

**"THE ROLE OF TRACHEOSTOMY IN WEANING  
FROM PROLONGED MECHANICAL  
VENTILATION."**

**A DISSERTATION SUBMITTED IN PARTIAL  
FULFILLMENT OF THE REQUIREMENTS FOR  
THE DEGREE OF MASTER OF MEDICINE IN  
ANAESTHESIOLOGY OF THE UNIVERSITY OF  
NAIROBI**

**Thomas Mwendwa Maingi**

**2006**

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## DECLARATION

This is my original work and to my knowledge it has not been presented for a degree in any other university.

SIGNED: *Thomas Maingi* DATE: 27/11/06

**Dr. Thomas Mwendwa Maingi,**  
Post Graduate Student in Anaesthesia,  
Anaesthesia Section, Department of Surgery,  
University of Nairobi.

This dissertation is submitted for the degree of Master of Medicine in anesthesiology with my approval as a university supervisor.

DEPARTMENT OF SURGERY  
COLLEGE OF HEALTH SCIENCES  
P. O. Box 19676 - 00202 KNH  
NAIROBI  
TEL: 2722890 / 2726300, Ext. 43773

SIGNED: *Thomas Maingi* DATE: MDV 27TH 2006

**Dr. T. M. Chokwe Bsc (Anat) MBChB, MMED (anaesth),**  
Lecturer in Anaesthesia,  
Department of Surgery,  
University of Nairobi.

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## DEDICATION

To my dear wife, Eunice and son, Nelson.

## ABBREVIATIONS

<b>ACCP</b>	American College of Chest Physicians
<b>CMV</b>	Controlled Mandatory Ventilation
<b>CPAP</b>	Continuous Positive Airway Pressure
<b>GA</b>	General Anaesthesia
<b>GCS</b>	Glasgow Coma scale
<b>ICU</b>	Intensive Care Unit
<b>KNH</b>	Kenyatta National Hospital
<b>LA</b>	Local Anaesthesia
<b>PDT</b>	Percutaneous dilatational Tracheostomy
<b>RTA</b>	Road Traffic Accident
<b>SIMV</b>	Synchronized Intermittent Mandatory Ventilation

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## SUMMARY

Patients with trauma often require mechanical ventilation for prolonged periods because of their inability to protect their airways, persistence of excessive secretions and inadequacy of spontaneous ventilation. Tracheostomy is often performed in patients with prolonged translaryngeal intubation on ventilatory support. Its role in weaning from mechanical ventilation remains however subject to practice variation.

This was a prospective study at Kenyatta National Hospital Intensive Care Unit (ICU) of patients admitted with trauma to determine the prevalence, timing and outcomes of patients done tracheostomy.

Glasgow coma score (GCS) was used to assess severity of illness. All trauma patients 13 years and above with GCS of 8 and below and mechanically ventilated were followed until successfully weaned off the ventilatory support. For patients on whom tracheostomy was performed, the timing of the tracheostomy was noted. Tracheostomy was considered early if it was done before 14 days and late if it was done after 14 days on the ventilatory support. The technique of tracheostomy was also noted.

Analysis was made to compare patients who had tracheostomy and those who did not have tracheostomy to establish if tracheostomy accelerates the weaning process in patients with anticipated prolonged ventilatory support. Further analysis was also made to compare early and late Tracheostomy to



establish if early tracheostomy is associated with faster rate of weaning compared to late tracheostomy.

This study was conducted for a period of six months starting from November 1<sup>st</sup> 2005 to April 30<sup>th</sup> 2006. Of a total of 108 trauma patients admitted to the ICU, initiated on mechanical ventilation and recruited into the study, tracheostomy was performed on 28 patients (17%). Comparing patients done to those not done tracheostomy, p value < 0.005, patients done tracheostomy were found to have been weaned faster off mechanical ventilation.

Comparing early (1-14 days) tracheostomy to late (>14 days), early was associated with shorter duration of mechanical ventilation, p-value < 0.015.

## INTRODUCTION

Tracheostomy is the formation of an opening into the trachea. There are two techniques available for performing tracheostomy; surgical tracheostomy and percutaneous dilatational tracheostomy. Open surgical tracheostomy refers to the technique where an incision is made anterior half way between the cricoid cartilage and the suprasternal notch to open the trachea vertically and then a tracheostomy tube inserted into the opening and the wound loosely sutured around the tube. Percutaneous dilatational tracheostomy refers to the technique whereby progressive dilatation of the airway is made after piercing the trachea by the seldinger technique via a guide wire.

Tracheostomy is usually performed in critically ill patients to provide prolonged airway care during slow weaning from assisted ventilation. Other factors which indicate the need for tracheostomy In ICU include acute or chronic neuromuscular conditions, bulbar dysfunction, brain injury and upper airway obstruction.

Tracheostomy in critically ill patients offers significant advantages over prolonged translaryngeal intubation. Less discomfort may allow a reduction in analgesic, sedative and muscle relaxant drugs. Tracheostomy facilitates clearance of airway secretions, mouth care and enteral nutrition. Airway resistance and anatomical dead space are reduced; lessening the work of breathing and improving the speed and overall success in weaning from assisted ventilation. Tracheostomy allows a seamless transition between different modes of assisted ventilation and weaning modes without trials of

extubation and re-intubations. There is reduced frequency of accidental extubation and endobronchial intubation.

Deciding when to convert translaryngeal intubation to tracheostomy at Kenyatta National Hospital Intensive Care Unit remains controversial. Considerable variation in the practice of tracheostomy has been noted despite its integral role in managing patients with anticipated prolonged mechanical ventilation.

Assessment of the risks and benefits of performing a tracheostomy in the ICU should be carried out to ascertain the specific benefit of such tracheostomy to the patient compared to prolonged translaryngeal intubation. There is increasing evidence for better outcomes with tracheostomy within the first few days of intensive care in patients who will require prolonged Ventilatory support. This includes patients with severe respiratory failure, severe trauma brain injury, and patients with chronic chest disease or neurological disease (e.g. Guillian Barre Syndrome).

## LITERATURE REVIEW

Tracheostomy means creating an opening into the trachea anteriorly to establish access to the airway. Tracheostomy may be a life saving procedure that is one of the oldest operations in the history of surgery. It is an operation that frequently opens the doors of breath to a dying patient. Since its first description by Chevalier Jackson in 1909, the modern technique of surgical tracheostomy (SGT) has been extensively used in intensive care patients to establish long term or emergency access to the airway<sup>1</sup>. Surgical tracheostomy refers to the tracheostomy technique whereby a short transverse incision is made on the anterior neck half way between the cricoid cartilage and the suprasternal notch to expose the trachea which is then opened vertically usually between second and third tracheal rings and then a tracheostomy tube is inserted through the opening. This is done either under general Anesthesia or local anaesthesia.

Sheldon and colleagues in 1967 and Toye and Weinstein in 1969 described methods for percutaneous Tracheostomy for the first time<sup>2,3</sup>. The classical technique of percutaneous dilatational tracheostomy using progressive dilators was introduced by Ciaglia and colleagues in 1985<sup>4</sup>.

