

COMPLICATIONS OF TRACHEOSTOMY IN PATIENTS PRESENTING TO A TERTIARY CARE HOSPITAL: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: A tracheostomy is a frequently performed surgical procedure for creating a secure airway in a patient who has an upper airway obstruction or is on prolonged mechanical ventilation. Although safe overall, it can be linked to several early and late complications after surgery that can cause patients to experience increased morbidity. Assessing the incidence and risk factors for these complications is crucial to enhancing surgical success and recovery.

Methods: After obtaining ethical approval, this prospective observational study was done in the Department of Otorhinolaryngology of Hayatabad Medical Complex, Peshawar, period of 20 February 2023 to 19 August 2023. Total of 96 consecutive patients undergoing elective or emergency tracheostomy were included in the study using consecutive non-probability sampling technique. The data on demographic, clinical, operative and postoperative was obtained prospectively. Data were analysed by SPSS version 26.0. A Chi-square or Fisher's exact test was used to compare categorical variables, and a p-value of < 0.05 was deemed significant.

Results: The mean age of participants was 49.8 ± 17.2 years, and 62.5% were male. Total, 27 (28.1%) patients had postoperative complications. Tube obstruction (7.3%) was the most frequent complication, followed by wound infection (6.3%), postoperative bleeding (4.2%) and accidental decannulation (4.2%). Emergency tracheostomy ($p = 0.014$), diabetes mellitus ($p = 0.009$), longer operative time ($p = 0.028$), and procedures performed by resident surgeons ($p = 0.037$) were significant factors associated with postoperative complications, while age and gender were not.

Conclusion: Tracheostomy is a safe and effective airway procedure with an acceptable complication rate if it is performed according to a standardized surgical procedure. Appropriate and thorough patient management, careful surgical technique, adequate operator training and thorough post-op management can minimize preventable complications and enhance patient results.

KEYWORDS: Tracheostomy, Airway Management, Postoperative Complications, Prospective Study, Tertiary Care Hospital, ENT Surgery.

INTRODUCTION

Tracheostomy, like most surgical procedures in modern surgery, is among the oldest and common surgical airway procedures. It is suggested for the purpose of securing an airway in patients with upper airway obstruction, for prolonged mechanical ventilation, for pulmonary toilet, and to minimize the problems associated with prolonged endotracheal intubation. In spite of improved surgical skills and peri-operative management, tracheostomy is still associated with early and late complications that can negatively impact patient outcome if not identified and treated in a timely fashion [1].

The uses of a tracheostomy have changed significantly in the last few decades. The most common indications for the procedure in the past were upper airway infections and trauma. Thanks to the development of intensive care facilities however, the most common indication in the world today is prolonged ventilatory support. Other prominent presentations include head and neck malignancy, neurologic disorders with poor protection of the airway, severe maxillofacial trauma and congenital abnormalities of the airway [2].

While tracheostomy is generally considered a safe procedure in the hands of an experienced surgeon, there is a wide range of reported rates of complications, ranging from about 5% up to 40% depending on patient factors, surgical indication, timing of the procedure, surgical technique, and length of follow up. The procedure may be complicated, or may become so within a few weeks or months after surgery, and close monitoring is necessary [3].

Initial complications are hemorrhage, pneumothorax, surgical emphysema, tube obstruction, accidental decannulation, tube displacement, wound infection, and false passages. If not managed properly, these complications can quickly and easily become life-threatening. Late complications can be tracheal stenosis, tracheocutaneous fistulization, persistent infection, formation of granulation tissue, tracheomalacia, dysphagia,

and cosmetic deformity which can have a great influence on the quality of life and is a reason for further interventions [4].

There are multiple factors that affect the risks of tracheostomy complications. Older age, obesity, diabetes mellitus, malnutrition, coagulopathies, emergency procedures, prolonged mechanical ventilation, and underlying malignancy are all factors that have been associated with higher postoperative morbidity rates. Similarly, training of the operator, standardization of surgical technique and careful aftercare of the postoperative tracheostomy are crucial in reducing postoperative complications [5].

The rates and types of tracheostomy complications vary between institutions due to variations in patient demographics, disease spectrum, surgical expertise, nursing care in the immediate postoperative period and the availability of critical care facilities. Thus, the results of the data from one healthcare system might not be a valid reflection of results from another. Local epidemiological studies are important, therefore, to help identify challenges unique to the institution and thus for guiding the quality improvement initiatives [6].

