Epidemiology of Tracheostomy Patients in Intensive Care Unit of King Abdulaziz Medical City

Farhan Alenezi[1], Sreekanth Mohan[1], Nourah Mohammad Aldekhayel[1], Arwa Hussain Alruwaili[1], Hind Mohammed Alshabanat[1], Winnie Philip[2] and Shoeb Qureshi[2*]

[1]*Department of Respiratory Therapy, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia.*
[2]*Department of Research, College of Applied Medical Sciences, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia.*

Authors' contributions

Article Information

Original Research Article

ABSTRACT

Introduction: Tracheostomy is one of the common procedures that are performed in the intensive care unit (ICU) for airway management. The primary aim of this study was to review the role of tracheostomy, its benefits and risks in ICUs of King Abdul-Aziz Medical City (KAMC), Riyadh, Saudi Arabia with a view to realize factors affecting the patient's outcome.
Materials and Methods: A retrospective study reviewed the charts of various adult ICUs of KAMC from the patients' medical records. Patients who aged 18 years and above and underwent tracheostomy in the ICU were evaluated for the incidence and hospital outcome. Analysis of data was done by SPSS (Version 22). Data was analyzed statistically by using frequencies, percentages mean, standard deviation. Mann-Whitney U test and chi-square tests were done to

---

Corresponding author: E-mail: qsab2002@yahoo.co.in;

study the influence and difference between of various variables.

Results: Total number of 128 patients was tracheostomized with predominance of males with mean age of 61.30 ± 20.05 years. The majority were diagnosed with Stroke/Traumatic Brain Injury (28.1%) followed by Carcinoma (13.3%). The predominant reason for tracheostomy was prolonged intubation 54.7% while the main complication was fever and infection (30.8%). The mean duration of the ICU stay was 37.01 ± 38.603 days. The outcome of this study showed low mortalities for tracheostomy patients.

Conclusion: Tracheostomy performed in the ICUs of KAMC was dominantly done in males mainly with indication of prolonged intubation. It was associated with fever and infection as complication and with low mortality rate.

1. INTRODUCTION

Tracheostomy is one of the common procedures that are performed in the intensive care unit (ICU) when prolonged mechanical ventilation (MV) is anticipated. It plays an integral role in the airway management of such patients. There are many proved advantages and complications for tracheostomy. Some of the reports on the advantages of tracheostomy contrasts with the large body of literature that shows the local complications of this procedure, this contrast may have encouraged us to conduct this study. Hence the purpose of this study is to review the role of tracheostomy, its benefits and risks in ICU of KAMC with a view to realize factors affecting the patient's outcome.

2. HYPOTHESIS

H1: All the tracheostomy patients have good outcomes.

All the patients' undergone tracheostomy has decreased length of ICU and hospital stay.

H0: Not all the tracheostomy patients have good outcomes.

None of the patient's undergone tracheostomy has decreased length of ICU and hospital stay.

3. LITERATURE REVIEW

Tracheostomy is a technique that is commonly carried out in critically ill patients in acute care settings with longer duration on mechanical ventilator [1]. It is done by introducing an artificial airway by creating a surgical opening in the anterior wall of the trachea [2]. It is indicated mainly for providing artificial ventilation and as an alternative for those patients with severe blocked upper airway. It is also performed in airway compromised patients and to those patients who are in need of airway toileting [3].

Tracheostomy procedures are mainly of 2 types. The Open tracheostomy or surgical tracheostomy and Percutaneous dilatational tracheostomy. In surgical tracheostomy, a 2–3 cm parallel or perpendicular skin incision is made halfway between the sternal notch and thyroid cartilage. It is performed as a modified Seldinger technique, together with a flexible bronchoscope which improves a clear view of trachea. It helps to relocate the endotracheal tube above the incision and helps to envisage the position of the needle and subsequent stomal dilation [4,5]. Bronchoscopy assists in preventing posterior tracheal wall trauma, ensuring tube positioning and helps airway toileting and hence it is extremely suggested [6-8].

