

Retrospective Analysis of Incidence of Difficult Endotracheal Intubation and Associated Complications in
St. Paul's General Specialized Hospital from January 2009 To January 2012 G.C.

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Abstract

Background: management of difficult airway remains one of the most relevant and challenging tasks for anesthesiologists and pulmonary physicians. Every person who will be required to perform intubation has to be familiar with the evaluation of difficult airway and in the event of the unanticipated difficult airway, to be able to use a wide variety of tools and techniques to avoid complications and fatality.

Objective: The objective of the study was to determine incidence of difficult endotracheal intubation in patients who underwent elective general anesthesia procedure with endotracheal intubation and associated complications with difficult intubation

Methods: Retrospective review of all elective cases who underwent general anesthesia with endotracheal intubation was reviewed based on anesthesia medical records from January 2009 to January 2012 G.C.

Results: The result of my study shows that 1954(55.5%) Mallampati class I, 1058(30.0%) Mallampati class II, 316(9%) Mallampati class III and 192(5.5%) Mallampati class IV. A total of 1385(39.5%) males and 2135(60.5%) females were reviewed. Greater numbers of patients were between the age ranges of 18 to 64 years (1561) with female predominance

Conclusion: There was no perfect predictor of difficult intubation. Incidence of difficult tracheal intubation is higher in obstetric population due to hormonally induced soft tissue changes rather than other anatomical factors.

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Table of contents

Contents	Pages
Abstract.....	I
Acknowledgement.....	II
Table of contents.....	III
List of tables.....	V
Acronyms.....	VI
Definition of Terms.....	VII
CHAPTER ONE.....	1
1. Introduction	
1.1. Background information.....	1

1.2 .statement of the problem.....	2
CHAPTER TWO	
2. Significance of the study.....	3
CHAPTER THREE 3. Literature review.....	4
CHAPTER FOUR: Objectives.....	7
4.1. General objective.. ..	7
4.2 Specific objectives.....	7
CHAPTER FIVE: Methodology.....	8
5.1. Study area	8
5.2. Study period	8
5.3. Study design	8
5.4. Population.....	8
5.4.1. source population	8
5.4.1. Study population	8
5.5. Study variables.....	9
5.5.1. Independent variables	9
5.5.2. Dependent variables	9
5.6. Data collection technique	9
5.7.Data analysis and interpretation	10
5.8 .Ethical consideration.....	10
5.9 Operational definition.....	10
5.10 Plan for dissemination of the result.....	10
5.11. Limitation.....	10
CHAAPTER SIX: RESULT.....	11
CHAPTER SEVEN: DISCUSSION.....	15
CHAPTER EIGHT: Conclusion and recommendation.....	17
References	18
ANNEX:.....	20
Questionnaires.....	20

Table 1: Demographic distribution of patients.....11
Table 2: Distribution of difficult laryngoscopy for different procedure.....12
Table 3: Distribution of oropharyngeal view of patients.....13
Table 4: Distribution of number of laryngoscope attempts.....13
Table 5: Distribution of incidence of associated complications with difficult endotracheal
intubation.....14

Acronyms

ASA - American Society of Anesthesiologists

UK –United Kingdom

SPo2—Oxygen saturation

TMJ_Tempero mandibular joint

AOJ_Atlanto occipital joint

Definition of terms

True positive: a difficult intubation that had been predicted to be difficult

False positive : an easy intubation that had been predicted to be difficult

True negative: an easy intubation that had been predicted to be easy

False negative: a difficult intubation that had been predicted to be easy

Sensitivity: the percentage of correctly predicted difficult intubation as a proportion of all intubation that were truly difficult, i.e

$$\text{True positive}/(\text{True positive}+\text{false negative})$$

Specificity: the percentage of correctly predicted easy intubations as a proportion of all intubations that were truly easy, i.e

$$\text{True negatives}/(\text{True negative} + \text{false positive})$$

Positive predictive value: the percentage of correctly predicted difficult intubation as a proportion of all predicted difficult intubation, i.e.

$$\text{True positive}/(\text{true positive}+ \text{false positive})$$

Negative predictive value: the percentage of correctly predicted easy intubations as a proportion of all predicted easy intubation,i.e

$$\text{True negative}/(\text{true negative}+ \text{false negatives})$$

CHAPTER ONE: Introduction

1.1. Background Information

Difficult intubation can be defined as when proper insertion of the tracheal tube with conventional laryngoscope requires more than three attempts or more than ten minutes (1).

