

To compare the accuracy of Prayer's sign and Mallampatti test in predicting difficult intubation in Diabetic patients

Mirza Mudassir Ali Baig, Fazal Hameed Khan

Abstract

Objective: To determine the accuracy of Prayer's sign and Mallampatti test in predicting difficult endotracheal intubation in diabetic patients.

Methods: The cross-sectional study was performed at Aga Khan University Hospital, Karachi, over a period from January 2009 to April 2010, and comprised 357 patients who required endotracheal intubation for elective surgical procedures. Prayer's sign and Mallampatti tests were performed for the assessment of airway by trained observers. Ease or difficulty of laryngoscopy after the patient was fully anaesthetised with standard technique were observed and laryngoscopic view of first attempt was rated according to Cormack-Lehan grade of intubation. SPSS 15 was used for statistical analysis.

Results: Of the 357 patients, 125(35%) were classified as difficult to intubate. Prayer's sign showed significantly lower accuracy, positive and negative predictive values than Mallampatti test. The sensitivity of Prayer's sign was lower 29.6 (95% Confidence Interval, 21.9-38.5) than Mallampatti test 79.3 (95% confidence interval, 70.8-85.7) while specificity of both the tests was not found to be significantly different.

Conclusion: Prayer's sign is not acceptable as a single best bedside test for prediction of difficult intubation.

Keywords: Prayer's sign, Mallampatti, Difficult intubation. (JPMA 64: 879; 2014)

Introduction

Diabetes mellitus (DM) is an increasingly common disease that affects people of all ages, resulting in significant morbidity and mortality. During the past 20-30 years, the incidence of DM has rapidly increased throughout the world, the prediction being that it will increase by 200% in the next several decades.¹ Fifty percent of the diabetic patients undergo surgery at some point in life.²

About one-third of long-term insulin-dependent (type I) diabetics present with laryngoscopic difficulties.³ This is due, at least in part, to diabetic stiff joint syndrome characterised by a short stature, joint rigidity, and tight waxy skin.⁴ Patients with diabetic stiff joint syndrome have difficulty in approximating their palms and cannot bend their fingers backwards (the prayer's sign). When the cervical spine is also involved, limited atlanto-occipital joint motion may make laryngoscopy difficult. Limitation of small joint mobility in the hand, when severe, is easily detectable by the prayer's sign.⁵ The prayer's sign is a simpler bedside test for interphalangeal joint involvement.⁶ Difficult or failed tracheal intubation has been identified as one of the most important causes of death or permanent brain damage during anaesthesia.⁷ Reported incidence of a difficult laryngoscopy and

endotracheal intubation varies from 1.5% to 13% in patients undergoing general anaesthesia.⁸ The incidence of abandoned/failed intubation is approximately 0.05%-0.35% whereas that of cases that cannot be ventilated by mask or cannot be intubated is around 0.01%-0.02%.⁹ Approximately 30% of the deaths in patients who experienced difficulties at laryngoscopy or intubation are caused by hypoxic brain damage secondary to inability to maintain the airway.⁹ The prediction of an airway of a patient for laryngoscopic intubation is not an easy task. The difficulty lies in the search for a fine balance between simplicity and reliability of the airway assessment. In clinical settings, the assessment should be simple and convenient to the clinician and it should be of a high predictive power.¹⁰ Many methods have been used to predict difficult laryngoscopy and tracheal intubation. Available tests such as Mallampati test, interincisor gap, sub-luxation of mandible, thyromental distance, length of mandibular rim, chin protrusion and atlanto-occipital extension are not totally reliable.¹¹ The accuracy of the Mallampati test may vary according to patient's ethnic group and gender and pregnancy.¹² The increase in Mallampati score correlates with gain in body weight.¹³ In Asian patients it may be more difficult to intubate the trachea than in Caucasians.¹⁴ Prayer's sign is a simple bedside test in diabetic patients that can be used as a tool to assess difficult intubation along with other commonly used indices like Mallampatti test.