Tracheostomy is one of the most common surgical procedures in critically ill patients<sup>5</sup>. Tracheostomy is usually performed in critically ill patients to provide prolonged airway care during slow weaning from assisted ventilation. Several factors (which may coexist) in an individual indicate the need for tracheostomy in the intensive care unit. This includes prolonged

weaning from assisted ventilation, acute or neuromuscular conditions, bulbar dysfunction, brain injury, and upper airway obstruction. Tracheostomy in the critically ill patient offers significant advantages over prolonged translaryngeal intubation. Less discomfort may allow a reduction in analgesic, sedative and muscle relaxant drugs. Clearance of airway secretions, mouth care and enteral nutrition are all facilitated. Airway resistance and anatomical dead space is reduced thereby reducing work of breathing and improving the speed and overall weaning from assisted ventilation. Tracheostomy allows seamless transition between different modes of assisted ventilation and weaning modes without trials of extubation and re-intubation. There is reduced frequency of accidental extubation and endobronchial intubation.

## Comparison of Prolonged Translaryngeal intubation to Tracheostomy during Prolonged Ventilatory Support

### Advantages of Tracheostomy Intubation

### Advantages of Translaryngeal

1) Ease of re-insertions	Ease and rapidity of initial insertion
2) Better secretion removal with suctioning	avoid acute surgical complication, posterior tracheal wall injury
3) Allow less skilled nursing care	Lower cost
4) Reduced Larynges damage	Avoid late surgical complication and infections, recurrent nerve injury, stomal stenosis.
Lower incidence of tube obstruction	
Less oral injury (tongue, teeth, palate)	
Improved patient confront	
Less sedation /analgesia required	
Better oral hygiene	
Improved ability to speech	
Preservation of glottis competence	
Less Aspiration, lower incidence of ventilator associated pneumonia	
Allowing earlier and feeding	

The indication and timing of tracheostomy in the ICU is still controversial. Recent evidence suggests that earlier tracheostomy in intensive care patients might decrease the duration of mechanical ventilation, ICU stay and total hospital stay<sup>7</sup>. The availability of different percutaneous dilatational techniques and their increasing wide use has allowed tracheostomy to be performed earlier on patients with anticipated prolonged mechanical ventilation. The effect of tracheostomy on airway resistance and the work of breathing remain controversial. Diehl and co-workers have shown that a tracheostomy substantially decreases the work of breathing in intensive care patients<sup>8</sup>. But the higher resistance of the conventional endotracheal tube used before tracheostomy was partly related to deposition of secretions. Modifications of ventilation assisted spontaneous breathing modes like Automatic tube compensations (ATC) may compensate for the resistance of the conventional endotracheal tube<sup>9, 10</sup>. Therefore the lower resistance of a tracheostomy tube might not necessarily be an argument for the performance of a tracheostomy.

The complications rate for bedside or operation room tracheostomy procedures is comparable<sup>11</sup>. If such procedures can be performed safely and with minimal complications at the bedside, then the risk of patient transport and cost of operating room use can be avoided<sup>12</sup>.

## PERCUTANEOUS DILATATIONAL TRACHEOSTOMY VERSUS SURGICAL TRACHEOSTOMY.

There are two techniques available currently for performing tracheostomy. Percutaneous dilatational tracheostomy (PDT) refers to the technique whereby progressive dilation of the airway is made after piercing the trachea by the seldinger technique with a guide wire. This is a simple procedure which with expertise can be easily performed by the bed side.

Open surgical tracheostomy refers to the tracheostomy technique whereby with the head fully extended, with a sandbag between the shoulders so that the major neck vessels are out of the way, a short transverse incision is made half way between the cricoid cartilage and the suprasternal notch. The incision divides the investing (deep) fascia vertically and passes between the strap muscles. The trachea is then opened vertically, usually dividing the second and third tracheal rings. A tracheostomy tube of the largest size that will fit the opening is comfortably inserted and the wound is loosely sutured around the tube.

There are few randomized studies concerning surgical and percutaneous dilatational tracheostomy directly, and this conflicts. In studies involving a total of 456 patients, percutaneous dilatational tracheostomy was found to be superior to surgical tracheostomy<sup>13</sup>. Other studies found no difference in major and minor complications<sup>14 15 16</sup>. A recent meta-analysis compared surgical and percutaneous dilatational tracheostomy in studies published between 1960 and 1996<sup>17</sup>. Post operative complications were more common in the SGT group. The most common complication of tracheostomy is



bleeding. Other complications include subcutaneous emphysema, tracheal stenosis, tracheostomy associated infections and cardio-respiratory arrest. Although recent studies have suggested that tracheostomy can be safe in the ICU<sup>18 19</sup>, tracheostomy has been found to lead to serious complications, including tracheal stenosis, increased bacterial colonization and hemorrhage<sup>20 21</sup>. Many critically ill patients' families have been hesitant in authorizing tracheostomy because of cosmetic issues.

### **Timing of Tracheostomy**

Tracheostomy is among the most frequently performed surgical procedures in critically ill patients being done in about 24% of patients in intensive care units<sup>22</sup>.

Comparing days of mechanical ventilation and length of ICU stay, patients who have a tracheostomy in the first 7 days on the ventilator may do better compared with those who receive a tracheostomy later<sup>23 24</sup>. Patients with a lower Glasgow Coma Scale levels may benefit from early tracheostomy<sup>25 26</sup>. In a prospective study of patients with respiratory failure, patients who received a tracheostomy did better than those treated with convectional endotracheal intubations<sup>27</sup>. The likelihood of tracheostomy and benefit was greater in patients with nosocomial pneumonia who needed aerosol treatment, those with aspiration pneumonia and those who needed re-intubation. Patients with severe trauma often require mechanical ventilation for prolonged periods because of their inability to protect their airway, persistence of excessive secretions and inadequacy of spontaneous

respiration<sup>28</sup>. Tracheostomy plays an integral role in the airway management of such patients but its timing remains subject to considerable practice variation<sup>29</sup>. The decision to proceed to tracheostomy is often made only if the patient could not be extubated within 10-14 days or more<sup>30</sup>.

In 1989, The American College of chest physicians (ACCP) consensus conference on artificial airways in patients receiving mechanical ventilation<sup>31</sup> concluded that the appropriate duration of translaryngeal intubation could not be defined. It was suggested that if the anticipated need for mechanical ventilation is longer than 21 days then tracheostomy is preferable. For mechanical ventilation that is anticipated to last between 10 and 21 days, the decision was left to the physician, and daily assessment was recommended. Recent ACCP guidelines<sup>32</sup> suggest that tracheostomy should be considered after an initial period of stabilization on the ventilator, when it becomes apparent that the patient will require prolonged ventilator assistance. Such practice was based on earlier reports showing high tracheal stenosis rates with tracheostomy as compared with endotracheal intubation<sup>33</sup><sup>34</sup>. For example one study reported in 1987<sup>35</sup> found an incidence of tracheal stenosis after tracheostomy of 65% as compared with 19% after endotracheal intubation. The authors of the study concluded that tracheostomy for patients requiring an artificial airway for periods as long as 3 weeks could not be recommended. However, the incidence of tracheal stenosis has decreased substantially with recognition of its etiology and improvements in tracheostomy materials, designs and management<sup>36</sup> particularly with the use of high volume, low pressure cuffs. Also the complications associated with prolonged endotracheal intubations are increasingly being recognized, including injury to the larynx and trachea,

and patient's discomfort. In addition, endotracheal intubations often require the administration of systemic sedation with its attendant complication. Finally, the incidence of ventilation associated pneumonia is directly related to the duration of mechanical ventilation, a complication that carries significant morbidity and mortality

## STUDY JUSTIFICATION

Kenyatta National Hospital is a 2000 bed hospital with ICU bed capacity of 20 beds (1%). Majority of the patients admitted in the intensive care units are very sick and require mechanical ventilation and in a good number of them prolonged mechanical ventilation is normally anticipated.