Certain criteria must be fulfilled for successful intubation under laryngoscope. This includes adequate flexion of the lower cervical vertebrae and extension of the neck at the atlanto occipital joint. It is also

essential that the patient is open the mouth and for the passage of the laryngoscope as well as an adequate pharyngeal cavity to facilitate laryngoscopic view (2).

It must be appreciated that for a safe intubation, the endotracheal tube must be seen to pass between the cords therefore, in essence, grade 3 and 4 laryngoscopes are blind procedures with a theoretical risk of 50% esophageal intubation(3).

1.2 .Statement of the problem

The failure to maintain a patient airway following the induction of general anesthesia is a major concern for anesthesiologists. For securing the airway, tracheal intubation using direct laryngoscope remains the method of choice in most cases. However, direct laryngoscope intubation is difficult in 1.2% of patients who have seemingly normal airways (4).

The unanticipated difficult laryngoscopic intubation places patients at increased risk of complications ranging from sore throat to severe airway trauma. Moreover, in some cases the Anesthesiologist may not be able to maintain a patient's airway, leading to serious complications such as brain damage or death (5).

The difficulty of achieving a patient airway varies with the anatomical and other factors in a patient. The identification of the patient with difficult airway is vital in the preoperative evaluation and planning anesthetic management, so that endotracheal intubation and positive pressure can be achieved safely by alternative methods of tracheal intubation;e.g, fiberoptic bronchoscope(5).

Several clinical criteria can be routinely assessed on patients prior to anesthesia including (Mallampati classification), head and neck movement, ability to prognath, thyromental distance and the body

weight. Accurate preoperative prediction of potential difficulty with intubation can help reduce the incidence of catastrophic complication by altering anesthesia personnel to additional precautions before beginning anesthesia and establishing an artificial airway. In addition, more accurate prediction of difficulty with intubation might reduce the frequency of unnecessary maneuvers (e.g., awake intubation) related to false positive predictor is important in detection of patients at risk of difficult airway management by noting anatomical landmarks and clinical factors associated with difficult airway. However, it is still questioned whether true prediction is possible and which variables should be chosen for evaluation (6).

Although several studies have predicted a difficult airway with the use single risk factor or risk factors used in combination i.e. multivariate analysis. The ease of laryngoscope intubation depends on several airway elements, no single measure of airway can be expected to predict difficult intubation accurately

CHAPTER TWO

2. Significance of the study

Research and reviews about this study are almost all rare in our country when we ask search on internet .So this research is expected to add some contribution for management of difficult endotracheal intubation. The result of this research is also expected to increase the awareness of anesthetists for the early detection of problem and preparation for management as early as possible. Moreover, the result of the study also motivates others for further detail researches.

CHAPTER THREE

Literature Review

There are different researches which are done on different parts of the world by using different various airway parameters to determine the incidence of difficult tracheal intubation.

According to researches which were conducted in Kashmiri on 600 patients which compare the efficacy of airway parameters to predict difficult intubation. Parameters studied were degree of head extension, thyromental distance, inter incisor gap, grading of prognathism, obesity and modified Mallampati classification. Incidence of difficult endotracheal intubation was 3.3%. 28.8% of patients were obese (BMI > 25) and 5.4% of patients were those who have thyromental distance < 6cm. And reported head and neck movement < 90 degree which had highest sensitivity (86.36%), high arched palate, thyromental distance and modified Mallampati classification as best predictors of difficult intubation (7).

Other studies which were conducted in India on 498 patients scheduled for various elective procedures under general anesthesia modified Mallampati class, degree of head extension, mento hyoid distance, thyromental distance, inter incisor gap, forward movement of the mandible were used as a predictive parameters. 430 (86.4%) patients were Mallampati class 1 and 2, while 68 (13.6%) Mallampati class 2 and 3.

