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Prevalence of difficult endotracheal intubation in unanticipated difficult airway in tertiary care centre of Arunachal Pradesh

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Abstract
Background: Airway management is the cornerstone of practice of Anaesthesiology. For successful airway management requires a range of knowledge with experience in management of airway. Thereby Anaesthesiologist must identify and perform difficult airway management with competent skill when necessary. 10% of apparently normal airway patients may be difficult to intubate[9]. The DAS mention that serious complication can occur in 1:22000 and death of 1:150000 GA cases.[7] Smita Prakash *Et al*[5] found an incidence of 9.7% and 4.5% for difficult laryngoscopy and difficult intubation, respectively, in Indian population with apparently normal airways. Keeping in mind the ethnicity and racial population of Arunachal Pradesh (AP), this study was designed to evaluate the prevalence of difficult airway in Tertiary care centre of Arunachal Pradesh; Tomo Riba Institute of Health and Medical Sciences (TRIHMS), Naharlagun, AP.
Aims and Objectives: To assess the prevalence of difficult airway in the tertiary care centre of Arunachal Pradesh during Endo-Tracheal Intubation (ETT).
Materials and Methods: The study was conducted in department of Anaesthesiology, Tomo Riba Institute of Health and Medical Sciences, Naharlagun, Arunachal Pradesh. After obtaining clearance from medical ethics committee, all the adult patients age 18 to 70 of ASA status I or II with normal airway indices, who underwent routine surgery under general anaesthesia were included in the study. Standard local protocol was followed for general anaesthesia. The patients' were intubated in supine and sniffing position to enable direct laryngoscopy, done with No 3 blade Macintosh laryngoscope al first attempts. The Modified Cormack-Lehane score were assessed with DL along with need of external laryngeal manipulation like BURP. The numbers of additional or multiple attempts for endotracheal intubation, time required to intubation, other modalities used to assist intubation, used of different blade size or ETT size and failed intubation is noted down. Failure to achieve successful tracheal intubation in a maximum of three attempts, fourth attempt should be done by more experience Anaesthesiologist. BJA (2015) 115 (6): 827–848).
Results and Observation: The prevalence of Difficult Direct Laryngoscopy (DDL) and Difficult Intubation (DI) was 4.75% (19) and 1.25% (5) respectively. The difficult mask ventilation was seen in 3% of the patient. Of all the parameters used to measure pre-anaesthetic predictor of difficult intubation, only mCLS was most accurate, followed by ULBT and then, SMD, TMD, BMI and MMT.
Conclusion: Prevalence of difficult intubation of population as per the Tertiary care centre of Arunachal Pradesh is 1.25% and prevalence of difficult direct laryngoscopy is 4.75%, difficult face mask ventilation of 0.75% and difficult airway in 5.5% in absolutely normal airway parameters.

Keywords: endotracheal, Airway, Anaesthesiology, Naharlagun

Introduction
Airway management is the cornerstone of practice of Anaesthesiology. And the successful airway management requires a range of knowledge with experience in management of airway. Therefore the Anaesthesiologist must identify and perform difficult airway management with competent skill when necessary and in emergent and difficult situation. Difficult Airway Society (DAS, 2015) [7] and All India Difficult Airway Association (AIDAA, 2016) [8] defines the Difficult Airway as, *"the clinical situation in which a conventionally trained Anesthesiologist experiences difficulty ventilation of upper airway via Mask, difficulty with tracheal intubation or in both".* Among many airway devices developed since the evolution of general anaesthesia one most commonly used airway device is intubation of trachea with ETT, which is reliable and definite airway device but it needs knowledge and practices. Not only it provides a conduit for ventilation but, the placement of a cuffed tube in the trachea offers the greatest protection against aspiration [7].

