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Peri-intubation cardiac arrest in emergency department of a tertiary care hospital, Nepal

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Abstract

Introduction: Peri-intubation cardiac arrest leads to morbidity and mortality. Patients present in emergency department with various presentations such as difficult intubation, refractory shock, respiratory distress and are at risk of complications like failed intubation and cardiac arrest. Cardiac arrest can be reduced if we treat physiological changes prior to intubation. This study aims to explore the peri-intubation cardiac arrest and its relation with physiological state of the patient.

Method: This was an observational-analytic-cross sectional study from secondary data conducted at Patan Academy of Health Science emergency department. The data source was emergency airway registry of Patan Academy of Health Sciences which started in Jan 2022. The available data till Feb 2024 was taken for the study.

Result: Total 196 patient underwent emergency intubation in study period, among them 31 cases (15.8%) developed peri-intubation cardiac arrest and mean age of cardiac arrest is 56 year and male to female ratio of cardiac arrest is 1.2:1. First pass intubation success rate is 61.73%. Nine hypotensive cases, 12 hypoxemic cases, 8 hypotensive as well as hypoxemic cases and 2 cases of neither hypotensive nor hypoxemic develop peri-intubation cardiac arrest.

Conclusion: Peri-intubation hypotension and hypoxemia are two main physiologically compromised states that is associated with peri-intubation cardiac arrest. The likelihood of cardiac arrest during emergency intubation decreases significantly if the tube is successfully inserted on the first attempt.

Keywords: Emergency Endotracheal Intubation, First Pass Intubation, Peri-Intubation Cardiac Arrest, Physiological Compromise

INTRODUCTION

Critically ill patients present in emergency department with various presentations such as difficult intubation, refractory shock, respiratory distress and are at risk of complications like failed intubation and cardiac arrest.[1] Systemic reviews and meta-analysis suggest that up to 28% of critically ill patients undergoing tracheal intubation may experience a life-threatening complication such as severe hypoxemia, hemodynamic instability and 2.7%of procedures are complicated by cardiac arrest.[2]

A descriptive study done in Korea showed that post-intubation cardiac arrest occurred in approximately 2% of critical cases in emergency department. Systolic hypotension before intubation is associated with this complication, which has potentially significant implications for clinicians at the time of intubation.[3]A study done on 2021 in various hospitals of USA in Emergency Department, in which 15,776 subjects who met selection criteria, 157 (1.0%, 95% CI 0.9 1.2%) experienced peri-intubation cardiac arrest.[4]

There are two clinical studies published from Nepal regarding intubation in emergency, however these studies have not addressed peri-intubation cardiac arrest. Cardiac arrest can be reduced if we treat physiological changes prior to intubation.[5] Therefore, this study aims to explore the peri-intubation cardiac arrest and its relation with physiological state of the patient. Peri-intubation cardiac arrest leads to morbidity and mortality, so prior intubation hypotension and hypoxemia should be corrected first rather than just inserting tube inside trachea.

Our study also aims to observe first pass intubation rate which may help emergency physicians to minimize the risk of physiological deterioration. High first pass success rate in physiologically compromised and difficult intubation cases will increase the confidence among emergency physician and hence improve the skill of emergency intubation by mitigating physiological challenges(hypoxemia, hypotension, acidosis).[6] This study may help to guide an approach to prioritize correction of physiological compromised state prior to emergency intubation. This study aims to provide an insights on understanding the risks associated with emergency intubation and assessing interventions to mitigate adverse outcomes by optimizing hemodynamics and peri-intubation oxygenation.

METHOD

This was an observational-analytic-cross sectional study from secondary data. The data source was from emergency airway registry of Patan Academy of Health Sciences from January 2022 to February 2024. General objective of this study was to study Peri-intubation cardiac arrest in emergency department. The Institutional Review Committee (IRC) (FLW2307161769) of PAHS gave approval for the study. Consent was taken prior to intubation to nearest relative explaining about the study, its use and outcome as well as confidentiality. Considering the limitation of time of one year in academic calendar, the sample size of 16 mortality cases was taken which would be sufficient to find out the prevalence and see the association of hypoxemia in this study. Previously recorded emergency intubations were also taken for good sample size and better results. Descriptive statistics was done for other variables like hypotensive, hypoxemic cases.

