

## Incidence and Associated Risk Factors of Endotracheal and Tracheostomy Tube Blockage in Intensive Care Unit

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### Abstract

**Background :** Different studies had been carried out at different hospitals through- out the world to find out incidence and to assess the risk factor of ETT and TT blockage at ICU setup. The aim of our study was to reach a consensus and to find out the best diagnostic tool to assess the incidence and associated risk factors ETT and TT blockage at ICU setup. To assess the incidence and associated risk factors ETT and TT blockage at ICU setup.

**Materials and methods :** Endotracheal Tube (ETT) and Tracheostomy Tube (TT) blockage is a common phenomenon at the Intensive Care Unit (ICU) setup of hospital . This is a cross sectional study carried out in the Medical Centre Hospital Between July 2018 to June 2019. Total 60 patients were included in the study. Data were analyzed and presented as both qualitative and quantitative data as applicable using SPSS version 20. The quantitative data were analyzed by mean, standard deviation. The qualitative data were analyzed by Mc NEMAR test (Mc NEMAR X2 test). For all analytical test, the level of significance was set at 0.05 and p value equal or less than 0.05 was considered as significant, p value more than 0.05 was considered as not significant.

**Results :** A total 60 patients were included in the study, who required mechanical ventilation support for different purposes either though ETT and/or TT. The Incidence of ETT/TT blockage was 9(15%). From those ETT was 6(10%) and TT was 3(05%) (p=0.042). Most causes of tube blockage was mucus 5(55.56%), debris 3(33.33%) and kinking of the tube 1(11.11%). The incidence of partial blockage was 5(55.56%) and complete blockage was 4(44.44%) consecutively (P=0.025). so it is statistically significant. During the night shift tube blockage was 6(66.67%) was slightly higher than the day shift, which was 3(33.33%).

**Conclusion :** ETT and/or TT blockage is an expected outcome in ICU setup . In spite of all measures, keen observation is very important to find out the blockage problem for early intervention.

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**Key word :** Endotrachealtube blockage; Tracheostomy tube blockage; ETT or TT suctioning.

### Intoduction

The incidence of tube blockage is significant in patients admitted to ICU who required Short Term Intubation (STI) and Long-Term Intubation (LTI). Most of the tubes are blocked either by blood clot, biting of the ETT, kinking of the ETT/TT and inspissated secretions (Mucus) that made it difficult to pass a suction catheter down these tubes.<sup>1</sup> The patients are allowed to breathe spontaneously with an endotracheal tube or TT tube in situ, received oxygen via catheter and intermittent saline/water nebulization to humidify the inspired gases. Obstruction of the ETT/TT may manifest as increased resistance to ventilation, high airway pressure and low tidal volume as well as clinical feature of tube blockage. ETT obstruction may be prevented by careful attention to the type of ETT/TT, inspection and checking of the ETT and TT tube prior to use and by humidification of inspired gases. The severity of the blocked tube is graded as partial tube blocked and complete tube blocked. The duration for which the tube is in situ, date and time of tube blockage, description of the type of tube blocked, severity of the blocked tube and its impact on the course of the patient's illness, whether preventable and if needed to be re-intubated are noted. Patency of an Endotracheal Tube (ETT) during mechanical ventilation is often compromised by the accumulation of luminal debris. Nevertheless, evidence suggests that, even if periodically repeated during mechanical ventilation, standard suctioning is not sufficient to preserve the ETT's original lumen size and nominal function. Sudden occlusion is rare but can be life-threatening, potentially requiring emergency airway restoration. If patency tube cannot be restored, the ETT/TT should be removed and replaced, if necessary over a tube exchanger. At ex-tubation some endotracheal tubes are noted to have a significant narrowing of the lumen due to encrustations. We attribute this to inadequate humidification and have started using

continuous saline/water nebulization's in STI. In LTI, heated humidifiers or Heat and Moisture Exchange Filters (HMEF) are used. HMEF's are known to provide efficient humidification with no tracheal tube occlusion for up to 48 hours and in some studies for up to 7 days without changing the filter.<sup>2,3</sup> ETT exchange may be required to ventilate and oxygenate the patient, a high-risk procedure in an emergency ICU setting.<sup>4</sup> The theoretical benefits of preserving the ETT's original function include :-

- i) Reducing the likelihood of sudden hazardous ETT occlusions and the subsequent need for emergency interventions
- ii) Decreasing airway resistance and work of breathing in intubated critically ill patients, eventually facilitating their weaning process, which might ultimately lead to reduced mechanical ventilation time
- iii) Reducing the incidence of ventilator associated events by preventing pathogens from forming bacterial biofilm within the ETT.

