THE PRAYER SIGN AS A PREDICTOR OF DIFFICULT LARYNGOSCOPY AND COMPARISON TO OTHER MEASURABLE PHYSICAL INDICES

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Introduction

The anesthesia provider must be proficient at the preoperative airway examination of the surgical patient. Difficult intubations remain the most common anesthesia-related cause of perioperative morbidity and mortality. Anticipation of and appropriate preparation for the difficult airway prior to induction of anesthesia and airway instrumentation increase patient safety. The purpose of this research study was to collect data to investigate the airway examination measures most predictive of difficult direct laryngoscopy. These factors include relevant patient history and physical indices such as mallampati classification, thyromental distance, incisor gap, neck circumference and body mass index. Studies demonstrate that each factor individually is insensitive as a predictor for the ease of direct laryngoscopy and tracheal intubation [1]. Part of this is due to the high intraobserver variability [2]. Numerous authors use different combinations of factors, such as developing an "Intubation Difficulty Scale", to help predict difficult airway management [3]. Ultimately, the use of multiple physical indices gathered during the preoperative assessment period may help the anesthesiologist prepare for difficult airway scenarios.

Many of the measurable physical indices are not sensitive to certain medical illnesses, such as diabetes mellitus. Previous studies show that patients with diabetes mellitus may have decreased mobility of the alanto-occipital joint [4]. This is partly due to limited joint mobility in diabetics, which can also manifest in the small joints of the hands with concurrent thickening and waxiness of the skin [5]. The joint changes may be seen in both insulin-dependent and non-insulin dependent diabetics, increasing in frequency with elevated hemoglobin A1C values, duration of diabetes, advanced age, and cigarette smoking [5]. The pathophysiology involves the enzymatic glycosylation of collagen and deposition into joints, such as those in the hands and axial skeleton [5]. Limited movement at the alanto-occipital joint can precipitate a potentially difficult airway scenario due to limited head and neck mobility. The anesthesia provider may examine the diabetic patient for the presence of the "Prayer sign", which tests the ability of the patient to flatten the hands together in a prayer-like fashion, where complete
approximation of the palmar aspects of the metacarpophalangeal, proximal interphalangeal, and distal interphalangeal joints comprise a negative test. The most common fingers affected in limited joint mobility are digits two through five. Another test used to diagnose joint glycosylation in the hands is the “palm print” test, which measures the ability of a patient to flatten the palm of his hand against the surface of a table.

There are many studies showing that diabetic patients can be difficult to intubate [8,9,10]. Previous studies demonstrate that the graded palm print test is a sensitive predictor of increased difficulty of laryngoscopy in the adult diabetic [6,7]. Yet, the method of using ink to determine difficult airway management may not be practical in private settings. In addition, in one study, only Type I or Type II diabetics were evaluated with the palm print test, with no comparison to controlled individuals. Moreover, both studies are limited by the ethnic makeup of the populations studied. While Nadal, JLY, et al compare multiple airway indices, including the prayer sign, they do not include quantitative criteria to define a positive prayer sign, which can lead to higher false positive results. Another study found that there is an increased frequency of difficult laryngoscopy and prayer sign in only Type II diabetics, with the duration of ten years as the inclusion criteria, but found that there was no relationship between the two variables [7].

Our goal was to determine the relationship between difficulty of direct laryngoscopy and limited joint mobility in insulin-dependent, non-insulin dependent and controlled (non-diabetic) patients, as demonstrated primarily by the prayer sign. Patients were grouped according to their age, gender, ethnicity, and social history. The “Prayer sign” was the diagnostic test for limited joint mobility and additional airway exams such as Mallampati classification, thyromental distance (TMD), incisor gap, neck circumference, cervical range of motion and body mass index (BMI) were also used. Blood glucose measurements and hemoglobin A1C levels, when available, were documented to provide a measure of diabetic control.
Methods

Patients undergoing general anesthesia with anticipated endotracheal intubation were randomly selected for inclusion in this study. Those patients with carpal tunnel syndrome, arthritis, dupuytren’s contracture, missing digits or other anatomic variations of the hands were excluded to minimize false positive Prayer Sign findings. Patients not meeting any exclusion criteria were asked about a history of diabetes; known diabetics were screened for their level of diabetes control with a bedside blood glucometer, and preoperative hemoglobin A1C values were included when available. The patient’s age, height, weight, and cigarette smoking history were also collected. Finally, in addition to the routine pre-anesthetic history and physical examination, the following specific diagnostic tests were performed:

I. Prayer Sign: patients asked to approximate the palms of their hands together, with any distance between the palmar aspects of the second to fifth digits measured with number of tongue blades

II. Mallampati classification: patients asked to be in the sitting position, mouth fully open, tongue fully extended, with no phonation, with classification as follows:
   a. Class I: soft palate, fauces, uvula, and tonsillar pillars are visible.
   b. Class II: soft palate, fauces, and uvular are visible.
   c. Class III: soft palate and base of the uvular are visible.
   d. Class IV: soft palate not visible.

III. Thyromental distance (TMD): patients asked to extend head fully and the distance between chin and notch of thyroid cartilage is measured

IV. Incisor gap: distance between the upper and lower incisors with mouth maximally opened

V. Cervical flexion and extension: angle from neutral head position to full cervical flexion and from neutral head position to full cervical extension were measured using a protractor.

