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COMPARISON OF STRESS RESPONSE PERFORMING ENDOTRACHEAL INTUBATION BY DIRECT LARYNGOSCOPY, FIBREOPTIC INTUBATION AND INTUBATION BY THE GLIDESCOPE LARYNGOSCOPE

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Stress response is regulated by two primary neuroendocrine systems—the hypothalamus-pituitary-adrenocortical (HPA) and sympathetic adrenomedullary (SAM) systems. Salivary alpha-amylase (AA) levels can be used as an index of the SAM activity, and serum cortisol as an index of HPA activity. The aim of the study was to compare patient stress response to different intubation techniques. Sixty adult patients, ASA I–III, scheduled for elective abdominal surgery were included in this study, with median age of 54±18 years. Patients were prospectively randomly divided into three groups—intubation with a GlideScope (GS), Macintosh laringoscope (ML) and PENTAX fibreoptic bronchoscope (FB). After preoxygenation for 3 min anaesthesia was induced with fentanyl 2 mkg/kg, mivacuronium 0.2 mg/kg and propofol 2 mg/kg, injected intravenously over 20 seconds. Intubation was started 2 min after mivacuronium injection. Anaesthesia was maintained with sevoflurane 1–2 vol% and fentanyl 1 mkg/kg as needed. Intubation time (IT) was measured, blood and saliva samples were collected before and shortly after intubation. Haemodynamic response was recorded. Intubation time was statistically significantly longer in the FB group (120±65 s) versus the ML group (29±5 s) and GS group (26±9 s), $P < 0.05$. *In the three patients groups the initial AA level was similar (54±20 KU/ml,* $P > 0.05$*). In GS patients the alpha amylase level after intubation significantly decreased (42±15 KU/ml,* $P < 0.05$*), but in ML and FB patients—significantly increased (68±24 KU/ml and 73±32 KU/ml, respectively,* $P < 0.05$*). After intubation, blood cortisol did not differ between the ML (377±181 U/ml) and GS (484±61 U/ml) patient groups, but was significantly higher (*$P < 0.05$*) in the FB group (530±79 U/ml). Both heart rate and blood pressure increased during intubation, the difference between groups was not significant. All intubations were successful, but in the FB patient group IT was significantly longer than in the ML and GS patient group. IT in the GS and FB patient groups did not statistically significantly differ. In our opinion, shorter and more confident intubations with a GlideScope produce less nociceptive stimulus and less stress to the patient. Intubations using GlideScope videolaryngoscope causes lesser stress response in comparison to intubation with a Macintosh laryngoscope or fibreoptic bronchoscope.*

Key words: *intratracheal intubation, GlideScope, stress response, alpha-amylase, cortisol.*

INTRODUCTION

Although the management of airways by direct laryngoscopy using a Macintosh laryngoscope is anaesthesiologist routine practice, alternative, safer and more convenient auxiliary devices are being designed and introduced into practice (Fun, 2007). Not only convenience of the devices and the effectivity of their use are of importance, but patient safety and comfort as well. Of the most commonly used devices, fibreoptic intubation allows to perform intubation also in difficult airway cases, but it requires extra training and a long intubation time. A novelty in airway management is the GlideScope, a new generation video laryngoscope, which consists of a high resolution digital video camera, located in the middle part of the blade of a multi-use laryngoscope and liquid crystal monitor. The blade of GlideScope is equipped with an antisweating system, decreased total thickness till 18 mm and 60 degrees curve, since there is no need for direct visualisation of the larynx. It is useful for both normal and difficult intubation cases (Fun, 2007), except when the mouth opening is less than 2 centimetres.

Laryngoscopy and intubation cause great stress to patients, either psychoemotional due to fear of the procedure, or physical due to nociceptive stimulation of pharyngeal, laryngeal mucosa and tracheal receptors during the intubation (Freye and Levy, 2007). Patient reaction to the stress caused by tracheal intubation may produce adverse cardiovascular complications in patients with cardiovascular disease in the case history and in patients without any comorbidities (Xue *et al.*, 2006; Paisansathan *et al.*, 2007), but especially in patients in acute situations.