Recent evidences show better outcomes in tracheostomised patients than the patients in endotracheal tube on mechanical ventilation for prolonged period [9-12]. Numerous studies have also undergone to detect the optimal time span from orotracheal intubation to placement of a tracheostomy tube. But none of the studies ended up in definitive conclusions [13,14]. This may be due to the diverse results obtained from varied populations with innumerable comorbidities. The American College of Chest Physicians endorses the performance of tracheostomy in intensive care patients who are intubated and mechanically ventilated for more than 3 weeks [15]. Early tracheostomy have its own benefits. The first and foremost is that it can prevent direct laryngeal trauma and can provide better comfort than that of the endotracheal tube. Further it can provide improvement in activities of daily livings such as communication, oral intake and mobility [16]. It has also noticed that tracheostomy has several added potential advantages over prolonged oral intubation which

includes enhanced pulmonary mechanics with reduced dead space ventilation, decreased duration in acute care or hospital stay.

While tracheostomy provides several added advantages, it also provides complications. The complications like hemorrhage, infection, pneumothorax, tube obstruction, and accidental decannulation are also reported [17,18].

4. MATERIALS AND METHODS

The methodology is detailed as under:

4.1 Study Area/Setting

The study was conducted in various intensive care units (ICUs), like Medical ICU, Trauma ICU, Neuro ICU, and Cardio-thoracic ICU of King Abdul-Aziz Medical City (KAMC), Riyadh, Saudi Arabia. All the intensive care units are covered by Intensivists, Respiratory Therapists and Critical care nurses 24 hours per day, 7 days a week.

4.2 Study Design

This study was performed as a retrospective cohort study.

4.3 Sample Size

As per 2015 data available from NGHA, a total number of 130 patients have been admitted in various ICUs per month. Patients who meet the inclusion criteria will be selected for the study with a margin of error of 5% and a confidence level of 95%.

4.4 Selection of the Subjects

The sampling strategy was consecutive sampling. Patients were all male and female with age 18 years or older who were admitted in adult ICUs, and have undergone tracheostomy during their ICU stay was taken for the study. While the patients who were on endotracheal tube and have not undergone tracheostomy for the whole ICU stay, and patients have undergone tracheostomy outside KAMC were excluded.

4.5 Data Collection Instrument

Patients undergoing tracheostomy were evaluated for the incidence and hospital outcome (mortality). We reviewed 130 patients with their initial parameters like age, gender, diagnosis and date of ICU admission. The data whether the patient was on mechanical ventilation, or on non-invasive ventilation, on T-piece with oxygen or on room air before and on date of tracheostomy, reason for tracheostomy, type of tracheostomy (whether it is Surgical or Percutaneous Tracheostomy) were taken. Vital signs before and after the tracheostomy procedure and first arterial blood gas (ABG) after the procedure were recorded. Other parameters like complications, length of ICU stay, weaning to ATC, decannulation, whether the patient is on chronic ventilator or not, patient readmission to the ICU were collected for each patient, and the hospital outcome categorized whether the patient is alive and discharged or dead (died during their first ICU admission, or died after transfer to the floor). The different variables were collected for the study are appended as (Appendix I). These data were obtained from the patient medical records (Best Care System).

4.6 Data Management and Statistical Analysis

The information was entered into Microsoft Excel sheet and subsequently uploaded into Statistical Package for Social Sciences (SPSS) software. Incidence of tracheostomy patients during the study period is calculated as:

$$\frac{\text{No.of new cases of tracheostomy patients}}{\text{Population at risk}} \times 100$$

The statistical analysis of the variables was carried out using SPSS software (version 20).

Data was analyzed statistically by using frequencies, percentages mean, standard deviation. Mann-Whitney U test and chi-square tests were done to study the influence and difference between of various variables (p value of 0.05 was considered significant).

4.7 Ethical Consideration

Institutional review board (IRB)-KAIMRC approved the study with the protocol number SP16/114. Privacy and confidentiality was completely protected. No identification or information of the participant such as name, ID's etc. was collected.

5. RESULTS

The results of the present study entitled, "Incidence and Outcome of Tracheostomy

Patients in Intensive Care Unit of King Abdul-Aziz Medical City" is detailed below:

5.1 Demographic Characteristics of the Respondents

This study was conducted in various ICUs at King Abdul-Aziz Medical City, Riyadh; Saudi Arabia. The study included a total number of 128 ICU patients. Out of this total number, 78 were males which constitutes 60.9% and 50 females which comes around 39.1% as shown in Fig. 1.

