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TRAUMA SURGERY

Trauma ICU patients requiring tracheostomy: a single-centre experience

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Background: The tracheostomy is a commonly performed procedure in the context of trauma care. There is paucity of data on factors affecting outcomes after a tracheostomy. This study aims to determine complication and mortality rates of tracheostomies in trauma patients and to determine the association of these outcomes with level of surgeon, urgency of procedure and surgical approach utilised.
Methods: This was a retrospective audit at a single academic hospital. All patients who had tracheostomies performed by trauma unit staff within the unit between 1 June 2016 and 31 May 2023 were included. Clinical variables and outcomes were evaluated.
Results: A total of 247 patients were enrolled in the study. The overall complication rate was 4.86%. There was no significant difference in complication rates when comparing level of surgeon ($p < 0.999$), urgency of procedure ($p = 0.469$) or surgical approach ($p = 0.444$). Thirty-day all-cause mortality rate was 21.05%. There was no significant difference in mortality rates among the different levels of surgeons ($p = 0.678$) or surgical approach ($p = 0.553$). Mortality rates were significantly higher ($p = 0.022$) in elective tracheostomies than emergency tracheostomies.
Conclusion: The use of different surgical approaches did not affect complication or mortality rates of tracheostomies performed. Elective procedures had a higher mortality rate than emergency procedures which suggests urgency alone may not be a risk factor and that burden of injury may need to be considered. Seniority of surgeon did not affect complication or mortality rates. This supports that structured training with adequate supervision allows junior doctors to safely perform such procedures.
Keywords: trauma, tracheostomy, airway management, intensive care, South African healthcare

Introduction

Trauma is a worldwide problem affecting all populations and is a leading cause of death and injury.[1] In the South African healthcare setting, trauma makes up a significant proportion of disease burden.[1] Trauma patients receiving ICU care often require tracheostomies and it is a commonly performed procedure.[2]

There are a variety of indications for tracheostomy, particularly in critically ill patients. The commonest indication for tracheostomy is a prolonged need for mechanical ventilation.[3] Patients having sustained neurologic insults who require airway protection also often require tracheostomies. Other indications for the procedure include upper airway obstruction, inability to perform endotracheal intubation, difficulty managing airway secretions and the management of major head and neck surgery or trauma.[3]

There is much debate regarding timing of tracheostomies.[4] The generally accepted ten-day period of endotracheal intubation[3] can be called into question when considering benefits of early tracheostomies. These include shorter weaning times, better pulmonary toilet and less need for sedation.[5] The decision on tracheostomy timing is generally left to physician discretion.[6] Figure 1 shows the guideline used in this institution.

There are several surgical approaches to tracheostomies.[7] In the traditional open surgical technique, an incision is made over the trachea at the level of the second tracheal ring, and a combination of blunt dissection and retraction is used to expose the trachea.[8] The anterior portion of the second tracheal ring is incised and removed with or without the aid of stay sutures, and the tracheostomy tube is inserted.[8]

With a percutaneous dilatational technique, a needle is inserted into the trachea and the Seldinger technique is used to sequentially dilate a tract and insert the tracheostomy tube.[9] This may be done under vision by means of bronchoscopy.[9]

There are advantages and pitfalls to both surgical and percutaneous dilatational tracheostomy techniques.[9] Using a hybrid semi-open tracheostomy technique aims to combine the safety of open tracheostomy with the efficiency of percutaneous techniques.[9] In the semi-open technique, skin incision and neck dissection are performed similarly to the open technique until the trachea is visualised. A needle is then inserted into the trachea, and dilatation and tracheostomy insertion are done as in percutaneous dilatational technique.[9]

Regardless of surgical approach, the tracheostomy can result in complications. Early complications include loss of airway, bleeding, damage to surrounding structures, pneumothorax, dislodged tracheostomy, surgical site infection and even death.[10] Late complications may occur even in patients who have been successfully decannulated.[10] These include tracheal stenosis, tracheo-oesophageal fistulae and tracheomalacia.[10]

