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ORIGINAL ARTICLE

Prediction of Difficult Tracheal Videolaryngoscopic Intubation Using El-Ganzouri Risk Index

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Summary
Introduction. Unanticipated difficult intubation still exists as a significant problem. El-Ganzouri risk index is a bedside difficult airway evaluation method, which can help determine risk of difficult airways. However, evidence of using of El-Ganzouri risk index in difficult laryngeal visualisation using videolaryngoscopes is limited.
Aim of the Study. Determine the specificity and sensitivity of El-Ganzouri multivariate risk index to predict difficult laryngeal exposure using Storz C-MAC videolaryngoscope equipped with D type blade.
Material and methods. We conducted a study of 29 patients, which were examined using El-Ganzouri risk index before induction of anaesthesia. After induction of anaesthesia videolaryngoscopy was performed using Storz C-MAC videolaryngoscope equipped with D-blade and laryngeal visualisation was graded using Cormack-Lehane scale. After laryngeal visualisation grading endotracheal tube insertion was performed and numbers of attempts as well as complications during intubation were recorded. Sensitivity, specificity, positive and negative predictive values were calculated, receiver operating characteristic curve and area under curve was obtained.
Results. Sensitivity and specificity were 54.2% and 80.0% at El-Ganzouri risk index cut-off value of 2 points. Calculated positive predictive value was 26.7% and negative predictive value was 92.9%. Calculated AUC was 78.3%.
Conclusions. El-Ganzouri risk index shows moderate sensitivity and specificity when used with Storz C-MAC videolaryngoscope. It can be used to predict difficult laryngeal visualization during videolaryngoscopic intubation.
Key words: difficult, intubation, pre-operative, evaluation, El-Ganzouri, videolaryngoscopy, Storz C-MAC, D-blade.

INTRODUCTION

Unanticipated difficult intubation, which is commonly associated with inability to achieve adequate laryngeal exposure, still remains general problem, which can lead to serious complications such as brain damage or even death(4). According to recent data, percentage of difficult intubation varies from 1 to 18% percent(8), and identification of the patient with a possible difficult airway scenario is one of the key points of managing anaesthesia in the most safe and optimal way. Multivariate risk indexes, such as El-Ganzouri multivariate risk index, are bedside airway evaluation tests used in pre-operative setting, which are designed to predict risk of difficult tracheal intubation and choose optimal way of intubation, when difficult intubation factors are not obvious(5,7). During recent years many alternatives to direct laryngoscopy, such as different types of videolaryngoscopy devices have been introduced, and Storz C-MAC(KARL STORZ GmbH & Co. KG, Tuttlingen, Germany) is one of them(9). According to study results, in which direct laryngoscopy and videolaryngoscopy techniques were compared, usage of videolaryngoscopes, including Storz C-MAC, not only improves the overall visualization of the glottic opening, the rate of first attempt intubation as well, but also improves success rate in case of difficult airways(1,9,14,16). However, despite the wide usage of videolaryngoscopes around the world, the evidence of usage of multivariate risk indexes in difficult laryngeal visualization using videolaryngoscopes is limited.

The purpose of this study is to determine the specificity and sensitivity of El-Ganzouri multivariate risk index by using Storz C-MAC videolaryngoscope equipped with D type blade.

MATERIAL AND METHODS

After acquiring hospital ethics committee approval and patients gave written informed consent this study included 29 patients, scheduled to undergo surgical intervention which required general anaesthesia with endotracheal intubation between 17th August 2017 and 28th September 2017. Patients with age less than 18 years and patients with pre-planned awake fibreoptic intubation were excluded from participation in this research. Before anaesthesia induction all patients were examined using El-Ganzouri risk index, ranging from 0 to 12 (Table 1), in which examination of patients mouth opening, oropharyngeal structure visibility, thyromental distance, head and neck movement, ability to prognath teeth and body weight was performed. In addition, patients were asked about previous difficult intubation. Mouth opening was recorded as an interincisor or intergingival distance with mouth fully opened, in which mouth opening was classified as ≥4 cm or <4 cm. Oropharyngeal structure visibility was examined in sitting position with protruded tongue

