Original Research Article

Predicting difficult intubation in head and neck cancer patients using clinical predictors: An observational study

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Abstract

Background: Airway assessment and management is most important part of anaesthesia in general and it demands special focus in the patients of head and neck cancer. Aim of the study is to predict difficult airway and intubation preoperatively and to manage difficult airway using various techniques in head and neck cancer patients. **Materials and methods**: All patients, 18 to 60 years of age, ASA physical status I, II and III and diagnosed with head and neck cancer were assessed for difficult airway by using following predictors: Modified Mallampati(MMT) classification. Jaw protrusion (Calder's test). Thyromental distance (TMD). Mobility of cervical spine. Atlanto occipital joint extension. Cormack and Lehane grading. Sensitivity, specificity and positive predictive value of MMT, jaw protrusion and thyromental distance were calculated. **Result:** The incidence of difficult intubation was 27.17% in our study. Sensitivity of MMT was 86.4 % and specificity was 91.4 %. Sensitivity of the jaw protrusion test was 90.9 % and specificity was 87.14%. Thyromental distance had sensitivity of 45.5 % and specificity of 60%. Combination of MMT and jaw protrusion were better predictors for this study. **Conclusions:** Accurate prediction of difficult airway is crucial especially in head and neck cancer patients. Use of different predictors along with ultrasonography for the prediction of difficult intubation should be taken into consideration in recent anaesthesia practice.
Key Word: head and neck cancer.

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INTRODUCTION

Head and neck malignancies are most common form of malignancy in India [1]. Airway assessment is most critical and important step in any pre-anesthetic checkup. There has been a remarkable improvement in the airway management but still it demands special attention due to specific problems like presence of intra oral mass, soft tissue edema, mass effect compressing trachea or major neck vessels, retrosternal extension of the mass and mass effect due to the same in head and neck cancer patients. A multitude of predictors [2,5,6] have been used to predict the difficult airway but none have prediction capability reaching 100%. Any test which can predict difficult airway i.e. difficult mask ventilation or difficult laryngoscopy or difficult intubation at pre-anaesthesia checkup can save lives. We can plan use of awake fiberoptic scope or video laryngoscope for the management of the airway. Aim of the present study was to predict difficult airway and intubation in head and neck cancer patients, to establish sensitivity, specificity and positive predictive value of each predictor [2,3,22]and to manage difficult airway using various techniques. American Society of Anaesthesiologists (ASA) task force [20] define difficult endotracheal intubation as "proper insertion of endotracheal tube with conventional

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laryngoscope requires multiple attempts". In our study we have defined difficult intubation according to ASA task force which is also similar to Canadian Airway Association (CAA) who has also defined difficult intubation as multiple attempts to intubate or use of alternative technique if conventional laryngoscopy fails.

MATERIAL AND METHODS

A total of 100 patients of age 18 to 60years, ASA physical status class I, II and III, diagnosed with head and neck cancer (cancer of oral cavity, buccal mucosa, cancer of nasopharynx, cancer of thyroid, parotid etcetera) were included in the study after obtaining permission from the ethical committee. The patients who were operated for the same disease, who had taken radiotherapy, patients having stiff joint syndrome, Body Mass Index (BMI > 35) and haemodynamically unstable patients were excluded from the study. After taking history and general examination of the patient, airway assessment of the patients was done by using following predictors:

- Modified Mallampati (MMT) classification.
- Jaw protrusion (Calder's test).
- Thyromental distance.
- Mobility of cervical spine.
- Atlanto- occipital joint extension.
- Cormack and Lehane grading.

Inorder to avoid inter-observer variability, all the predictors were assessed by same consultant. Mallampati classification was modified by Samsoon and Young [4]. It was assessed by asking the patient to seat, to open the mouth and protrude the tongue while keeping head in neutral position without phonating. The view then graded as:

Class I: Soft palate,fauces, uvula and pillars seen.
Class II: Soft palate, uvula, fauces seen and not the pillars.
Class III: Soft palate and base of uvula seen.
Class IV:Only hard palate visible.

