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Original Research Article

A Hospital Based Prospective Assessment of Incidence of Difficult Airway in Intensive Care Unit: An Observational Study

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Abstract

Aim: The aim of this study was to find out the incidence of difficult airway and to develop a score that predict difficult airway in critical care unit.

Methods: This study was conducted at Sri Krishna medical college and Hospital, Muzaffarpur, Bihar, India for two years. Patients were admitted due to acute respiratory failure with COPD, chronic kidney disease with pulmonary oedema, trauma with multiple bone fracture, head injuries with cervical spine injuries, septic shock with multiorgan dysfunction, congestive heart failure, liver cirrhosis with portal hypertension with hypotension, and other medical illness.

Results: In two years, total, 3450 patients admitted in the ICU, out of them 2000 patients require invasive ventilatory support, out of 2000, ADA was found in 500 (25%) patients and PDA in 1300 (65%) patients and anatomical with physiological difficult airway (ADA+PDA) was found in total 200 (10%) patients. ADA is noted in total 500 (25%) of the patients, out of them 288 (57.6%) were male and 212 (42.4%) were female. DBMV were seen in 180 (9%) patients, DSDP in 60 (3%), DI in 160 (8%), DSA in 100 (5%) of the patients. Most common age group having DBMV >81year, 40 male followed by 61- 80year male 32 and DSDP is also common in age group 61 to>81yeras male, and DI is also most commonly noted in male >81 years, 32 followed by 61-81year male, 24 females. In our study 10% was very difficult airway due to anatomical and physiological reasons, 25% was difficult due to anatomical factors of patients and 65% are moderate difficult due to physiologically factors of the patients in ICU.

Conclusion: Incidence of difficult airway is very high in ICU as compare to OT due to anatomical factors and physiological factors of the patients, so each and every patient requires different strategies of airway management in ICU.

Keywords: Difficult airway, anatomical, physiological, bag and mask, supraglottic device, surgical, invasive ventilator.

Introduction

Endotracheal intubation for critical patients always is a routine and dangerous performance in an emergency room and intensive care unit (ICU). Critically ill patients are physiologically very different from patients who undergo intubation in an operating room (OR) for various reasons, such as the presence of pre-

existing hypoxemia, fragile hemodynamic state, metabolic acidosis, and high intracranial pressure. New data showed that the incidence of adverse events associated with airway management in ICUs was higher by a factor of 55 when compared with that in ORs. [1] Complications associated with intubation have been reported to occur in up to 45% of critically ill patients, with cardiovascular instability occurring in 42%, severe hypoxemia in 9.3%, aspiration in 3.9%, cardiac arrest in 3.1%, and cardiac arrhythmia in 5.6%. [2]

For critically ill patients, the main risk of peri-intubation adverse events arises from the failure of the first attempt at endotracheal intubation, in addition to "physiologically difficult airway." An adaptive procedure should include preintubation patient assessment, preoxygenation, rapid intubation procedures, and other recommended measures to improve the intubation success rate and minimize intubation-related issues. However, there are some controversies regarding the patient's position, cricoid pressure, and the use of neuromuscular blocking agents (NMBAs). [3,4]

Difficult airways are a challenge for those who perform endotracheal intubations. The incidence of the difficult airway is lower in surgical patients [5] but is higher in non-preoperative (e.g., emergency department, ED) patients. The consequences of the worst-case difficult airway, the "cannot intubate and cannot ventilate" situation, can be catastrophic. [6]

Majority of ICU patients require mechanical ventilation support to assist breathing through an endotracheal tube [ET] or a tracheostomy tube [TT]. Endotracheal Intubation[EI] is high-risk procedure associated with high mortality rate in ICU as compare to Operation Theatre [OT] because ICU patients are hemodynamically unstable having hypoxemia, metabolic acidosis, raised intracranial pressure, and coagulopathy and are prone for hypotension and hypoxemia in the immediate post-intubation phase due to blunting of compensatory sympathetic response, thus requiring significant expertise in airway handling as well as understanding of pathophysiology of the disease process. Airway-related events in ICU are potentially fatal, thus giving minimal margin of error to the intensives. [7-9] Difficult airway encountered in terminally ill patients is called Physiological Difficult Airway [PDA] because various pathophysiological changes pertaining to disease process in body like alveolar flooding causing loss of alveolar capillary interface along with relative fluid deficit, neuromuscular fatigue and coexistent organ dysfunction, so the induction and intubation can be potentially life threatening due to reduced physiological reserves. [10] Anatomical difficult airway [ADA] is another common problem encountered by anaesthetist and intensivist. The term ADA is used when there is difficulty in bag mask ventilation or in inserting supraglottic airway device or in visualisation of glottic opening or passing of endotracheal tube through the opening. Awake intubation is gold standard. [11]

The aim of this study was to find out the incidence of difficult airway and to develop a score that predict difficult airway in critical care unit.