In patients with anticipated prolonged mechanical ventilation, the benefits of tracheostomy versus prolonged translaryngeal intubation accelerate the process of weaning from the ventilators. This outcome depends on the timing of the tracheostomy.

Accelerated weaning process with tracheostomy reduces the duration of ICU stay and therefore the cost of management of these patients.

The pressure of beds in the ICU occasioned by prolonged periods of ICU stay will be lessened therefore more patients will benefit from the ICU resources.

There is no similar or related study undertaken locally.

## **OBJECTIVES**

### **BROAD OBJECTIVES**

To evaluate the role of tracheostomy in weaning patients from mechanical ventilation at the intensive care unit (ICU) of Kenyatta National Hospital.

### **SPECIFIC OBJECTIVES**

- (i) To determine the prevalence and techniques of Tracheostomy in patients with prolonged mechanical ventilation at the Kenyatta National Hospital intensive care unit.
- (ii) To determine the timing of tracheostomy and the effect of the timing i.e. early versus late tracheostomy in weaning patients with anticipated prolonged mechanical ventilation.
- (iii) To determine if tracheostomy in patients with anticipated prolonged mechanical ventilation can accelerate the process of weaning these patients off ventilatory support.

## METHODOLOGY

### Study design

Trauma patients admitted in to the intensive care unit, Kenyatta National Hospital and mechanically ventilated formed the study population. Inclusion criteria included patients with Glasgow coma scale of 8 and below at admission as this is an indication for intubation and ventilatory support at admission. Informed consents were first obtained from the patients guardians before recruitment into the study. Consecutive sampling was done.

These patients were followed up until successfully weaned off mechanical ventilation. Mechanical ventilation hereby referred to all modes of assisted ventilation. This included controlled mandatory ventilation (CMV), synchronized intermittent mandatory ventilation (SIMV) and continuous positive airway pressure (CPAP) ventilation. In a group of these patients endotracheal ventilation was converted into tracheostomy ventilation, then the timing of this was noted. Eventually a comparison was made between the group that had tracheostomy and the group that did not have and an analysis was made of the impact of the tracheostomy to the weaning process.

The end point in this study was successful removal of the patients from ventilatory support and the outcome was represented in terms of the number of days taken during the weaning process. Patients recruited in

this study were 15 years and above. Influencing factors like unrelated co-morbid conditions at the time of admissions were taken into consideration.

### **Study site**

This study was carried out at the Intensive Care Unit (ICU) of the Kenyatta National Hospital.

### **Study Population**

Trauma patients admitted into the Intensive Care Unit and initiated on mechanical ventilation.

### **Study Duration**

This study was carried out for duration of six months consequently starting November 1<sup>st</sup> 2005 to April 30<sup>th</sup> 2006.

### **Inclusion criteria**

a All trauma patients with Glasgow coma score of eight and below and above 15 years of age admitted in the ICU KNH and started on mechanical ventilation.

b. Availability of informed consent from the guardian.

### **Exclusion criteria**

- a. Trauma patients with tracheostomy at admission to the Intensive Care Unit (ICU)
- b. Trauma patients on re-admission to the Intensive Care Unit.
- c. Trauma patients on referral from other hospitals.
- d. Patients in whom consent was not given to enable participation in the study.
- e. Trauma patients initiated on mechanical ventilation and declared dead before successfully weaned off ventilatory support.

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## Sample size

The sample size was calculated according to the formula below<sup>37</sup>:-

$$n = 4s^2 (Z_{1-a} + Z_{1-b})^2 / d^2$$

n = Sample size

$Z_{1-a}$  = 1.96, based on 5% level of statistical significance

$Z_{1-b}$  = 1.28, to achieve 80% power to the test.

$s^2$  = 0.4 variance.

d = 15%, meaningful difference expected

Therefore n was 108

## **DATA COLLECTION INSTRUMENT**

A preformed data capture form was administered on the patients on admission to the intensive care unit. These patients were then followed up until discharge from the Intensive Care Unit.

### **Study procedure**

Patients included in the study were followed up for the entire period on mechanical ventilation. The investigator collected the data with the help of a trained assistant to minimize errors, delays or omission.

## **DATA MANAGEMENT AND ANALYSIS**

Data from the coded data capture form was cleaned and verified then entered into a computer and analyzed using Statistical Package for Social science Software (SPSS)

## **ETHICAL CONSIDERATIONS**

- a. The study did not entail any invasive procedures, drug administration, drug omission or any hazard whatsoever to the participants.
- b. The study did not seek to alter patient management. Simple data was obtained from routine intensive care records. Patients who declined consent to participate in the study still continued to receive ICU care and treatment.
- c. Informed consent was sought from the guardian of the subjects before being included in the study. In absence of a guardian, the consultant in-charge was informed of the recruitment of the patient to the study.
- d. The study was undertaken with the approval of the Ethics and Research Committee of the Kenyatta National Hospital.

## RESULTS

During the period of this study 108 trauma patients admitted into the intensive care unit and initiated on mechanical ventilation were recruited. These patients were followed up until successfully weaned off ventilatory support.

### 1. Patient characteristics.

#### a) Age.

The patients' ages ranged from 15 years to 66 years with a median age of 38 years.

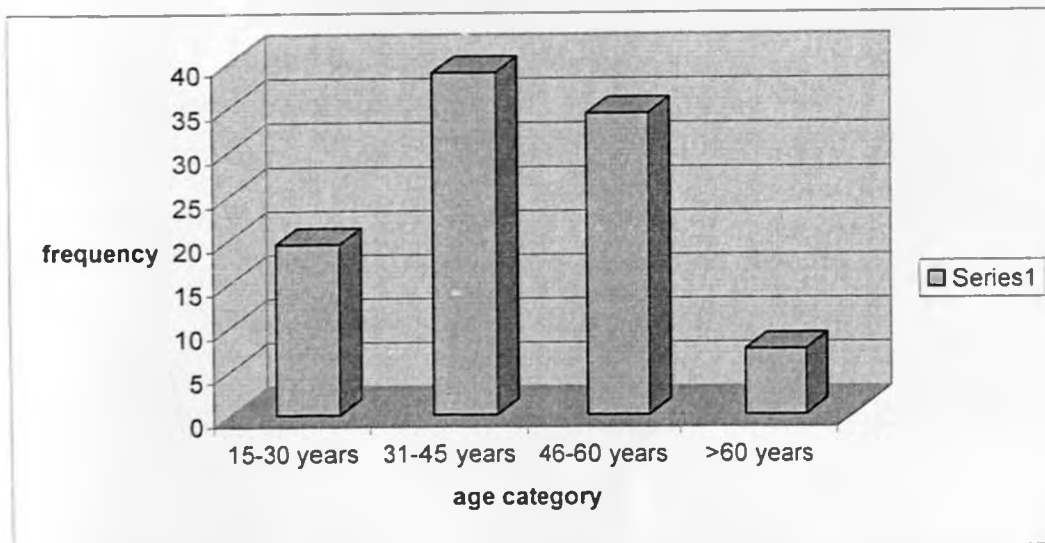


Fig 1 – Age distribution.

b) Gender.