.....
Department of Anaesthesiology, Aga Khan University Hospital, Karachi.

Correspondence: Mirza Mudassir Ali Baig. Email: mudassir.baig@aku.edu

Apart from these studies, to our knowledge, there are no studies on this subject in our country. Our study was planned to be the first one in the country to compare Prayer's sign and Mallampatti test for the assessment of difficult intubation in DM patients.

Patients and Methods

The cross-sectional observational study was done at Aga Khan University Hospital (AKUH), Karachi, from January 2009 to April 2010 after approval from the institutional ethics review committee. A total of 357 patients having American Society of Anaesthesiologists (ASA) II status, age above 18 years and known cases of DM defined as fasting plasma glucose >126 mg/dl (7.0mmol/L) and 2-hour plasma glucose (PG)/oral glucose tolerance test (GTT) >200 mg/dl (11.1mmol/L) random PG >200 mg/dl (11.1mmol/L),¹⁵ planned for elective surgeries requiring general anaesthesia were included in the study. Those who already had airway deformity due to surgical or medical problem or those undergoing rapid sequence induction were excluded.

Pre-operatively, the primary investigator, who was not involved in intubating the airway of patient, performed Prayer's sign and Mallampatti test. Cormack and Lehane's criteria of laryngoscopy were taken as the gold standard. During intubation with Macintosh laryngoscope, the laryngoscopic view was graded according to Cormack & Lehane intubation grades:¹⁶ Grade I view connoted a full view of the entire glottic aperture; Grade II represented a half of glottic view; Grade III represented visualisation of the epiglottis; and Grade IV represents inability to visualise even the epiglottis.

Cormack and Lehane's classification of difficult intubation was also categorised as Grade I and II as Easy and Grade III and IV as Difficult.

The Prayer's sign was performed with the patient in the sitting position and asked to bring both his palms together as 'Maafe' and categorised as "Difficult intubation" when there was a gap between the palms and "Non-difficult intubation" when there was no gap between the palms (Figure-1).¹⁷

The Mallampatti Test (MT) was performed with the aid of flashlight and the patient was in a sitting position and asked to open mouth and protrude tongue without phonation. Oropharyngeal structures were visualised and graded as:

Class I: faucial pillars, soft palate and uvula were visualised; Class II: faucial pillars and soft palate were visualised;¹⁶ Class III: only soft palate was visualised; Class

IV: only hard palate was visualised.

Class I and II were considered "easy intubation" and class III and IV "difficult intubation" (Figure-2).

Another anaesthesiologist, who had at least one year's experience in anaesthesia, intubated the patient. He/she had not been informed of the pre-operative Mallampatti and Prayer's sign grades of the patient, done by the primary investigator.

On the day of the surgery, the patients were pre-medicated with oral midazolam 0.2mg/kg one hour before the operation. The patients were positioned with a standard pillow under the head. The patients were induced with inj. thiopentone sodium 5mg/kg, inj. morphine 0.1mg/kg or inj. pethidine 0.8mg/kg or inj. fentanyl 2 μ g/kg and inj. atracurium 0.5mg/kg. When the patient was adequately anaesthetised and fully relaxed, as confirmed by loss of four twitches in the peripheral nerve stimulator, laryngoscopy was done with Macintosh laryngoscope blade size 3 or 4 and laryngoscopic view of the first attempt were graded according to Cormack and Lehane classification. All these data, including demographic and easy and difficult intubation, according to criteria were entered in the proforma.

The data was double-entered into EPIDATA (version 3.0) and was validated for data entry errors. Final data was transferred into SPSS15 and was analysed. Frequencies and percentages were computed for qualitative observation, while mean and standard deviation (SD) of quantitative variables like age, duration of diabetes and number of attempts at intubation were computed and analysed by independent sample t test. $P<0.05$ was considered significant. Open-Epi calculator¹⁸ was used to estimate sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) with their 95% confidence intervals (CI) and likelihood ratio for Prayer sign and Mallampattit test, taking Cormack & Lehane intubation grade, as the gold standard.