The information on the incidence and risk factors associated with the complications of tracheostomy is relatively scarce in Pakistan, especially from the major tertiary care teaching hospitals. Published studies have generally been retrospective or small, thus limiting the ability to draw conclusions and formulate temporal relationships and detailed histories of the postoperative period. A systematic documentation of the complications as they occur with a prospective evaluation will give better documentation of the frequency of the complications, and lead to better evidence of associated risk factors [7].

One of the largest tertiary unit hospitals in Khyber Pakhtunkhwa is Hayatabad Medical Complex, which has a significant patient load with regards to elective and emergency tracheostomy. Returning to the perioperative management of this population with a better understanding of the spectrum of complications may help to optimize the management protocol and improve the postoperative care, and also minimize preventable morbidity. The results might also provide important regional data for those who are caring for patients in need of airway management or surgical intervention [8].

Objective

To determine the frequency and pattern of early and late complications following tracheostomy in patients presenting to a tertiary care hospital and to identify factors associated with the development of these complications.

METHODOLOGY

This prospective observational study was conducted in the Department of Otorhinolaryngology (ENT) of Hayatabad Medical Complex, Peshawar, Pakistan, for six months duration from 20 February 2023 to 19 August 2023 after getting ethical approval from the Institutional Research and Ethical Review Board (IREB), Hayatabad Medical Complex, Peshawar, Pakistan (Approval No. 1107 dated 19 January 2023). All participants or their legally authorized attendants gave written informed consent prior to participation.

The study included all consecutive patients undergoing elective or emergency tracheostomy during the study period. All patients with any indication undergoing tracheostomy, irrespective of gender or age were included. Patients who were referred for tracheostomy after another health-care institution performed it were excluded from the study, as were patients with incomplete clinical records or those who could not be found at the time of assessment of postoperative complications, and patients and their attendants who refused consent.

The sample size was estimated using the WHO sample size calculator, assuming that the anticipated complication rate was 20 per cent as reported in the literature [9] with a 95 per cent confidence level and a margin of error of 8 per cent and a minimum sample size of 96 patients was required. Consecutive non-probability sampling was used to get the necessary sample size.

A standard proforma was created to collect baseline demographic and clinical data such as age, gender, indication for tracheostomy, comorbid conditions, smoking status, elective vs. emergency tracheostomy, surgeon type, level of surgeon and length of hospital stay. All tracheostomy procedures were done under standard institutional procedures by consultant ENT surgeons or under the supervision of senior residents using the traditional open surgical approach.

Patients were followed up from the day of surgery until they were discharged and then visited in the ENT outpatient department up to 30 days after surgery. The main outcome was the development of complications related to the tracheostomy. Complications were classified as intra-operative, early post-operative (within 7 days) and late post-operative (8–30 days). Intraoperative complications were bleeding, false passage, pneumothorax and injury to nearby structures. Early complications of surgery were tube obstruction, accidental decannulation, wound infection, surgical emphysema, tube displacement, and postoperative bleeding. Tracheocutaneous fistula, tracheal stenosis, granulation tissue, persistent wound infection and tracheomalacia were some of the late complications. All the complications were diagnosed by clinical examination and relevant investigations if indicated.

The collected data was entered and analyzed by Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables (age and length of hospital stay) were presented as mean $\pm$ SD or median (IQR) as appropriate. Categorical variables such as the gender, indication for tracheostomy, the type of procedure and complications after surgery were stated as numbers and percentages. The Chi-square test or Fisher's exact test (as appropriate) was used to determine associations between categorical variables and

complications. Continuous variables between groups were compared using Independent Student's t-test or Mann–Whitney U test. The significance of p value <0.05 was set.

RESULTS

This is a prospective study of 96 patients undergoing tracheostomy. The mean age was 49.8 ± 17.2 years (range 3 – 82 years). A majority of the patients were males (62.5%, N=60) and females (37.5%, N=36). The age range for most patients undergoing tracheostomy was 41–60 years (35.4%) followed by >60 years (30.2%). Fifty-eight (60.4%) patients had elective tracheostomy and 38 (39.6%) had emergency tracheostomy.

The most common reasons for tracheostomy were prolonged mechanical ventilation (34.4%), upper airway obstruction due to malignancy (25.0%), traumatic airway injury (17.7%), deep neck infection (11.5%), neurological disorders (7.3%), and other causes (4.2%). The most common comorbidities were DM (28.1%), hypertension (22.9%) and COPD (10.4%).