58% of all the patients seen in the study were males while 42% were females.

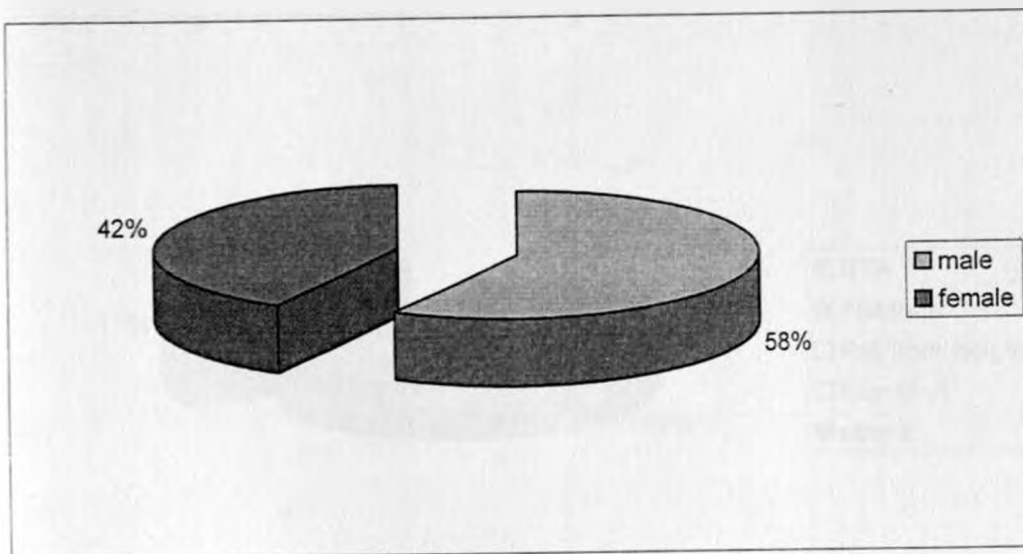


Fig 2 – Gender distribution.

**c) Cause of trauma.**

The cause of injuries was mainly road traffic accidents (RTA), 67%. Other causes included assault (17%), fall from a height (6%) and gunshot related injuries (7%).

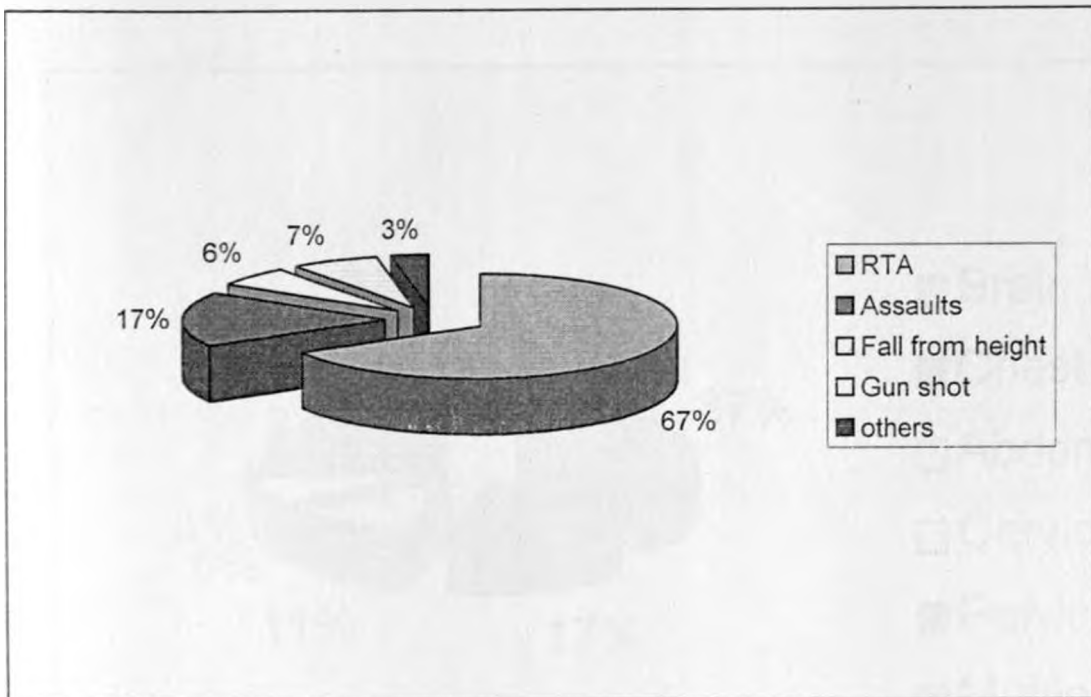


Fig – 3 cause of trauma.

**d) Type of injuries.**

Traumatic brain injury was the main type of injury (37%). 23% of patients had multiple injuries. Other injuries included chest (17%), abdominal (11%) and cervical spine (8%).