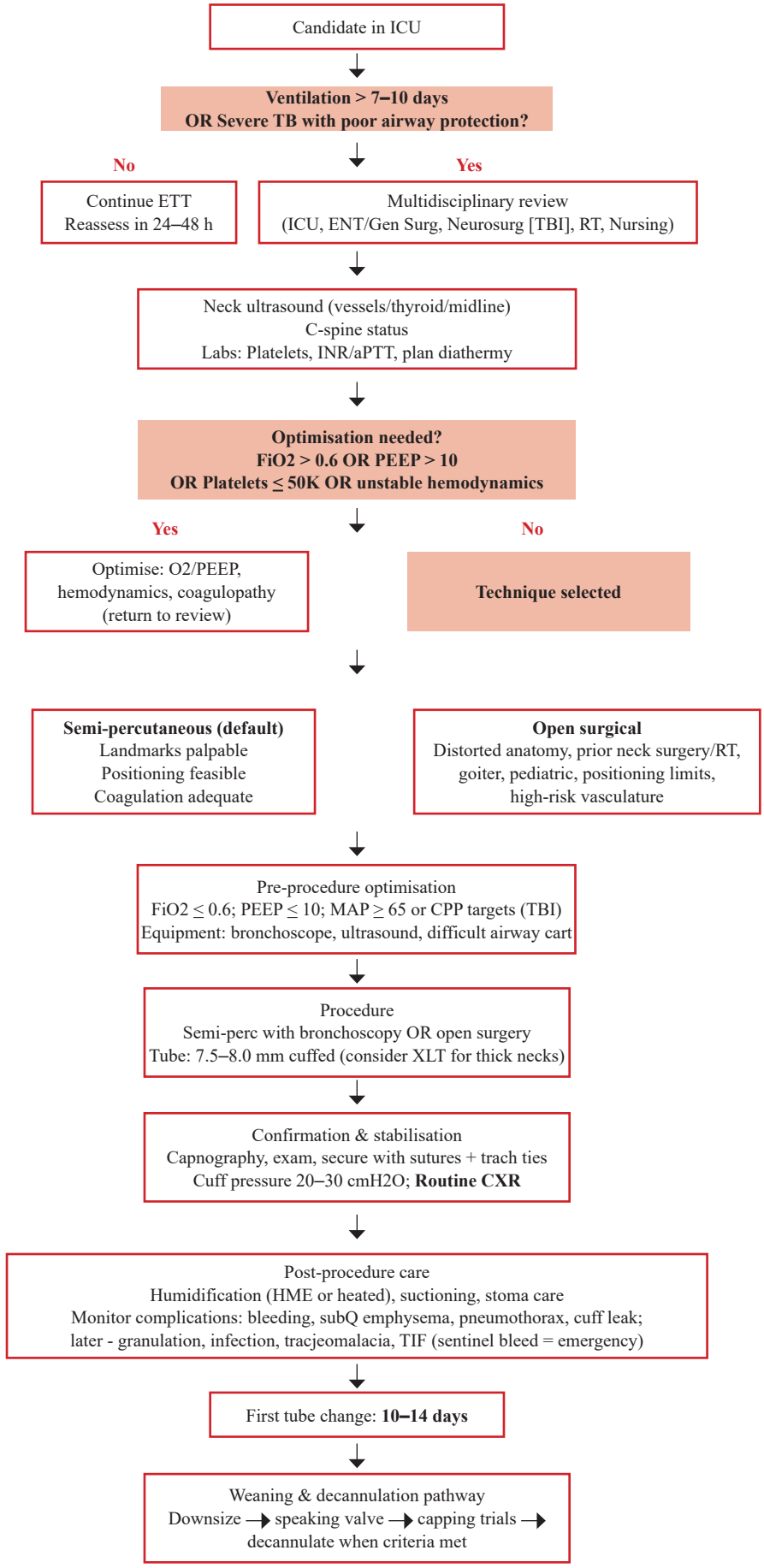

Figure 1: Tracheostomy timing guideline

The aim of this study is to determine complication and mortality rates of tracheostomies in this setting and to determine the association of these outcomes with level of surgeon, urgency of procedure and surgical approach utilised. Additionally, number of days intubated prior to tracheostomy and patient mechanism of injury were assessed.

