

Outcome of Emergency Endotracheal Intubation in Critically Ill Adults in General ward, Critical Care Unit and Triage: A Comparative Study

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Abstract

Background & Aims: Emergency endotracheal intubation is a life-saving procedure in any setting. We compared the outcomes of emergency endotracheal intubation calls for Anesthesiologists in General ward, Critical care unit and Triage in a single medical centre.

Settings and Design: Prospective, Cross sectional study.

Methods and Material: We evaluated all patients admitted to the Ward, Critical care unit and Triage between October 2021 to November 2022. A total of 186 patients, >18 years of age, who required emergency endotracheal intubation were included in this study. Primary outcome was to estimate the proportion of difficult & failed endotracheal intubation. Secondary outcome was to assess the incidence of complications, survival and neurological outcome.

Results: General ward had the highest proportion of difficult intubations (67.74%), followed by Triage (62.9%), and CCU (61.29%). General ward had 4.83% failed intubation followed by Triage 1.61%. The incidence of hypoxemia (33.87%) and hemodynamic collapse (12.9%) was higher in General ward as compared to CCU (12.9% & 9.68%) and Triage (24.19% & 11.2%), (P=0.02 & 0.04 respectively). There was a trend of higher survival rate in CCU (67.74%) as compared to General ward (25.61%) & Triage (51.61%). Among these locations, CCU had the highest rate of neurologically intact (53.23%) survival to hospital discharge as compared to General ward (16.13%) & Triage (30.63%).

Conclusions: We concluded that the proportion of difficult and failed intubation, was highest in General ward followed by Triage and CCU. Incidence of complications was least in CCU followed by Triage and General ward.

Keywords: Endotracheal Intubation; CCU; Triage; Difficult and Failed Intubation.

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INTRODUCTION

At a teaching medical centre, an Anesthesiologist is primarily responsible for difficult airway management in ICU and non ICU settings. Despite advances in monitoring and equipment, urgent or emergency difficult endotracheal intubations are encountered frequently. The inability to take a detailed history and physical examination or discussion and planning among the health care team are limitations



which lead to further unanticipated difficulties.

Various factors contribute to difficult intubation. Operator-related factors: the level of experience and training of the operator, use of pharmacologic agents that facilitate the procedure. Patient related factors include difficult airway, and physiologic factors that limit the duration of the laryngoscopy attempt, such as hypoxemia and hemodynamic instability of the critically ill patient. Environmental factors include limited space, poor lighting, and suboptimal bed characteristics that limit the ability to properly position or access to the patient's head and airway.¹ These conditions are again influenced by the area of the hospital. In Triage and CCU, most intubations are performed under controlled condition, therefore rate of complications are relatively low. General ward is staffed by support personnel who are less experienced in identifying and assisting in emergent clinical scenarios. Lack of recognition of respiratory distress and delay in intervention may lead to hemodynamic alterations and difficulty with oxygenation and ventilation.²

Majority of airway management calls come from the Critical Care Unit and Triage. These are the sites that handle the highest volume of critically ill patients with respiratory, cardiac and neurological problems.

We hypothesized that Endotracheal intubation in the ward using direct laryngoscopy will be associated with worse intubation conditions and more complications compared with those in the Critical care unit and Triage. Despite the high incidence of emergency endotracheal intubations, there have been no recent studies comparing the outcomes of emergency intubations in these areas. Therefore, the current study was undertaken to compare the outcomes of emergency Endotracheal intubation calls for Anesthesiologists in the general ward, Critical care unit and Triage in a single medical centre.

MATERIALS AND METHODS

This study was conducted in the department of Anesthesiology and Pain Management, Pt. J.N.M. Medical College and Dr. B.R.A.M. Hospital Raipur (C.G.) after approval from Institutional Scientific and Ethics Committee. We prospectively analysed all adult patients requiring emergency endotracheal intubation in the General ward, CCU and Triage that called for the anesthesiologist at our tertiary care institution between October 2021 and November 2022. Patients less than 18 years of age and pregnant females were excluded

from the study. The attenders of the patient were informed about the technique and study design following which a written informed consent was taken from them. All intubations were performed by a single Anesthesia resident (at least 1 year of training experience) supervised by attending Anesthesiologist.

