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ORIGINAL RESEARCH

Predictors of Difficult Airway Intubation in Patients Undergoing General Anaesthesia at a Tertiary Care Hospital in Raichur- An Observational Study

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ABSTRACT

Background: Difficult airway is a condition in which a trained anaesthesiologist has trouble with complications. Risk factors associated with difficult airway are failure or delay identifying at risk patients and poor planning. Objectives: To study predictors of difficult airway intubation in patients undergoing general anaesthesia.

Materials & Methods:Single centre, prospective observational study in which patients scheduled for surgery were included. In addition to patient's demographic information, indication for surgery, modified Mallampati grading, inter incisor distance, neck circumference was noted. Patients were monitored intraoperatively.

Results: Mean Age was 35.9 ± 14.2 years, majority were of ASA status I (65.5%). Mean sternomental distance was 15.1 ± 2.1 cm, mean thyromental distance was 6.1 ± 1.1 cm & ratio of height to thyromental distance (RHTMD) was 23.1 ± 5.1. Mallampati class 3/4 in supine position were 28.25%, class 3/4 sitting were 19.25%, other significant features were short muscular neck (10.5%), neck movement <80˚ (4%), inter incisor distance ≤3.5 cm (4%) & limited mandibular protrusion (2.25 %). Difficult intubation was noted in 8%. Significant factors associated with difficult intubation were Mallampati class 3/4 (sitting), increased sternomental distance, increased thyromental distance, increased ratio of height to thyromental distance (RHTMD), short neck, snoring history, neck movement <80˚, short inter‐ incisor distance, cervical spondylosis & limited mandibular protrusion.

Conclusion: Significant factors associated with difficult intubation were Mallampati class 3/4 (sitting), more sternomental distance, more thyromental distance, increased ratio of height to thyromental distance (RHTMD), short neck, snoring history, neck movement <80˚, inter‐ incisor distance ≤3.5 cm, cervical spondylosis & limited mandibular protrusion. Predicting difficult intubation during the preoperative assessment is a key challenge, as no single clinical predictor is sufficiently valid for predicting the outcomes.

Key words: Difficult Airway, Malampati Grading, Sternomental Distance, Thyromental Distance, Mandibular Protrusion.

INTRODUCTION

Unanticipated difficult intubations continue to be a major concern for anesthesiologists due to the highly serious consequences of failed endotracheal intubations.[1] Difficult airway is a clinical condition in which a trained anesthesiologist experiences difficulty with face mask

ventilation and/or laryngoscopy and/or intubation. Difficulties in intubation have been related with serious complications, particularly when unsuccessful intubation has occurred. Poor recognition of at-risk patients has been classified as one of the causes of difficult airway management.[2]

The incidence of difficult intubation in surgical patients undergoing general anesthesia is estimated to be approximately 1–18%, whereas that of failure to intubate is 0.05–0.35%.[3,4] Risk factors connected to difficult airway setting include poor identification of at-risk patients, poor or inadequate planning, inadequate delivery of skilled staff and equipment, delayed detection of events, and failed rescue due to failure in interpretation of the capnography.[5,6]

Anaesthesia in a patient with a difficult airway can result in both direct airway trauma and morbidity from hypoxia and hypercarbia. Much of the morbidity precisely attributable to managing a difficult airway comes from an interruption of gas exchange (hypoxia and hypercapnia), which may then cause brain injury and cardiovascular activation or depression.[7] Difficult airway in a patient is most likely to be evident in an operating room, nonetheless, succeeding events might happen in various places and involve physician or nonphysician providers. In present study we aimed to study predictors of difficult airway intubation in patients undergoing general anaesthesia.

MATERIALS & METHODS

It was a single-centre, prospective, observational study in which patients from age group 18-60 years, with American Society of Anaesthesiologists (ASA) status I and II, scheduled for surgery under general anaesthesia and requiring endotracheal intubation were included. The study was conducted for a period of two months. The sample size was calculated using the formula n= 4pq/d2, where p=10, q=100-p= 90, allowable error d=3 and the calculated sample size estimated was 4009. Study was explained to patients/ relatives & a written informed consent was obtained. Patient's demographic details (age, gender, anthropometric measurements), indication of surgery, medical history (comorbidities, present medications, any history of snoring and difficult intubation in the previous surgery), laboratory & radiological investigations were noted in case record proforma. In preanaesthetic evaluation, Modified Mallampati grading, inter‑ incisor distance, neck circumference (NC) at the level of cricoid cartilage, and TMD (Thyromental distance) measured by straight distance from thyroid notch to inner mentum with neck in extended position were noted. In the operating room, standard monitoring was established (electrocardiogram, non-invasive blood pressure, pulse oximetry, and capnography) and patients was positioned in sniffing position. After preoxygenation with 100% O2 for 3 min, patient was induced, and intubation was attempted. Intubation difficulty was assessed by intubation difficulty scale (IDS) developed by Adnet et al.8 Patients from age group 18-60 years, with American Society of Anaesthesiologists (ASA) status I and II, scheduled for surgery under general anaesthesia and requiring endotracheal intubation were included in the study. Patients with upper airway pathology, neck mass, and cervical spine injury and pregnant females were excluded. Data was collected and compiled using Microsoft Excel and was analysed using SPSS 23.0 version. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.05 was considered as statistically significant.