A total of 27 (28.1%) patients suffered from one or more complications associated with the tracheostomy during the follow-up period, while 69 (71.9%) did not develop any complications. The early postoperative complications were found to be higher in comparison to the late postoperative complications. Tube obstruction (7.3%) and wound infection (6.3%) were the most common complications followed by accidental decannulation (4.2%), surgical emphysema (3.1%), granulation tissue (3.1%), tracheocutaneous fistula (2.1%) and tracheal stenosis (2.1%). During the study period, there was no mortality directly attributed to tracheostomy.

Complication rates were significantly higher in EM compared to EP (42.1% vs. 19.0%, $p=0.014$) as shown in the statistical analysis. Additionally, diabetic patients had significantly higher postoperative complications when compared to non-diabetic patients (48.1% vs 20.3%, $p=0.009$). Prolonged operative time (>30 minutes) ($p=0.028$) and resident surgeons working under supervision versus those taught by consultant surgeons ($p=0.037$) were also significantly associated with the occurrence of complications. There was no statistically significant correlation between complications and patient's age ($p=0.284$) or gender ($p=0.618$).

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population (n=96)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
≤20	8	8.3
21–40	25	26.0
41–60	34	35.4
>60	29	30.2
Mean age (years)	49.8 ± 17.2	
Gender		
Male	60	62.5
Female	36	37.5
Type of Tracheostomy		
Elective	58	60.4
Emergency	38	39.6
Indication for Tracheostomy		
Prolonged mechanical ventilation	33	34.4
Upper airway malignancy	24	25.0
Trauma	17	17.7
Deep neck infection	11	11.5
Neurological disorders	7	7.3
Others	4	4.2
Comorbidities		
Diabetes mellitus	27	28.1
Hypertension	22	22.9
COPD	10	10.4
No comorbidity	37	38.5

Table 2. Frequency and Pattern of Tracheostomy-Related Complications (n=96)

Complication	Frequency (n)	Percentage (%)
No complication	69	71.9
Overall complications	27	28.1
Early Complications		
Tube obstruction	7	7.3
Wound infection	6	6.3
Postoperative bleeding	4	4.2
Accidental decannulation	4	4.2

Surgical emphysema	3	3.1
Late Complications		
Granulation tissue	3	3.1
Tracheocutaneous fistula	2	2.1
Tracheal stenosis	2	2.1
Pneumothorax	1	1.0
False passage	1	1.0
Mortality related to tracheostomy	0	0.0

Some patients experienced more than one complication.

Table 3. Association of Selected Variables with Tracheostomy-Related Complications (n=96)

Variable	Complications Present n (%)	Complications Absent n (%)	Test	p-value
Age Group			$\chi^2 = 3.81$	0.284
≤40 years (n=33)	7 (21.2)	26 (78.8)		
>40 years (n=63)	20 (31.7)	43 (68.3)		
Gender			$\chi^2 = 0.25$	0.618
Male (n=60)	18 (30.0)	42 (70.0)		
Female (n=36)	9 (25.0)	27 (75.0)		
Type of Tracheostomy			$\chi^2 = 6.05$	0.014
Elective (n=58)	11 (19.0)	47 (81.0)		
Emergency (n=38)	16 (42.1)	22 (57.9)		
Diabetes Mellitus			$\chi^2 = 6.82$	0.009
Present (n=27)	13 (48.1)	14 (51.9)		
Absent (n=69)	14 (20.3)	55 (79.7)		
Duration of Procedure			$\chi^2 = 4.82$	0.028
≤30 minutes (n=54)	10 (18.5)	44 (81.5)		
>30 minutes (n=42)	17 (40.5)	25 (59.5)		
Operating Surgeon			$\chi^2 = 4.33$	0.037
Consultant (n=55)	11 (20.0)	44 (80.0)		
Resident under supervision (n=41)	16 (39.0)	25 (61.0)		

DISCUSSION

This is an observational study in prospective design that aimed at assessing the incidence and the pattern of complications associated with the tracheostomy in patients who have undergone tracheostomy in a tertiary care hospital. The overall complication rate was 28.1%, and most of the patients (71.9%) had an uncomplicated postoperative course. The complication rate is within the range reported in previous studies with the complications of 5%–40% of patients depending on the study design, patient characteristics, indication for tracheostomy, and study duration [9,10]. Standardized surgical techniques, consultant supervision and structured postoperative care might explain the low complication rate observed in the present study.

The mean age of the study population was 49.8 ± 17.2 years and the age group 41–60 years had the largest percentage of patients. The study population showed a marked male predominance as the males accounted for 62.5%. This is consistent with previous reports, that middle aged men accounted for the largest proportion of patients undergoing tracheostomy [11,12]. This could be due to the fact that head and neck cancers, trauma and chronic respiratory diseases are more common in males, which often require surgical airway management.