and was described as Mallampati(M) class 1, in which soft palate, faucial pillars and uvula can be visualized; M class 2, in which both faucilar pillars and soft palate can be visualized with partial visualization of the uvula; M class 3, in which only soft palate is visible or M class 4, in which nor soft palate, faucilar pillars nor uvula can be visualized.Thyromental distance, a line between thyroid notch and lower part of mandibular mentum with head fully extended, was measured and classified as >6.5 cm, 6.0-6.5 cm or <6.0 cm. Head and neck movement was measured as a range of motion from full flexion to full extension and was classified into >90°, 80-90° or <80° ranges. Teeth prognation was examined and categorised as an ability or inability to protrude lower incisors in front of upper incisors. Patient weight was categorised as <90 kg, 90-110 kg or >110 kg. Previous difficult intubation was classified as absent, questionable or definite.

Anaesthesia induction was performed by intravenous administration of medication in following order - Fentanyl 1-2 mcg/kg, Propofol 2-3 mg/kg and Atracurium 0.25-0.5 mg/kg. After initial dose of Atracurium every patient was manually ventilated for 3 minutes. Laryngeal exposure was performed using Storz C-MAC videolaryngoscope equipped with D blade while patient's ear tip and sternal notch were positioned on the same level, laryngeal visualization was graded using Cormack-Lehane(C-L) scale, in which most of the glottic opening and both epiglottis and arytenoids are visible with grade 1. In C-L grade 2, the glottic opening is visible partially or only arytenoids with epiglottis are visible. In C-L grade 3, no glottis but only epiglottis is visible, and in grade 4 neither glottis nor epiglottis nor arytenoid cartilages can be visualized. Malleable stilette was used to bend the endotracheal tube in such manner, so that endotracheal tube follows the blade of laryngoscope. Both risk index measuring and laryngeal exposure was performed by the same person for every patient. The correct placement of the endotracheal tube was determined by presence of end-tidal CO_2 on the monitor and by auscultation of both lungs.

Outcomes recorded were C-L grade seen on the monitor during laryngeal exposure, successful first-attempt tracheal intubation, trauma of the teeth, traces of blood on the laryngoscope blade after intubation.

In this study, C-L grade ≥2 was defined as difficult intubation, and El-Ganzouri risk index was defined as high risk, if total El-Ganzouri risk score was ≥2 in each case. Collected data are presented as median (interquartile range) and number (proportion). Data were analysed using R v2.12.1 (Free Software Foundation's GNU General Public Licence. R Development Core Team. A language and environment for statistical computing. R Foundation for Statistical Computing: Vienna, Austria, 2006). Specificity, sensitivity, as well as negative predictive value and positive predictive value were calculated for El-Ganzouri index. Receiver operating characteristic (ROC) curve was generated, and then area under curve (AUC) was calculated.

RESULTS

Convenience group of 29 patients, from which 10 patients (35%) were males and 19 patients (65%) were females were included in this study(Table 2). The median age was 54 years (38 – 65 yr). The minimum obtained value of El-Ganzouri index during examination was 0, maximum obtained value was 7. 27 patients of 29 were intubated during first attempt, and in those patients which required second attempt, C-L grade 2 and 3 were seen. 22 patients were judged to be at high risk of difficult intubation according to El-Ganzouri risk index, and of those 5 had C-L grade ≥2, and 17 had C-L grade 1 on laryngeal exposure. Of the 7 patients who had El-Ganzouri risk index <3 all had C-L grade 1.After statistical analysis, calculated sensitivity was 54.2%, and specificity was 80.0%. Calculated positive predictive value was 26.7% and negative predictive value was 92.9%. The receiver operating characteristic curve (ROC) is displayed in Figure 1, and calculated AUC was 78.3%.