10% of apparently normal airway patients may be difficult to intubate [9]. The DAS mention that serious complication can occur in 1:22000 and death of 1:150000 GA cases [7]. Smita Prakash *et al.* [5] found an incidence of 9.7% and 4.5% for difficult laryngoscopy and difficult intubation, respectively, in Indian population with apparently normal airways. Keeping in mind the ethnicity and racial population of Arunachal Pradesh (AP), this study was designed to evaluate the prevalence of difficult airway in Tomo Riba Institute of Health and Medical Sciences (TRIHMS), the tertiary care centre of Arunachal, Naharlagun, A.P.
Aims and Objectives: - To assess the prevalence of difficult airway in the tertiary care centre of Arunachal Pradesh during Endo-Tracheal Intubation (ETT).

Methodology
This study was a prospective, observational study consisting of 400 patients admitted for surgery under General Anaesthesia (GA) with ETT intubation, conducted in

Department of Anaesthesiology, TRIHMS, Naharlagun, Arunachal Pradesh. The data were collected from PAC document and subsequent ETT intubation by trained Anaesthesiologist. After obtaining approval from the Institutional Ethics Committee (IEC) TRIHMS, and the patient consented to undergo surgery under GA, the patient was included in study with consent. The patients' included were adult up to 70 years with ASA I / II scheduled for elective surgery under GA, with endotracheal intubation in TRIHMS operation theatre (OT). All the patients were intubated using Macintosh Laryngoscope blade No 3. Patients' with following were excluded:

- Patients' with very short stature or neck rigidity
- Patients' with obvious airway or facial deformity
- Inadequate mouth opening (<2F), Mallampati ≥ III,
- History of burn or trauma of Head and Neck
- Mass or tumour on face and neck
- History of surgery or implant in neck and cervical area.
- Emergency surgery and patient needing rapid sequence induction like Pregnancy
- Edentulous patient
- Uncooperative to airway assessment

Materials

- Single group of patients with surgery done under general anaesthesia
- Patient's Pre-Anaesthetic Check-up document
- Anaesthetic record

Methods

A) Pre-anaesthetic Check-up (PAC)

As in all routine practice, Pre-anaesthetic evaluation was mandatory for all patients and was included in study only after clearance to general anaesthesia by concern Anaesthesiologist after complete medical, surgical or anaesthetic history. Physical assessment along with Routine investigations and vital parameter (baseline) were measured with mandatory informed consent to undergo surgery under GA. Particulars of Patient, Weight, Height, BMI (body metabolic index) Airway assessment, and ASA (American Society of Anaesthesiology) physical grade recorded. Patient had routine pre-anaesthetic advice as per the guideline and subjective requirement

Table 1

Table showing ASA Classification		
ASA class	Definition	Example
I	A normal healthy patient	Healthy, non-smoker
II	A patient with mild systemic disease	Controlled DM, obesity
III	A patient with severe systemic disease that is not incapacitating to life	Poorly controlled hypertension or DM
IV	A patient with severe systemic disease that is incapacitating to life	Recent H/O MI or CVA
V	A moribund patient who is not expected to live without the operation	Ruptured abdominal or thoracic aneurysm
VI	A patient who is already been declared brain-dead and whose organ are being removed for transplant	