Materials and Methods

This study was conducted at Sri Krishna medical college and Hospital, Muzaffarpur, Bihar, India for two years. Patients were admitted in our ICU due to acute respiratory failure with COPD, chronic kidney disease with pulmonary oedema, trauma with multiple bone fracture, head injuries with cervical spine injuries, septic shock with multiorgan dysfunction, congestive heart failure, liver cirrhosis with portal hypertension with hypotension, and other medical illness.

Consent for the management was obtained from the immediate relative(s) of the patients. Patient's performa was filled including patient name, age, gender, BP, PR/HR, RR, spo2, type of difficult intubation.

Patient's selection criteria

1. Only critically ill patient admitted in ICU and who require intubation.
2. Age group 18 to 90 years, all patients were managed according to the protocol. If the patient was directly transferred to the

ICU from the emergency ward or after a surgical procedure, a tracheostomy was performed and the patient was transferred to the general neurosurgery ward once the respiratory parameters were stable and the patient was breathing spontaneously. Tracheostomy is a surgical procedure that creates an opening in the anterior wall of the trachea to facilitate airway access and ventilation. According to the tracheostomy timing, patients were classified as early group such as tracheostomy done in ≤7 days, or late (LT) such as >7 days. The outcome was assessed on the basis of a Glasgow outcome scale (GOS) includes Grade I (death), Grade II (vegetative), Grade III (mostly dependent), Grade IV (minimally dependent), and Grade V (normal). Glasgow outcome scale (GOS) was assessed after one month at the time of hospital discharge. ENT was ready with the tracheostomy on standby as any case required.

Method of intubation

Equipment's used in ICU for airway management-

1. Capnography- must be used for confirmation of correct position of EI
2. Difficult airway Trolley and Bronchoscope- For immediate management of DI
3. Metal blade for direct laryngoscopy - like Macintosh, Mc-coy, and Magill of all sizes to improve the success rate of EI.
4. Video laryngoscopes (VL) - for intubation in ICU must be used either initially or after failure of direct laryngoscopy.
5. Supraglottic devices (SGD) - must be used in the management of difficult intubation, to oxygenate the patient, and facilitate intubation under bronchoscope control.

Drugs used in ICU for intubation

1. Hypnotic agents- Propofol, Ketamine, Etomidate to facilitates induction, choice depends on patient clinical condition.
2. Succinylcholine to facilitate tracheal intubation during RSI (rapid sequence induction)
3. Rocuronium at a dose above 0.9 mg/kg [1.0–1.2 mg/kg] should be used when succinylcholine is contraindicated.
4. Sugammadex- for reversal of neuromuscular blockade should probably be rapidly available when rocuronium is used.

Protocols of Airway management in ICU patient

In critically ill patients requiring ICU admission, monitor is attached to record vital parameter like ECG, HR, NIBP, Spo2, RR. After inserting Intravenous cannula, blood samples sent in central lab for renal function test (RFT), liver function test (LFT), CBC, Coagulation profile, Serum electrolytes, arterial blood gas (ABG) and then IV Fluid started.

On the basis of clinical parameters and ABG report, patients requiring invasive ventilatory support were pre-oxygenated by use of Non-invasive ventilation and induction with hypnotic agents and neuromuscular blockade was done according to clinical condition of the patients.

Statistical analysis

The data obtained was coded and entered in to Microsoft excel Worksheet and the data was analysed by using rate, ratio, percentage, and proportion.

Results

Table 1: Distribution of Difficult airway in ICU

Type of difficult airway	N%
ADA	500 (25)
PDA	1300 (65)
AD+PDA	200 (10)
Total	2000 (100)

In two years, total, 3450 patients admitted in the ICU, out of them 2000 patients require invasive ventilatory support, out of 2000, ADA was found in 500 (25%) patients and PDA in 1300 (65%) patients and anatomical with physiological difficult airway (ADA+PDA) was found in total 200 (10%) patients.