RESULTS

During study period 400 patients were considered for present study. Mean Age of cases was 35.9 ± 14.2 years, with male predominance (68.5 %), majority were of ASA status I (65.5%), Mean Weight was 59.1 ± 11.8 kgs, mean Height was 158.9 ± 9.2 cms & mean Body mass

index (kg/m2) was 23.1 ± 5.6 kg/m2. Other characteristics like mean sternomental distance was 15.1 ± 2.1 cm, mean thyromental distance was 6.1 ± 1.1 cm & ratio of height to thyromental distance (RHTMD) was 23.1 ± 5.1. Based on Mallampati class, class 3/4 in supine position were 28.25% while Mallampati class 3/4 sitting were 19.25%, other significant features were short muscular neck (10.5%), neck movement <80˚ (4%), inter incisor distance ≤3.5 cm (4%) & limited mandibular protrusion (2.25 %).

Table I Overall patient data

Patient characteristics	No. of cases (n=400)	Percentages
Mean Age (yr.)	35.9 ± 14.2	
Gender		
Male	274	68.50
Female	126	31.50
ASA status		
I	262	65.50
II	138	34.50
Mean Weight (kg)	59.1 ± 11.8	
Mean Height (cm)	158.9 ± 9.2	
Mean Body mass index (kg/m2)	23.1 ± 5.6	
Other characteristics		
Sternomental distance (cm)	15.1 ± 2.1	
Thyromental distance (cm)	6.1 ± 1.1	
Ratio of height to thyromental distance (RHTMD)	23.1 ± 5.1	
Mallampati class		
Mallampati class 3/4 (supine)	113	28.25
Mallampati class 3/4 (sitting)	77	19.25
Short muscular neck	42	10.50
Neck movement <80˚	16	04.00
Inter-incisor distance ≤3.5 cm	11	04.00
Limited mandibular protrusion	9	02.25

Difficult intubation (IDS scale > 5) was noted in 32 patients (8%). Significant factors associated with difficult intubation (IDS scale > 5) were Mallampati class 3/4 (sitting), more sternomental distance, more thyromental distance, increased ratio of height to thyromental distance (RHTMD), short neck, snoring history, neck movement <80˚, inter- incisor distance ≤3.5 cm, cervical spondylosis & limited mandibular protrusion.

Table II Study characteristics

Laryngoscopy	Easy (n=368) No. of cases/ mean ± SD	%	Difficult (n=32) No. of cases/ mean ± SD	%	P value
Mallampati class (sitting)					
0	10	02.72	0	0	0.645
1	180	48.91	2	9.52	
2	123	33.42	4	19.05	
3	46	12.50	6	28.57	
4	9	02.45	9	42.86	

Other characteristics					
Sternomental distance (cm)	15.1 ± 1.8		13.1 ± 1.9		0.028
Thyromental distance (cm)	6.7 ± 1.0		5.8 ± 1.1		0.001
Ratio of height to thyromental distance (RHTMD)	23.9 ± 4.1		26.1 ± 5.6		0.001
Short neck	15	5.88	14	66.67	0.001
Snoring history	28	10.98	11	52.38	0.001
Neck movement <80˚	5	1.96	6	28.57	0.001
Inter- incisor Distance ≤3.5 cm	7	2.75	4	19.05	0.001
Cervical spondylosis	1	0.39	3	14.29	0.001
Limited mandibular protrusion	5	1.96	1	4.76	0.031
Beard	13	5.1	2	9.52	0.092
Facial malformation/deformity	3	1.18	1	4.76	0.62
Receding mandible	1	0.39	1	4.76	0.0