477 patients were inter incisor gap < 3cm and the incidence of thyromental distance < 6cm were 46 (9.2%). Direct laryngoscopy was difficult in 40 (8%) patients. Degree of head extension, mento hyoid distance of 4cm and modified Mallampati class 3 and 4 were found to have significant association with difficult glottis exposure (8).

Studies in Karachi, Pakistan, on a total of 150 patients requiring tracheal intubation for elective surgery, an airway assessment test was conducted on each patient with respect to mouth opening, thyromental distance and oropharyngeal (Mallampati) classification, neck movement, length of mandibular ramus, ability to prognath and body mass index. Incidence of difficult intubation was 4 (2.6%) cases out of 150 patients. Airway test that were significant for predicting difficult tracheal intubation was inter incisor distance > 3cm, Mallampati class 3, neck circumference > 40cm and subluxation grade 2 with sensitivity of 100%, 3.3%, 20% and 17.64% respectively (9).

According to a research which was conducted in UK teaching hospital, between June 2002 and September 2003 on 156 patients requiring endotracheal intubation in the resuscitation room, there were 114 Cormack and Lehane grade 1 intubations, 29 grade 2 intubations, 11 grade 3 intubations and 2 grade 4 intubations. Patients with large incisors, a reduced inter incisor distance, a reduced thyroid to floor of mouth distance were all more likely to have a poor laryngoscopic view (grade 2, 3 or 4). Patients

with a high airway assessment score were more likely to have poor laryngoscopic view compared with those patients with low airway assessment score(10).

Study conducted in University Hospital Erlangen, Germany, from November 2005-November 2010 shows that in patients with impaired view of the entire soft palate(Mallampati class 3 or 4),the incidence of difficult laryngoscopy was significantly higher compared to patients with a Mallampati status 1 or 2(6.4%Vs 0.4%, $p<0.001$). There was no significant influence of gender , neither for the entire population nor for the patients assigned to the age groups.Patients graded ASA 3 or 4 had significantly higher incidence of difficult laryngoscopy compared to patients graded ASA 1 or 2(3.8%vs0.8% , $p<0.001$). Regarding the clinical impact of the study, it was stated that difficult laryngoscopy is a predictor of difficult intubation, and difficult tracheal intubation implies a strong risk factor for hypoxia (11).

In RamathibodiHospital, Bangkok Thailand,1888 consecutive patients requiring endotracheal intubation were evaluated preoperatively using the modified Mallampati classification and thyromental distance. The study found Mallampati class 1=1050 patients(55.6%),grade 2 =730 patients(38.7%),grade 3=104 patients(5.5%),grade 4=4 patients(0.2%) and thyromental distance<6cm =85 patients (4.5%) ,thyromental distance >6cm =1803 patients (95.5%). Difficult laryngoscopy occurred in 60 patients (3.2%) (12).

In Singapore General Hospital, Singapore,250 patients were underwent general anesthesia after preoperative assessment using Mallampati classification and by measuring their thyromental distance.

The ease or difficulty of direct laryngoscopy was assessed at the time of induction of anesthesia.Retrognathia was seen in 15.6%of patients and the incidence of difficult endotracheal intubation without external laryngeal pressure was 8.2%.It was found that both assessments predicted less than two in three difficult laryngoscopies and had false positive rates. External laryngeal pressure often improve the view of the glottis in difficult laryngoscopies(13) .

The study done by the National Project Audit of Anesthetists and Difficult Airway Management Society examining major complications of difficult airway examined over 10,000 emergency tracheal intubations in one institution over a period of 10 years found multiple attempts at laryngoscopy to a highly associated with marked increase in rates of complication . Compared to intubation which was achieved on first or second laryngoscopy those requiring > two laryngoscopies led to a seven –fold increase in hypoxia(14 –fold severe hypoxia),six-fold increase in esophageal intubation, seven fold increase in regurgitation, fourfold increase in aspiration and seven fold in cardiac arrest(14).