B. Airway assessment

1. Dentition: - Normal, edentulous, partially edentulous (numbers of missing teeth), temporary or permanent dentures, dental splints or any kind of dental problem like carries, protrusion etc.
2. Mouth opening or inter-incisor Gap (IIG): - Measure in full mouth opening and distance between upper and lower central incisors are taken. Adequate when more than 3.5 cm or three finger wide. IIG of less of 2finger breadth or < 3 cm will be documented.
3. Modified Mallampati Test (MMT): - The Modified Mallampati test of I, II, III, IV and 0 (the visibility of epiglottis) grade is assessed using visibility of hard palate, soft palate, fauces, tonsillar pillars and epiglottis when patients is asked to open to mouth with protruded tongue. MMT is considered most commonly used airway index (Millar's Anesthesia, 8th Edition).
   - Grade 0 – Epiglottis visible
   - Grade I – Palate, Fauces, Uvula and Tonsillar Pillars are visible
   - Grade II - Palate, fauces and uvula are visible, tonsillar pillars are obscure by base of the tongue
   - Grade III – Only soft palate and base of Uvula are visible
   - Grade IV – Only hard palate is visible, soft palate not visible
4. Neck mobility: - Subject will be ask to fully extend the neck (<80^0 will consider restricted) and flexed, also to turn side to side to see the integrity of cervical spine and ranges of neck mobility. Any restriction will be noted.
5. Atlanto-occipital joint movement: - This is to assessed feasibility of sniffing or Magill position for intubation i.e. alignment of oral, pharyngeal and laryngeal axis into an arbitrary straight line. To assess oral-pharyngeal-tracheal axis, the patient is asked to hold head erect, facing directly to the front, then he is asked to extend the head maximally and the examiner estimates the angle traversed by the occlusal surface of upper teeth. Measurement can be by simple visual estimate or more accurately with a goniometer. Any reduction in extension is expressed in grades: Grade I : >35°, Grade II: 22°-34°, Grade III: 12°-21°, Grade IV: < 12°. Normal angle of extension is 35° or more. In supine position oral-pharyngeal-tracheal axis is achieve by elevating head by 7-9 cm and neck extension.

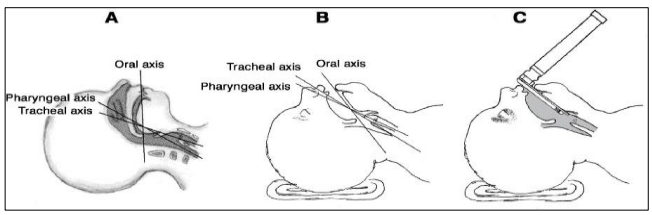

Fig 1

6. Sterno-mental Distance (SMD): - The Distance between top of sternum to the bony mentum in full neck extension in closed mouth. It is considered short neck if the distance is ≤ 12 cm, quantitatively, this measures the AOJ movement (> 12.5cm is good predictor).
7. Thyromental distance (TMD):- Measure from top of bony mentum at midline to the top of thyroid notch in full neck extension with mouth closed. Distance is

adequate if ≥6.5cm (rounded to nearest 0.5 as Class I ≥ 6.5cm, Class II 6-6.5cm and Class III < 6cm) or >3F breadth.

8. Upper lip bite test: - Ability of subject to bite the vermillion line of upper lip by the lower central incisors. It is considered to be best predictor to difficult endotracheal intubation according to study of Pratibha Jain Shah *Et al* (2013) and Michael E Detsy *Et al* (2019) found it easy and accurate in 60% subjects. Alternatively, edentulous patient can be assessed with lip catch test.

- Class I – lower central incisor can bite above the line of upper lip vermillion
- Class II – lower central incisors can bite lip below line of vermillion.
- Class III – lower incisor cannot bite the upper lip.

C. Anaesthetic Procedure

After the routine check list of anaesthetic machine, airway equipments, drugs to be used, and PAC, the patient was monitored with minimum monitoring standard for general anaesthesia. Base line non-invasion blood pressure, heart rate and oxygen saturation ($Sp0_2$) are recorded and intravenous line started with insertion of intravenous cannula of size 20G or more. The anaesthetic regimen followed were standard care as per the local standard care for all patients. Every patient was pre-oxygenated for adequately prior to induction and continued till orotracheal intubation which was considered end point of study.