#### Materials and methods

This prospective study was carried out at Medical Centre Hospital July 2018 to June 2019. Sixty patients were selected for the study . The mean patient age was 40.9±9.1 years ranged from 10 to 70 years. Data were collected in a prescribed data collection sheet. The data of each patients included age, sex, 1 diagnosis, type of tube blocked, degree of tube blocked, episodes, modes of ventilation and others important aspects, necessary to reach a consensus . Then all data were compiled and analyzed. Statistical analysis was done by using appropriate statistical test.

#### Inclusion criteria :

- All the patient admitted into the ICU of Medical Centre Hospital and gave consent.
- Patients who fulfilled all the criteria on the prescribed data collection sheet.

#### Exclusion criteria

- Patients who didn't give consent
- Patients who didn't fulfill all the criteria on the prescribed data collection sheet.

The risk and benefits were explained to the patients and their attendants. It was assured that all information and records will be kept secret. The procedure would be helpful for both patients

and doctors in making rational approach of case management. Written informed consent from the patient is obtained . Finally ethical directives from the Managing Director of Medical Centre Hospital for this study was obtained.

#### Results

**Table I** Socio-demographic characteristics of ETT/TT tube blockage

Variable	Frequency	Percentage (%)
Age group		
10 years --- 30 years	2	22.22%
31 years--- 50 years	5	55.56%
51 years--- 70 years	2	22.22%
Sex group		
Male	7	77.78%
Female	2	22.22%
Cause of ICU stay		
Medical	6	66.67%
Surgical	3	33.33%
Specific Diagnosis		
GBS	1	11.11%
Respiratory Faillure	3	33.33%
Stroke	2	22.22%
Trauma	3	33.33%

**Table II** Description of ETT/TT blockage

Variable	Frequency	Percentage (%)
Type of Tube Blockage		
ETT	6	66.67%
TT	3	33.33%
Degree of Tube Blockage		
Partial	5	55.56%
Complete	4	44.44%
Episode		
1 episode	6	66.67%
2 episode	2	22.22%
3 episode	1	11.11%
When Blocked		
Day shift	3	33.33%
Night shift	6	66.67%
Mode of Ventilation		
CMV/AC	3	33.33%
SIMV	5	55.56%
CPAP	1	11.11%
Spontaneous	0	0

**Table III** Risk factors associated with Tube blockage

Variable	Frequency	Percentage (%)
Smoking		
Yes	2	22.22%
No	7	77.78%
Comorbidity		
Yes	4	44.44%
No	5	55.56%

Suctioning		
Every 2 Hour	1	11.11%
2-4 Hour	4	44.44%
4-6 Hour	1	11.11%
When needed	2	22.22%
Hole of suction Catheter		
Tip of tube	2	22.22%
Side of tube	2	22.22%
Both sides	5	55.56%
Cause of tube blockage		
Mucus	5	55.56%
Debris	3	33.33%
Kinking	1	11.11%
Duration on ETT/TT		
< 1 Day	1	11.11%
1-3 Days	1	11.11%
• Days	2	22.22%
>7 Days	5	55.56%
Gas heat/moisture		
Yes	3	33.33%
No	6	66.67%
Use of Normal Saline during Suction		
Regular use	1	11.11%
When needed	6	66.67%
Never	2	22.22%

**Table IV** Descriptive statistics of ETT/TT blockage

Variable	Frequency	Percentage (%)
Sign of tube blockage		
Agitation	1	11.11%
High Respiratory Rate	2	22.22%
High Airway Pressure	2	22.22%
Respiratory Distress	4	44.44%
Impact of ETT/TT blockage		
Bradycardia	1	11.11%
Hypoxia	3	33.33%
Cardiac arrest	1	11.11%
Re-intubation	4	44.44%

**Discussion**

In our study, the incidence of ETT/TT tube blockage was 9(15%) from a total of 60 patients . The most cause of ETT/TT blocked was mucus 05(55.56%) by debris 3(33.33%) and tube kinking 1(11.11%) . The degree of blocked which was partial and complete tube blocked (55% vs45%) that means, it is almost similar. Our result was slightly lower because of small data was collected and short time of data collected, so compared to a retrospective study was done in India, to assess Endotracheal or Tracheostomy Tube Blockage and their Impact among the patients in ICU, Data were collected retrospectively from the ICU assessment record of patients admitted from November 2012 to October 2014 The result showed that,the cause of

tube blockage was mostly because of inspissated secretions (92.15%), followed by blood clotting (7.85%) among the noted cases. The degree of blocked tube was partial/near complete blockage cases were more than those of complete blockage (92.8 vs. 7.2%) among the mentioned cases.<sup>5</sup> And also the study was done to identify airway associated patient safety incidents submitted to the UK National Patient Safety Agency from critical care units in England and Wales, from October 2005 to September 2007. The number of incidence ETT and TT blockage has 28(11%) babies & 51(8%) adults/children. ETT blockage has 26(98%) babies and 7(14%) adults/children, TT blockage has 1(4%) babies and 42(82%) adults/children.<sup>6</sup> The incidence of tube blockage higher in my study. The discrepancy between this studies may be the size of data difference between two studies.