In fact, tracheal intubation methods, which exclude or decrease oropharyngeal stimulation, should reduce stress response and decrease the number of cardiovascular and pulmonary complications. However, in the studies published there is only a slight or controversial experience as to the effect of various intubation techniques on patient stress response (Barak *et al.*, 2003; Kahl *et al.*, 2004; Dahaba *et al.*, 2006; Zhang *et al.*, 2006). Regarding the comparatively new intubation device – GlideScope, which allows excellent visualisation of oropharyngolaryngeal structures, there is also controversal data: the opinion exists that it causes much lesser stress response, in comparison to fibreoptic intubation, and even the classical Macintosh laryngoscope (Xue *et al.*, 2006), while others consider that the imposed stress response is equivalent to that of fibreoptic intubation (Li *et al.*, 2007).

Regulation of stress response is achieved by means of two different neuroendocrine systems: hypothalamus-pituitary-adrenocortical (HPA) and sympathetic adrenomedullary (SAM) (Fig.1) (Schommer, 2003).

The HPA system secretes cortisol, which takes place in suprarenal glands via the adrenocorticotropal hormone. The cortisol level in saliva is closely correlated with its level in blood and changes under stress (Rifkin-Graboi, 2008). The SAM system secretes catecholamines: norepinephrine and epinephrine, but their detection in patient blood is very complicated, as this calls for instant blood test and immediate freezing of the sample (Rohleder *et al.*, 2004). Catecholamines are excreted also through saliva, but their level in saliva is not correlated with the level in blood (Schwab, 1992). Reports have found differences between patient groups in haemodynamic indices, but not in the catecholamine level in blood serum (Nishiyama *et al.*, 1997).

It is useful to choose a method that allows storage of samples at room temperature till the time for doing the second test and delivery of the samples to the laboratory. As an alternative, it is possible to determine alpha amylase of saliva (AA), as it is the main salivary enzyme in humans and it is produced by salivary glands in response to stimulation of the sympathetic nervous system (Gallacher and Petersen, 1983). It has been proved that the levels of this salivary enzyme are related to SAM system activity (Takai *et al.*, 2004; Rohleder *et al.*, 2004; van Stegren *et al.*, 2006) as well as with the norepinephrine level in blood serum (Rohleder *et al.*, 2004).

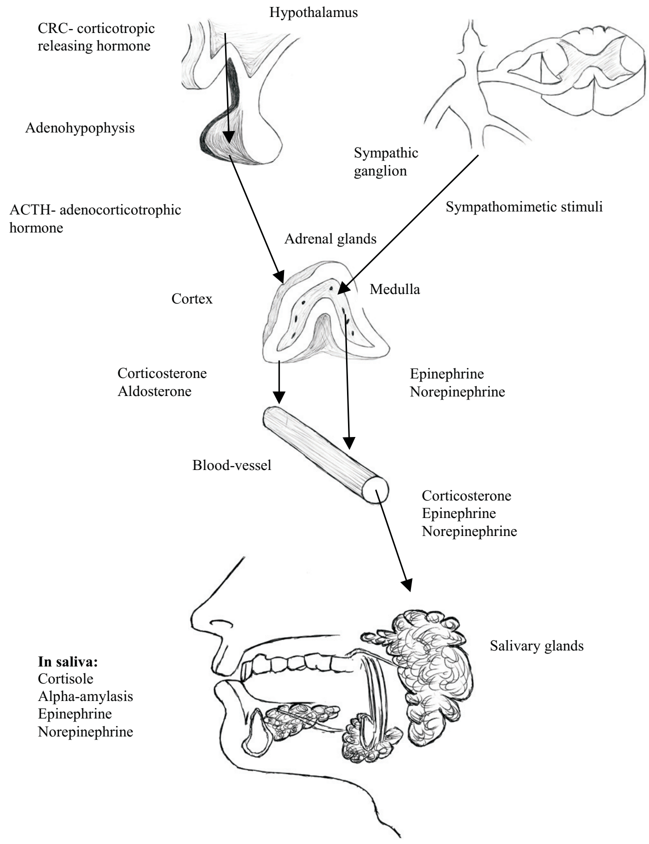

Fig. 1. Stress response in hypothalamus-pituitary-suprarenal and sympathoadrenal system.