The absolute rates of complications associated with difficult tracheal intubations are notably high: after >two attempts at intubation the rates of complication were 70% hypoxia (28% severe hypoxia), 52% esophageal intubation, 22% regurgitation, 13% aspiration and 11% cardiac arrest (15)

CHAPTER FOUR

Objectives

4.1 General objectives

To assess the incidence of difficult endotracheal intubation, associated complications and socio-demographic characteristics in St. Paul's Specialized Hospital from January 2009 to January 2012 G.C

4.2 specific objectives

1. To determine the incidence of difficult endotracheal intubation
2. To determine the associated complications following difficult tracheal intubation
3. To determine separately the incidence of difficult endotracheal intubation among patients admitted for elective General surgery, Gynecologic and obstetric surgery, orthopedic surgery and maxillofacial surgery
4. To assess patients' socio-demographic characteristics

CHAPTER FIVE

5.Methods and Materials

5.1 Study Area

The study was conducted on St. Paul's General Specialized Hospital. St. Paul's General Specialized Hospital is the second largest Hospital in Ethiopia and located in Gulele Subcity in Addis Ababa. The Hospital was built by Emperor Haile Selassie I in 1969 with the help of the German Evangelical Church with the aim of helping the poor. It has 350 beds and sees an annual average of 200,000 patients and has a catchment population of more than 5 million.

5.2 Study period

Study was conducted from May 4- 15, 2013 G.C

5.3 Study design

Retrospective descriptive study of incidence of difficult endotracheal intubation and associated complications of the past three years in St.Paul's General Specialized Hospital from January 2009 to January 2012 G.C

5.4 Population

5.4.1 Source population

All patients those admitted for surgical procedure from departments of general surgery, gynecologic and obstetrics, orthopedic and maxillofacial side from January 2009 January 2012 G.C

5.4.2 Study population

All patients those underwent general anesthesia with endotracheal intubation from January 2009 to January 2012 G.C.

5.5 Study variables

5.5.1 Independent variables

Age

Thyromental distance

Sex

Sterno mental distance

Body mass index

Inter incisor gap

5.5.2 Dependent variables

Laryngoscopic grade

Difficult intubation

Clinical diagnosis

5.6 Data collection techniques

After questionnaires prepared and ethical clearance about data collection obtained, surgical and anesthetic records were reviewed from St.Paul's specialized hospital. Data was collected by the principal investigator with three other fourth year anesthesia students.

5.7 Data processing and analysis

The data was analyzed manually using scientific calculator, summarizing tables, and used for presentation of the result, and detail interpretation of the result would be presented

5.8 Ethical considerations

Official letter (clearance) from Jimma University was sent to the St.Paul's Specialized Hospital.

5.9 Plan for dissemination of the result

After completing, the research it will be disseminated to SRP Office, college of public health and medical science and also to department of anesthesia

5.10 Operational definitions

Difficult intubation : when proper insertion of the tracheal tube with conventional laryngoscope requires more than three attempts or more than ten minutes .

Thyromental distance: The distance from the tip of the thyroid cartilage to the tip of the mandible, with neck fully extended.

Sternomental distance: The distance from the upper boarder of the manubrium to the tip of the mandible.

Inter incisor gap: The distance between the upper and lower incisors with the mouth opened maximally.

Failed Intubation: Inability to intubate the trachea with three or more laryngoscopic attempts or more than ten minutes repeated trial by well experienced anesthetist or anesthesiologist.

5.11 Limitation

Incomplete records of anesthetic charts

Lack of access to computer and internet

CHAPTER SIX

RESULTS

Table 1: Age and sex distribution of patients

Age	M		F	
	No.	%	No.	%
< 1month	45	1.3	33	0.9
1month -1yr	78	2.2	72	2.0
2yr -5yr	100	2.8	84	2.40
6yr-14yr	141	4.0	204	5.80
15yr -17yr	270	7.70	232	6.60
18yr-65yr	391	11.0	1170	33.20
>65yr	360	10.20	340	9.60
Total	1385	39.20	2135	60.80

There were 3523 patients identified for the study out of which 3 patients were referred to Black Lion Hospital due to unavailability of advanced equipment to secure anticipated difficult airway. 3520 patients those underwent general anesthesia with endotracheal intubation retained in complete analysis. Patient's age and sex distribution is shown in table 1. There were 1385(39.2%) males and 2135(60.8) female patients

Table 2: Distribution of difficult laryngoscopy among procedures from different department