The study subjects were between the age group ranging from 19 to 105 years with mean age of 61.30 ± 20.05 years.

5.2 Tracheostomy Types

Mainly 2 types of tracheostomy procedures are usually performed –surgical/open tracheostomy and percutaneous dilatational tracheostomy (PDT). As mentioned in Table 1, 67 (52.3%) patients had undergone surgical tracheostomy while 61 (47.7%) received percutaneous tracheostomy.

5.3 Major Diagnosis of ICU Patients

The majority of patients who got admitted in ICU were diagnosed with Stroke/Traumatic Brain Injury (28.1 %), Carcinoma (13.3%), Pneumonia (13.3%), Septic Shock (4.69%), Cardiac arrest (3.91%), Burns (3.13%), Chronic Obstructive Pulmonary Disease (COPD) with respiratory failure (3.13%) and the remaining minority of patients were diagnosed with Alzheimer's disease, liver cirrhosis, renal failure, vocal cord paralysis etc.

Table 1. Type of tracheostomy used for the respondents

Type of tracheostomy	Details of subjects (n= 128)*
Surgical	67 (52.3)
Percutaneous	61 (47.7)
Total	128 (100)

The numbers in parenthesis indicate percentage

5.4 Indications and Complications for Tracheostomy

There were numerous reasons for tracheostomy. Among those, the predominant reason was prolonged intubation which comprised 70 patients (54.7%) followed by failed extubation 39 (30.5%), then tracheostomy to protect the airway 17 (13.3%), vocal cord paralysis 4 (3.1%) and low Glasgow coma scale GCS 3 (2.3%) as shown in Fig. 2.

The status of the patients who got admitted in the ICU with various diagnoses prior to tracheostomy procedure is revealed in Table 2. It included Invasive ventilator (IV) which contributed the major part 114 (89.2%) patients, Noninvasive ventilator (NIV) which is either Continuous Positive Airway Pressure (CPAP) or Bi Level Positive Airway Pressure (BIPAP) 3 (2.3%) patients, on room air 8 (6.2%) patients and on oxygen 3 (2.3%) patients.
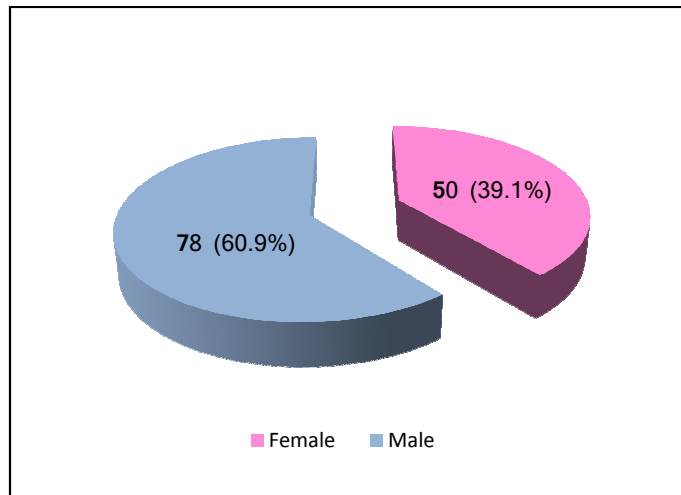