The aim of the study was to assess and compare the influence of various intubation methods on patient stress response. The objectives of the study were differences in the intubation time, as well as cortisol level in blood serum and alpha amylase concentration in patient saliva before and after intubation, depending on the intubation method applied. Haemodynamic indices (heart rate and systolic blood pressure) were also estimated before and after intubation.

MATERIALS AND METHODS

On permission of the ethics committee and patient written consent, 60 adult patients (ASA I–III and Mallampatti I–III), 23 males and 37 females, were included in the study. Patients with predictable difficult airways, psychiatric and endocrine diseases were excluded as were those who had used beta adrenoblockers and cholinolytics. Mean age of patients was 54±18 years. The patients were scheduled for elective abdominal operation under general endotracheal intubation anaesthesia. To follow the circadian rhythm of hormonal fluctuations, only those patients were included into the study who had been operated on in the morning from 8 a.m. till 12 a.m. For premedication, 30 min prior to anaesthesia, Diazepam 5–10 mg was introduced intramuscularly. In the operating room, after 3 min preoxygenation, anaesthesia was induced with Fentanil 2 mkg/kg, Mivacuronium 0.2 mg/kg and Propofol 2 mg/kg, injected within 20 seconds. Intubation was started within 2 min after the injection of Mivacuronium. Anaesthesia was maintained with Sevofluran 1–2 vol% and Fentanyl 1 mkg/kg as needed. Patients were randomly divided into three groups, 20 patients in each group: intubation with Macintosh laryngoscope (ML), GlideScope (GS) and PENTAX fibreoptic laryngoscope (FB). All intubations were conducted by the same anaesthesiologist.

Intubation with Macintosh laryngoscope was performed by shifting the tongue to the right, lifting epiglottis with the end of the blade, directly visualising vocal cords and introducing the intubation tube between them.

Intubation with GlideScope was done introducing the blade along the middle line of the tongue, larynx opening was observed in a LCD monitor, endotracheal tube was introduced with a stylet, beforehand bent in a 60 degree angle.

In the ML and GS patient groups the intubation tube localisation was tested by auscultation and capnography.

In the FB patient group the intubation was done with a PENTAX fibreoptic bronchoscope, pulling the intubation tube onto it in advance to visualise the larynx, the fibrobronchoscope was inserted as far as tracheal bifurcation and, by using the fibrobronchoscope as a guide, the intubation tube was guided through the pre-prepared tube downwards. Localisation of the intubation tube was checked visually by fibrobronchoscope.

The intubation time (IT) was recorded by chronometer. Saliva and venous blood samples were collected before inducing anaesthesia and just after intubation. Heart rate and arterial blood pressure were checked before intubation (start indices), during intubation (0 min) and every 5 min after intubation.

Saliva samples were collected by B. Brown's aspiration system, dissolved with 0.9% NaCl solution and centrifuged. Alpha amylase level was determined in saliva samples. AA level was determined using AMIR Roche liquid table PNPG7.

Cortisol level was determined in blood serum, it was done by hemiluminescence method using Siemens DPC Immulite 2500 test system.

For data statistical analysis the computer programme SPSS-11 was used. We used the t test to compare two mean values, Z test to compare two proportions, and the Chi-squared test to compare three groups. Statistically significant P value was accepted to be less than 0.05.

RESULTS

There was no statistically significant difference between patient groups by age, weight, gender proportions or Mallampatti scale. The mean patient weight was 72±12 kg and did not statistically differ between patient groups. All intubations were successful.

Intubation time was statistically significantly longer in the FB patient group (120±65 s) (P < 0. 05). There was no statistically significant difference between the GS and ML patient groups. Intubation time in the ML group was 29±5 s, but in the GS group it was 26±9 s (Fig. 2).

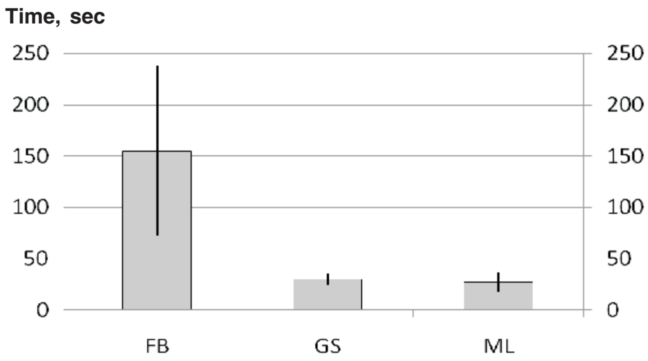

Fig. 2. Intubation time in various patient groups.