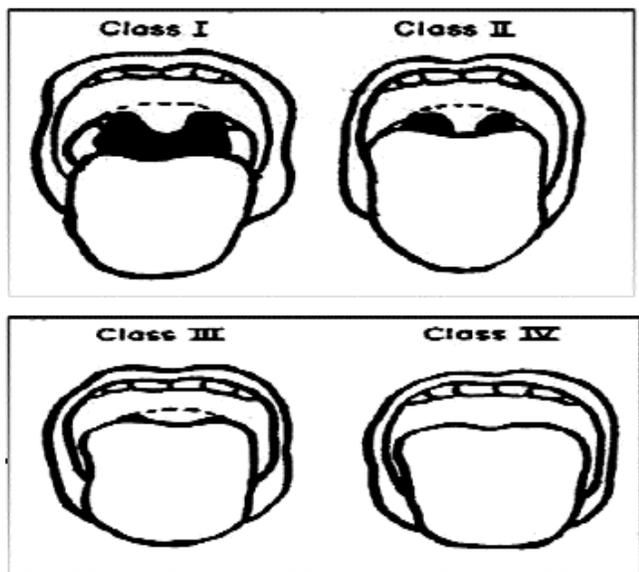
Results

Of the 357 patients in the study, there were 212 (59.4 %) males and 145(40.6%) females. Regarding ASA status of the patients, 214(59.9%) patients were in ASA-II; 140(39.2%) in ASA-III and 3(0.8%) in ASA-VI. The mean age and duration of diabetes was 53.7 ± 11.9 years and 9.06 ± 6.06 years respectively. Mean difference of age and experience of anaesthetics were not significant in easy versus difficult intubations, while mean difference of duration of DM and number of laryngoscopic attempts were significant between difficult and non-difficult



Difficult: When there is a gap between the palms, "Difficult intubation"
Easy: When there is no gap between the palms, "Non-difficult intubation"

Figure-1: Prayer's Sign.



Easy **Class I:** Faucial pillars, soft palate and uvula are visualised.
 Class II: Faucial pillars and soft palate are visualised.
Difficult **Class III:** Only soft palate is visualised.
 Class IV: Only hard palate is visualised.

Figure-2: Mallampatti Test (MT).

Table-1: Patient's Biometric data (n=357).

| Variables | Cormack & Lehan grade I & II (n=125) | Cormack & Lehan grade III & IV (n=232) | P-value |
|----------------------------------|--------------------------------------|--|---------|
| Age (in years) | 53.69 (9.294) | 53.7 (13.113) | 0.98 |
| Duration of DM (in years) | 11.21 (5.87) | 7.91 (5.86) | <0.001 |
| Experience of Anaesthetist | 2.96 (0.932) | 2.89 (0.667) | 0.52 |
| Number of laryngoscopic attempts | 1.74 (0.554) | 1.15 (0.36) | <0.001 |

Data are presented as mean and Standard Deviation and analysed by independent sample t test. CI: Confidence interval.

Table-2: Comparison of Predictive values for the Prayer's sign and Mallampatti test to predict difficult intubation.

| Statistical Test | Prayer's Sign | Mallampatti Test |
|-------------------------------------|------------------------|------------------------|
| True Positive (TP) | 37 | 99 |
| False Positive (FP) | 14 | 2 |
| True Negative (TN) | 218 | 230 |
| False Negative (FN) | 88 | 26 |
| Predictive values | | |
| Sensitivity | 29.6% (21.9% to 38.5%) | 79.3% (70.8% to 85.7%) |
| Specificity | 94.0% (90% to 96%) | 99.2% (96.6% to 99.7%) |
| PPV | 72.5% (58% to 83.7%) | 98% (92.3% to 99.7%) |
| NPV | 71.2% (66% to 76.2%) | 89.8% (85.3% to 93.1%) |
| Accuracy | 71.4% (66.5% to 75.8%) | 92.2% (88.9% to 94.2%) |
| Likelihood ratio of a Positive Test | 4.90(3.76 to 6.4) | 91.87 (34.4 to 246.1) |
| Likelihood ratio of a Negative Test | 0.74(0.73 to 0.76) | 0.21 (0.19 to 0.22) |

Results are presented as number, percentage (95%Confidence Interval).