S.no	Types of operation	Categories		Frequency of difficult intubation					
				M	F	M	F		
		No	%	No	%	No	%	No	%
1.	General surgery	610	17.5	559	16.3	3	.49	2	.33
2.	Gynecologic surgery	–	–	587	16.7	–	–	1	.17
3.	Obstetric surgery	–	–	250	7	–	–	7	2.8
4.	Orthopedic surgery	387	11	370	10	1	.26	–	–
5.	Maxillofacial surgery	387	11	370	10	3	.77	1	.27
	Total	1385	39.5	2135	60.5	7	1.52	11	3.57

The cases reviewed by categorizing into types of operations done among departments of general surgery, gynecologic and obstetric surgery, maxillofacial surgery and orthopedic surgery to extract incidence of difficult endotracheal intubation in each type of operation (see table 2). The incidence of difficult endotracheal intubation is highest in Obstetric populations (2.8%) followed by maxillofacial cases(0.77%) relative to other procedures. The overall incidence of difficult endotracheal intubation in the last three years review is 0.5%

Table3: Distribution of oropharyngeal view of patients

Mallampati classes	Frequency	
	No	%
Class I	1954	55.5
Class II	1058	30.0
Class III	316	9.0

Class IV	192	5.5
Total	3520	100.0

From the total 3520 anesthetic notes of patients those underwent general anesthesia with endotracheal intubation, 1954(55.5%) patients were Mallampati class I,1058(30.0%) Mallampati class II, 316(9%) Mallampati class III and 192(5.5%) Mallampati class IV.

Table 4: Distribution of number of laryngoscope attempts at intubation

	Mallampati classes		Number of attempts					
			1st		2nd		>3rd	
	No	%	No	%	No	%	No	%
Class I (n=1954)	1897	54	56	1.6	1		.03	
Class II (n=1058)	973	27.6	82	2.3	3		.08	
Class III (n=316)	221	6.3	90	2.5	5		.1	
Class IV (n=192)	100	2.8	83	2.4	9		.25	
Total (n=3520)	3191	90.7	311	8.8	18		.46	

Ease of tracheal intubation analyzed in each Mallampati classes and number of patients intubated at each laryngoscopy attempts is described.

Difficult intubation was occurred in 18 cases of which 9 cases Mallampati class IV, 5 cases Mallampati class III,2 cases from Mallampati II and only 1 case from Mallampati class I. The difficulty of endotracheal intubation was overcome by optimal patient positioning with using different stylets and gum elastic bougies. There were no eventually failed endotracheal intubations among these encountered difficulties.

As age increases the difficulty of laryngoscopic visualization decreases in paediatric age groups, especially under five children and neonates but it is vice versa for the elders due to reduced mobility and calcification of important determinant joints ,i.e. TMJ and AOJ.

Table5: List of associated complications with difficult endotracheal intubation

S .N	Complications	No	%
1	Desaturation	9	50.0
2	Oesophageal intubation	5	27.8

3	Laryngospasm	3	16.7
4	Difficult ventilation	1	5.5
5	Vocal cord paralysis	-	-

Associated complications with difficult endotracheal intubation were identified. The most common associated complication was desaturation (Spo₂<90%) with 50% followed by oesophageal intubation (27.8%). Laryngospasm found in 3 patients (16.7%) and difficult ventilation occurred in 1 patient (5.5%). There was no vocal cord paralysis.

CHAPTER SEVEN

7.1. Discussion

This study has attempted to determine the incidence and associated complications of difficult endotracheal intubation over the past three years in St. Paul's General Specialized Hospital. Charts of 3520 patients those underwent general anesthesia with endotracheal intubation were reviewed. The results of this study are believed to give some baseline for future management of the problem. The incidence of difficult intubation is reported to be 1%-18% depending on the criteria used to define it; that of failure to intubate is 0.05%-0.35% , but in this study the incidence of difficult endotracheal intubation was 0.51% which is lower than the above result and it is due to variations of anesthetists experience and number of patients studied and failed intubation was 0.08% in this study that is lower than the previous study(16).

A test to predict difficult intubation should have high sensitivity, so that it will identify most patients in whom intubation will truly be difficult. It should also have a high predictive value, so that only a few patients with airways actually easy to intubate are subjected to the protocol for management of a difficult airway(17).