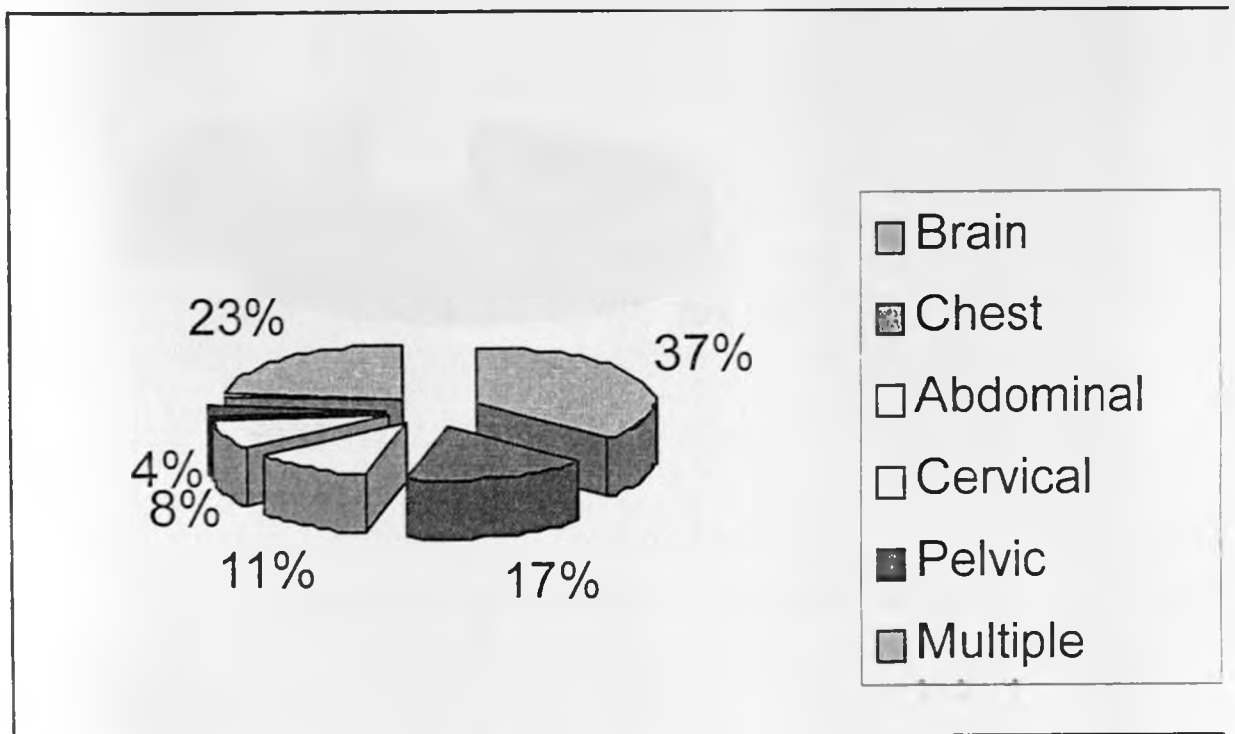


Fig 4 – Type of injury

**e) Severity of injury at admission.**

This study considered patients with Glasgow Coma scale (GCS) of 8 and below at admission. 70% of cases had GCS of 3-5 while 30% had GCS of 6-8.

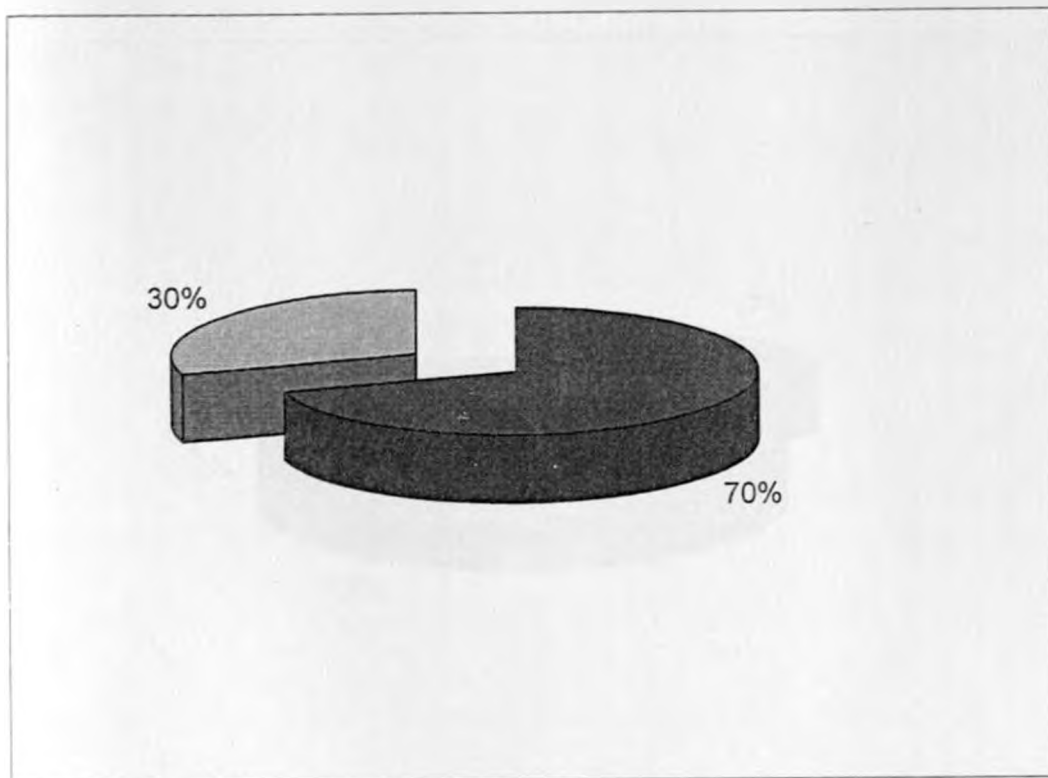
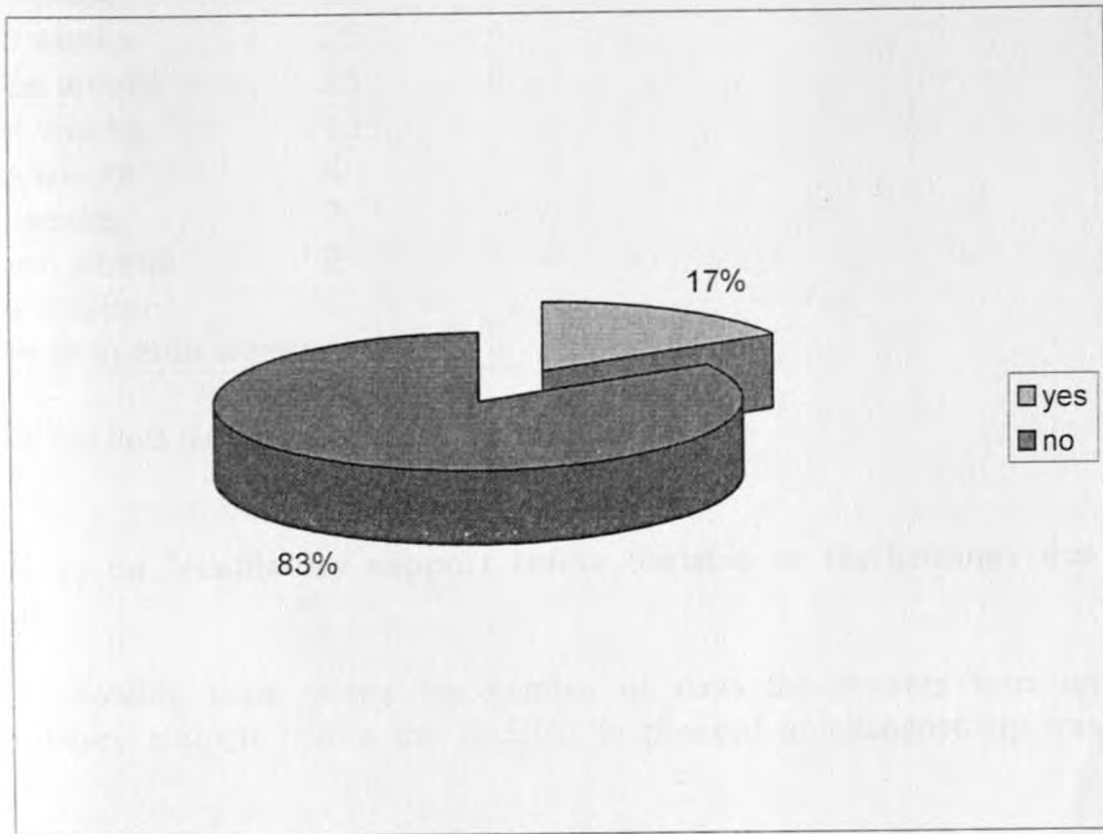


Fig 5 – severity of injury.