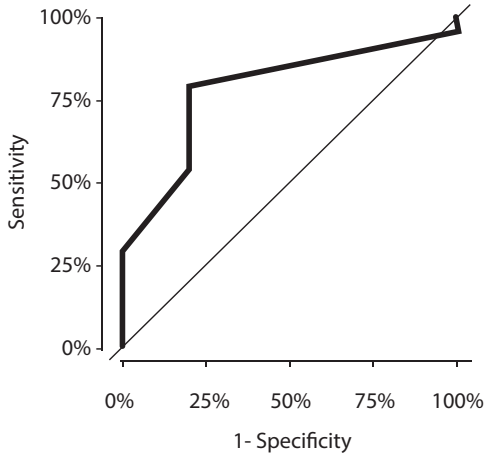

Fig. 1. - Receiver operating characteristic curve for El-Ganzouri risk index

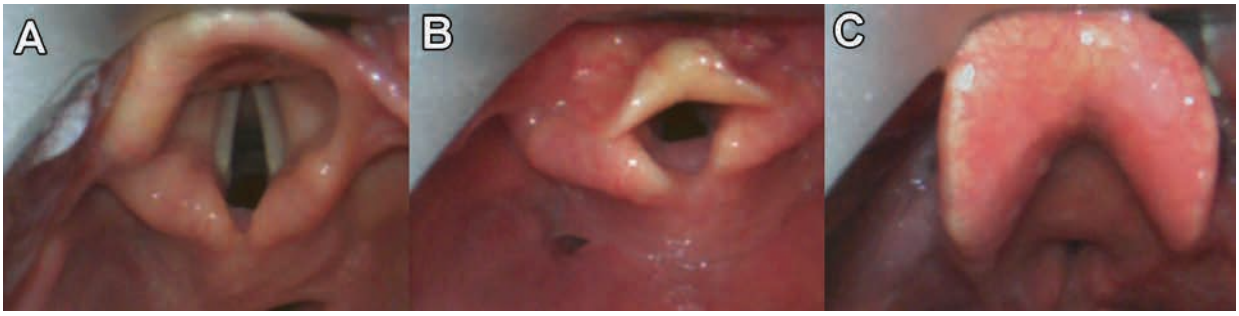

Fig. 2. Visualisation of laryngeal structures, using Storz C-MAC, equipped with D-blade. A - C-L grade 1; B - C-L grade 2; C- C-L grade 3

Table 1. El-Ganzouri multivariate risk index

Variable	Score
Mouth opening	
≥4 cm	+0
<4 cm	+1
Thyromental distance	
>6.5 cm	+0
6.0-6.5 cm	+1
<6.0 cm	+2
Mallampati class	
I	+0
II	+1
III	+2
IV	+2
Neck movement	
>90°	+0
80-90°	+1
<80°	+2
Teeth prognation	
Patient is able to prognath	+0
Patient is not able to prognath	+1
Body weight	
<90 kg	+0
90-110 kg	+1
>110 kg	+2
Previous difficult intubation	
Absent	+0
Questionable	+1
Definite	+2

Table 2. Patients' baseline characteristics and outcomes, characteristics of El-Ganzouri risk index multivariates

	Patient group, *n* = 29
Age, years	54 (38 – 65)
Gender, male, n (%)	10 (35%)
Laryngeal visualisation	
C-L grade I	24
C-L grade II	4
C-L grade III	1
C-L grade IV	0
First-attempt intubation rate	93%
Mouth opening	
≥4 cm	26
<4 cm	3
Teeth prognation	
Patient was able to prognath	26
Patient wasn't able to prognath	3
Mallampati score	
I	6
II	12
III	9
IV	2
Thyromental distance	
>6.5 cm	21
6.0-6.5 cm	6
<6.0 cm	2
Neck mobility	
>90°	13
80-90°	15
<80°	1
Patient weight	
<90 kg	26
90-110 kg	3
>110 kg	0
Previous difficult intubation	
Absent	24
Questionable	5
Definite	0