The longest mechanical ventilation (34.4%) was the most frequent indication for tracheostomy in the current study, followed by upper airway obstruction as a result of malignancy. This is due to the changing nature of tracheostomy use in contemporary intensive care medicine, in which many patients are now undergoing the procedure for a much longer time for the purpose of prolonged ventilatory support, rather than for infection as was more common in earlier years [13,14]. This has changed and has been a major contribution of the increasing availability of intensive care units and the development of mechanical ventilation.

Tube obstruction (7.3%), wound infection (6.3%), postoperative bleeding (4.2%), accidental decannulation (4.2%) and surgical emphysema (3.1%) were most common postoperative complications. The most frequent early complications are tube obstruction due to thick, thickened tracheobronchial secretions, under-

humidification and poor suctioning of the airways. Likewise, wound infection and postoperative bleeding continue to represent important causes of postoperative morbidity despite improvements in surgical techniques and perioperative care [15]. Importantly, there was no mortality directly related to tracheostomy in the present study, indicating that timely and early recognition and management of complications played an important role in favoring clinical outcome.

A statistically significant correlation was seen between emergency tracheostomy and postoperative complications ($p = 0.014$). The complications occurred more often in the patients undergoing emergency procedures than in the patients undergoing elective tracheostomy. Emergency tracheostomy is frequently done under difficult clinical conditions such as compromised airway, malformed anatomy, bleeding or lack of preparation, leading to an increased degree of difficulty and risks of complications [16,17]. The results highlight the need for early airway evaluation coupled with prompt decision making, thus preventing unnecessary emergency surgical interventions if possible.

The current study also revealed that diabetes mellitus was significantly related to postoperative complications ($p = 0.009$). Likewise, procedures carried out by residents, or procedures conducted during long operations (more than half an hour), had significantly higher complication rates. Delay in wound healing or repair is associated with diabetes mellitus, but may be equally associated with technically challenging procedures with increased tissue manipulation and blood loss during longer operative duration. Similarly, operator experience has been consistently found to be a critical factor affecting surgical outcomes and thus the importance of proper training and supervision during tracheostomy surgery [18].

In the present study, no statistically significant relationship was noted between the age and gender and the occurrence of postoperative complications. Advanced age is often a common factor for multiple comorbidities and a higher perioperative risk; however, demographic factors were not independent of complications in our patient population. These findings indicate that clinical status, underlying disease, surgical urgency, and peri-operative management could have a greater impact on the peri-operative outcomes than age and gender [19].

In general, the results of the present study confirm the safety and efficacy of tracheostomy when performed by skilled surgeons using consistent surgical methods, and when adequate post-surgical care is provided. The complications that were encountered were mostly minor, manageable and early and did not lead to any procedure-related mortality. The identification of factors that can be modified, such as emergency surgery, extended operative time, diabetes mellitus, and operator experience, offers excellent chances to improve the management of peri-operative risk factors and to prevent unnecessary morbidity. Standardized tracheostomy care protocols, frequent staff education, a multidisciplinary airway team and structured post-operative care could further enhance patient safety and clinical outcomes [20].

Limitations: There are some limitations of the present study. It was done at a single tertiary care center, and may not be applicable to other healthcare settings. The number of patients was relatively small, and the duration of follow-up was short, 30 days, and may have underestimated late complications like tracheomalacia or tracheostomy narrowing. Moreover, the study design did not allow for causal inferences to be drawn for the associations between each risk factor and the postoperative complications.

Future Recommendations: Larger multicenter prospective studies with longer follow-up are recommended to further assess long-term tracheostomy-related complications and their predictors. In addition, the success of standardised tracheostomy care protocols, the multidisciplinary airway team, simulation for surgical training and structured postoperative surveillance should be evaluated in future studies to determine their contribution to reducing the rates of complications and to patient outcome.

CONCLUSION

Under standard surgical protocols and with proper postoperative management, the tracheostomy is a safe and effective surgical procedure for airway management. The overall complication rate in the present study was 28.1% of which the most common postoperative complications were tube obstruction and wound infection. Age and gender were not significantly associated with complications, but emergency tracheostomy, diabetes mellitus, longer surgical time and less experienced surgeons were significant. To minimize preventable complications and to maximize patient outcomes, it is important to identify high-risk patients, to be careful in surgery, to train the surgeon to the best of his ability, and to standardize postoperative tracheostomy care.

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