VI. Body mass index (kg/m²): calculated from the patients’ height and weight measured on the day of surgery

Patients received anesthetic premedication with midazolam in the preoperative holding area prior to being taken to the operating room. Upon arrival in the operating
room, standard ASA monitors were placed. Patients were pre-oxygenated for greater than three minutes, followed by induction of general anesthesia. All patients received a neuromuscular blocking agent prior to airway instrumentation. Direct laryngoscopy was performed with a Macintosh blade by an attending anesthesiologist, who graded the view according to the modified Cormack and Lehane system, as demonstrated in Table 1 below:

<table>
<thead>
<tr>
<th>Original Cormack and Lehane system</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>View at laryngoscopy</td>
<td>Full view of the glottis</td>
<td>Partial view of the glottis or arytenoids</td>
<td>Only epiglottis visible</td>
<td>Neither glottis nor epiglottis visible</td>
</tr>
<tr>
<td>Modified system</td>
<td>1</td>
<td>2a</td>
<td>2b</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>As for original Cormack and Lehane above</td>
<td>Partial view of the glottis</td>
<td>Arytenoids or posterior part of the vocal cords only just visible</td>
<td>As for original Cormack and Lehane above</td>
</tr>
</tbody>
</table>

Table 1. Comparison of the original Cormack and Lehane system and the Modified Cormack and Lehane system, with corresponding views at laryngoscopy. [1]

Results

A total of 34 patients were included in this study. The age of the patients ranged from 18 to 81 years old, with a mean age of 45 and median age of 47. There were a total of 20 males (70%) and 14 females (30%). 4 patients had a known history of type II diabetes mellitus. 2 patients demonstrated a positive Prayer Sign, but neither of these patients were diabetics. The patients with positive Prayer Signs were found to have Modified Cormack and Lehane System grades of 1 and 2b on direct laryngoscopy.

The Mallampati classification, BMI, Prayer Sign finding, TMD, neck circumference, cervical flexion and extension angles, incisor gap, and modified Cormack and Lehane grading for each patient were transcribed into a Microsoft Excel spreadsheet. The preoperative measures and findings (BMI, Prayer Sign finding, TMD, neck circumference, cervical flexion and extension angles, and incisor gap) were then compared to the corresponding Modified Cormack and Lehane grade for each patient using linear regression analysis. Correlation, coefficient of determination, and P values were calculated. The Mallampati classification, as it did not consist of a strict ordinal sequence, was compared with the Modified Cormack and Lehane grades by calculating
the Spearman's rank correlation coefficient, which is equivalent to the P value. The data is presented in Table 2 below:

<table>
<thead>
<tr>
<th></th>
<th>BMI (kg/m^2)</th>
<th>Mallampati Classification</th>
<th>Prayer Sign (Tongue Blades)</th>
<th>TMD (cm)</th>
<th>Neck Circumference (cm)</th>
<th>Neck Flexion (degrees)</th>
<th>Neck Extension (degrees)</th>
<th>Incisor Gap (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>33.1</td>
<td>N/A</td>
<td>0.0571</td>
<td>8.73</td>
<td>40.5</td>
<td>59.4</td>
<td>56.3</td>
<td>4.91</td>
</tr>
<tr>
<td>Median</td>
<td>30.8</td>
<td>N/A</td>
<td>0</td>
<td>7</td>
<td>41</td>
<td>60</td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>Correlation with Modified Cormack &amp; Lehane System</td>
<td>0.0325</td>
<td>N/A</td>
<td>0.0824</td>
<td>-0.141</td>
<td>0.315</td>
<td>-0.0784</td>
<td>-0.33</td>
<td>-0.417</td>
</tr>
<tr>
<td>Coefficient of Determination</td>
<td>0.00106</td>
<td>N/A</td>
<td>0.00679</td>
<td>0.0200</td>
<td>0.0995</td>
<td>0.00620</td>
<td>0.11</td>
<td>0.174</td>
</tr>
<tr>
<td>P Value</td>
<td>0.855</td>
<td>0.228</td>
<td>0.643</td>
<td>0.426</td>
<td>0.0692</td>
<td>0.659</td>
<td>0.058</td>
<td>0.0141</td>
</tr>
</tbody>
</table>

Table 2. Measurable physical indices and correlation with Modified Cormack and Lehane System airway grading during direct laryngoscopy.

Discussion

The measurable physical indices with the highest correlation to the Modified Cormack and Lehane System were the incisor gap (-0.417), range of neck extension (-0.33), and the neck circumference (0.315). As one might expect, a larger neck circumference has a moderate linear correlation with a higher Modified Cormack and Lehane System grade, suggestive of increased difficulty with direct laryngoscopy. In contrast, a larger incisor gap and an increased range of neck extension have a moderate linear correlation with a lower Modified Cormack and Lehane System grade, facilitating easier direct laryngoscopy. These values, however, do not suggest a strong linear correlation, as they do not exceed the positive threshold of 0.75, nor do they fall below the negative threshold of -0.75. Only the incisor gap demonstrated a statistically significant correlation with a P value less than 0.05 (0.0141).

The Prayer Sign, which was the primary physical exam measure being investigated, had a very weak positive correlation (0.0824) with the Modified Cormack and Lehane System (P value 0.643). The lack of patients in the study population, and thus the small number of patients with a positive Prayer Sign (n=2), limits the significance of these findings and any conclusion made therein.

Furthermore, the Mallampati classification for preanesthetic airway grading, which is widely used as a predictor of difficult airways, did not demonstrate a statistically significant relationship to the Modified Cormack and Lehane System (P value 0.228). It
is difficult to say whether this would continue to hold true if the study population were larger.

Numerous airway examination measures, airway classification systems and other physical indices have been used by anesthesiologists to help predict those patients for which direct laryngoscopy and endotracheal intubation will be difficult. The quality of these measures and the degree to which they can predict for a difficult airway has far-reaching implications to the practice of anesthesiology. There is a need for further research in this area, and plans to expand upon this particular study are underway with the primary goal of increasing the size of the study group.

References