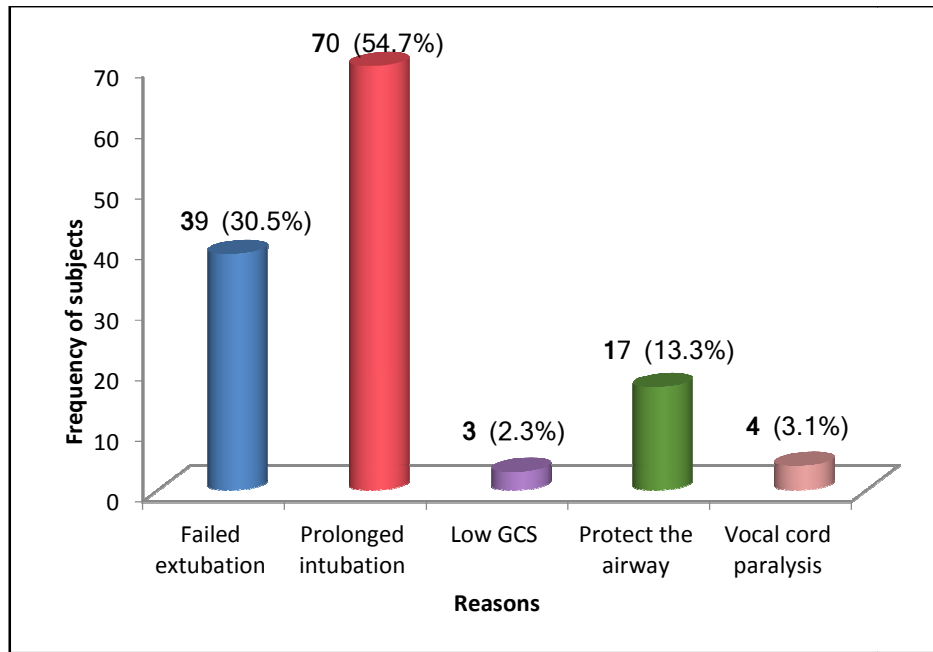**Fig. 1. Gender distribution of the respondents**

Fig. 2. The reasons for tracheostomy

Table 1. Devices used before the tracheostomy

Type of devices	Subjects numbers*
Invasive ventilator	114 (89.2)
Noninvasive ventilator	3 (2.3)
Room air	8 (6.2)
Oxygen	3 (2.3)
Total	128 (100)

The numbers in parenthesis indicate percentage

Like any other procedure, there were so many complications for tracheostomy. This study have encountered many complications in post tracheostomy days. Out of the total subjects, 91 (71.1%) patients got one or the other complications as mentioned in Table 3. Regarding the complications, many (30.8%) had fever and Infection, pneumonia (26.3%), Cardiopulmonary arrest (13.2%), Bleeding (8.8%) respectively as explained in Table 4.

Table 2. Post tracheostomy complications

Complications	Subjects numbers*
Present	91 (71.1)
Absent	37 (28.9)
Total	128 (100)

The numbers in parenthesis indicate percentage

Table 3. Major complications of tracheostomy

Major complications	Subjects numbers*
Fever and Infection	28 (30.8%)
Pneumonia	24 (26.3%)
Cardiopulmonary Arrest	12 (13.2%)
Bleeding	8 (8.8%)

The numbers in parenthesis indicate percentage

5.5 Tracheostomy Outcomes

In the total study subjects, many patients (N 94, 73.4%) were undergone the weaning trails from mechanical ventilation during their ICU stay, 40 patients of them were decannulated, and the others (N 34, 26.6%) continued to be on tracheostomy and on mechanical ventilation after their first ICU stay as displayed in Fig. 3.

The hospital outcome was significantly influenced by whether the patient underwent the weaning trails or not. Also, the hospital outcome influenced by the complications developed by tracheostomy. As well as, the outcome of tracheostomy type did not influence the hospital outcome (Chi-square= 0.58) as mentioned in Table 5.

The incidence of tracheostomy among adult patients in the ICU of KAMC is 19.36%. The mean duration of the ICU length of stay was

37.01 ± 38.603 days. Even though there were many complications associated with tracheostomy the hospital outcome of the patients were better. 86 patients (67.2%) were alive and were either shifted from ICU or got discharged and 42 patients (32.8%) got expired which is demonstrated as pie diagram in Fig. 4.

As by Mann-Whitney U test there were significant deference between the number of patients who were alive or dead post-tracheostomy (Test statistic U= 12555, p= 0.005) as shown in Table 6. The mean age of study subjects who died with tracheostomy was 77.62 as seen in Table 6.

6. DISCUSSION

Tracheostomy is one of the most important procedures performed in the ICUs. In this study titled as "Incidence and Outcome of Tracheostomy Patients in Intensive Care Unit of King Abdul-Aziz Medical City" the discussion as follows:

6.1 Demographic Characteristics

A total of 128 patients have undergone tracheostomy during the period of this study. All males and females aged 18 years and above with equal chances were selected. A higher rate of tracheostomy has been identified among males with a percentage of 60.9%, as seen in this study, which is similar with Arabi et al. report from a previously published study [9]. The age of the patients ranged from 19 to 105 years. The mean age in this study was 61.30 years, while Flatten et al. study showed a mean age of 49.2 years [3].

