Asian Journal of Pharmaceutical and Health Sciences
www.ajphs.com

Comparison of five bedside airway screening tests in predicting difficult intubation

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ARTICLE HISTORY

Received: 09.08.2015

Accepted: 25.10.2015

Available online: 30.12.2015

Keywords:

Mallampati, laryngoscopy, bedside, difficult intubation.

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ABSTRACT

There is a need for at least sensitive test (so that majority of difficult cases can be identified) but also highly specific test (so that the false positive will be low in whom the test is used routinely). In the present study, an attempt is made to evaluate the value of the five bedside test namely modified mallampati test, sternomrental distance, thuromental distance interincisor gap and degree of head extension in predicting difficult intubation.The present cross-sectional study was carried out in general hospital at Mumbai for three months duration. One hundred patients undergoing elective surgery under general anesthesia requiring endotracheal intubation were studied with reference to preoperative airway evaluation using five bedside parameter to anticipate difficult intubation.

Preoperative airway assessment included five bed side parameters namely modified mallampati test, sternomental distance, thyromental distance, intercisor gap and degree of head extension. After induction of general anaesthesia laryngoscopic view was graded as per Cormack and lehane classification. The incidence of difficult intubation in our study was 9%. Thyromental test had a sensitivity of 88.9%. Mallampati test had a sensitivity of 44.4% with the highest positive predictive accuracy of 66.7%. Sternomental distance has the lowest sensitivity 11.1%. Intercisor gap did not correlate well with laryngoscpic view. Degree of extension has sensitivity 66.7% better than mallampati test and sternomental distance. Thyromental distance of ≤6.5cms has the highest sensitivity and specificity and is the best predictor of difficult intubation. Sternomental distance had the lowest sensitivity and is not a reliable parameter for predicting difficult intubation. Mallampati test is modestly sensitive test to predict difficult intubation. Head extension has better specificity but is less sensitive than thyromental distance in predicting difficult intubation.

INTRODUCTION

The fundamental responsibility of an anaesthesiologist is to maintain a patent airway and gas exchange. Failure to maintain a patent airway for more than a few minutes may be confronted with difficult and challenging airway. Basic life support begins with proper airway control aiming at oxygenation, ventilation, and removal of secretion. There is no emergency more acute than the one, which threatens oxygenation because lack of oxygen not only stops machine but wrecks the machinery.

The incidence of difficult intubation associated with rigid laryngoscopy has been variously reported between 0.5 to 13.6%. Thus, it is not surprising that >85% of all respiratory related closed malpractice claims involve a brain damaged or dead patient. Preoperative screening to anticipate difficulty in tracheal intubation may avoid accidents and save lives. Methods requiring x-rays of the head and neck, which can help in prediction of difficult intubation, are impractical for population screening.

It has been suggested that difficult intubation is associate with certain anatomical feature, measurement of which can be made from x-rays of the mandible and cervical spine. However it is not feasible to carry out these radiological tests on every patient before surgery. The existing bedside tests have been shown in

various studies to have a high false positive rate, which detracts from their usefulness. In the present study, an attempt is made to evaluate the value of the five bedside test namely modified mallampati test, sternomrental distance, thuromental distance interincisor gap and degree of head extension in predicting difficult intubation.

So we have considered few bedside tests, which can be quickly performed. The aims of this study were to evaluate the efficacy of bedside tests in predicting difficult intubation, to determine the values of modified mallampati test, sternomental distance, thyromental distance, interincisor gap and head extension as predictors of intubation.

MATERIAL AND METHODS

This study was carried out in a general hospital. One hundred patients undergoing elective surgery under general anesthesia requiring endotracheal intubation were studied with reverence to preoperative airway evaluation using five bedside parameter to anticipate difficult intubation.

Inclusion and Exclusion criteria:

Patients undergoing surgery under general anesthesia requiring endotracheal intubation. The patients with diabetes mellitus, rheumatoid arthritis, ankylosing spondylitis, patients with neck swellings. Patients with temporomandibular joint ankylosis, mandibular fracture, post burn contractures, cervical spine pathology or other airway pathology.

During preanesthestic checkup rounds, purpose of the study was explained to each patient. A valid, informed and written consent was taken. Demographic data as name age, sex, height and weight of each patient were noted. A detailed preoperative history regarding medical illness and surgical pathology was taken along with investigations as required and noted down in the proforma attached herewith. Detailed airway assessment of each patient was done preoperatively which included the g bedside tests as modified mallampati test, sternomental distance, thyromental distance, intercisor gap and degree of head extension.

Modified mallampati test:

Patient was seated with mouth fully open and asked to protrude the tongue as far as possible and neck in the neutral; position. Looking from the patients eye level, pharyngeal strures were inspected with a pen torch and graded as follows- 1) soft palate, uvula, fauces and pillars visible 2) soft palate, uvula, fauces visible but pillars obscured 3) soft palate visible only and 4) soft palate not visible.