All consecutive emergency intubation registered in the registry was taken for the study until the required sample size was achieved. All patients registered in emergency airway registry and patients with intubation attempts in emergency department of age more than 18 years were included in the study. Incomplete records and non consented entry for prospective study were excluded. The emergency intubation registry was started by the department of General Practice and Emergency Medicine, PAHS from January 2022. All patients undergoing endotracheal intubation in emergency are recorded electronically by resident or medical officer who takes part in intubation. The electronic form is available in the web page of the department (www.sites.google.com/pahs.edu.np/gpem).[7] The registry consists of hospital registration and variables which helps in anticipating difficult bag mask ventilation, difficult laryngeal intubation and difficult supraglottic airway. The intubating team fills up the registry as soon as intubation is completed.

Retrospective sample

The data were obtained from the emergency airway registry of PAHS GPEM site. Intubating doctor of emergency room entered the data immediately upon completion of intubation as soon as possible during duty hour, but delayed entry was permitted if immediate entry was not possible. Intubating doctor can fill the data on computer of station at emergency room or mobile device by scanning QR code attached on the emergency station.

Prospective sample

After intubation clinician fill the airway registry form by opening the google GPEM site, after completion which will be submitted. Data regarding peri intubation cardiac arrest, demographics data, hypotension, hypoxemia and intubation attempts will be extracted from there. Emergency airway registry does not require patients name, which will be confidential.

Data analysis was done using MS-SPSS V.16 and MS-Excel V.2012. Variables were expressed in percentage prevalence, age in years and first pass intubation percentage. Chi square test was used to find an association of hypotension, hypoxemia and first pass intubation with peri-intubation cardiac arrest and in peri-intubation non-cardiac arrest

group. Results with a P-value of <0.05 deemed as statistically significant.

RESULT

Total 196 patient underwent emergency intubation in study period, among them 31 cases (15.8%) developed peri-intubation cardiac arrest and mean age of cardiac arrest is 56 year and male to female ratio of cardiac arrest is 1.2:1. First pass intubation success rate is 121(61.73%)). 9(29%) hypotensive cases, 12(38.7%) hypoxemic cases, 8(25.8%) hypotensive as well as hypoxemic cases and 2(6.5%) cases of neither hypotensive nor hypoxemic develop peri-intubation cardiac arrest. Table 2 and 3: Association of peri-intubation cardiac arrest with hypoxemia, association of peri-intubation cardiac arrest with hypotension were statistically significant with respective P values <0.00001, 0.000608 i.e <0.05 but association of peri-intubation cardiac arrest with first pass success is not statistically significant i.e. 0.206. (Table 4)

Incidence of peri-intubation cardiac arrest is indeed higher in cases with hypoxemia compared to those without hypoxemia. This finding is statistically significant. Peri-intubation cardiac arrest occurring more frequently in hypotensive cases compared to non-hypotensive cases, with statistical significance, is an important finding in clinical practice, low blood pressure, can pose significant challenges during intubation procedures. Incidence of peri-intubation cardiac arrest is lower when the endotracheal tube is successfully inserted on the first attempt compared to multiple attempts which is statistically not significant.

DISCUSSION

Cardiac arrest during or immediately after emergency intubation can results from various causes like severe hypotension during intubation, hypoxemia, multiple intubations attempt and drugs (eg. Rocuronium, Ketamine) used during intubations itself. Physicians have very less

Table 1. Clinical/Demographics results

Clinical/Demographics	N(%)
Total airway registries	196
Number of peri-intubation cardiac arrests	31(15.8%)(M=17, F=14)
Mean age of cardiac arrest	56 years
Cardiac arrest Male: Female	1.2: 1
First pass intubation success rate	61.7(%)
Cardiac arrest in hypotensive cases	9(29%)
Cardiac arrest in hypoxemic cases	12(38.7%)
Cardiac arrest with hypotension and hypoxemia	8(25.8%)
Cardiac arrest without hypotension and hypoxemia	2(6.5%)