6.2 Tracheostomy Types

The surgical/open tracheostomy and percutaneous dilatational tracheostomy (PDT) were both conducted in KAMC. It has been recognized that 67 (52.3%) open/surgical tracheostomies were carried out while compared with 61 (47.7%) percutaneous dilatational tracheostomies, which was not statistically significant. In contrast with this study, Flaatten et al. and Arabi et al. reported that percutaneous dilatational tracheostomy was performed more frequently [3,9].

6.3 Major Diagnosis of ICU Patients

In this study the majority of the patients were diagnosed with Stroke/Traumatic Brain Injury (28.1 %), which is similar to the study done by Terra et al. which revealed that the most common diagnosis was neurological conditions [12]. Whereas in a study conducted by Combes et al. the majority of the cases were diagnosed with ARDS [11].

6.4 Indications and Complications for Tracheostomy

Tracheostomy was performed for various reasons. The study subjects had more than one reason for tracheostomy. This study demonstrated that tracheostomy was more likely to be performed in patients who had prolonged period of mechanical ventilation (54.7%) which was followed by those with extubation failure (30.5%) as shown in Fig. 2. A study done by Blot et al. showed indications which is similar to the indications mentioned in this study, that the most
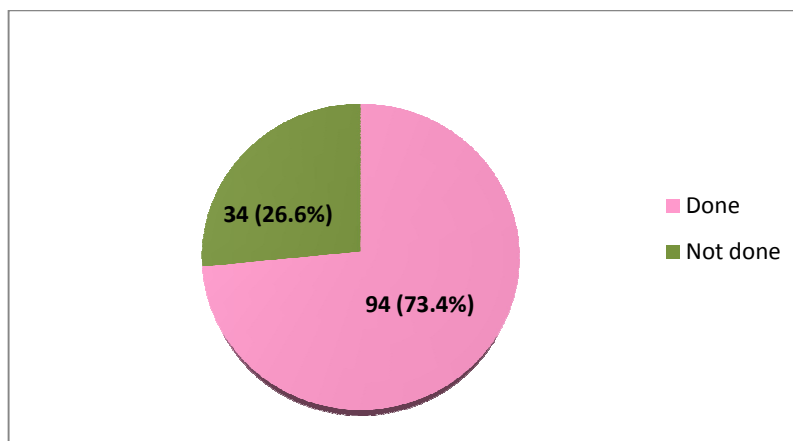

Fig. 3. The number of respondent weaned during their hospitalization

Table 4. Relation between hospital outcome and other factors with the chi square value and p value

| Variable	Hospital outcome		Total	Chi square value	p value
	Alive	Dead			
Tracheostomy type				0.58	0.447
Surgical	43 (64.2%)	24 (35.8%)	67 (100%)		
Percutaneous	43 (70.5%)	18 (29.5%)	61 (100%)		
Total	86 (67.2%)	42 (32.8%)	128 (100%)		
Complication				4.56	0.033*
Present	56 (61.5%)	35 (38.5%)	91 (100%)		
Absent	30 (81.1%)	7 (18.9%)	37 (100%)		
Total	86 (67.2%)	42 (32.8%)	128 (100%)		
Weaning				14.21	0.001*
Done	72 (76.6%)	22 (23.4%)	94 (100%)		
Not done	14 (41.2%)	20 (58.8%)	34 (100%)		
Total	86 (67.2%)	42 (32.8%)	128 (100%)		
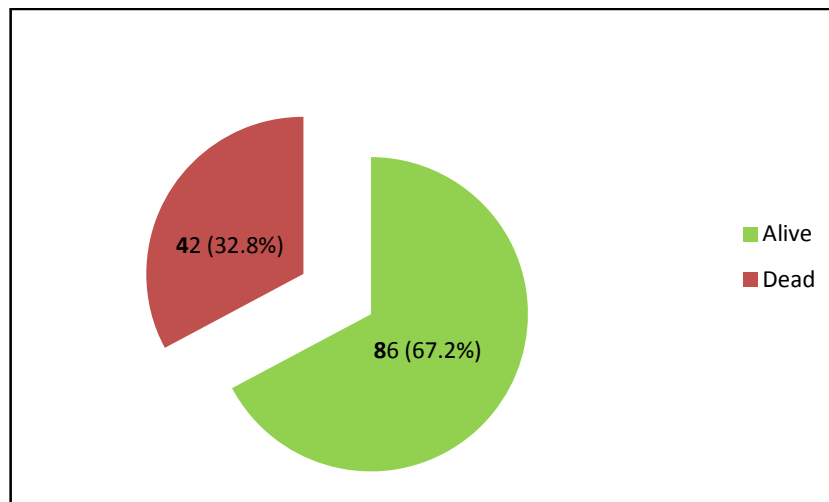
Fig. 4. Hospital outcome of respondents with tracheostomy

