by the Institutional Ethics Committee.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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