PREDICTING DIFFICULT AIRWAY IN APPARENTLY NORMAL ADULT AND PEDIATRIC PATIENTS

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Abstract
The aim of the study was to determine the predicting tests for difficult airway and difficult intubation in apparently normal patients.

Methods: We were using the literature about the specific tests for predicting difficult airway and single parameters that could be a significant test for prediction of difficult or impossible intubation. Clinical risk factors for difficult intubation in pediatric patients are related to the anatomic differences between pediatric patients and adults.

Quantitative evaluation of difficult intubations could be realized using Cormack-Lehane (CL) scale and Mallampati score (without speaking – Mallampati test – and modified Mallampati test during speech).

The Cormack-Lehane (CL) scale is a grading system commonly used to describe the view of the larynx during direct laryngoscopy. Grades 3 and 4, in which the glottis is not visualized, are considered difficult intubations. The Mallampati score, estimates the size of the tongue relative to the oral cavity and the ability to open the mouth. This system graded the patient (grades 1 to 4) based on the structures visible in the oropharynx with maximal mouth opening. Grade 3 or 4 suggests a significant chance that the patient will be difficult to intubate.

Results: Our results showed that 24 patients (20 adult patients and 4 pediatric patients), 3.2% from total of 750 involved in the study had difficult intubation (Mallampati grades 3 and 4). 35% of the patients had impaired glottis exposure (grades 3 and 4 of the Cormack-Lehane scale).

Conclusion: We used only two criteria for describing both the visibility of the oropharyngeal structures and the quality of the laryngeal view. The effective and reliable prediction requires a combination of several parameters (BMI, head and neck movement, dentition status, upper lip bite test, interincisor gap and thyromental distance).

Key words: predicting test, difficult airway, Mallampati test, Cormack-Lehane scale.

Introduction
Predicting difficult airway is very important preoperative examination, because the unexpected difficulties may occur in 25–30% of cases in clinical practice and it could be diminished on 10% of cases with prescribed preoperative evaluation.

Difficulty prediction is based upon: the airway history, clinical examination of the face and the neck and direct measuring of some parameters or tests.

Specific tests for predicting the difficult airway are [14]:

1) interincisor distance (or intergingival distance in case of mobile prosthesis);
2) pharyngeal structures visibility (without speaking – Mallampati test – and modified Mallampati test during speech);
3) mental-thyroidal distance in head extension;
4) mental-hyoid bone distance;
5) grade and correction possibility of maxillary prognatism;
6) mental-jugular distance in head extension;
7) neck flexion-extension degree.

Some of them are significant tests that are useful for prediction of impossible intubation, and the others are considered signs of predictable or certain difficult intubation associated with another circumstances.
Single parameters that could be a significant test for prediction of the difficult or impossible intubation are [13]:

a) interincisor distance equal or less than 30 mm (if less than 20 mm, neither laryngoscopic traditional blades nor the majority of extraglottic devices can be introduced into the mouth);

b) large prominence of superior teeth above inferior teeth, especially if not corrigible with jaw-thrust manoeuvre;

c) mental-thyroidal distance equal or less than 60 mm;

d) Mallampati test degree 4, not modified by phonation;

e) fixed neck in flexion;

f) scar tissue or large post-irradiation scars of tongue and soft tissues and large submandibular masses.

Considered signs of predictable or certain difficult intubation associated with another circumstances:

a) interincisor distance between 30 and 35 mm;

b) modest or severe but corrigible prognathism;

c) mental-thyroidal distance between 60 and 65 mm;

 Airway evaluation criteria in pediatric patients are: anamnesis and clinical evaluation.

Clinical risk factors for difficult intubation in pediatric patients are related to the anatomic differences between pediatric patients and adults, including [15]:

- the relative position of the larynx in the neck,
- a less rigid airway,
- the size of the occipital bones,
- tongue size,
- decreased functional pulmonary reserve,
- less developed accessory muscles of respiration, and
- small airway diameter.

Most cases of acute airway compromise in children are the result of infections, the presence of foreign bodies, or trauma.

Additional predictors of a difficult intubation in pediatric patients include the following:

- Small mouth opening;
- Mental-hyoid distance (a measure to evaluate the submandibular space);
- Impaired head and neck mobility;
- Micrognathia (small lower jaw);
- Retrognathia (receding mandible or maxilla);
- Mandibular dysplasia or hypoplasia;
- Macroglossia (enlargement of the tongue);
- Space-occupying airway lesions;
- Supralaryngeal inflammatory pathology;
- Nasal airway obstruction;
- Pathologic obesity;
- Craniofacial abnormalities.