Sternomental distance:

Sternomental distance was measured with the head fully extened on the neck with the mouth closed and head in the neutral position. The straight distance between the upper border of the manubrium sterni and the bony point on the mentum was measured. A thread and a ruler were used for the measurement.

Thyromemntal distance:

Thyromental distance was measured with the head fully extended on the neck with the mouth closed and head in the neutral position.the straight distance between the thyroid notch and the bony point on the mentum was measured. A thread and a ruler were used for measurement.

Interincisor gap:

Intrincisor gap was measured by asking the patient to open the mouth as far as possible and the distance between the upper and the lower incisor measured. In case of edentulous patient the distance between the gingival in the midline was measured.

Degrees head extension:

The patient sitting on a chair with the head held erect in the neutral position and facing directly to the front was asked to open the mouth as far as possible. In this position the occlusal surface of the upper teeth is horizontal and parallel to the ground. The patient was the asked to extend the atlantooccipital joint i.e. the head over the neck as much as possible and the angle traversed by the occlusal surface of the upper teeth measured. Any reduction in extension was expressed as a fraction of the normal and graded accordingly. Grade 1 none, grade 2 was 1/3, grade 3 as 2/3 and grade 4 with complete.

On the morning of the surgery patients were wheeled into the operation theater where starvation was confirmed and consent verified. After attaching noninvasive monitors intravenous line secured. Preoxygenation was done for three minutes. General anesthesia was induced using suitable induction agent, followed by succinylcholine 2mg/kg body weight. After achieving complete muscle relaxation as evident by jaw relaxation laryngoscopy was performed by qualified senior anesthesiologist using a Macintosh blade. Laryngoscopic view was graded according to Cormack and Lehane grade. Grade 1 vocal cord visible, grade 2 only posterior commissure or arytenoids visible, grade 3 only epiglottis visible and grade 4 no glottic structure visible.

Patents were then intubated with appropriate size endotracheal tube, female patients were intubated using 7.5 number portex cuffed endotracheal tube and male patients were intubated using 9.5cm number portex cuffed endotracheal tube. Confirmation of correct tube was done. Long blade laryngoscope, gum elastic bougies were kept ready and used as and when required. In case of failed intubation by qualified anesthesiologist the senior consultant had taken over. During intubation patient was observed for any signs of hemodynamic instability like ecg changes etc, and appropriate measures taken.

Body mass index was calculated using the following formula as weight in kg/ (height in meters)[2]. Demographic data between easy intubation and difficult intubation groups compared statistically. Age, height, weight and body mass index were compared using unpaired t test. Sex distribution between the two groups was compared using chi-square test. $P<0.05$ was considered to be significant.

To assess the clinical performance of the five bedside parameters sensitivity, specificity, predictive accuracy for positive and negative results, false positive and false negative values were calculated for all the five indices. To determine the correlation of interincisor gap with laryngoscopic view correlation analysis was used. Karl Pearson coefficient was calculated.

Sensitivity:

The term sensitivity is a statistical index of diagnostic accuracy. It has been defined was the ability of a test to identify correctly all difficult intubation cases that is true positive, for e.g. a 90% sensitivity means that 90% of patients screened by the test will give a true positive result and remaining 10% a false negative

Table 1. : Distribution of patients according to intubation status

Test		Number of patients	Easy intubation	Difficult intubation
Mallampati test	I	56	55	1
	II	38	34	4
	III	6	2	4
	IV	0	0	0
Sternomental Distance	≤12.5cms	2	1	1
	≥12.5cms	98	90	8
Thyromental distance	≤6.5cms	13	5	8
	≥6.5cms	87	86	1
Intercisor gap	≤5cms	48	41	7
	≥5cms	52	50	2
Head extension	I	81	78	3
	II	18	12	6
	III	1	1	0
	IV	0	0	0

Table 3. : The difficult laryngoscopic view patient's findings

SN	Age	Sex	Ht.	Wt.	BMI	MPC	SMD	TMD	IIG	HE	LV	Attempts
1	58	F	152	65	28.1	II	13.7	5	4	44	III	3
2	40	M	162	44	16.7	I	16	4.5	5	33	III	4
3	50	F	150	60	26.6	II	11	4.5	4	30	III	3
4	40	M	154	55	23.1	I	14.7	3	4.2	30	III	5
5	50	M	165	50	18.3	III	13.5	6	3.5	55	IV	3
6	65	M	165	68	24.9	III	17	6.8	4	28	III	3
7	40	F	140	52	26.5	III	15	5	4	28	IV	4
8	60	M	169	51	17.8	III	15	6	4.1	38	III	3
9	75	F	158	60	24	II	13	6	5	28	III	3

result.