PPV: Positive predictive value.

NPV: Negative predictive value.

intubations (Table-1).

Overall, 125(35%) patients had difficult intubations at laryngoscopy i-e grade III & IV (Cormack & Lehan). There was no failed intubation. Based on Prayer's sign 306(85.7%) patients were Prayer's sign -ve predicted to have easy laryngoscopy and 51(14.3%) had Prayer's sign +ve, predicting difficult laryngoscopy. Compared with Prayer's sign, difficult laryngoscopy was predicted in 37(72.5%) patients found to have Cormack & Lehan grade III & IV and 14(27.4%) had grade I & II indicating easy intubation.

Based on Mallampatti test (MT), patients who had MT for difficult intubation were 99(98%) having Cormack & Lehan grade III & IV, while 2 (1.9%) patients had Cormack & Lehangrade I & II.

All of these patients were successfully intubated after a mean number of 2±0.52 laryngoscopic attempts (range: 1-3). No patient had post-operative morbidity and mortality associated with difficult intubation.

Predictive values for prayer's sign and MT in predicting difficult intubation were noted (Table-2). Using the diagnostic test, differences were observed between these two tests showing higher level of sensitivity 79.3% and accuracy 92.2% for Mallampatti Test than Prayer's sign, which had sensitivity and accuracy of 29.6% and 71.4% respectively. Statistical analysis indicated that in diabetic patients Prayer's sign was a poor predictor for difficult intubation compared to Mallampatti test.

Discussion

Assessment of the airway and prediction of difficulty in laryngoscopy is done by most anaesthesiologists during the pre-operative check-up. Management of airway and maintaining the airway during anaesthesia is the prime responsibility of an anaesthesiologist and in order to provide safe anaesthesia it is mandatory to have a reliable tool for the assessment of airway prior to the surgery. Facing difficulty or failing in performing tracheal intubation has been identified as one of the most important causes of death or permanent brain damage during anaesthesia. Various studies have shown different incidences of a difficult laryngoscopy and endotracheal intubation in patients undergoing general anaesthesia. This variation in incidences might be due to the different reference standard for difficult intubation among studies which were based on Cormack-Lehane intubation grades,¹⁵ numbers of laryngoscopic attempts¹⁹ and use of Backward Upward Rightward Pressure (BURP) manoeuvre.⁹

Diabetic patients are said to be difficult to intubate.²⁰ A study³ reported an incidence of 32% (37 out of 115) in diabetic patients who had renal and pancreatic transplantation. Another study²¹ reported an incidence of 13% (7 out of 55) in patients who had pancreatic transplantation. Yet another study²² reported difficult laryngoscopy in 31% (19 out of 62) diabetic patients undergoing renal transplantation. Limited joint mobility syndrome occurs in 25% to 45% of patients with longstanding DM.²³ Glycosylation of tissue proteins from chronic hyperglycaemia resulting in abnormal cross-linking of collagen is believed to be responsible for this joint immobility. A study has suggested that diabetic patients may have abnormality of collagen metabolism and increased cross-link formation.¹⁶ Atlanto-occipital joint involvement may limit adequate positioning of the head and neck during intubation.²⁴ Thus a combination of limited cervical joint mobility and limited atlanto-occipital joint motion may make laryngoscopy and intubation difficult.⁵

Many methods to assess the airway, such as Mallampatti test, thyromental distance, inter-incisor gap, length of

mandibular rim, chin protrusion, atlanto-occipital extension, Palm test and Prayer's sign have been described in literature, but all have their limitations and no one test alone is 100% sensitive and specific. Combination of these different tests may increase their predictive value for difficult intubation.