DISCUSSION

Although the incidence of difficult or failed tracheal intubation is comparatively less, unforeseen difficulties and poorly managed situations may lead to a life threatening condition or even death.[10] Predictors of difficult direct laryngoscopy are limited mouth opening, limited mandibular protrusion, narrow dental arch, decreased thyromental distance, modified Mallampati class 3 or 4, decreased submandibular compliance, decreased sternomental distance, limited head and upper neck extension, increased neck circumference as well as pregnant patients, those suffering from facial/maxillary trauma, those with small mandibles or intra-oral pathology such as infections or tumours are all more likely to present difficulties during intubation.[11]

Many studies have been done to conclude that the use of Modified Mallampati test or Thyromental distance as a single examination is of limited value whereas some found combination of these tests to be more useful in predicting difficult airway and intubation.[12,13]

Among the 200 patients, Dhanger S et al.,[14] noted that 26 patients had difficult intubation with an incidence of 13%. Among different variables, the Mallampati score and neck circumference/thyromental distance (NC/TMD) were independently associated with difficult intubation. Receiver operating characteristic curve showed a cut- off point of 3 or 4 for Mallampati score and 5.62 for NC/TMD to predict difficult intubation.

Prakash S et al.,[15] studied 330 adult patients receiving general anaesthesia with tracheal intubation, were studied, incidence of difficult laryngoscopy and intubation was 9.7% and 4.5%, respectively. On univariate analysis showed that increasing age and weight, male gender, modified Mallampati class (MMC) 3 and 4 in sitting and supine positions, inter- incisor distance (IID) ≤3.5 cm, thyromental (TMD) and sternomental distance, ratio of height and TMD, short neck, limited mandibular protrusion, decreased range of neck movement, history of snoring, receding mandible and cervical spondylosis were associated with difficult laryngoscopy. Multivariate analysis identified four variables that were independently associated with difficult laryngoscopy: MMC class 3 and 4, range of neck movement <80˚, IID ≤ 3.5 cm and snoring. Similar findings were noted in present study.

In study by Hemanth N et al.,[16] difficult tracheal intubation was observed in 26.7% of all patients studied. Sensitivity, specificity, PPV, NPV and accuracy for upper- lip bite test (ULBT) was 6.3%, 97.7%, 50%, 74.1% and 73.3%, respectively, whereas those for Mallampati test (MMT) were 25%, 86.4%, 40%, 76% and 70%, respectively. Mallampati test (MMT) showed 50% sensitivity and 84.5% specificity in assessing difficulty in intubation when compared with ULBT, whereas all the other methods have shown 0% sensitivity. MMT is a better predictor of difficulty in intubation when compared with ULBT due to its high sensitivity, better specificity, PPV and accuracy.

AK Gupta et al.[17] conducted a study on Kashmir population regarding predictors of difficult intubation and reported the sensitivity, specificity, PPV and NPV of Mallampati class as 77.3%, 98.2%, 48.7% and 99.5%, respectively.

Wajekar AS et al.,[18] compared upper lip bite test (ULBT), modified Mallampati test (MMC) and thyromental distance (TMD) individually and in various combinations to verify which of these predictor tests are significantly associated with difficult glottic exposure. Among 402 ASA I and II adult patients, incidence of difficult laryngoscopy was 11.4% and failure to intubate 0.49%. None of the three are a suitable predictive test when used alone. Combination of tests added incremental diagnostic value.

In many clinical situations the application of external laryngeal pressure facilitates a laryngoscopic view and intubation can be performed without difficulty. In addition, direct laryngoscopy is not the only way to secure and maintain an airway, although it is the most common means of facilitating intubation.[19]

Parameters, such as interincisor distance (IID), mandibular protrusion (MP), thyromental distance (TMD), sternomental distance (SMD), oropharyngeal space (modified Mallampati class), and grade of laryngoscopic view, are the most commonly used preoperative tests that can assist to predict difficult intubation. For each of these parameters, there are several airway measures available, and their reliability and predictive ability varies widely.

If the cases of difficult airway could be predicted confidently in the preoperative period, the anesthesiologist could plan the safest and the most effective way of managing tracheal intubation by arranging special equipment like stylet, gum elastic bougie or plan for procedures like fiberoptic intubation, tracheostomy etc.

CONCLUSION

Predicting difficult intubation during the preoperative assessment is a key challenge, as no single clinical predictor is sufficiently valid for predicting the outcomes. Significant factors associated with difficult intubation (IDS scale > 5) were Mallampati class 3/4 (sitting), more sternomental distance, more thyromental distance, increased ratio of height to thyromental distance (RHTMD), short neck, snoring history, neck movement <80˚, inter- incisor distance ≤3.5 cm, cervical spondylosis & limited mandibular protrusion.

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