Another common approach to predicting difficult intubation is an evaluation guided by the mnemonic LEMON airway assessment method [12]:

- **L** = Look externally for anatomic feature that may make intubation difficult;
- **E** = Evaluate the 3-3-2 rule; Mouth opening (3 finger-breadths); Hyoid-chin distance (3 finger-breadths); Thyroid cartilage-floor of mouth distance (2 finger-breadths);
- **M** = Mallampati score; Class 1: soft palate, uvula, pillars visible; Class II: soft palate, uvula visible; Class III: soft palate, base of uvula visible; Class IV: hard palate visible;
- **O** = Obstruction: examine for partial or complete upper airway obstruction;
- **N** = Neck mobility.

Other bedside tests that assess for anatomic indicators of a potentially difficult intubation include measurement of thyromental, sternomental, hyomental, and interincisor distances:

- Thyromental distance (TMD) is a measurement taken from the thyroid notch to the tip of the chin with the head extended. Determination of TMD can be difficult in patients who are overweight, patients who are immobilized, and patients with goiters or other neck diseases [8];
- Sternal distance (SMD) is the distance from the tip of the chin to the sternal notch with the mouth closed and head in full extension [16];
- Hyomental distance is the distance from the hyoid bone to the mentum (chin) [18];
- Interincisor distance (IID) measures the distance between the patient’s incisor teeth [18];
- The upper lip bite test assesses the patient’s ability to bite the upper lip with the lower teeth [18].

The Aim

The aim of the study was to determine the predicting tests for difficult airway and difficult intubation in apparently normal patients.

**Material and methods**

We design a study to determine the accuracy of the modified Mallampati test (during speech) for predicting difficult tracheal intubation and laryngoscopic view using the Cormack-Lehane scale at adult patients and children.

750 patients (ASA I physical status) were divided in two groups: 600 adult and 150 pediatric patients undergoing ENT surgery.
We defined classes 3 and 4 of the modified Mallampati test (during speech) as a predictor of difficult intubation and grades 3 and 4 of the Cormack-Lehane classification of the laryngoscopic view as impaired glottic exposure.

We were using the literature about the specific tests for predicting difficult airway and single parameters that could be significant test for prediction of the difficult or impossible intubation.

Clinical risk factors for difficult intubation in pediatric patients are related to the anatomic differences between pediatric patients and adults.

Quantitative evaluation of difficult intubations could be realized using Cormack-Lehane (CL) scale and Mallampati score (without speaking – Mallampati test – and modified Mallampati test during speech).

The Cormack-Lehane (CL) scale is a grading system commonly used to describe the view of the larynx during direct laryngoscopy. Grades 3 and 4, in which the glottis is not visualized, are considered difficult intubations.

The modified Mallampati score, estimates the size of the tongue relative to the oral cavity and the ability to open the mouth, during the speech. This system graded the patient (grades 1 to 3) based on the structures visible in the oropharynx with maximal mouth opening. Grade 3 or 4 suggests a significant chance that the patient will be difficult to intubate.

Clinical examinations consist of:

1. Exploration of oropharyngeal region, oral cavity – tongue relative ratio and temporo – mandibular joint motility. Mallampati test may not always be performed in pediatric patients, because they are not cooperative as adults are. Macroglossia or infiltrating process of the oral cavity used to be predicting factors for difficult intubation, especially if they are associated with narrow mandibular space.

2. Exploration of mandibular or submental space (mental-hyoid distance) is proportionally reduced at pediatric patients than the adults (1.5 cm in the newborn and the infant, 3 cm in the child). Thyro-mental distance is not a strong predictive value for difficult intubation at pediatric patients opposite to the adults.

3. Temporo-mandibular joint motility (35°) is another not strong predicting test in pediatric patients.

4. Head-neck motility – head extension less than 35° is rarely reduced in pediatric patients.

Quantitative evaluation of difficult intubations

Visibility of the glottis during the intubation using a direct laryngoscopy technique is often documented to describe predicted ease of intubation.

The Cormack-Lehane (CL) classification is a grading system commonly used to describe the view of the larynx during direct laryngoscopy. Grades 3 and 4, in which the glottis is not visualized, are considered difficult intubations [4, 9].

Another commonly used predictor of difficult intubation, the Mallampati score, estimates the size of the tongue relative to the oral cavity and the ability to open the mouth. Originally, this system graded the patient (grades 1 to 3) based on the structures visible in the oropharynx with maximal mouth opening; a fourth grade was subsequently added. Grade 3 or 4 suggests a significant chance that the patient will be difficult to intubate [11, 17].

Results

Our results showed that 24 patients; 20 adult patients and 4 pediatric patients, (3.2%) from total of 750 involved in the study had difficult intubation (Mallampati grades 3 and 4). 35% of the patients had impaired glottis exposure (grades 3 and 4 of the Cormack-Lehane scale).

Discussion

The Mallampati test is a worldwide used scoring system for predicting difficult intubation. It has been cited in numerous publications since 1985. The accuracy of the Mallampati test has been questioned a number of times and there is controversy about its value 3 and 4. On the other hand it still remains a clinical assessment method for many anesthesiologists.