A study was done Tata Memorial Hospital, the Result showed that, 781 patients (1440 tube days) were studied. 665 patients (951 tube days) required an endotracheal tube. 116 patients (489 tube days) had a tracheostomy. Overall there were 55 airway accidents with an incidence of 7.04% of patients and 3.82 /100 tube days. Blocked tubes (2.15 per 100 Tube Day's) and unplanned extubations (1.32 per 100 Tube Day's) were the most common airway accidents<sup>7</sup>. In my study, the Incidence of ETT/TT tube blockage was 9(15%) from 60 intubated patients and the duration of tube day less than 1 day 1(11.11%), 1-7 day 3(33.33%) and greater than 7 tube 5(55.56%), so the tube blockage more in those intubated time was increased as a study was done in Tata Memorial Hospital, Mumbai, to assess airway accidents in an ICU between June 2001 and January 2002, all adult patients admitted to the ICU with either an endotracheal tube or tracheostomy were included in the study.<sup>7</sup> All most similar result between this studies.

In our study done for 12 months the Incidence of ETT/TT tube blockage and associated risk factor in ICU, the pulse oximeter reading showed 55% to 88% saturation, after intervention the oxygen saturation improved 92% to 100%, It was similar results, but the desaturation was more in our study compared to with to a casereport on 11/01/2017, about masked blocked tracheostomy tube in Malaysia.<sup>8</sup> Because the setup and nurse-patient ratio was higher in Malaysia.

In our study cardiac arrest was happened to 1 patient, the percentage was 11.11%. Eventually the patient succumbed to death from cardiac arrest. The patient was on ETT, so almost similar outcome, but there were no death in India because of the difference between the setup and tube care in our study area was lower than a retrospective study was done to assess all tracheal tube related accidents over 3 years (January 2012–December 2014) in a 5-bedded CCU (Medical and surgical) under the Department of Anesthesiology public Teaching Hospital of Eastern India.<sup>9</sup> Also there were two studies done in UK and New Delhi had lower result compared to my study which was 09(15%). The discrepancy was significant because of a higher setup and higher ETT/TT tube care compared to my study area.

A prolonged observational study of tracheal tube displacements: Bench marking an incidence <0.5-1% in a medical-surgical adult intensive care unit, 14-may-2014, India.<sup>10</sup> This was a prospective observational study of Intubated and ventilated patients in a General MedicalSurgical Adult ICU. The incidence of accidental extubation, self extubation, partial displacement and blockages of tracheal tubes were recorded. The results was overall tracheal tube displacement rate was 61/10,112 (0.6%) per patient and 61/28,464 (0.22%) per tracheal tube day. There were 30 additional incidents of blockage, kinking or biting of the tracheal tube. Physiological consequences-69 were mild, 10 moderate, 12 major and one death. Of the 91 accidents, 30 were partly and 30 were completely preventable. 76 incidents involved an endotracheal tube (54 displaced, 12 blocked and 10 bitten-kinked) and 15 a tracheostomy tube (Seven displaced and eight blocked). Accidents were more common in medical than surgical patients (medical = 48, cardiac surgical = 17 and other surgical/trauma = 26).<sup>10</sup> In our study time, there were TT tube blockage was 3(33.33%) and the impact was hypoxia, but no cardiac arrest as well as death. So the discrepancy of this study may be the smaller data was collected, the short duration of the study period and low setup compared to a prolonged observational study of tracheal tube displacement, in India. Study conducted at Hope hospital UK had found low incidence of tube blockage both for ETT and TT.<sup>11</sup> In the study the sample size and

duration of study was much larger compared to us. Markowicz et al found cardiac arrest is the most devastating outcome in ETT/TT blockage cases.<sup>11</sup> Though none of the studies could sort out standard definition of tube blockage.

#### **Limitation**

The present study was conducted in a very short period of time. Small sample size was also a limitation. The study population was selected from single selected hospital in Chattogram. So that the result of the study may not reflect the exact picture of the country.

#### **Conclusion**

Management of patients at ICU with Endotracheal Intubation and with tracheostomy is still a matter of great concern. Proper nursing, early detection and timely intervention is the key to prevent any kind of unwanted outcome in these patients. So that meticulous nursing and care should always be pertained with these patients in Intensive Care Units.

#### **Recommendation**

Proper assessment, care, early detection and timely intervention may limit complications. Even early interventions may reverse some complications completely. Study like this may be conducted in larger scale in future for the benefit of the patient.

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#### **Contributions of authors**

SD-Conception, design, data analysis, drafting, critical revision & final approval.  
PKD-Acquisition of data, interpretation of data & final approval.

#### **Disclosure**

Both the authors declared no competing interests.

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