Patients and methods

A retrospective audit was conducted at Charlotte Maxeke Johannesburg Academic Hospital, a single Level 1 Trauma Centre in Johannesburg from 1 June 2016 to 31 May 2023. All adult patients who had tracheostomies performed by the trauma surgery staff within the unit in this period were included. Patient demographics, mechanism of injury, duration of intubation, urgency of procedure, surgical approach and level of surgeon were recorded. Emergency tracheostomies were those that were performed on day 0 of intubation. Surgical trainees have completed 3 years of general medical training and surgical consultants have completed at least 5 years of specialist training. Outcomes evaluated included in hospital complications and mortality rates within 30 days of tracheostomy.

Statistical analysis was completed with assistance from the Surgical Statistics Hub at the University of the Witwatersrand Department of Surgery. STATA version 17 was used to analyse data. Categorical data relationships were determined using chi- square or Fischer exact tests. Continuous data relationships were determined using Shapiro-Wilk or Mann Whitney U tests. Logistic regression methods were applied to compare different variables. Statistical significance was determined using p-value < 0.05.

Results

A total of 247 patients were enrolled in the study. Of these patients 86.6% (n = 214) were male and 13.36 % were female. The ages of patients enrolled in the study ranged from 18 to 92 years old with a median age of 33 years and interquartile range of 28–41 years.

The predominant mechanism of injury in patients requiring tracheostomies was blunt trauma consisting of 68.83% (n = 170) of the cohort as opposed to 31.17% (n = 77) being penetrating trauma. The patients who required tracheostomies had a median intubation period of 8 days (IQR 5–10 days) before tracheostomy was performed. Tracheostomies performed were done by a semi-open hybrid technique (63.97%), open technique (34.82%) and percutaneous dilatational (1.21%) technique.

Acute tracheostomy complications occurred in 4.86% of patients enrolled in the study (Table I).

Table I: Overall complication rates

Type of complication	Rate of complications *n* (%)
Dislodged tracheostomy	1 (0.4%)
Pneumothorax	1 (0.4%)
Blocked tracheostomy	4 (1.62%)
Haemorrhage	3 (1.21%)
False tract	3 (1.21%)

There was no statistically significant difference in complication rates across the different surgeon levels in the study (p < 0.999). There was also no statistically significant difference (p = 0.469) in the complication rates of emergency and elective tracheostomies (Table II). However, a significant difference was observed in the distribution of procedure urgency (p < 0.001): consultants performed 40.38% of emergency tracheostomies with a surgical trainee observing, whereas they carried out only 9.23% of elective tracheostomies. Registrars and medical officers performed the remaining procedures as outlined in Table III. The type of tracheostomy performed (i.e. surgical approach) had no statistically significant bearing on complication rates (p = 0.444).

Table II: Complication rates

Factors	Complication rates
Level of surgeon	
Consultant	5.13%
Registrar	5.10%
Medical officer	0%
Urgency	
Elective	5.64%
Emergency	1.92%
Type of tracheostomy	
Hybrid semi-open tracheostomy	3.8%
Open tracheostomy	6.98%
Percutaneous dilatational tracheostomy	0%

Table III: Level of surgeons performing procedures of differing urgency

Urgency of procedure	Level of surgeon *n* (%)
Elective	Consultant 18 (9.23%) Registrar 167 (85.64%) Medical officer 10 (5.13%)
Emergency	Consultant 21 (40.38%) Registrar 29 (55.77%) Medical officer 2 (3.85%)

The all-cause mortality rate at 30 days within the study cohort was 21.05%. The average time to death was 10 days after tracheostomy (± 8 days). Mortality rates were significantly higher in patients who had elective tracheostomies compared to emergency tracheostomies (p = 0.022), with mortality rates of 24.1% and 9.62%, respectively (Table IV). The study found no significant difference in mortality rates among the various surgeon levels (p = 0.678), injury

Table IV: Mortality rates

Factors	Mortality rates
Level of surgeon	
Consultant	20.51%
Registrar	21.94%
Medical officer	1.92%
Urgency	
Elective	24.1%
Emergency	9.62%
Mechanism of injury	
Blunt	19.53%
Penetrating	24.36%
Number of regions injured	
Single	26.21%
Multiple	46.55%

mechanisms (p = 0.404) or the number of regions injured (p = 0.7338).