The sample size was calculated based on the data from the previous study by Hsiao et al.³ The sniffing position was used as a standard head positioning for direct laryngoscopy and endotracheal intubation, however the anesthesiologist was free to vary patient's head positions, adapting to the clinical situation (e.g., the ramped position for obese patients if necessary). Sellick's manoeuvre was used for preventing gastric inflation during manual bag and mask ventilation. The choice of anesthetic agents was left to the discretion of the anesthesiologist. Both non-invasive blood pressure and oxygen saturation were noted before hand, during the tube insertion and again in the 0,15 and 30 min period after endotracheal intubation. Failed attempts were subsequently managed at the discretion of the attending anesthesiologist. If the oxygen saturation dropped below 90% during intubation attempts, the anesthesiologist withdrew the laryngoscope and initiated mask ventilation.

After each tracheal intubation in Ward, Critical care unit and Triage the operator completed a data collection form, which included the following information: patient demographics, indication of intubation, anesthetic agent, neuromuscular blocking agent, the best modified Cormack-Lehanoglottic view, number of attempts of tracheal intubation, the need for adjuncts to direct laryngoscopy (gum elastic bougie/stylet), operator reported difficulty of intubation, and complications during endotracheal intubation. Visualization of the laryngeal inlet was assessed according to the modified Cormack and Lehane classification.

We recorded complications including Hypoxemia, Hemodynamic collapse, Cardiac arrest, Pulmonary aspiration of gastric content and Oesophageal intubation. Oesophageal intubation was confirmed by presence of breath sound over epigastrium, absence of condensation within the lumen of tube and Capnography. Hypoxemia was defined as decrease in SpO₂ level to <80% during intubation. Hemodynamic collapse was defined as patients with unstable hemodynamics [systolic blood pressure <65mmHg recorded at least one time, despite 500ml-1000ml of crystalloids/colloids solutions loading] who required introduction of vasopressor support 5-10 min before or during

intubation, or cardiac arrest needing resuscitation. Cardiac arrest was defined as the sudden cessation of cardiac activity so that the victim becomes unresponsive, with no normal breathing and no signs of circulation. Aspiration was defined as an observation of gastric contents at the glottis opening or in the endotracheal tube, in addition to diagnosis by radiologist in chest radiography taken after intubation.

All patients were followed up until death or discharge from the hospital. The outcome was evaluated by Charlson comorbidity score, complications, survival and Cerebral performance category (CPC). [1. Good Cerebral Performance (Normal Life), 2. Moderate Cerebral Disability (Disabled but Independent), 3. Severe Cerebral Disability (Conscious but Disabled and Dependent), 4. Coma/Vegetative State (Unconscious), 5. Brain Death (Certified brain dead or dead by traditional criteria)].

RESULTS

There were total 186 emergency endotracheal intubation calls for the Anesthesiologist. Demographic characteristics (Age, gender and BMI) were not significantly different between General ward, CCU and Triage. The proportion of hypertension, Chronic kidney disease and total CCI score were higher in the General ward than in CCU and Triage.

Most frequent indication for intubation in all patients was respiratory failure ($n=87$ (46.77%)), followed by GCS <8 [$n=54$ (29.03%)], hemodynamic collapse [$n=34$ (18.2%)], and Cardiac arrest [$n=11$ (5.91%)]. In General ward and Triage, respiratory failure was the most frequent indication for intubation [$n=40$ (64.5%) and $n=28$ (45.16%), respectively), ($p=0.017$) However, in CCU, the most frequent indication for intubation was GCS <8 [$n=27$ (43.55%)], ($p=0.007$) followed by respiratory failure [$n=19$ (30.6%)].