Table 5. Age and hospital outcome

Hospital outcome	N	Mean rank	Test statistic	P value
Alive	86	58.09		
Dead	42	77.62	U= 12555	0.005*
Total	128			

frequent indications were prolonged MV and failure of extubation [1]. As in this study, previous studies showed that the respondents were on invasive mechanical ventilation prior to tracheostomy [1,11,12]. Besides the indications, this study has addressed multiple complications. It was found that the predominant complications were fever, infection, cardiopulmonary arrest and bleeding, respectively as mentioned in Table 4. In contrary, studies conducted by Silvester et al. and Terra et al. reported that the major complication was hemorrhage [7,12].

6.5 Tracheostomy Outcomes

This study has evaluated short-term outcome, that appeared within the ICU stay, with focus on mortality. So far many studies have been published regarding outcomes of tracheostomy, but they were difficult to compare with the outcome of this study. While this study was conducted in tracheostomy patients in multiple ICUs in KAMC with uneven diagnosis, other studies were either conducted in one single ICU [3] or in multicentered ICUs [12] or some of the

7

studies focused merely on percutaneous dilatational tracheostomy (PDT) [16] or for evaluating specific diagnosis such as traumatic [9] or severe head injury patients only [10]. Outcome usually include mortality as was shown in this study, which differ with studies that focused on the non-mortality outcome which was difficult to compare [7]. Regardless of these differences, there were consistency concerning the low mortalities for tracheostomy patients, as seen in previous reports, which concur with the findings of this study as shown in Fig. 3 [2,4,6]. The mean age of study subjects who died with tracheostomy was 77.62 as shown in Table 6. The mean duration of the ICU length of stay was 37.01 ± 38.603 days. Most of the cases 73% (94 patients) were undergone the weaning trials within their hospital stay, 40 patients of them were decannulated and 22 were expired as seen in Table 5.

6.6 Limitations

There were a few limitations for this study which has to be mentioned. The first limitation was the difficulty of accessibility to patients' medical records. Also, as this study is a retrospective cohort study, another limitation was to obtain the data from the patient medical records which might had an under reporting of some events like desaturation and any other complication. Next, the study had not evaluated long-term outcome such as after ICU and hospital discharge and post decannulation. These data might be the focus of future studies. Finally, the strength of this study was that it is include all medical/surgical ICUs, which ended up in more accurate outcomes of tracheostomy.

7. CONCLUSION

Tracheostomy is one of the common procedures that are performed in the intensive care unit (ICU) when prolonged mechanical ventilation (MV) is anticipated. It plays an integral role in the airway management of such patients. Tracheostomy performed in the intensive care units (ICUs) of hospitals was associated with low mortality rate.

The mean age of the subjects was 61.30 years. The present study observed a higher rate of tracheostomy among males. Most of the patients were diagnosed with Stroke/Traumatic Brain Injury.

Both surgical/open tracheostomy and percutaneous dilatational tracheostomy (PDT) were conducted in KAMC. The main indication of tracheostomy was prolonged period of mechanical ventilation, followed by failure of extubation.