DISCUSSION

This study was aimed to investigate the predictive value of El-Ganzouri risk index using Storz C-MAC laryngoscope equipped with D-blade. Results of this study shows moderate sensitivity and specificity of El-Ganzouri risk index, which means that El-Ganzouri risk index can identify the difficult (i.e., C-L ≥2) airway patients but at the same time may be falsely-positive in patients with "simple" airways as well. During recent decades many videolaryngoscopy devices with angulated blade such as Storz C-MAC D-blade modification, GlideScope (Verathon Inc., U.S.A.)Titanium with LoPro blades and other devices were introduced, which share main principle of construction – light source and camera are integrated in the blade, which is connected to the display, which allows to get a wide-angle image of larynx, as shown in Figure 2.In research, conducted by Cortellazzi et al.(5), El-Ganzouri risk index sensitivity and specificity when using GlideScope videolaryngoscope was 93.3 and 76.6 percent respectively at cut-off value of 3 points of El-Ganzouri risk scale, which is higher than predictive value of El-Ganzouri risk index with the same cut-off, obtained in this study. As it was concluded in several studies(1,3,12), usage of videolaryngoscopes enables much better visualization of glottic opening and increases the possibility of first-attempt intubation in comparison with direct laryngoscopy. In the study of Teoh et al.(15), in which Storz C-MAC, GlideScope and Airway scope was compared with direct laryngoscopy, usage of videolaryngoscopes increases laryngeal exposure – 87% of patients had C-L I grade of laryngeal exposure and 11% had C-L II grade of laryngeal exposure in C-MAC group, successful first attempt rate was lower(93%) in C-MAC group. In this study, similarly to results of research described above, 83% of patients had C-L grade I, 14% of patients had C-L grade II, and successful first-attempt intubation was achieved in 27 patients (93%) of 29.In the study of Serockiet al.(11), in which Storz C-MAC equipped with D-blade performance was compared to direct laryngoscopy and GlideScope performance in expected difficult airway scenario, adequate laryngeal visualization(C-L grade 1, if using C-L scale described above) was obtained in every single patient enrolled in study(n = 95) when laryngoscopy with Storz C-MAC was performed. Until now there are many bedside tests and test combinations, proposed to detect possible difficult airways, but none of them is considered fully reliable, since predictive value varies from one study to another(2,6,10,13). As stated by Azis et al.(1), despite similar approaches and aims of direct laryngoscopy and videolaryngoscopy, both airway management methods are entirely different and probably should have different criteria for difficult airways and therefore should have different methods of difficult airway assessment. Both this statement and results of studies above may lead to possible explanation of moderate predictive value of El-Ganzouri risk index in this study – possible difficulty of direct laryngoscopy not always points out the difficulty of videolaryngoscopy, since videolaryngoscopy is different from direct laryngoscopy and improves glottic visualization per se. If so, does it mean that the videolaryngoscopy should be reconsidered as a possible "plan A" tool for airway management in modern anaesthesia practise, since difficult airway problem still exists?

One of the main limitations of this study is relatively small group of patients, and before making conclusions about accuracy of El-Ganzouri risk index, further studies with larger patient groups should be conducted to prove or disprove that. Furthermore, in this study we tested Storz C-MAC with D-blade, and in further researches predictive value of El-Ganzouri risk index should be studied by using different videolaryngoscope models in comparison with more "classical" direct laryngoscopy method to see comparison of different methods with same patients, as Serocki and colleagues did.

CONCLUSION

El-Ganzouri risk index shows moderate sensitivity and specificitywhen used with Storz C-MAC videolaryngoscope. It can be used to predict difficult laryngeal visualization during videolaryngoscopic intubation.

Conflict of interest: None

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