FB, intubation with Fibreoptic Bronhoscope; GS, intubation with GlideScope; ML, intubation with Macintosh laryngoscope.

The alpha-amylase level in saliva before inducing anaesthesia was similar among the groups (54±20 KU/ml, P < 0.05). The AA level in saliva after intubation in various patient groups did not differ statistically significantly—in the GS patient group the AA level fell after intubation to (42±15 KU/ml, P < 0.05), but in the ML and FB patient groups increased significantly (68±24 KU/ml and 73±32 KU/ml, respectively, P < 0.05) (Fig. 3).

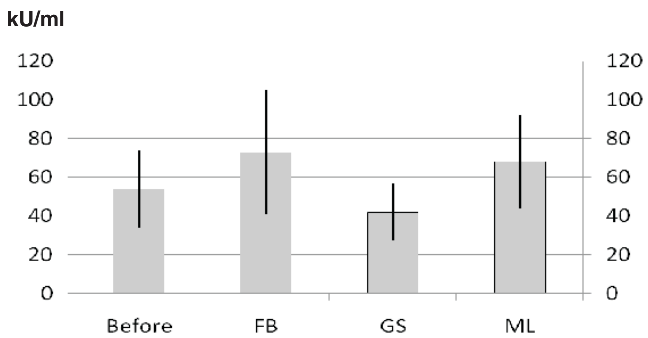

Fig. 3. Alpha amylase concentration after intubation in various patient groups.

FB, intubation with Fibreoptic Bronhoscope; GS, intubation with GlideScope; ML, intubation with Macintosh laryngoscope.

The cortisol level in blood serum before inducing anaesthesia did not significantly differ. After intubation, the cortisol level in blood serum did not significantly differ between the ML (377±181 U/ml) and GS (484±61 U/ml) patient groups, but was significantly higher (P < 0.05) in the FB patient group (530±79 U/ml) (Fig. 4).

Haemodynamic response to intubation stress. During the intubation, the systolic blood pressure in all patient groups increased without any significant difference between patient

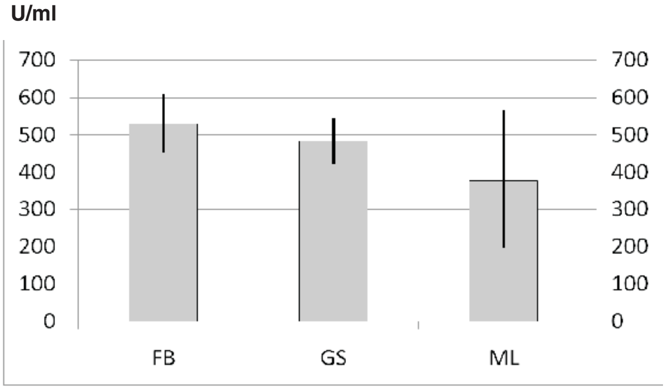

Fig. 4. Cortisol level in blood serum after intubation depending on intubation method.

FB, intubation with Fibreoptic Bronhoscope; GS, intubation with GlideScope; ML, intubation with Macintosh laryngoscope.

groups (Fig. 5); in all patient groups the heart rate similarly increased (Fig. 6).

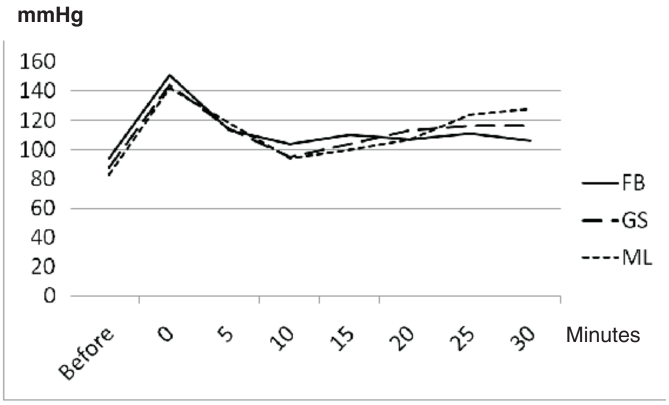

Fig. 5. Systolic blood pressure changes after intubation depending on intubation method.