Tracheostomy was found associated with multiple complications; the predominant were fever and infection. The majority of the respondents had undergone weaning trials within their ICU stay. In addition, the mean duration of the ICU length of stay was 37.01 ± 38.603 days.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Blot F, Melot C. Commission d'Epide´miologie et de Recherche Clinique. Indications, timing, and techniques of tracheostomy in 152 French ICU's. Chest. 2005;127(4):1347-1352.
2. Kollef MH, Ahrens TS, Shannon W. Clinical predictors and outcomes for patients requiring tracheostomy in the intensive care unit. Crit Care Med. 1999;27(9):1714-1720.
3. Flaatten H, Gjerde S, Heimdal JH, Aardal S. The effect of tracheostomy on outcome in intensive care unit patients. Acta Anaesthesiol Scand. 2006;50(1):92-98.
4. Cameron JL. Current surgical therapy. 9th ed. Philadelphia (PA): Mosby; 2008.
5. Zollinger RM, Zollinger RM. Zollinger's atlas of surgical operations. 8th ed. NewYork (NY): McGraw-Hill; 2003.
6. Catheter replacement of the needle in percutaneous arteriography; A new technique.SELDINGER SIActa radiol.1953; 39(5):368-76.

7. Silvester W, Goldsmith D, Uchino S, et al. Percutaneous versus surgical tracheastomy: A randomized controlled study with long-term follow-up. Crit Care Med. 2006; 34:2145–52.

8. De Boisblanc BP. Percutaneous dilational tracheostomy techniques. Clin Chest Med. 2003;24:399–407.

9. Arabi Y, Haddad S, Sirawi N, Al Shimemeri A. Early tracheostomy in intensive care trauma patients improves resource utilization: A cohort study and literature review. Crit Care. 2004;8(5):R347-R352.

10. Bouderka MA, Fakhir B, Bouaggad A, Hmamouchi B, Hamoudi D, Harti A. Early tracheostomy versus prolonged endotracheal intubation in severe head injury. J Trauma. 2004;57(2):251-254.

11. Combes A, Luvt CE, Nieszkowska A, Trouillet JL, Gibert C, Chastre Jl. Is tracheostomy associated with better outcomes for patients requiring long-term mechanical ventilation? Crit Care Med. 2007;35(3):802-807.

12. Terra RM, Fernandez A, Bammann RH, Castro AC, Ishy A, et al. Open bedside tracheostomy: Routine procedure for patients under prolonged mechanical ventilation. Clinics (Sao Paulo). 2007;62: 427–432. Doi.org/10.1590/S1807–59322007000400 009.

13. Mallick A, Bodenham AR. Tracheostomy in critically ill patients. Eur J Anaesthesiol 2010;27: 676–82. DOI: 10.1097/EJA.0b013e32833b1ba0.

14. Runicardi FC, Anderson A, Billiar T, Dunn D, Hunter J, Pollock RE. Sydney: McGraw-Hill Professional. Schwartz's Manual of Surgery; 2006.

15. Koitschev A, Graumueller S, Zenner HP, Dommerich S, Simon C. Tracheal stenosis and obliteration above the tracheostoma after percutaneous dilational tracheostomy. Crit Care Med. 2003;31:1574–6.

16. Norwood S, Vallina VL, Short K, Saigusa M, Fernandez LG, McLarty JW. Incidence of tracheal stenosis and other late complications after percutaneous tracheastomy. Ann Surg. 2000;232:233–41.

17. Feller-Kopman D. Acute complications of artificial airways. Clin Chest Med 2003; 24(3):445–455.

18. Myers EN, Carrau RL. Early complications of tracheotomy: Incidence and management. Clin Chest Med. 1991;12(3):589–595.

APPENDIX I

King Saud bin Abdulaziz University for Health Sciences
College of Applied Medical Sciences
Respiratory Therapy Program
Research Methodology I (CAMS411)
Research on "Incidence and Outcome of Tracheostomy Patients in Intensive Care Unit of King Abdulaziz Medical City"

DATA COLLECTION SHEET

SI No.:		Date:			
Patient		1	2	3	4
Age					
Gender					
Diagnosis					
Reason for Tracheostomy					
Tracheostomy Date					
Type of Tracheostomy					
On Mechanical ventilator, Noninvasive ventilator, Oxygen or on room air					
Duration in ICU					
Vital signs:					
Heart rate, Respiratory rate, Blood pressure, Temperature					
ABG parameters:					
pH					
pCO2					
pO2					
HCO3					
BE					
Shifted to (ward, IMCU, or other area)					
Expiry on tracheostomy in ICU					
Readmission to ICU					
If yes –why?					
Expiry in floor					