Thyromental distance is measured to determine the alignment of pharyngo-laryngeanl axis and tongue displacement into submandibular space. It is the distance from the mentum to the thyroid notch and it is measured while keeping head fully extended. Thyromental distance of > 6.5 cm is normal and < 6.5 cm suggests difficult airway. The other predictor used, was jaw protrusion (Calder's test). It is the ability of the patient to protrude mandible as far as possible. The lower incisors will be either anterior (class A), aligned or equal (Class B),or posterior to (Class C) upper incisors. Class B and Class C were considered as difficult airway.Inter incisor gap i.e. distance between the upper and lower incisors was taken. A distance of 4.5 cm or more is normal and distance less than 3.5 cm predicts difficult airway. Extension at atlanto occipital joint was also noted. We considered modified Mallampati test class III and IV, jaw protrusion class B and C and thyromental distance <6.5 cm as predictors for difficult intubation. All the patients belonging to Mallampati class IV and mouth opening less than one finger were prepared for the awake fiberoptic intubation. The patients were kept nil by mouth for 8 hours. Written informed consent was taken on the day of surgery in the pre anaesthesia room. Intravenous line was taken, injection ringer lactate was started, patients were premedicated with injection glycopyrrolate4µg/kg and injection midazolam 0.5 mg and injection fentanyl 2 µg/kg. Patient having Class IV MMT grading with mouth opening less than one finger where prepared for awake fiberoptic intubation. After applying standard monitors like ECG, NIBP and SpO_2. Patients were pre-oxygenated for 3 to 4 minutes, and induced with injection Propofol 2-2.5mg/ kg intravenously. After confirming that patient can be ventilated, the muscle relaxant injection Succinylcholine 2mg/kg was given IV and ventilated till fasciculations faded. Supplemental high flow oxygen at 15 litre/min was given by nasal prongs to all patients to maintain oxygenation throughout the laryngoscopy. In patients of Mallampati grade I, II and III, direct laryngoscopy was done and view of larynx was graded according to Cormack and Lehane grading.

Grade I: Visualisation of entire glottis.
Great II: Visualisation of posterior commissure only.
Grade III: Visualisation of epiglottis only.
Grade IV: Only soft palate seen.

Close clinical monitoring of vital parameters like blood pressure, pulse rate, SpO_2 and $EtCO_2$ was done throughout the surgery. The methods of assistance during laryngoscopy included BURP maneuver (backward, upward, rightward pressure), stylet and bougie in oral intubation, magill's forceps in nasal intubation. Cormack and Lehane grading was recorded before giving BURP. Number of attempts of intubations were noted. Statistical analysis was done by using descriptive analysis and sensitivity, specificity and positive predictive value of each predictor was calculated. The analysis was used to find out the incidence of difficult intubation in our study. The data were analysed using SPSS version 15. Sensitivity and specificity values were calculated using STATA softwear. Sensitivity - the percentage of correctly predicted difficult intubation that was truly difficult. Specificity - the percentage of correctly predicted easy intubation as proportions of all intubation that were truly easy. Positive Predictive Value (PPV) -the percentage of correctly predicted difficult intubation as a proportion of all predicted difficult intubation. Negative Predictive Value (NPV) : It is the percentage of correctly predicted easy

intubations as a proportion of all predicted easy intubations.

Accuracy: It is the percentage of correctly predicted easy or difficult intubations as a proportion of all intubations.

RESULTS

In the present study 100 patients were assessed, out of which 75% were male and 25% were female, age ranging from 18to 60 years, the mean height was 160±7.3 cm and the mean weight was 55.38±12.5 kg. Out of 100 patients, 8 patients were having MMT class IV and inter incisor gap was less than 1 finger breadth so they were intubated by awake fiberoptic intubation and were not graded by Cormack and Lehane grading. Out of other remaining 92 patients, 25 patients belonged to Cormack and Lehane grading III and IV, so the incidence of difficult intubation was 27.17%. These patients either required more than 3 attempts of intubation with manipulation or they were intubated using video-laryngoscope while maintaining oxygenation using high flow oxygen with nasal prongs during laryngoscopy.

Table 1: Distribution of patients among different airway predictors

Predictive Test	Class/Grade	No. of Patients
MMT	Class I	35
	Class II	32
	Class III	25
	Class IV	8
Jaw Protrusion	Class A	63
	Class B	12
	Class C	25
Thyromental Distance	≥ 6.5 cm	58
	< 6.5 cm	42

Table 2: Distribution of patients according to laryngoscopy view (92 patients)

S.No.	Predictive Test	Cormack and Lehane Grading	
		Class III and IV	Class I and II
1	MMT (8 Class IV patients were not graded) Class III (25) Class I and II (67)	 19 (76%) 3 (4.48%)	 6 (24%) 64(95.52%)
2	Jaw Protrusion (8 MMT Class IV patients were not graded) Class B and C (29) Class A (63)	 20(68.97%) 2 (3.18%)	 9(31.03%) 61 (96.82%)
3	Thryomental Distance <6.5 cm (38) (4 patients were not graded) ≥ 6.5 cm (54) (4 patients were not graded)	 10 (26.32%) 12(22.22%)	 28(73.68%) 42(77.78%)

Out of 92 patients, according to MMT 25 patients were belonged to class III and were predicted to be having difficult intubation. But in reality, out of 25 only 19 patients were actually having difficult intubation and 6 were false positive so sensitivity of MMT was 86.4 %. Out of 67 patients of class I and II MMT,64 patients were true negative and 3 were false negative so specificity of MMT was 91.4 %. According to jaw protrusion, 29 patients were predicted to be having difficult intubation but only 20 patients were true positive so the sensitivity of the test was 90.9 %. 63 patients were predicted to be easy intubation, 61 were true negative and 2 were false negative so specificity of the test is 87.14%

Patient's airway predicted by Thyromental distance, 38 patients were predicted to be having difficulty in intubation, out of which 10 patients were true positive and 28 were false positive so sensitivity of this test was 45.5 %.54 patients were predicted of having easy intubation, 42 were true negative and 12 were false negative so specificity was 60%. (Table 2 and 3).