Table 2: Distribution of Incidence of ADA in ICU

Age(year)	DBMV		DSDP		DI		DSA		Total	
	M	F	M	F	M	F	M	F	M	F
18-40	15	10	7	3	14	10	14	5	50	28
41-60	20	15	10	4	18	18	12	10	60	47
61-80	31	25	8	8	24	20	12	14	75	67
>81	40	20	10	10	32	24	21	16	103	70
M/F	110	70	35	25	88	72	59	45	288(57.6%)	212(42.4%)
Total	180 (9%)		60 (3%)		160 (8%)		100 (5%)		500(25%)	

ADA is noted in total 500 (25%) of the patients, out of them 288 (57.6%) were male and 212 (42.4%) were female. DBMV were seen in 180 (9%) patient, DSDP in 60 (3%), DI in 160 (8%), DSA in 100 (5%) of the patients. Most common age group having DBMV >81year, 40 male followed by 61- 80year male 32 and DSDP is also common in age group 61 to>81yeras male, and DI is also most commonly noted in male >81 years, 32 followed by 61-81year male, 24 females.

Table 3: Distribution of Incidence of PDA in ICU

Physiological difficult airway	Male	Female	Total
1.Neuro-physiologic derangement (raised intracranial pressure)	180	100	280 (14%)
2.Cardiovascular derangement (derangements of preload, afterload, contractility or rhythm)	130	60	190 (9.5%)
3.Respiratory derangement (hypoxemia and hypercarbia	150	50	200 (10%)
4.Hepatic derangement (raised intracranial pressure and coagulopathy)	68	25	93 (4.65%)
5. Renal derangement (encephalopathy, pulmonary oedema, hyperkalaemia and metabolic acidosis)	156	75	231 (11.55%)
6.Gut derangement (raised intra-abdominal pressure, abdominal compartment syndrome)	108	85	193 (9.65%)
7.Severe sepsis (lactic acidosis, distributive shock, multiple organ dysfunction	58	55	110 (5.65%)
Total	850(65.38%)	450(34.62%)	1300(65%)

Incidence of PDA is around 1300 (65%), out of them 850 (65.38%) were male and 450 (34.62%) were female. The most common difficulty in intubation were faced in patient with raised ICT 280 (14%) followed by renal derangement 231 (11.55%) and Gut derangement 193 (9.65%).

Table 4: Distribution of Incidence of DBMV + PDA

Difficult airway	Male	Female
DBMV+ Raised ICT	30	6
DBMV+ Raised IAP	24	8
DBMV+PE	7	6
DBMV+SEPSIS	17	4
DBMV+ Respiratory distress	25	7
DBMV+ Hepatic	10	9
DBMV+ Cardiac cause	17	10
Total	130 (65%)	50 (25%)

200 (10%) patients having ADA as well as PDA, out of them 180 patients having DBMV+PDA (9%) and 20 (1%) patients having DI+PDA. There is not a single patient noted with DSDP with PDA and DS+PDA in our critical care unit. DBMV+PDA is seen in total 180 (9%) of patient, out of them 130 (65%) were male and 50 (25%) were female. Most common condition cause difficult airway in ADA+PDA was raised ICT with DBMV, was seen in 30 male followed by DBMV+ raised IAP 24 male and DBMV+ Respiratory distress 25 male, DBMV+ sepsis 17 male, DBMV+ Cardia 17 male patients.

Table 5: Distribution of Incidence of DI + PDA

DI+PDA	Male	Female
DI+IAP	15	0
DI+ respiratory distress	3	0
DI+ Sepsis	2	0
Total	20	0

DI+ PDA was noted in 20 (1%) male patients, out of them 15 male patients had DI with raised IAP followed by DI with respiratory distress 3 and DI with sepsis 2 male patients.

In our study 10% was very difficult airway due to anatomical and physiological reasons, 25% was difficult due to anatomical factors of patients and 65% are moderate difficult due to physiologically factors of the patients in ICU.