**f) Tracheostomy.**

Of the 108 cases which fitted the inclusion criteria, tracheostomy was done in 18 patients (17%). In 83% of the patients tracheostomy was not done.



**Fig 6. – Tracheostomies.**

**g) Days on the ventilator.**

The following table shows the number of days the patients were on ventilator before successfully being weaned off Ventilatory support.

<b><i>Weeks on the ventilator</i></b>	<b><i>N</i></b>
One week	32
Two weeks	26
Three weeks	25
Four weeks	13
Five weeks	4
Six weeks	2
Seven weeks	2
nine weeks	3
More than nine weeks	1

Table 1- Days patients were on Ventilatory support

**h) Days on Ventilatory support before decision to tracheotomy was made.**

The following table shows the number of days the patients were on Ventilatory support before the decision to proceed to tracheostomy was made.

<b><i>weeks to making decision</i></b>	<b><i>N</i></b>
One week	0
Two weeks	3
Three weeks	12
More than three weeks	3

Table 2- number of days patients were on ventilator before decision to perform tracheostomy was made.

For patients on whom tracheostomy was performed, the decision to operate was mainly made on the third week of mechanical ventilation. No decision to proceed to tracheostomy was made during the first week of ventilation. In only 3 patients was the decision to do tracheostomy made in the first 2 weeks of Ventilatory support.

**i) Duration of Ventilatory support to the time tracheostomy was performed.**

There was marked delay in performing the tracheostomy after decisions to perform them had been made. Despite majority of the decisions (66%) being made on the third week, 50% of the tracheostomies were done on the fourth week.

<i>Weeks to actual tracheostomy</i>	<i>N</i>
Two weeks	2
Three weeks	7
More than three weeks	9

Table 3- number of days on the ventilator to the day tracheostomy was performed.

**j) Technique of tracheostomy.**

100% of the tracheotomies were surgically performed under General Anaesthesia in theatre. No tracheostomy was performed on the bed side and the percutaneous dilatational technique was never used in any of the patients.

**k) Time on ventilator after tracheotomy.**

After tracheostomy, 50% of the patients were on the ventilator for about a week before successful weaning. 33% were weaned at the end of second week while 17% were still on the ventilator by the fourth week.

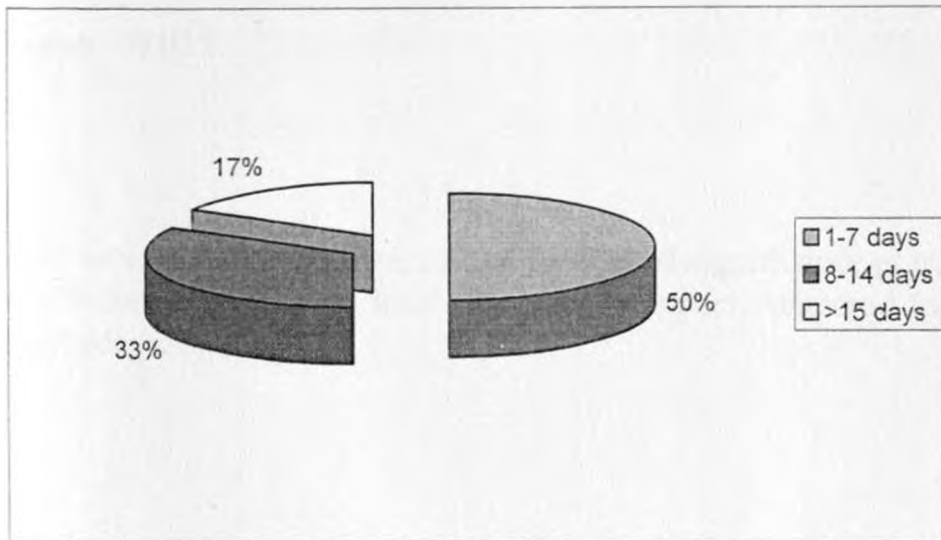


Fig 7- Duration on the ventilator after tracheostomy.

**2. Comparing early (1-14 days) tracheostomy to late (>15 days) if timing had a significant difference in weaning off the ventilator.**

	After	Before	Total
Early	9	2	11
Late	9	16	25
total	18	18	36

P-value = 0.015

There was significant difference at 5% level of significance at tracheotomies done before the 14th day into Ventilatory support compared to those done after 14 days.

**3. Comparing number of days on the ventilator in patients who had tracheostomy and those who did not have tracheostomy.**

	Done tracheostomy	Tracheostomy not done	Total
1-7 days	0	34	34
8-14 days	1	25	26
15-21 days	6	15	21
22-28 days	5	9	14
> 28 days	6	7	13
Total	18	90	108

P-value = 0.005.

P value=0.005 implied that tracheostomy in patients with anticipated prolonged mechanical ventilation accelerated the period of weaning from mechanical ventilation.

## DISCUSSION

Mechanical ventilation refers to the use of life support technology to perform the work of breathing for patients who are unable to breathe on their own. Majority of critically ill patients admitted into Intensive Care Units (ICU) are unable to breathe on their own and therefore will require this form of treatment. Advances in resuscitation, improvements in clinical care and changes in the delivery of mechanical ventilation have resulted in a growing population of patients who require prolonged Ventilatory support. Many of these patients benefit from prolonged support programs and are eventually liberated from mechanical ventilation. This has therefore increased the demand for ICU resources. The use of ICU resources is associated with very high costs and this continues to increase for patients on prolonged Ventilatory support. Aggressive weaning programs have therefore been designed to accelerate the weaning process. One of the clinical observations often made is that weaning from mechanical ventilation in difficult patients is hastened by tracheostomy<sup>41</sup>.

Tracheostomy is usually performed in the critically ill patients to provide prolonged airway care during slow weaning from assisted ventilation. Several factors (which may co-exist in an individual patient) indicate the need for tracheostomy. These factors include acute or chronic neuromuscular conditions, poor cardiovascular reserve, bulbar dysfunction, brain injury, and upper airway obstruction.

In patients with anticipated prolonged mechanical ventilation, Tracheostomy is a common practice. Tracheostomy in the critically ill patients offers significant advantages over prolonged translaryngeal intubation. Less discomfort may allow reduction in analgesic, sedative and muscle relaxant drugs. Airway resistance and anatomical dead space are both reduced by tracheostomy thereby reducing work of breathing and improving the speed and overall weaning from assisted ventilation. Tracheostomy allows

seamless transition between different modes of assisted ventilation without trials of extubation and re-intubations.

This study was designed to determine whether tracheostomy in patients with anticipated prolonged mechanical ventilation accelerates the weaning process compared to patients maintained on endotracheal intubation. This study was also aimed at determining the prevalence and techniques of tracheostomy in the ICU of Kenyatta National Hospital. The timing of the tracheostomies was also determined and a comparison made on the impact of timing i.e. early versus late tracheostomy, on the overall rate of weaning.

The minimum age of patients recruited to this study was 15 years and the maximum age was 66 years with a median age of 38 years. 108 patients were reviewed in this study.

62 (58%) males were initiated on Ventilatory support compared to 55 (42%) females. Males are more likely to suffer from trauma and as a result initiated on mechanical ventilation based on their more physically involving lifestyles.