Table 3: Sensitivity, Specificity, Positive Predictive Value, Negative Predictive value and Accuracy of Individual predictors

Test	Sensitivity	Specificity	PPV	NPV	Accuracy
MMT	86.4%	91.4%	76.0%	95.52%	64.20%
Jaw Protrusion	90.9%	87.14%	68.97%	96.83%	88.04%
TMD	45.5%	60.0%	26.32%	77.78%	56.52%

MMT- Modified mallampati Test, TMD – Thyromental Distance, PPV – Positive Predictive Value, NPV- Negative Predictive Value

DISCUSSION

Head and neck cancer as malignant tumor of oral cavity, oropharynx, nasopharynx, larynx and neck ranks sixth in overall incidence [1]. Airway assessment for predicting difficult airway i.e. for laryngoscopy and intubation and its management is crucial in head and neck cancer patients as well as in general surgical patients. It has been estimated that 90% of difficult endotracheal intubation can be anticipated from preoperative clinical evaluation, yet as many as 50% of these are not being predicted. This disparity is the most frequent cause of airway catastrophy. Ideally any test for prediction of difficult intubation must be rapid and easy to perform on all the patients, should be without the inter observer variability and easily understood by the patient as well as the examiner. It should have high sensitivity, specificity and positive predictive value in order to detect difficult intubation correctly, but there is no test available till date which has 100% sensitivity or specificity [2,22]. Thus it is inevitable to miss few cases of difficult intubation and some cases of easy intubation can be predicted as difficult. Screening test should also have high positive predictive value so that only a few patients of easy intubation are subjected to protocol of difficult airway management. In our study, the incidence of difficult intubation was 27.17% which was higher than the other studies in which the percentage was ranging from 5.7% to 16.5%[12,13,22] where as it was similar to the study conducted by Sushma *et al*[22] which was 26.5% .The incidence of difficult intubation was higher in our study as the study population consisted of the head and neck cancer patients and they had limited mouth opening and limited mandibular space resulting from tumor or edema. The three important predictors used in this study were modified Mallampati test, thyromental distance and jaw protrusion. In other studies[7,8,9,10]sensitivity of MMT was ranging from 11.1% to75% where as in our study it was 86.4 % and specificity was 91.4 %. Jarne *et al*[2] also have 92% sensitivity of MMT in their study The high sensitivity and specificity of modified Mallampati test was attributed to test done by the same consultant so as to nullify the inter observer variability and number of true positive were more. Jaw protrusion or the upper lip bite test was proposed by Khan *et al*[13] and he found sensitivity of 91.69% and our results were nearly similar to theirs (Table 3). This test was very useful in our study to pick up difficult airway cases because our study includes patient of head and neck cancer which had pathology involving oral cavity and buccal mucosa and they had fibrosis of the tissue around the mandible which restricts the movement or subluxation of mandible hence causing difficulty in laryngoscopy.

Thyromental distance of < 6.5 cm was generally accepted as a predictor of difficult laryngoscopy and intubation in various studies.[2,7,8,12,13,22,24] In various other studies[7,8,9,10,13,14] sensitivity of thyromental distance vary from 62% to 82%. In our study the sensitivity and specificity of thyromental distance was 45.5 % and 60% respectively. As compared to thyromental distance alone, ratio of patients height to thyromental distance have been considered as a better predictor.[16]Many indices or combination of indices like Wilson's score [7] were used to predict difficult airway, but none of them were found to be highly specific or sensitive [14,20,22]. We also tried the combination of predictors to find out the incidences of difficult intubation in study population. In this study when we used the combination of MMT and jaw protrusion we observed that out of 25 patients who were having MMT grade III were also having jaw protrusion of Class B and C and their Cormack Lahane grade on direct laryngoscopy was III or IV. All these patients were having difficult intubation and they either required more than 3 attempts or video laryngoscope for intubation. Combination of MMT and Thyromental distance (TMD) was also studied and the result showed that out of 25 patients with MMT grade III only 6 patients were having TMD of <6.5 cm. That is why we concluded that for this study combination of MMT and jaw protrusion were better predictors than MMT and TMD.[12]

CONCLUSION

Accurate prediction of difficult airway is of utmost importance especially in head and neck cancer patient as this helps in reducing the airway catastrophe associated with difficult intubation. This helps in reducing the airway trauma, reduces the unplanned tracheostomy and morbidity and mortality associated with it. We can incorporate the practice of using Ultrasonography for the prediction of difficult airway along with other predictors to increase the accuracy.

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