In General ward, 24 (38.71%) patients received anesthetic agent for intubation & 13 (20.97%) received both anesthetic agent and muscle relaxant to facilitate intubation. In CCU, 22 (35.48%) patients received anesthetic agent only, where as 10 (16.13%) received both anesthetic agent and muscle relaxant to facilitate intubation. Similarly in Triage, 31 (50%) patients received anesthetic agent only & 22 (35.48%) received both anesthetic agent and muscle

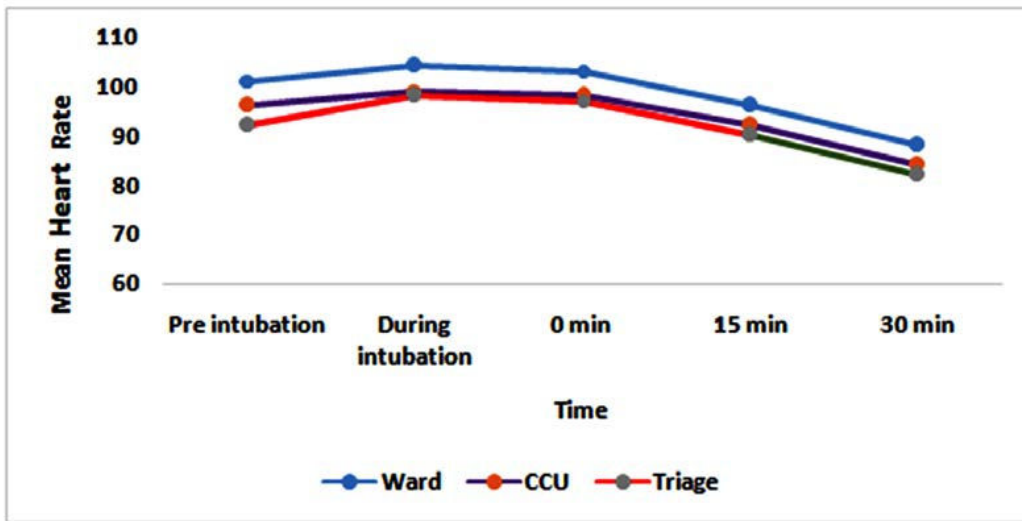
relaxant. ($p=0.009$).

Bougie guided intubation was mostly performed in the CCU [$n=26$ (41.94%)] ($P=0.013$) where as stylet was mostly used in the Triage ($n=22$ (35.48%), ($P=0.024$).

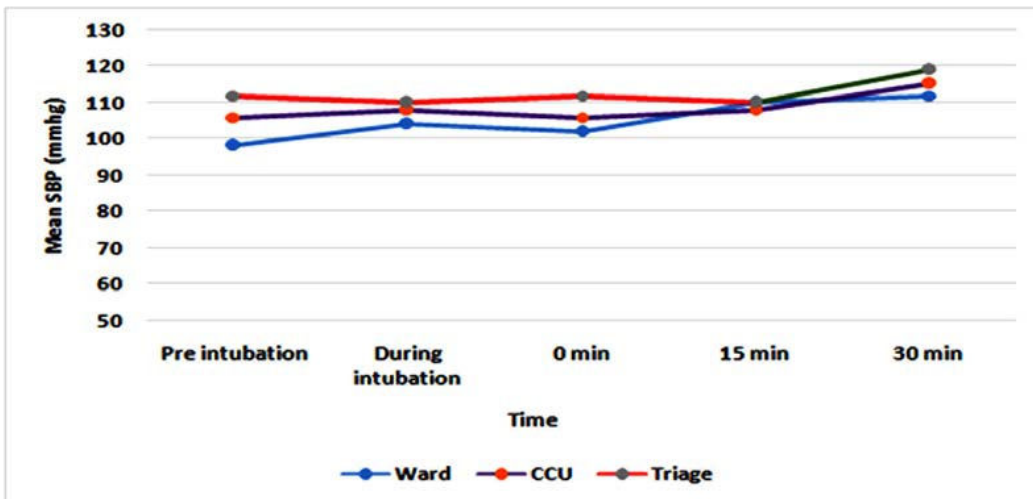
Of the 186 patients, 119 (63.97%) were recognized as difficult intubation by the Anesthesiologist and no difficulty was faced while intubating 63 (33.87%) patients. Among the three areas, General ward had the highest proportion of difficult intubations [$n=42$ (67.74%)], followed by Triage [$n=39$ (62.9%)], and CCU [$n=38$ (61.29%)]. There were total 04 (2.15%) failed intubation & among these, General ward had 03(4.83%) and 1 (1.61%) was in Triage ($P=0.74$).