Patients were induced with intravenous propofol 1.5 – 2mg/Kg body weight bolus with prior premedication of Ondansetron 4mg I.V. bolus and Fentanyl 2microgram/Kg body weight or Morphine 5 – 10mg. Endotracheal intubation to be done under direct vision facilitated by succinylcholine (2mg/Kg wt) intravenous bolus and anaesthesia maintained as usual with inhalational agent or intravenous anaesthetic with oxygen-nitrous oxide, non-depolarizing muscle relaxant and control ventilation. Analgesia maintained by multi-drug regimen of Opioid and NSAID (Diclofenac 75Mg infusion or IM with or without Paracetamol 10mg/Kg wt infusion). The patients were placed in supine and sniffing position to enable direct laryngoscopy. Direct Laryngoscopy (DL) was done with Macintosh curve laryngoscope of optimum size blade (medium size; 3). The Modified Cormack-Lehane score assessed with DL. Then, the intubation will be done by trained Anaesthesiologist and data will be recorded: -

1. Modified Cormack – Lehane's Scoring (CLS): -

a. Grade 1: - Most Vocal cord visible
b. Grade 2a: - Only posterior commisure is visible
c. Grade 2b: - Only Arytenoids visible
d. Grade 3a: - Only Epiglottis visible and lift able
e. Grade 3b: - Epiglottis adherence to the Pharynx
f. Grade 4: - None of the Laryngeal structure visible without external manipulation

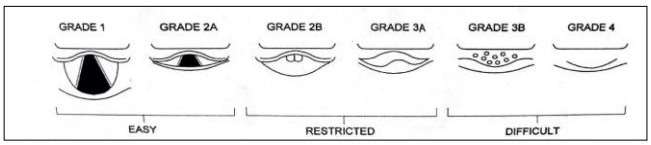

Fig 2

2. Difficulty Laryngoscopy Score based on modified Cormack-Lehane's score after optimising oropharyngo-laryngeal axis with BURP (Backward-upward-rightward-pressure) manoeuvre: additional operator, used of extra lifting force of Laryngoscopy more than conventional force, with or without Cricoid pressure while intubation will also be noted down. The difficult airway parameters are also to be noted in this stage. They are defined as following:

- Difficult laryngoscopy: Difficulty visualising part of larynx with or without multiple attempts with optimum position and BURP (Backward-upward-rightward-pressure) manoeuvre by trained Anaesthesiologist. Usually corresponds to mCLS 3 or more
- Difficult tracheal intubation: Endotracheal intubation of multiple attempts of 3 or more by trained Anaesthesiologist
- Failed intubation: - Failure to achieve successful tracheal intubation in a maximum of three attempts or more than 10minutes, fourth attempt should be done by more experience Anaesthesiologist. BJA (2015) 115 (6): 827–848).

Table 2: Showing Difficult Airway

Difficult Airway:	**Yes / No**	**If Yes, then Specify Difficult with Face Mask ventilation / Difficult in Supraglottic Device/ Difficulty in Tracheal Intubation/ All of the above**
Difficult Face Mask Ventilation:	Yes / No	If Yes, then Specify Inadequate Mask Seal/ Large Volume leaks/ Excessive Resistance to Ingress Gas/ Excessive Resistance to Egress of Gas
Difficult Laryngoscopy:	Yes / No	
Difficult Endotracheal Intubation:	Yes / No	If Yes, then Specify ≥3 attempts / > 10 minutes Or Both
Failed intubation:		

The haemodynamic parameters (HR in beats per minute, BP in mm Hg and Spo2 in %) recorded after the successful intubation and at 5 and 10 minutes. The procedure will be deemed complete once the intubation is done successfully. Any adverse effect during the procedure will be recorded separately.

Statistical Analysis

The Sample size was calculated using Daniel formulae[2] as below;

$N = \{Z^2 P (1 – P)\}/d^2$ where n = sample size,

Z = Z statistic for a level of confidence,

P = expected prevalence or proportion[5] (in proportion of one; if 4%, $P = 0.04$), and

d = precision (in proportion of one; here since p=0.04, therefore; $d = 0.04/2 = 0.002$).

Results and Observation

Total numbers of General Anaesthesia (GA) cases included in study was 400. 107 male and 293 female patients were included in the study. Total of 310 patients had ASA status I and 90 ASA II. The mean Body Mass index (BMI) of study was 24.2, but the patients who had been found to be exhibiting mean BMI of 27.48.