The cause of injury was mainly Road traffic accident (RTA), (67%). Other causes of injuries included assault (17%), fall from a height (6%), and gunshot related injuries (7%). Head injuries account for up to half of all trauma related intensive care admissions<sup>39</sup> in other centers. In this study 37% of the injuries were traumatic brain injury. RTA was the main cause of traumatic brain injury. Other type of injuries included chest 17%, abdominal 11%, cervical 8% and pelvic injuries 4%. Multiple injuries involving more than one organ comprised 23% of the patients.

One of the indications for Ventilatory support in trauma patients is Glasgow coma scale of 8 and below<sup>38</sup>. 30% of the patients had Glasgow coma scale of 3-5 while 70% had GCS of 6-8 at admission. Patients with early tracheostomy had lower GCS,  $p=0.004$ , reflecting the common practice of performing tracheostomies earlier in patients with low GCS while delaying



tracheostomy in patients with higher GCS in case extubation becomes possible.

Tracheostomy is one of the most common surgical procedures in critically ill patients. It is done in about 24% of patients admitted into intensive care units<sup>22</sup>. This study analyzed 108 trauma patients initiated on mechanical ventilation. Tracheostomies were done in 18 (17%) of the 108 patients reviewed in this study. Successful extubation was done on 90 (83%) of the patients. 11 (62%) males and 7 (38%) females were tracheostomized. There were more males than females who were mechanically ventilated and therefore higher tracheostomies in males compared to females were anticipated.

One of clinical observation often made is that weaning from mechanical ventilation in difficult patients is hastened by tracheostomy<sup>41</sup>.

Weaning from mechanical ventilation was significantly faster in this study;  $p=0.05$ . Patients with trauma initiated on mechanical ventilation and done tracheostomy were weaned faster compared to those not done tracheostomy. This could be explained by the fact that tracheostomy allows reduction of sedative and muscle relaxant drugs. There is also improved clearance of airway secretions with reduction of airway resistance and anatomical dead space thereby reducing work of breathing and therefore improving the speed of weaning from assisted ventilation<sup>6</sup>.

In a study to determine the prevalence and timing of tracheostomies in ICU, Fishier et. al<sup>41</sup>, showed that most tracheostomies were performed during the second week of ventilation but there was no guideline on the best timing for tracheostomy. In 1989, The American College of chest physicians (ACCP) conference on artificial airways in patients receiving mechanical ventilation<sup>31</sup>, it was concluded that the appropriate duration of translaryngeal intubation could not be defined. It was suggested that if the anticipated need for mechanical ventilation is longer than 21 days then tracheostomy is preferable. For mechanical ventilation that is anticipated to last between 10 to 21 days decision was left to the physician and daily assessment was recommended. Recent ACCP guidelines<sup>32</sup> suggest tracheostomy should be considered after an initial period of stabilization on the ventilator when it

becomes apparent that the patient will require prolonged ventilatory assistance. Comparing days of mechanical ventilation, patients who have a tracheostomy in the first 7 days on the ventilator may do better compared to with those who receive a tracheostomy later<sup>23 24</sup>.

There has been therefore practice variation as far as the timing of tracheostomy is concerned. In patients with anticipated prolonged mechanical ventilation and in whom tracheostomy is anticipated, patients done tracheostomy early are thought to do better than patients done tracheostomy later. In this study tracheostomy was considered early if it was done on or before 14 days and late if done after 14 days. A cut off of two weeks between early and late tracheostomy was suggested in this study based on observations made earlier that no tracheostomies were done on the first week of ventilation at the KNH ICU and therefore no objective analysis could have been achieved in this study by classifying early tracheostomy as that done before 7 days as by Yaseen Arabi et al<sup>12</sup>.

Early tracheostomies are associated with faster rate of weaning<sup>23 24</sup>. Out of the 18 tracheostomies done in this study, only 2 (11%) tracheostomies were done in the first two weeks of Ventilatory support. 7 (38%) were done on the third week while 9 (50%) were done on the fourth week. Comparing patients done tracheostomy early to those done tracheostomy late,  $p$  value=0.015, there was a significant difference in that patients were shown to wean faster if tracheostomy was done early.

All tracheostomies, (100%) in this study were surgically done under general anaesthesia in main theatre by Ear, Nose and Throat (E.N.T) surgeons. In studies comparing open surgical and percutaneous techniques in ICU, patients have tended to favor the latter though operator experience and local after care are likely to be as important as choice of the insertion technique<sup>40</sup>. In many units dilatational techniques have almost completely replaced conventional techniques in adult patients. Percutaneous techniques are quicker and easier to perform by the bedside; there is less risk of stomal infection and also tracheal stenosis. Better cosmetic outcome is also associated with percutaneous techniques because of the small incision

needed for the guide wire. Percutaneous techniques can be safely performed by the bedside by a trained ICU personnel<sup>40</sup>.

There was significant delay of on average seven days in performing the tracheostomies after a decision to perform them had been made. Reasons for this delay were given as failure to notify the Ear, Nose and throat (ENT) surgeons in good time, delay of the surgeons to respond, unavailability of theatre and unstable patient. With earlier tracheostomies associated with faster rate of weaning<sup>23 24</sup>, then this delay contributed significantly in delaying the overall weaning period. This delay could be minimized by encouraging the use of percutaneous techniques which can be done on the bedside by trained ICU personnel rather than by ENT surgeons who are not routinely involved in the care of the ICU patients.

With better outcome demonstrated in this study with tracheostomy as a useful tool in the weaning process, then its use needs to be encouraged in the ICU. Percutaneous techniques need to be considered, and ICU personnel trained on their use. This study demonstrated that early tracheostomy was preferred to late tracheostomy. However a large multicenter randomized controlled trial would be the best way to determine the ideal timing for tracheostomy in patients with anticipated prolonged mechanical ventilation.

## CONCLUSIONS

1. Tracheostomy in patients with anticipated prolonged mechanical ventilation accelerates the weaning process.
2. Early tracheostomy compared to late tracheostomy was associated with a significant reduction in the duration of mechanical ventilation.
3. There was significant delay in performing tracheostomies after decisions had been reached to perform them.
4. All tracheostomies were done under general anaesthesia in theatre. None was done on the bedside via the percutaneous dilatational technique.

## RECOMMENDATIONS

1. Tracheostomy should be considered in patients admitted into the ICU, initiated on mechanical ventilation and with anticipated prolonged Ventilatory support.
2. In a case with anticipated prolonged mechanical ventilation when Tracheostomy is considered, early tracheostomy is preferable as it is associated with faster weaning compared to late tracheostomy.
3. The KNH ICU care team should be trained on bedside tracheostomy procedures. Percutaneous dilatational tracheostomy is a simple procedure which with expertise can be easily performed by the bedside.
4. This study was observational and based in one center. A large multicenter randomized controlled trial in which patients are randomized to early versus late tracheostomy would be ideal way to test the impact of timing to the weaning process
5. This study did not look into complications associated with tracheostomy. Another study is therefore recommended that would look into complications associated with tracheostomy.

## STUDY LIMITATIONS

This study did not take into consideration factors which can make the weaning process difficult. These factors include underlying co-morbid conditions at time of admission. Examples here are medical illnesses like sepsis, diabetes mellitus and hypertension. Other factors like ventilator associated pneumonia, nosocomial infections in the ICU and multiple organ failure will complicate the weaning process.