Of all 186 patients, 44 (23.65%) patients presented with hypoxemia where as hemodynamic collapse was noted in 21(11.2%), Cardiac arrest in 13(6.45%), aspiration of gastric content in 10 (5.37%) and oesophageal intubation in 06 (3.22%) patients. Incidence of aspiration was similar in General ward [$n=4$ (6.45%)], CCU [$n=2$ (3.22%)] and Triage [$n=4$ (6.45%)] ($P=0.65$). However, the incidence of hypoxemia [$n=21$ (33.87%)] and hemodynamic collapse [$n=08$ (12.9%)] was higher in General ward as compared to CCU [$n=08$ (12.9%) & $n=06$ (9.68%)] and Triage [$n=15$ (24.19%), $n=07$ (11.2%)]. ($P=0.02$ & 0.04 respectively). There was no incidence of oesophageal intubation in CCU.

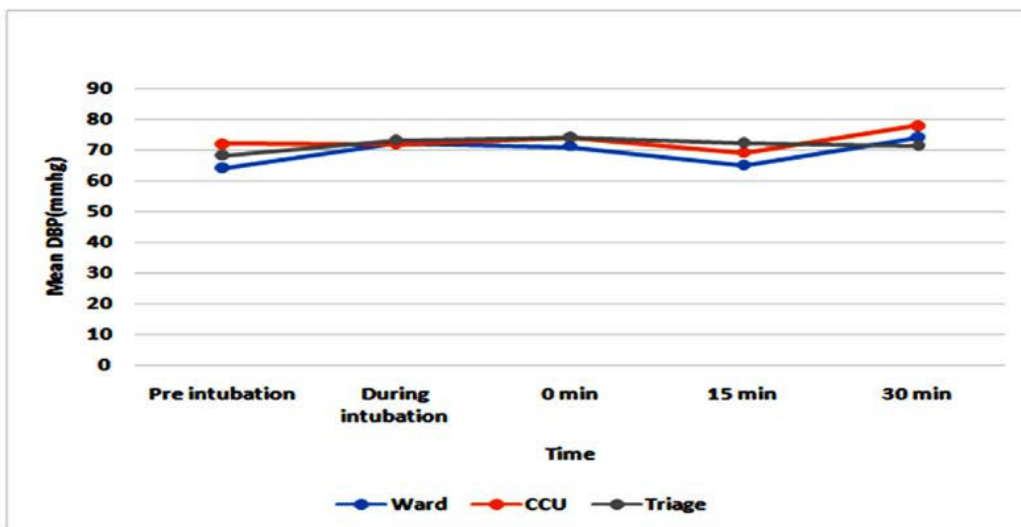
Total 90 (48.38%) patients survived to discharge from hospital. There was a trend of higher survival rate in the CCU [42 (67.74%)] as compared to General ward [16 (25.61%)] & Triage [32 (51.61%)]. Mortality rate was higher in General ward [46 (74.19%)] as compared to CCU [20 (32.26%)] & Triage [30 (48.39%)] ($p<0.001$). Out of 90 (48.38%) patients discharged from hospital, 62 (38.33%) were discharged with CPC scores of 1 or 2, 16 (8.6%) with CPC score of 3, and 12 (6.2%) with scores of 4 or 5. In CCU, 33 (53.23%) patients were discharged from the hospital with CPC scores of 1 or 2, 06 (9.68%) with a score of 3, and 03 (4.84%) with scores of 4 or 5. In Triage 19 (30.63%) patients were discharged from the hospital with CPC scores of 1 or 2, 08 (12.9%) with a score of 3, and 05 (8.07%) with scores of 4 or 5, where as in General ward 10 (16.13%) patients were discharged from the hospital with CPC scores of 1 or 2, 02 (3.23%) with a score of 3, and 04 (6.45%) with scores of 4 or 5. In these different locations, we found that CCU had a higher rate of intact neurological survival to hospital discharge, as