Table 3: showing the total cases with different airway parameters

Total cases 400	Parameter		Mean
ASA	I	310	NA
	II	90	
Age	<45	424	34.64
	≥45	86	
BMI	<25	328	24.4
	>26	72	
Dentition	Normal	369	NA
	Missing Tooth	31	
Mouth Opening	Adequate (>3cm)	400	NA
HNM / Atlanto-occipital joint movement	Adequate	399	NA
	<35°	1 (30°) due to Pain (ChemoT)	
TMD	≥6.5cm	382	NA
	6 – 6.5 cm	18	
SMD	>12.5cm	379	NA
	≤12.5 cm (Short neck)	21	
MMT	I	320	NA
	II	76	
	III	4	
ULBT	I	313	NA
	II	70	
	III	17	
Modified Cormack-Lehane grade	1	353	NA
	2a	21	
	2b	8	
	3a	16	
	3b	2	
	4	1	

The prevalence of Difficult Direct Laryngoscopy (DDL) and Difficult Intubation (DI) was 4.75% (19) and 1.25% (5) respectively, which is shown in the table below. Out of the five difficult intubation cases ETT size of two patients was reduced and intubated with lower tube size of 6.5. However, five patients did not have DDL/DI but needed re-intubation and one needed decrease in ETT size to 6.5. Three cases had Difficult Mask Ventilation (DMV), of which one had DDI also.

Table 4: Total numbers of GA cases with difficult Airway Score

Parameters	percentage
Difficult Airway	19 (4.75%)
Difficult Mask Ventilation	3 (0.75%)
mCLS 3 and 4	5 (1.25%)
Difficult Laryngoscopy	19 (4.75%)
Difficult intubation	5 (1.25%)
Time taken for DL > 10min	0
Failed Intubation	0

The results were Analysed using SPSS software and Chi square test was used to compare the data as shown in the table with p-value of 0.000. This result was comparable to the results of study done in New Delhi by Smita P *et al.* [5]. Our results were also compared to the Chinese study [13] which was found to be comparable.

Table 5

	Easy Intubation	Dif. Intubation	Total
Easy Laryngoscopy	381	0	381
Difficult laryngoscopy	14	5	19
Total	395	5	400

Table 6

	Value	df	Asymptomatic significance	Exact Sig (2 sided)	Exact Sig (1 sided)
Pearson Chi-Square	101.532	1	.000		
Continuity correction	81.332	1	.000		
Likelihood ratio	31.857	1	.000		
Fisher's exact test				.000	.000
Linear by linear association	101.278	1	.000		
No. Of valid cases	400				

The number of cases in which use of different technique to enable modified Cormack – Lehane Scoring (mCLS) or ETT intubation is tabulated below:

Table 6: showing nature of difficult direct laryngoscopy and intubation

No. of additional Anaesthetist	**4**	
No. of Alternative Intubation Technique used (Specify Alternate Intubation Technique)	9	Bougie aided in 8
		↓ ETT size in 3
		↑ curve (no 4) in 1
Need for excessive lifting force	28	
Need for Anterior Laryngeal pressure	115	
Need for Vocal Cord Adduction	113	

We did not include ASA III, narrow mouth opening, edentulous or inability to extant the neck. One patient had Atlanto-occipital joint movement of 30°, which was due to pain in the area. Total number of patient showing difficult airway with airway parameters are shown below in table 3. The commonest aid to be used was Bougie.

In our study we found that only difficult laryngoscopy to be 100% accurate predictor of difficult intubation, since all the patients with difficult intubation have difficult direct laryngoscopy. The relative risk for difficult intubation can be best predicted by ULBT (sensitivity 35.2 with RR of 60%), followed by short neck determine by SMD of less than 12.5cm (sensitivity of 19% with RR of 40%) and TMD <6.5 (sensitivity of 13.88%). BMI, AOJ and MMT were found to be less sensitive.