The objective of the current study was to determine the accuracy of Prayer's sign and MT in predicting difficult intubation and relating their sensitivity, specificity and PPVs against actual laryngoscopic view by using gold standard, Cormack & Lehane grading.

Results showed that the accuracy 71.4% sensitivity 29.6% PPV 72.5% and NPV 71.2% of Prayer's sign were lower than Mallampatti test, while specificity of both the test were similar.

Regarding Mallampatti test accuracy, sensitivity and PPV and NPV values were 92.2%, 79.3%, 98% and 89.8% respectively which were higher than Prayer's sign.

Sensitivity of Mallampati test was significantly more in our study compared to earlier studies^{9,21} which were done in Asian population and may have reflected some ethnic correlation with the sensitivity of Mallampati test. This possibility is also supported by the finding of a study,⁸ which found low sensitivity (42%) of Mallampati test.

Other probable reason for "low sensitivity" of Prayer's sign in our study may be the absence of inter-observer reliability factor as all the patients were assessed by the primary investigator. This issue of inter-observer reliability was confirmed by studies^{7,16} which showed poor inter-observer reliability for Mallampati test compared to other tests.

- ◆ The main strength of the current study was that Prayer's sign and MT were performed for the assessment of airway by the primary investigator, which reduced the risks of inter-observer variation, and increased the reliability of the tests.

- ◆ Besides, the sample was calculated accurately and the study design was appropriate.

In terms of limitations, some patients did not completely understand the instructions, and our suggestion is that the anaesthesiologists should demonstrate the test in front of the patient to increase patient compliance. Besides, Prayer's sign cannot be performed in patients having congenital or traumatic joint disorder as well in uncooperative patients. High incidence of difficult intubation was also a limitation as majority of the intubations were done by an anaesthetist with 2-year or more experience in Anaesthesia. The incidence would

have been low if intubations were done by senior anaesthetists with more experience. Though we compared Prayer's sign with Mallampati test, our suggestion is that it should be compared with the other prevailing tests which are often used to assess difficult intubations.

Conclusion

Though several tests are available to anaesthesiologists, in diabetics Palm print is the best single predictor of a difficult intubation, followed by Mallampati and the Prayer's sign. Diabetic patients in our population were generally not difficult to intubate. Results showed that Prayer's sign had a lower level of accuracy compared to Mallampati test. In several patients, Prayer's sign was not able to identify difficult laryngoscopy even if the test had predicted difficult laryngoscopy, whereas ability to predict both easy and difficult laryngoscopies were also less with Prayer's sign compared to Mallampati test. Due to better sensitivity and PPV, Mallampati test appears to be a better choice for the pre-operative airway assessment with its limitation that this cannot be performed in edentulous, restricted mouth opening as well as in uncooperative patients.