No association was made in this study between the type of trauma and response to mechanical ventilation. Further, no long term outcomes were analyzed in relation to length of ICU stay following tracheostomy.

## APPENDIX I

### DATA CAPTURE INSTRUMENT

#### 1. Patients characteristics

Age 15 -30  31 -45  46 -60   >60

Sex M

Date of ICU admission \_\_\_\_\_

#### 2. Cause of Trauma

RTA

Assault

Fall from a height

Gunshot injuries

Others (specify) \_\_\_\_\_

#### 3. Type of injuries

Brain/Head

Maxillofacial

Chest

Cervical

Abdominal

Pelvic

Others (Specify) \_\_\_\_\_

4. .Severity of injury (at admission)

Glasgow coma score \_\_\_\_\_

5. **Outcome.** Death on the ventilator.....

Successfully weaned off ventilation.....

6. How many days was this patient on the ventilator?

Was Tracheostomy done

**7 (For patients who had tracheostomy)**

A. How many days was the patient on the ventilator before a decision to Tracheostomy was made.....

B. How many days was the patient on the ventilator before Tracheostomy was done.....

C. State reason for the delay to do the tracheostomy after the decision was made.



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\_\_\_\_\_

D. Technique of tracheostomy

Surgical \_\_\_\_\_

Percutaneous dilatation \_\_\_\_\_

E. Anesthetic technique

GA \_\_\_\_\_

LA \_\_\_\_\_

F. How many days was this patient on the ventilator after the tracheostomy? \_\_\_\_\_

G. State any complications associated with the tracheostomy procedure

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8. (For patients who did not have tracheostomy done)

Number of days on mechanical ventilation \_\_\_\_\_

## APPENDIX 11

### STUDY CONSENT

I, Dr Thomas Mwendwa Maingi, Telephone 0722794937, a final year student in anaesthesia here by undertake to explain the nature of my study to you.....guardian  
to.....who is admitted in the intensive care unit of Kenyatta National Hospital and unable to give this consent in person due to the severity of the illness. I clearly understand that is a very difficult time in your life and therefore i take this earliest opportunity to wish your Beloved one very early recovery.

This study will aim to evaluate the role played by creating an opening through the anterior of the neck into the trachea during the process of removing a patient from a machine which assists in breathing. This machine is called a ventilator. Other patients whereby this opening is not created are normally assisted to breath through a tube which is passed either through the mouth or the nose. This study will help to establish how frequent this procedure is performed, its timing and whether the timing has any influence on the rapidity of getting these patients off Ventilatory support.

There will not be any invasive procedures on your patient and data will be collected during routine ICU care of your patient. Decisions concerning management of your patient will be left to the ICU team, in consultation with you. This consent is therefore only for the purpose of the study.

Participation in the study is purely voluntary. Any questions arising in the course of the study can be addressed to me. You will have the freedom to terminate the participation any time you so wish. Your patient cannot be denied treatment for refusing to participate in this study.

I.....  
.....

Having been clearly explained and understood the nature of the study hereby consents to participation in the study. This consent is given on behalf of..... Who is unwell and unable to give this consent in person.

Signature.....Date.....  
.....

I clearly state that I have explained the nature of my study and that this consent has been voluntarily obtained.

Signature.....Date.....

#### CONTACTS OF THE INVESTIGATOR

THOMAS M. MAINGI  
UNIVERSITY OF NAIROBI MEDICAL SCHOOL  
P.O BOX 19676  
NAIROBI.  
MOBILE TELEPHONE 0722794937.

## FOMU YA UKUBALI WA MSHIRIKI

Kwa kuweka Sahii kwenye mkataba huu Nimekubali kuhojiwa na mtafiti au wasaindizi wake katika hosipitali kuu ya Kenyatta. Ninaelewa fika kwamba hiki kibali ninakipeana kwa niaba ya..... ambaye ni mngonjwa sana na kwa hivyo hawezi kupeana hiki kibali mwenyewe. Ninaelewa ya kwamba hiki kibali kitamruhusu mwanajamaa wangu kushiriki katika utafiti ulio na lengo la kuchunguza njia za kumsaidia mngonjwa mahututi kupumua kwa njia ya machini.

Utafiti huu hutalinganisha njia ya kupumua Kwa machini kupitia kwa koo na kupitia kwa mshiba unaowekwa mdomo hau mapua. Nimeelezwa kwamba kushiriki au kutoshiriki kwa mwanajamaa wangu hakutakuwa na madhara katika hudumaambazo mimi au mwanajamaa wangu anaweza kupata kutoka kitengo cha afya na watoa huduma kwa watu wote kwa jumla. Utafiti huu utasaidia kuimarisha ufahamu mzuri ulio mwafaka Kwa jinsi ya kuwasaidia wagonjwa walioko kye machini za kupumua kuweza kutolewa kwa hizo machini.

Ninaelewa ya kwamba nikiwa na maswali yoyote au nikitaka kupata majibu ya huu utafiti ninawenza kuwasiliana na mtafiti kwa anwani kama inapoandikwa hapo chini.

Mimi.....

Ninaelewa ya kwamba hiki kibali ninakipeana Kwa niaba ya.....ambaye ni mwanajamaa wangu na hawezi kupeana hiki kibali mwenyewe.

Sahii-----Tarehe.....

Ninathibitisha ya kwamba nimemueleza mgonjwa kikamilifu kuhusu utafiti huu na amenipatia kibali cha kushiriki kwa hiari yake mwenyewe.

Sahii-----Tarehe.....

**THOMAS M. MAINGI**  
**SHULE YA UUGUZI**  
**CHUO KIKUU CHA NAIROBI**  
**SANDUKU LA POSTA 19676**  
**NAIROBI.**

## **CONSENT EXPLANATION**

I, Dr Thomas Mwendwa Maingi, MBChB (NBI) a final year Anaesthesia registrar, mobile number **0722794937**, will give the participant's guardian or the consultant in charge of the ICU in the absence of the guardian a full explanation of my intended study before the consent form is signed.

### **The study**

The study aims to outline role played by tracheostomy in weaning patients from ventilators in situations of prolonged mechanical ventilation.

### **Confidentiality**

The participant's identity will be protected. Only codes will be used for reference.

### **Participation in the study**

Participation will be voluntary and no patient who refuses to participate in the study will be denied any treatment.

No invasive procedures shall be carried out on the participants. Data will be carried out during routine ICU care of the participants. The study will not be at any extra cost to the patient. No complications are expected to occur as a result of participation in the study.

## **APPENDIX III**

### **Glasgow coma score**

#### **Eye opening Response**

4 = spontaneous

3 = speech

2 = pain

1 = none

#### **Verbal Response**

5 = oriented to name

4 = confused

3 = inappropriate speech

2 = incomprehensible sounds

1 = none

#### **Motor Response**

6 = follows commands

5 = localizes to painful stimuli

4 = withdraws

3 = abnormal flexion (decorticate posturing)

2 = abnormal extension (decerebrate posturing)

1 = none

**The Glasgow coma score is the sum of the best scores in each of the three categories.**

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