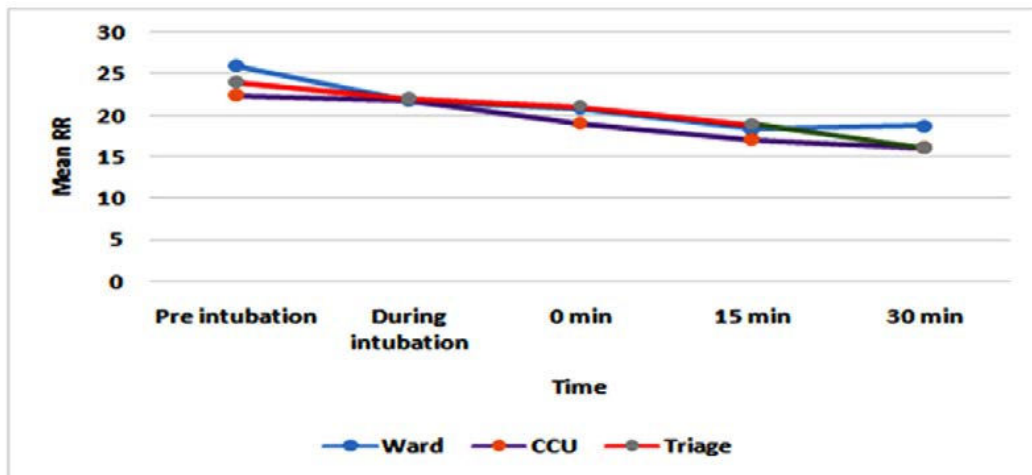
Graph 1: Comparison of mean heart rate



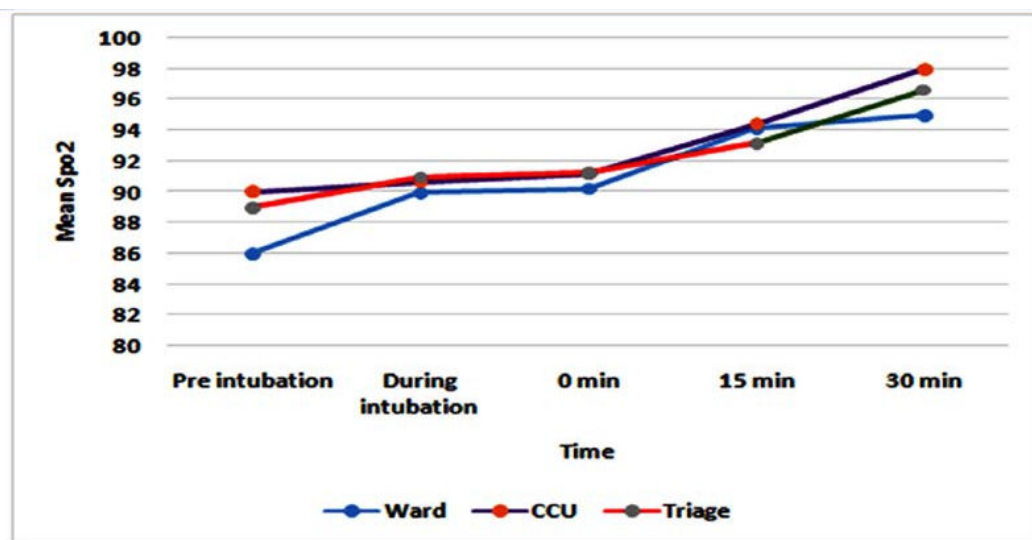
Graph 2: Comparison mean systolic blood pressure (mmHg)



Graph 3: Comparison of mean diastolic blood pressure (mmHg)



Graph 4: Comparison of Mean RR



Graph 5: Comparison of Mean SPO2

compared to General ward and Triage. ($p=0.0004$).

DISCUSSION

This is a novel study to compare the outcomes of emergency endotracheal intubation outside CCU.

In our study, patients intubated in CCU had a higher rate of survival to hospital discharge with a better neurological outcome than the General ward and Triage. Assessment of the risk factors for DET intubation, and early calls for the Anesthesiologist to conduct intubations, were possible contributing factors to a better outcome.⁴

It is evident from our data that patients who underwent Emergency endotracheal intubation outside CCU had higher mortality after their procedure. The likely reasons were delay in recognizing deterioration, lack of triage on first

contact leading to critical outcomes and delay in transport to CCU due to lack of a proper redressal system.