References

1. Robertshaw HJ, Hall GM. Diabetes mellitus: anaesthetic management. *Anaesthesia* 2006; 61: 1187-90.
2. Jonasson O. Surgical aspects of diabetes mellitus. In: Sabiston CD Jr Ed. *Sabiston Textbook of Surgery. The biological basis of Modern Surgical Practice*, 13th ed. Philadelphia: WB Saunders; 1997, pp 183.
3. Hogan K, Rusy D, Springman SR. Difficult laryngoscopy and diabetes mellitus. *Anesth Analg* 1988; 67: 1161-5.
4. Grgic A, Rosenbloom AL, Weber FT, Giordano B, Malone JJ, Shuster JJ. Joint contracture - common manifestation of childhood diabetes mellitus. *J Pediatr* 1976; 88: 584-8.
5. Rosenbloom AL, Silverstein JM, Lezotte DC, Richardson K, McCallum M. Limited joint mobility in childhood diabetes indicates increased risk for microvascular disease. *N Engl J Med* 1981; 305: 191-4.
6. Sauseng S, Kastenbauer T, Irsigler K. Limited joint mobility in selected hand and foot joints in patients with type I diabetes mellitus: a methodology comparison. *Diabetes Nutr Metab* 2002; 15: 1-6.
7. Hilditch WG, Kopka A, Crawford JM, Asbury AJ. Interobserver reliability between a nurse and anaesthetist of tests used for predicting difficult tracheal intubation. *Anaesthesia* 2004; 59: 881-4.
8. Siddiqui R, Kazi WA. Predicting difficult intubation, a comparison between Mallampati classification and Wilson Risk-Sum. *J Coll Physician Surg Pak* 2005; 15: 253-6.
9. Naguib M, Scamman FL, Sullivan CO, Aker J, Ross AF, Kosmach S, et al. Predictive performance of three multivariate difficult tracheal intubation. *Anesth Analg* 2006; 102: 818-24.
10. Hung O, Mills M. Predictions and clinical decisions: a fine balance. *Can J Anaesth* 2000; 47: 721-4.
11. Khan ZH, Kashfi A, Ebrahimkhani E. A comparison of the upper lip bite test (a simple new technique) with modified Mallampati classification in predicting difficulty in endotracheal intubation. A prospective blinded *Anesth Analg* 2003; 96: 595-9.
12. Davis JM, Weeks S, Crone LA, Pavlin E. Difficult intubation in the parturient. *Can J Anaesth* 1989; 36: 668-74.
13. Pilkington S, Carli F, Dakin MJ, Romney M, DeWitt KA, Doré CJ et al. Increase in Mallampati score during pregnancy. *Br J Anaesth* 1995; 74: 638-42.
14. Wong SH, Hung CT. Prevalence and prediction of difficult intubation in Chinese women. *Anaesth Intensive Care* 1999; 27: 49-52.
15. Gale EAM, Anderson JV. Diabetes mellitus and other disorders of metabolism. *Kumar and Clark's Clinical Medicine*. 7th edition. Edinburgh: Saunders Elsevier, 2009; pp 1029-76.
16. Elberhart LHJ, Arndt C, Cierpka T, Schwaneckamp J, Wulf H, Putzke C. The reliability and validity of the upper lip bite test with Mallampati classification to predict difficult laryngoscopy: An external prospective evaluation. *Anesth Analg* 2005; 101: 284-89.
17. Vani VV, Kamath SK, Naik LD. The palm print as a sensitive predictor of difficult laryngoscopy in diabetics: a comparison with other airway evaluation indices. *J Postgrad Med* 2000; 46: 75-9.
18. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. (Online) 2013/04/06. (Cited 2013 Oct 28] Available from URL: http://www.openepi.com/v37/Menu/OE_Menu.htm.
19. Brodsky JB, Lemmens HJ, Brock Utne JG, Vierie M, Saidam LJ. Morbid obesity and tracheal intubation. *Anesth Analg* 2002; 94: 732-6.
20. Buckingham BA, Uitto J, Sandborg C, Keens T, Kaufman F, Landing B, et al. Scleroderma-like and non-enzymatic glycosylation of collagen in children with poorly controlled insulin-dependent diabetes. *Pediatr Res* 1981; 15: 626.
21. Beebe DS, Belani KG, Yoo M, Rainer WG. Anaesthetic considerations in pancreatic transplantation based on a one year review. *Am J Anaesthesiol* 1995; 22: 237-43.
22. Reissell E, Orko R, Manunksela EL, Lindgren L. Predictability of difficult laryngoscopy in patients with long-term Diabetes Mellitus. *Anaesth* 1990; 45: 1024-7.
23. Nadal JLY, Fernandez BA, Escobar IC, Black M, Rosenblatt WH. Palm print as a sensitive predictor of difficult laryngoscopy in diabetics. *Acta Anaesthesiol Scand* 1998; 42: 199-203.
24. Salzaru HH, Taylor LA. Diabetic "stiff joint syndrome" as a cause of difficult endotracheal intubation. *Anaesthesiology* 1986; 64: 366-8.