FB, intubation with Fibreoptic Bronhoscope, GS, intubation with GlideScope, ML, intubation with Macintosh laryngoscope.

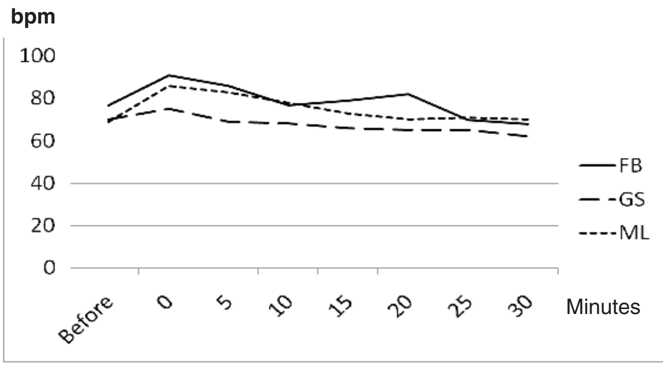

Fig. 6. Heart rate changes after intubation depending on intubation method.

FB, intubation with Fibreoptic Bronhoscope, GS, intubation with GlideScope, ML, intubation with Macintosh laryngoscope.

Bpm, beats per minit

DISCUSSION

In our study endotracheal intubation with a fibreoptic bronchoscope required the longest time and caused the most pronounced stress response. A significantly longer intubation time in the FB patient group might be explained by the fact that before the intubation the patients were introduced myorelaxants. This produce pharyngeal muscle slackening, the tongue and epiglottis slide towards posterior pharyngeal wall and decreases the volume of pharynx, thus making visualisation difficult. On the other hand, ML and GS techniques allow to lift the epiglottis, improving the visualisation. Other authors also have reported that FB intubation requires a longer time in comparison to other methods (Barak *et al*., 2003). The shortest intubation time was in the GS patient group, as also reported previously by some authors (Lim *et al*., 2005; Li *et al*., 2007), but contradicts to others (Xue *et al*., 2007). In fact, the intubation time, although statistically significant, differed only by some seconds in the GS and ML patient groups (Li *et al*., 2007; Xue and Yeo, 2007), while in the FB patient group being almost twice as long (Barak *et al*., 2003).

Longer contact of the device with the oropharyngolaryngeal zone mucosa receptors also produces greater stress response. Therefore, we recommend using fibreoptic intubation without the use of miorelaxants. Pharynx of muscle tone and unflattened allows to avoid unnecessary contact with pharyngeal walls.

The observed haemodynamic changes (blood pressure and heart rate increase after intubation) coincide with other reports (Kahl *et al*., 2004; Kayhan *et al*., 2005; Xue *et al*., 2008). These changes did not differ between the Macintosh laryngoscope and GlideScope patient groups, as observed by others (Zhang *et al*., 2006; Xue *et al*., 2007). Barak *et al*. (2003) did not observe differences in haemodynamic indices between FB and other type intubations, and further reported that haemodynamic changes disappeared just in 5 minutes. This shows that haemodynamic response to stress is very fast and the effect is lost very quickly, thus, more precise recording of changes should be made every minute and invasively.

Both cortisol level in blood serum and AA level in saliva were high in the FB patient group. Although fibreoptic intubation has been recognised as a golden standard in difficult airways, it is also well known to be a comparatively longer process (Barak *et al*., 2003) and causes greater irritation (Latorre *et al*., 1993) and, consequently, much greater stress (Barak *et al*., 2003). This might be reduced by performing extra surface anaesthesia (Latorre *et al*., 1993).

It is interesting that although in the GS and ML patient groups the stress response was statistically less significant than in the FB patient group, it was still different. The GS patient group had a lower AA level, while in the ML patient group the serum cortisol level was lower. This shows once again, that in stress response both neuroendocrine systems, HPA and SAM, are of importance and can react differently (Schommer *et al*., 2003).