In St. Pauls Hospital the routine airway test performed and recorded on patients' anesthetic notes was Mallampati classes and ASA physical status. Because there was no earlier and recent research done in Ethiopia regarding this topic and importance of completely recorded chart is not practically well known.

The Mallampati tests have limited accuracy for predicting the difficult airway and thus are not accurate screening tests when used alone. The accuracy of Modified Mallampati Test for predicting difficult laryngoscopy was five times higher in obstetric patients than in non-obstetric patients. This is consistent with studies that showed pregnancy caused 34% increase Mallampati class IV and that the risk of difficult intubation in obstetric patients was approximately 8 times more than in another surgical patient. More difficult laryngoscopy in obstetric patients was found to be most likely due to facial and pharyngeal edema secondary to hormonally induced soft tissue changes and fluid retention(3). To decide the poor to good accuracy of the Mallampati tests, anesthesiologists should balance the cost of failing to predict a difficult airway when there is a false negative result versus the possibility of unnecessary treatment when there is a false positive result. Used alone, the Mallampati tests are insufficient to confidently predict the presence or absence of a difficult airway. (16).

The article published by American Society of Anesthesiologists in November 2005 suggested that the overall incidence of difficult endotracheal intubation was 5.8% for the overall normal patient population. The result of my study is lower than the earlier one because the number of patients operated per day and risk factors associated with the difficulty may affect it.

Repeated attempts at intubation found to cause trauma to airway mucosa and to teeth, swelling of the airways, bleeding down into the trachea and makes ventilation more difficult associated with desaturation from longer period of apnea resulted which has higher dominance in obstetric population that is similar to the result of this present research (14). The result of my study is also similar to this study that higher with 50% compared with other complications.

Esophageal intubation is more common complication if the personnel is inexperienced but may also occur in the experienced hands. Intubating the esophagus is not disastrous, but failure to detect and correct the condition is so(15). Esophageal intubation as a complication of difficult tracheal intubation is the second common complication in my study.

CHAPTER EIGHT:

Conclusion and Recommendation

8.1. Conclusion

Different variables were used to predict difficulty of airway; but there is no accurate (perfect) predictor of difficult endotracheal intubation

In this study Modified Mallampati Test has high predictive value to assess difficult endotracheal intubation.

Incidence of difficult tracheal intubation is higher in obstetric population that may be due to hormonally induced soft tissue changes rather than other anatomical factors

8.2 Recommendation

Based on the result obtained the following recommendations are forwarded

- ☐ Anesthesia professionals of St.Pauls Hospital should record full preoperative,intraoperative and postoperative patients' information on anesthetic charts
- ☐ St.Paul's Hospital administration should buy and satisfy different difficult intubation instruments like Fiberoptic bronchoscope and devices like McCoy Laryngoscope
- ☐ Greater attention should be given to obstetric cases by anesthesiologists preoperatively assessing adequate airway assessment and by preparing different alternative anesthetic equipment.

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ANNEX

Questionnaires

Jimma University College of Public health and Medical science

This format questionnaire aimed to assess incidence of difficult endotracheal intubation

Grade level: a/ Diploma b/ Degree (BSc) c/ Consultant d/ senior

Operation Type: -----

Age-----

Sex -----

Weight -----

I .Preoperative assessment

1. ASA physical status: a/I b/II c/III d/ IV

2. Mallampati class : a/ I b/II c/III d/IV

II. 1/ Tracheal intubation: a/ awake b/ IV c/ inhalational

2. laryngoscopic grade: a/ I b/ II c/ III d/ IV

3. Status of tracheal intubation: a/ easy b/ moderately difficult c/ difficult (impossible intubation)

4. Was other technique used at intubation? A/yes b/ no (If yes, specify-----)

5. At what intubation attempts patient intubated?a/ 1st attempt b/ 2nd attempt c/ >3rdattempt

6. Was there any complication due to difficult tracheal intubation?

a/ yes b/ no

7. If yes, which one of the following?

a/ desaturation (SPo2<90%)

b/ laryngospasm

c/ vocal cord paralysis

d/ difficult ventilation

e / oesophageal intubation