Tracheostomy in ICU

Discussion

Airway assessment before intubation is recommended in multiple difficult airway management guidelines11 and may allow those intubating to prepare sufficient devices, staff, and contingent strategies prior to induction. Nevertheless, inconsistent evaluation methods are often utilized with relatively low accuracy. [12]

There are many complications associated with difficult intubation due to severe hypoxia and cardiovascular collapse in ICU like cardiac arrest, cerebral hypoxia and death. To prevent and limit the incidence of difficult intubation, specific risk factors for difficult intubation in the ICU have been identified and pre-oxygenation techniques and intubation algorithms have been developed. According to De Jong et al.2013b [13] average incidence of difficult intubation is 10% and it's range from 1% to 23% depending on the centre and the definition used (Martin et al. 2011; Heuer et al. 2012; Simpson et al.; 2012; Le Tacon et al. 2000). [14-17]

In our study the incidence of ADA was 25% and PDA in 65% patients and anatomical with physiological difficult Airway in total 8.76% patients. This is favoured by a study conducted by (Heuer JF et al.2012) showed that 30% intubations in ICU was easy, 47% of intubation was moderate easy, 23% was difficult intubation in ICU. [18] ADA was found in 26.92% (N=504) of patients in our study. DBMV was found in total 8. 92% (n=167) of the patients. Yildiz TS et al. [19] study results are in favour of our study results. Old age, male gender, increase Mallampati class 3- 4, history of snoring, lack of teeth, and beards, body mass index 30 or more, neck mass or radiation, limited thyromental distance, sleep apnoea were found to be significantly associated risk factors for DMV. [20,21]

We all know that difficult intubation is significantly higher in the ICU setting compare to operating room because airway assessment is not possible in ICU patients as patients admitted on emergency basis. Schwartz et al. found that intubation to be difficult in nearly 8% of the critically ill patients and requiring more than two attempts at laryngoscopy by a physician skilled in airway management. Oesophageal intubation occurred in 8% of the patients, pulmonary aspiration was present on chest radiography after 4% of intubations. Mortality associated with emergent tracheal intubation is highest in patients who are hemodynamically unstable and receiving vasopressor therapy before intubation. [22] Le Tacon et al. found DI in 22.5% of patients in ICU and concluded that a special airway management protocol must be developed in critical care unit in order to reduce the rate of DI. [23]

Physiologically difficult airway is very common condition faced by intensivist, because the process of induction and intubation can be potentially life threatening due to reduced physiological reserves pertaining to disease process [21]. So intubation must be in single attempt and less time consuming in critically ill patients as baseline physiological derangements worsen with increased number of attempts to intubate. [24] The incidence of PDA is around 65% patients in our ICU and it is considered as moderately difficult intubation because ICU patients are under physiological stress due to their underlying disease. Many of them are in compensatory state of their physiological derangement of existing disease. Traumatic brain injury and stroke patients requiring intubation and mechanical ventilation form a specific subgroup where raised intracranial pressure is the key physiological derangement. These patients also show wide fluctuation of blood pressure during rapid sequence induction and intubation. [25]

Intubation in patients with right ventricular failure is extremely risky because unlike left ventricular function, right ventricular function deteriorates with increased intra-thoracic pressure caused by positive pressure ventilation. Right ventricular preload and afterload optimization is needed before intubation in order to prevent cardiovascular collapse. Methods of right ventricular afterload optimization include inhaled pulmonary vasodilators like nitric oxide or epoprostenol, correction of hypoxic pulmonary vasoconstriction by oxygen supplementation and decreasing atelectasis via non-invasive ventilator support. [26,27] Renal failure patients may require intubation due to increased work of breathing caused by severe metabolic acidosis. These patients maintain their pH within normal range by increasing minute ventilation and washing out carbon dioxide. Induction of anaesthesia causes fall in minute ventilation and loss of compensatory response. Using neuromuscular blocking drug can further bring down the pH and cause precipitous fall in blood pressure and dangerous rise in potassium concentration. These patients should be intubated keeping rapid changes in metabolic milieu in mind. Succinylcholine should be avoided in renal failure as it causes hyperkalaemia. [28,29]

Conclusion

We concluded that incidence of difficult airway is more in critically ill patients compared to elective patients posted in OT due to previously no assessment of anatomical as well as physiological factors of the underlying disease. Thus, each and every patient admitted in ICU must be treated as a case of difficult airway, keeping all the equipment and drugs ready for difficult airway management.

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