We can compare our results with Milan Adams et al [1]. They have a similar proportion of patients with inadequate glottis exposure (28 cases out of 210 patients and 48 cases out of 1,518 patients). Using the Mallampati test, they failed to detect as many as 35.4% patients in whom the glottis exposure during direct laryngoscopy was found inadequate (64.6% sensitivity).

In a series of 1,956 patients undergoing elective general anesthesia, Cattano et al [3] demonstrated a good correlation between the Mallampati scale and the CL classification, although the Mallampati scale lacked the sensitivity to be predictive when used alone.

Risk indexes have been developed based on quantitative evaluations. Wilson et al [18] developed a risk scoring system based on body weight, head and neck movement, jaw movement, and the presence or absence of mandibular recession and protruding teeth.

The Naguib model considers TMD, Mallampati score, IID, and height [13].

The El-Ganzouri risk index was devised from prospective evaluation of 10,507 patients [25].
The multivariate risk index combined and stratified seven variables derived from parameters and observations individually associated with difficult intubation.

A case-controlled, double-blind study examined three multivariate risk indexes, the Wilson, Arne, and Naguib risk models, to determine the most sensitive model in the prediction of difficult intubations. The Naguib model demonstrated the highest sensitivity (82.5%) and specificity (86.5%).

A meta-analysis by Shiga et al. [17] evaluated bedside tests for predicting difficult intubation, including the Mallampati classification, TMD, SMD, mouth opening, and the Wilson risk score. These tests had poor-to-moderate discriminative power when used alone. Combinations of tests add incremental diagnostic value; the most useful combination of tests for prediction of difficult intubation was the Mallampati classification and TMD. Similarly, a systematic review of the accuracy of the original and modified Mallampati score concluded that when used alone, the Mallampati test is insufficient to predict a difficult intubation. Forty-two studies enrolling 34,513 patients were included [10].

Conclusion
We used only two criteria for describing both the visibility of the oropharyngeal structures and the quality of the laryngeal view.

The effective and reliable prediction requires a combination of several parameters (BMI, head and neck movement, dentition status, upper lip bite test, interincisor gap and thyromental distance).

History evaluation (anamnesis) and target clinical tests are necessary for prediction of the difficult airway in pediatric patients and the adults as well. Preoperative evaluation, planning of difficult airways management strategies and the description of all observed parameters represent a fundamental part of anaesthesiological evaluation.

REFERENCES

Резиме

ПРЕДВИДУВАЊЕ НА ТЕЖОК ДИШЕН ПАТ КАЈ НАВИДИДУМ НОРМАЛНИ ВОЗРАСНИ И ПЕДИЈАТРИСКИ ПАЦИЕНТИ

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Целта на оваа студија е да се детерминираат тестовите кои можат да предвидат постоуене на тежок дишеш пат и тешка интубација кај навиди нормални пациенти.

Методи: Користење литература за специфичните тестови со кои се предвидува постоуенето на тежок дишеш пат како и едностани параметри кои можат да бидат значајни тестови за предвидување на тешка или невозможна интубација.

Клиничките ризични фактори кај педијатриските пациенти се во сооднос со анатомските варијации помеѓу педијатриските пациенти и возрасните.

Квантитативната евалуација на тешка интубација може да биде реализирана со помош на Cormack-Lehane (CL) скалата и Mallampati тестот (без зборуване – Mallampati тест – и модифициран Mallampati тест, изведен за време на зборуване).

Cormack-Lehane (CL) скалата е скала која се користи за да се опише изгледот на гласните жици за време на директна ларингоскопија. Скалите 3 и 4, кои се однесуваат на гласни жици кои не можат да се видат, предвидуваат тешка интубација.

Mallampati тестот се однесува на соодносот на големината на јазикот и устната празнина, како и на можноста да се отвори сила устата. Тестот се базира на видливоста на структурите на орофаринксот при максимално отварање на устата и ги содржи степените од 1 до 3. Степените 3 и 4 се значителен доказ дека пациентот е кандидат за тешка интубација.

Резултати: Наѓите резултати покажаа дека 24 пациенти, од кои 20 возрасни, а 4 педијатрски пациенти (3.2%) од вкупно 750 пациенти кои беа анализирани, имаа тешка интубација (Mallampati 3 и 4). Отежнатата видливост на гласните жици има 35% од пациентите (степен 3 и 4 од Cormack-Lehane скалата).

Заклучок: Ние користевме само два критериум со кои ја проценуваае видливоста на орофарингеалните структурни и видливоста на гласните жици.

За поефикасна процена потребна е комбинација на неколку параметри (BMI – индекс на здобеленост, движење на главата и вратот, дентицискиот статус, тестот на загриз на горна усна, растојанието помеѓу иницизивите и тиреоменталното растојание).

Ключни зборови: тестови за предвидување на тежок дишеш пат, Mallampati тест, Cormack-Lehane скала.