General ward had the highest proportion of difficult intubations [$n = 42$ (67.74%)], followed by Triage [$n = 39$ (62.9%)], and CCU [$n = 38$ (61.29%)]. It was observed that most patients in the General ward who had BMI $>25\text{kg/m}^2$, CL grade III & IV, or intubations performed in settings like poor lighting, limited space and suboptimal bed characteristics, limited the ability to properly position, led to difficult intubations.^{5,6} The higher mortality rate in General ward (74.19%) seemed to be associated with a higher CCI score. A shortage of experienced medical staff was a serious problem on the weekend.

Anesthetic agents &/or muscle relaxants are used highest in Triage, possibly due to acute injury

causing pain, anxiety and uncooperative behaviour of the patient. Previous studies have reported that use of neuromuscular blockers, especially non depolarizing agents, could lead to life threatening hypoxia, when the trachea cannot be intubated, inducing paralysis with no spontaneous respiration.⁷ The likely detrimental effects were avoided in CCU due to timely assessment, better equipment to handle the airway and correct timing to call for help to the senior Anesthesiologist. Most intubations in the presence of an experienced Anaesthesiologist precluded the need for muscle relaxants.⁸

Of total 186 patients, 44 (23.65%) patients presented with hypoxemia, hemodynamic collapse was noted in 21 (11.2%), Cardiac arrest in 13 (6.45%), aspiration of gastric content in 10 (5.37%) and oesophageal intubation in 06 (3.22%) patients. In our study, most frequent complication was Hypoxemia with 33.87% occurrence in General ward, 12.9% in CCU, and 24.19% in Triage. The incidence of hemodynamic collapse with emergency intubation in General ward was higher as compared to CCU and Triage. Previous study reported that increased number of attempts of emergency or DET intubation increase the incidence of hemodynamic collapse & airway complication.⁹

In our study during emergency tracheal intubation, airway related complication rate was 8.6% & the most common complications were aspiration of gastric content which occurred in 6.45% of cases in General ward, 3.23% of cases in the CCU, and 6.45% of cases in Triage. Given the increased incidence of difficult intubation in the General ward, and frequent blood, vomitus or secretions in the airway, the incidence of aspiration was slightly higher in these settings previous study had demonstrated that aspiration occurs more frequently among general ward patients compared with CCU. This was possibly because CCU is better equipped with functioning suction, oxygen and resuscitation equipment.¹⁰ Compared to other studies, we observed a lesser aspiration rate in our study setting.

In our study overall, 90 (48.38%) cases were discharge from hospital. We reported 51.61% of overall in-hospital mortality, within which the mortality rate of General ward (74.19%) was higher than CCU (32.26%), and Triage (48.39%). In General ward, 16 (25.61%) patients survived to discharge. In our study mortality rate was 32.26% in CCU & 67.74% of patients were discharged home.

There are several limitations to this study. First, as an observational study, we could not enforce specific

care protocols or airway management algorithms. Second the possibility of imperfect documentation and under reporting of complications must be considered. Third, sources of bias in data arises primarily from the self-reported nature of data and may be prone to recall bias of events/techniques. Fourth, even if there were perfect definitions for complications, the timing of events relative to airway management is often impossible to discern. Similarly, although it is often difficult to distinguish airway related hemodynamic alterations from underlying pathologic states. It may be of interest to document these data in the future. The data is from a single centre, and this must be considered when extrapolating the results to other clinical settings. Incorporating a multicentre design in future could further validate these findings. In addition, complications such as dental injury and trauma were not documented, and their inclusion may have improved the study. Future prospective studies are needed to evaluate the impact of comorbidities on the outcome during emergent and DET intubation.

CONCLUSION

We concluded that the proportion of difficult and failed intubation, was highest in the general ward. Incidence of complications was least in CCU. Adjuvant airway device use, in particular the bougie introducer, was observed to be particularly helpful. High CCI score, grade III or IV laryngoscopy view, and locations like the General ward were associated with increased complication rates during emergent airway management. Therefore, early calls to the Anaesthesiologist for DET intubation, involving trained staff, easy availability and accessibility to emergency equipment and drugs for intubation, continuous monitoring and prompt action in case of any adverse events will result in a higher rate of neurologically intact survival to hospital discharge.

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