In conclusion, intubation with a fibreoptic bronchoscope requires the longest time, causing the greatest stress response to patients. Intubation with GlideScope laryngoscope is faster in comparison to Macintosh laryngoscope, and to a fibreoptic bronchoscope, at the same time causing the lesser stress response to patients. The GlideScope laryngoscope is a reliable laryngoscope for patient safety.

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STRESA REAKCIJAS SALĪDZINĀJUMS ENDOTRAHEĀLĀS INTUBĀCIJAS LAIKĀ, VEICOT INTUBĀCIJU AR TIEŠO LARINGOSKOPIJAS, FIBROBRONHOSKOPIJAS UN *GLIDESCOPE* METODĒM

Atbildi uz stresa reakciju nosaka divas neiroendokrīnas sistēmas: hipotalāma-hipofīzes-virsnieru (HPA) un simpātiski adrenālā (SAM) sistēma. Siekalu alfa-amilāze raksturo SAM aktivitāti, savukārt asins seruma kortizola līmenis – HPA aktivitāti. Darba mērķis bija salīdzināt stresa reakcijas izteiktību atkarībā no dažādām intubēšanas metodēm. Pētījumā tika iekļauti 60 pieauguši pacienti, ASA I–III, kam bija paredzēta plānveida abdomināla operācija. Vidējais pacientu vecums bija 54±18 gadi. Pacientus nejaušināti iedalījām trīs grupās un veicām intubāciju ar *GlideScope* laringoskopu (GS pacientu grupa), Makintoša laringoskopu (ML grupa) un PENTAX fibrooptisko bronhoskopu (FB grupa). Pēc trīs minūšu ilgas preoksigenācijas tika uzsākta anestēzija ar fentanilu 2 mkg/kg, mivacuroniju 0,2 mg/kg un Propofolu 2 mg/kg, kas tika ievadīti intravenozi 20 sekunžu laikā. Intubācija tika uzsākta pēc 2 minūtēm kopš mivakuronija injekcijas. Anestēzija tika turpināta ar sevoflurānu 1–2 vol% un fentanilu 1 mkg/kg pēc nepieciešamības. Tika noteikts intubācijas laiks, paņemti siekalu un asins paraugi pirms un īsi pēc intubācijas. Intubācijas laiks bija statistiski ticami ilgāks FB pacientu grupā (120 ± 65 sekundes) salīdzinājumā ar ML grupu (29 ± 5 s) un GS grupu (26 ± 9 s), $P < 0{,}05$. Visās trīs pacientu grupās alfa amilāzes līmenis siekalās pirms intubācijas bija vienāds (54 ± 20 KU/ml, $P > 0{,}05$). GS pacientu grupā alfa amilāzes līmenis pēc intubācijas pazeminājās (42 ± 15 KU/ml, $P < 0{,}05$), bet ML un FB pacientu grupās – statistiski ticami pieauga, attiecīgi līdz (68 ± 24 KU/ml un 73±32 KU/ml, $P < 0{,}05$). Pēc intubācijas asins seruma kortizola līmenis statistiski ticami ($P < 0{,}05$) pieauga FB pacientu grupā (530 ± 79 U/ml). Kortizola līmenis pēc intubācijas ML grupā bija (377±181 U/ml) un GS grupā (484±61 U/ml), šis pieaugums nebija statistiski ticams salīdzinājumā ar

pirmsoperācijas līmeni. Gan sirdsdarbības frekvence, gan asinsspiediens pieauga intubācijas laikā, taču nenovērojām statistiski ticamu atšķirību starp pacientu grupām. Visas intubācijas bija sekmīgas, taču FB pacientu grupā intubācijas laiks bija statistiski ticami garāks salīdzinājumā ar abām pārējām pacientu grupām, kur tas neatšķirās. Mūsuprāt, ātrāka un drošāka intubācija ar *GlideScope* laringoskopu rada mazāku nociceptīvo elpceļu un rīkles stimulāciju, līdz ar to rada arī mazāku pacientu stresa reakciju. Intubācija ar *Glidescope* laringoskopu pacientiem rada mazāku stresu nekā intubācija ar Makintoša laringoskopu vai fibrooptisko bronhoskopu.