Table 2. Association of peri-intubation cardiac arrest with hypoxemia

	Hypoxaemia (Yes) %	Hypoxaemia (No) %	Chi square (p value)
Peri intubation cardiac arrest	64.5	35.5	< 0.00001
No peri intubation cardiac arrest	30.3	69.7	

Table 3. Association of peri-intubation cardiac arrest with hypotension

	Hypotension (Yes) %	Hypotension (No) %	Chi square (p value)
Peri intubation cardiac arrest	54.8	45.2	0.000608
No peri intubation cardiac arrest	30.9	69.1	

Table 4. Association of peri-intubation cardiac arrest with first pass success

	Peri intubation cardiac arrest (Yes) %	Peri intubation cardiac arrest (No) %	Chi square (p value)
First pass success	13	87	0.206
No first pass success	20	80	

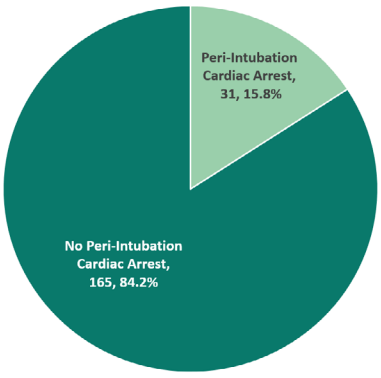

Figure 1. Pie chart showing percentage of peri-tubation cardiac arrest

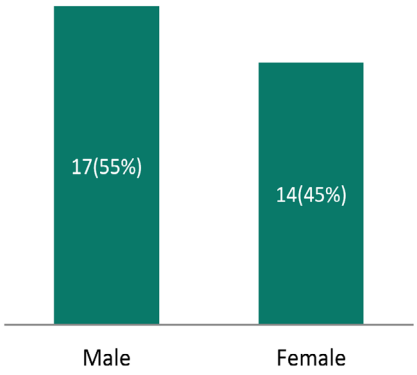

Figure 2. Bar graph showing demography of peri-intubation cardiac arrest

information about co-morbidities and past histories for red cases presenting in emergency, which also may lead to difficulties during treatment.[7] In our study peri-intubation cardiac arrest is 31(15.8%) among 196 emergency intubations. One study shows cardiac arrest during emergency intubation is very less approximately 1% among all emergency intubations.[4] A meta analysis done at Taiwan in 2023 showed incidence of peri-intubation cardiac arrest was 2.1%.[8] Comparing this analysis peri-intubation cardiac arrest is significantly higher in our study. Reason behind high cardiac arrest rate might be because of multiple intubation attempts, untimely managed severe hypotension and hypoxemia.

Our study was done in one-year study period. A National Emergency Airway Registry (NEAR) study done at various hospital of USA over 3 years period, out of 15,776 subjects who met selection criteria, 157 experienced peri-intubation cardiac arrest.[4] One year duration and missed registries after intubation may be the reason behind having high cardiac arrest in our study. No exact similar studies performed in our settings, but a study done at BPKIHS, endotracheal intubation in emergency- an experience from eastern Nepal in 2017, haemodynamic instability within 15 minutes of intubation requiring CPR was seen in 4 cases among 215 cases.[7]

The hemodynamic state of the patient before intubation play a major role in the development of intubation related cardiac arrest according to most of the studies in our review. Studies have found that either hypoxemia, hypotension, or Shock index were independent risk factors for intubation related cardiac arrest.[9] Similarly our study also showed that peri intubation cardiac arrest is higher in hypotensive cases than non-hypotensive ones. Similar study done at Korea in 2018 reported mean pre-intubation oxygen saturation levels of 92% in patients that developed emergency intubation-related cardiac arrest compared to oxygen saturation levels of 97% in patients that developed emergency intubation unrelated cardiac arrest.[10] Another similar study, Michael D April, et al showed that pre-intubation oxygen saturation <90% and clinician-reported need for immediate intubation without time for full preparation were associated with higher likelihood of peri-intubation cardiac arrest. Similar findings regarding hypoxemia is noticed in our study also.