Specificity:

It measures the ability of test to identify all with easy laryngoscopy that is true negatives. 90% specificity means 90% of patients with normal airway examination will give true negative result.

False negative percentage:

The ratio indicated the number of patients in whom laryngoscopy was difficult but had predicted normal laryngoscopy. It amount to give us a false assurance. A screening test which is very sensitive has few false negatives. The lower the sensitivity the larger will be the number of false negatives.

False positive percentage:

The number of the patients in whom the test predicted difficult laryngoscopy but was easy. A screening test with a high septicity will have few false positive results.

Predictive accuracy:

In addition to sensitivity and specificity, the performance of a screening test is measured by its predictive value, which reflects the diagnostics power of the test. The predictive accuracy depends upon sensitivity and specificity. The predictive value of a positive test indicates the probability that a patient with a positive test result has in fact, the disease in question (in our study difficult laryngoscopy).

To assess the clinical performance the five parameter sensitivity and specificity was determined. In addition false positive, false negative, positive predictive value of each test was also determined. To determine correlation of intercisor gap and laryngoscopic view, correlation analysis was used.

RESULTS

The present study was carried out in a general hospital. One hundred patients were posted for elective surgery and given general surgery, given general anaesthesia, requiring endotracheal intubation**.** In this randomized study almost equal number of male and females participated. The patient's age was ranged from 18-75 years with mean 41.3±13.26.

The height of the patient's was 140-177cms with mean 158.4±8. The weight of the patients ranged from 30-110 with average weight 54.6±12.82kgs. 91 patients had a BMI of < 27 and 9 patients had a BMI of ≥27 suggesting obesity. The average BMI

was 21.7±4.47. Distribution of demographic data in patients who had easy intubation and difficult intubation was found statistically to be not significant.

The modified mallampati test shoed 556 patients has MPC grade I, 38 patients had MPS grade II, 6 were grade III and no one in grade IV. Mean sternomental distance was 16.7±2.06cms. 2patients had sternomental distance ≤ 12.5 cms and 98 patients had sternomental distance > 12.5cms. Mean thyromental distance was 7.6±1.25cms. 13 patients had thyromental distance 6.5cms, 87 patients had thyromental distance >6.5cms.

Mean intecisor gap distance 4.8± 0.76 patients had intercisor gap of ≥5cms. 81 patients had head extension grade 1 i.e. >35° 19 patients had grade 2/3 and none of the patients had extension grade 4. 91 patients had easy layngoscopic view (grade I, II), whereas 9 patients had difficult laryngoscopic view (grade II, IV).

DISCUSSION

Incidence of failed tracheal intubation has been variously reported between 0.55- 13.6%[1]. This study is carried out inn general hospital. One hundred patients who were posted from elective surgery and were administered general anesthsisa wuith endotracheal intubation were studied. Preoperatively five bedside tests to assess airway were carried out on the patients.

Incidence:

The incidence of difficult intubation associate with rigid laryngoscopy has been variously reported between 0.5% - 13.6%[1]. The incidence of difficult intubation in our study was 9%. In the study done by Oates A JDL and colleagues [3] the incidence was 1.8%. Wilson and colleagues[2] found an incidence of 13%. The incidence of difficult intubation in D,Savvas [4] study was 4.9%.

Demographic data:

An almost equal number of male (51) and female (49) patients participated in the study. The age of the patients ranged from 18-75 years. Mean age was 41.3-13.26. The height of the patients ranged from a40-a77cms. The mean height was 158.4-8cms.weight of the patients ranged from 30-110kgms. The average height was 54.6-12.82kgm. From height and weight body mass index was calculated. Demographic data was compared statistically. Age, eight and BMI were compared using unpaired t test and sex distribution was compared using chi square test.

Modified mallampati test:

In our study 56 patients had MPC grade i, 38 patients had MPC grade ii, 6 patients had grade iii and no patients had mallampati classification grade iv. MPC grade iii and iv were considered suggestive of difficult intubation. Out of 6 patients who had MPC grade iii, 4 patients had a difficult laryngoscope view grade iii/iv. This test had a sensitivity of 44.4a% and specificity 94.5%. This test had a positive predictive value of 66.7%, negative predictive value of 2.2%. This test has thus shoed a moderate ability to to detect truly positive patents but had a better ability to detect the truly positive negative cases. In the study done by Nafareck CM[5] in 1991, this test showed a sensitivity of 81.5% which is better than our study. Freck included two patients in whom a bougie was used to facilitate intubation I his difficult group. If these cases were excluded as suggested by AI Calder[6] the incidence of difficult intubation becomes 1.6% in Frecks study, in contrast to 4.9%. Dsavva[4] got a sensitivity of 64.7% and specificity of 66.12% which was lesser than our study. In a study done by Oates JDL and colleagues[2] they found that many patients were predicated to be difficult by mallampati test Wilson risk score.