Discussion

This study showed that patients requiring tracheostomies were more likely to have sustained blunt traumatic injuries than penetrating injuries. This is consistent with current data which shows that tracheostomies are predominantly required in patients who are intubated for prolonged periods after sustaining traumatic brain injuries from blunt trauma.[11]

The mean age of patients enrolled in our study correlates with that of the general trauma population as trauma affects young patients globally.[12] The timing of tracheostomies in our study population is also fairly consistent with international trends for tracheostomies performed for prolonged intubation.[13] It is generally accepted that endotracheal intubation and mechanical ventilation for more than 10 days necessitate tracheostomy.[11] The feared complication of prolonged endotracheal intubation is tracheal stenosis.[14]

However, there is discourse that promotes earlier tracheostomy to facilitate early liberation from mechanical ventilation, better pulmonary toilet and decreased sedation requirements.[6] The unit favours tracheostomies after 10 days of endotracheal intubation in order to minimise unnecessary procedures. However, physician discretion is used to attempt to predict which patients may require prolonged mechanical ventilation and thus require earlier tracheostomies.

Complication rates in our study were comparable to the study done by Murray et al.[10] Level of surgeon and urgency of procedure had no significant effect on complication rates. Tracheostomies done by surgical trainees are done under the supervision of a consultant within a structured training programme which may account for the low complication rates.

In our clinical setting, the most performed surgical approach was a semi open hybrid technique followed by open tracheostomy and percutaneous dilatational tracheostomy. The hybrid approach is favoured as it allows surgical trainees to learn the skill of the open tracheostomy,[12] which may be required in emergent situations. The surgical approach showed to have no significant impact on complication rates. This interestingly contrasts with a meta-analysis by Johnson-Obaseki et al. which showed higher infection rates in patients who underwent open tracheostomies.[15] This may indicate that stringent infection prevention and control measures in the unit are effective in minimising the risk of infection in open tracheostomies.

The mortality rate in our study mirrored that of the general trend.[16] It is important to note that mortality in this context is influenced by underlying injury and may not be related to the procedure itself. Level of surgeon, mechanism of injury and number of regions injured did not influence mortality rates. It is however noteworthy that patients who had elective tracheostomies had a significantly higher mortality rate than those who had emergency tracheostomies. This may be due elective tracheostomies being performed for prolonged intubation on patients with poorer recovery prognoses.[17] Further investigation into injury severity scoring and patient comorbid conditions may be warranted to better understand mortality rates in our patient cohort.

Medical officers, registrars and consultants performed tracheostomies in this study. The mortality rates and distribution of complications were similar across all surgeon levels. This suggests that within this unit tracheostomies are being performed safely regardless of seniority of the surgeon which may reflect adequate supervision and training or protocol standardisation. Consultants performed significantly more emergency tracheostomies than elective tracheostomies. This may indicate that in more urgent situations, deference is given to more senior surgeons to perform the procedure.

Conclusions

The use of different surgical approaches to performing tracheostomies does not largely affect complication or mortality rates from the procedure. Our study demonstrated higher mortality rates in patients who had elective tracheostomies. This suggests that urgency alone may not be a risk factor and further interrogation of injury severity and comorbid conditions is necessary. Seniority of surgeons had little effect on complication and mortality rates from tracheostomies. This supports a structured training programme with adequate supervision allowing junior doctors to safely perform procedures. It further supports that competence rather than seniority alone is imperative.

Further studies with larger sample size and prospective design may be necessary to further interrogate outcomes of tracheostomies in trauma patients.

Limitations

There are several limitations that should be acknowledged in relation to this study. The study was conducted in a single academic hospital, and results may not be easily extrapolated to other contexts. As a retrospective review, the data collected was limited to routinely kept patient records. This may have limited the sample size as well as the parameters investigated in the study.

Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the University of Witwatersrand Human Research Ethics Committee (Ref M231165).

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