Peri-intubation cardiac arrest is comparatively higher in hypotensive patients in our study, we need to focus on optimising physiology before intubation and frequent hands on trainings, simulations related to emergency intubation are required. Peri-intubation cardiac arrest during or immediately after emergency intubation can result due to hypoxemia or the combination of pre- and peri-intubation shock.[4] Pre-intubation systolic blood pressure <100 mm Hg were associated with higher likelihood of peri-intubation cardiac arrest. Major risk factors (i.e., pre-intubation hypotension, pre-intubation hypoxemia, two or more intubation attempts, use of succinylcholine, and elevated pre-intubation SI) were identified by T Hao, et al. Hypotension was defined as systolic blood pressure lower than 100 mmHg in one study while as systolic blood pressure lower than 90mmHg in the others.[4] T Hao, et al., results showed that hypotension, with a pooled OR of 4.96, was associated with a significantly increased risk of peri-intubation cardiac arrest. Michael D April, et al., reported most common reason behind cardiac arrest are peri-intubation hypoxia and hypotension. In our study also major causes of cardiac arrest were peri-intubation low blood pressure and critical hypoxemia.

First pass intubation success rate in our study is 61.73%. Association of first pass intubation with peri-intubation cardiac arrest is not statistically significant in this study, but after achieving first-pass intubation success, there is a significantly lower rate of cardiac arrest. One Similar study, Harry L et al. a registry study of 4496 intubation attempts, 4082 (91%) succeeded on the first attempt.[11] Another similar study done by Abdullah Bakhsh in 2021, Improving first-pass success rates during emergency intubation at an academic emergency department showed first pass success rate at first was 57.1% and 80% at the end of study. Among 146 intubations, video laryngoscopy used in 101 and direct laryngoscopy in 44 patients.[12] Similar study done at IOM(TUTH), among 265 emergency intubations 82% had first pass success.[13] This was a observational cross sectional study. Another cross-sectional descriptive study in a Medical University in the Eastern part of Nepal showed 76% first pass success intubation rate. Among 215 intubated patients first attempt in 164 patients (76.28%), second attempt in 33 patients (15.35%) and third attempt in 18 patients (8.37%). The reason behind having less first pass success rate in our study may be due to different level of intubation skill and experience among physicians (residents, fellows and faculties).

We should not aim only to insert tube inside trachea during emergency intubation, rather should focus on hemodynamic and physiological instabilities and correct BP, hypoxemia before and after intubation. Previous studies have mentioned various mechanisms of peri-intubations cardiac arrests in emergency department.[14, 15] Sedatives and neuromuscular blocking agents used during intubation may lead to cardiac arrest due to their inhibitory action against catecholamine secretion stimulated in response to stress. In our study we did not include the induction and paralytic agents and their effects in patients hemodynamics. Hemodynamic instability is also a reason for inhibition of neuromuscular blocking agents upon catecholamine secretion potentially causes cardiac arrest.[16, 17] Decreased venous return due to increased intrathoracic pressure lead by Positive pressure during ventilation further leads to inadequate cardiac output, leading to hypotension. This

mechanism is more severe in critically ill patients who are hypovolemic or have poor cardiac function.[10]

In summary, this study aims to help emergency physicians prepare more thoroughly for intubation, such as correcting hypotension and improving pre-intubation oxygenation. It is important to improve intubation technique and identify difficult airway intubations to reduce the number of intubation attempts. (Need to explore on early identification and systematic approach to deal with difficult airway patients) Whether these interventions can directly reduce the incidence of cardiac arrest needs to be confirmed by future larger studies.[1,2]

Limitation of this study is, it is a single center study, Conducting multi-centered studies with larger sample sizes can provide more precise and reliable results.

CONCLUSION

Peri-intubation hypotension and hypoxemia are two main physiologically compromised states that is associated with peri-intubation cardiac arrest. The likelihood of cardiac arrest during emergency intubation decreases significantly if the tube is successfully inserted on the first attempt.

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