Discussion

Complications of airway management are infrequent, however they do exist. In our study we had one case of surgery which was differed due to complication of difficult intubation. C. Frerk *et al*. (2015) [7] in guidelines of Difficult Airway publish by Difficult Airway Society estimated that airway management resulted in one serious complication per 22000 general anaesthetics, with death or brain damage complicating 1:150000. Thus, Guidelines exist to manage complex emergency problems in other areas of clinical practice, with cardiopulmonary resuscitation. Assessing mouth opening, neck mobility, and the location of the cricothyroid membrane with airway indices before surgery will help not only to determine the possibility of difficult intubation but whether some rescue techniques are unlikely to be successful.

In the study of Smita P *et al*. (2013) [5], they have found that in Indian population the incidence of difficult laryngoscopy and difficult intubation as 9.7% and 4.5% which to almost same as that mention in Millers Anesthesia [6]. In our study prevalence of difficult laryngoscopy and difficult intubation was found to be 4.75% and 1.25% respectively, which was found to be comparable to study of Wong [13] in Chinese population (1.99% and 1.54% in Pregnant and non-Pregnant respectively). Considering the average build and the facial feature of the ethnic population of Arunachal Pradesh, we compared our data with the study of Tadese Tamire *et al*. (2019) [10], whose study was conducted in Ethiopia found DDL/DI to be 13.5% and 5% respectively.

In our study; all patients of difficult intubation (considered three or more attempts of endotracheal tube intubation) had difficult laryngoscopy (inability to visualised part of vocal cord with conventional direct laryngoscope). Of all the parameters to predict difficulty, only Cormack Lehane grade 3 or 4 have the sensitivity and specificity to predict difficult intubation (26.32% DDL cases exhibited difficult intubation). As mention in other study, only mCLS was the only parameter showing 100% predictor of difficult intubation, followed by ULBT, SMD, TMD, BMI and MMT.

As DAS [7] 2015 guidelines states, "*Prediction of difficulty in airway management is not completely reliable; the anaesthetist should have a strategy in place before the induction of anaesthesia, and this should be discussed at the team brief and the sign-in (pre-induction) phase of the WHO Surgical Safety Checklist*". Among all the variables to predict difficult laryngoscopy and intubation, upper lip bite test shows the most predictable indice (Realtive Risk of 35.2, which was found to consistant with the finding of Pratibha Jain *et al*. (2013) [4] and Michael E Detsky *et al*. (2019) [9]. In study conducted by Tridip Jyoti Borah *et al*. [12] in the North Eastern Indira Gandhi Institute of Health and Medical sciences Thyromental distance of less than 6cm and mCLS are the strongest relative risks for difficult intubation. In study of Shristi Shah [11] in the Nepalese Population, mCLS was found to be good predictor of difficult intubation, but her finding was also similar to the other study.

We compare our study to study of Wong SH and Hung CT [13], which was prospective, blind observational study to investigate the prevalence and prediction of difficult intubation in Chinese women. Two groups of Chinese women; 151 pregnant and 260 non-pregnant were included, they prevalence of difficult intubation was 1.99% in the pregnant and 1.54% in the non-pregnant group. And their finding was similar to our study. We also compare study result with results of study of Aida Rosita Tantri [15], which was conducted in Malay patient of Indonesia in study of difficulty in visualizing the larynx was found in 28 (10.1%) patients compared to 4.75% in our study.

In our study we did not include patients' who are edentulous or undergoing neck or mandibulo-facial surgery. Thus, may have excluded numbers of cases which may have shown difficult laryngoscopy as well as difficult intubation. Therefore, from our study the prevalence of difficult is 1.25% and 4.75 in patients showing normal airway parameter.

Conclusion

From the study, Prevalence of difficult intubation of population as per the Tertiary care centre of Arunachal Pradesh is 1.25% and prevalence of difficult direct laryngoscopy is 4.75%, difficult face mask ventilation of 0.75% and difficult airway in 5.5% in absolutely normal airway parameters.

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