Sternomental distance:

In our study mean sternomental distance was 16.7±2.06 cms. Sternomental distance of ≤ 12.5cms was considered to be suggestive of difficult intubation. Out of 100 patients only 2 Patients had sternomaental distance. 12.5cms.the sensitivity and specificity of this parameter were 11.1% and 98.9% respectively. This test had a positive predictive value of 91.8%, false positive value of 1% and false negative value of 88.9%. Thus this test was found to be the least sensitive, hence has a poor ability to detect the true positive case. This test had a very high false negative value, hence cannot be used a s a routine test for predicting difficult intubation. In contrast to our study Dsavva[4] found that sternomental distance had a sensitivity 82.4% and specificity 0f 88.6%. In our study if sternomental distance of ≤14cms was taken as suggestive of difficult intubation, sensitivity of this test improved to 44.4% which can be compared with sensitivity of modified mallampati test and false and false negative results decreased to 55.6%.

Thyromental distance:

In our study mean thyromental distance was 7.6%±1.25cms. In easy intubation group mean distance was 7.8±1.09cms; whereas in difficult intubation group mean was 5.5±0.8cms. 13 patients had thyromental distance ≤6.5cms, which was considered to be predictor of difficult intubation. 87 patients thyromental distance >6.5cms. Out of 13 patients predicted difficult intubation, 8 patients had difficult leryngoscopic grade II/IV view and 5 patients had easy laryngoscopic view grade I/II.

The sensitivity of this test was 88.9% and the specificity was 94.5%, this shows that this test had the best ability to detect true positive patients. This test had a positive patients and true negative patients. This test had a positive predictive accuracy 61.55 and negative predictive accuracy 98.9%. It had a false positive value of only 5.5% and false negative value of 11.1%. Hence we can conclude that, I our study thyromental distance was the most accurate predictor of difficult intubation.

M. Mathew and colleagues[7] study showed that the patients with TMD <6cms, combined with horizontal distance of mandible <9cms had a good correlation with class III/IV laryngoscopic view and had a higher probability of difficult intubation. DSavvas[4] study showed a sensitivity of 64.7% and specificity of 81.9%, positive predictive value of 15.1%. CM Frecks[5] study had a sensitivity of 90.9% and specificity of 81.5%. He assumed a distance of ≤7cms as suggestive of difficult intubation.

Interincisor gap:

The mean interincisor gap in our study was 4.8±0.76cms. An interincisor gap of 5cms or their finger breadth is considered normal. 48 patients had an interincisor gap was suggestive of difficult intubation only 7 patients had a difficult layngopscopic view grade III/IV.

The sensitivity of interincisor gap in study was 77.8% and specificity was 54.8%. this shows that this test had a moderate ability to detect true positive predictive accuracy of mere 14.6% and a negative predictive accuracy of 967..2% false positive value of 22.2% and false negative value of as high as 46.1%.

Wilson and colleagues[3] suggested that an interincisor gap of <2 cms rather than 5cms is a predictor of difficult intubation. According to them intubation group had a mean interincisor gap of 3.8cms. Our study showed that a mean interincisor gap of 4.8±0.76cms. Coefficient of correlation (Karl Pearson coefficient) was used to determine correlation between interincisor gap and laryngoscopivc view. R value was calculated. R value ranges -1 to +1. A value near +1 shows positive correlation whereas a value near -1 shows negative correlation. R vale for interincisor gap wad almost zero, which shows that this test did not correlate at all with laryngoscopic view. DSavva[4] also did not find any correlation between interincisor gap and laryngoscopic view.

Degree of head extension:

In our study mean degree of head extension wwas $40.4^0 \pm 6.4^o$ in easy intubation group and $34.9^0 \pm 9.20^0$ in difficult intubation group. The sensitivity of this test was 65.7%, which was better than sensitivity of mallampati test and sternomental distance. The specificity of this test was 86.7%. This shows that this test has a better to detect true positives than mallampati test and also better specificity i.e. to detect true negatives. The predictive accuracy for positive test was 31.6% and predictive accuracy for negative test 96.3%. False positive value was 33.3% and false negative value was 14.3%.

CONCLUSION

Thyromental distance of ≤6.5cms has the highest sensitivity and specificity and is the best predictor of difficult intubation. Sternomental distance had the lowest sensitivity and is not a reliable parameter for predicting difficult intubation. Mallampati test is modestly sensitive test to predict difficult intubation. Head extension has better specificity but is less sensitive than thyromental distance in predicting difficult intubation. Interincisor gap raised more false positive alarms than any other parameter and did not correlate with laryngoscopic view.

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