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Effect of video laryngoscope on Tp-e interval, QTc and Tp-e/QTc ratio compared with direct laryngoscope in patients with double-lumen tube undergoing thoracic surgery

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Abstract

Aim: QT interval is generally related to the increased risk of polymorphic ventricular tachycardias and ventricular arrythmias. Intubation and laryngoscopy might change in cardiac repolarization and an increase in QT interval length. Video laryngoscopes provide better laryngeal view, higher intubation success, and better correct positioning on double-lumen tube (DLT) intubation. We aimed to compare McGRATH MAC 5 video laryngoscope to direct Macintosh laryngoscope and their effects on Tp-e interval, QTc and Tp-e/QTc ration in those patients requiring intubation having DLT.

Materials and Methods: The randomly controlled prospective work is carried out on 94 patients, scheduled for thoracic surgery, aged between 18-65. After anaesthetic induction and before tracheal intubation, all patients airway were evaluated Cormack and Lehane in using a Macintosh laryngoscope and patients having Cormack and Lehane grade-1 or -2a views included in study. The patients who are intubated with video laryngoscope (McGRATH MAC) are allocated into Group V and intubated with direct Macintosh Laryngoscope was allocated into Group L. The primary aim was compared between the two devices on Tp-e interval, QTc and Tp-e/QTc ratio with ECG recordings. The secondary goal was assessment of hemodynamic status and intubation conditions.

Results: In Group V, QTc interval, Tp-e intreval and Tp-e/QTc ratio was lower in a significant way than Group L. There has not been a significant difference in terms of hemodynamic assessment among those two groups at all measurement periods. Cormack-Lehane scores, intubation times, DLT types and sizes were similar between two groups.

Conclusion: McGRATH MAC video laryngoscope decreased Tp-e interval, QTc and Tp-e/QTc ratio compared to direct Maintosh laryngoscope. Hemodynamic response and intubation parameters are seen as similar to each other in both of the present groups.

Introduction

QT interval represents ventricular depolarization and repolarization period on Electrocardiography (ECG). It is related to an increased risk of polymorphic ventricular tachycardias and ventricular arrhythmias like ventricular fibrillation. Because the QT interval is difficult to measure, the clinically corrected QT interval is called QTc. The Tp-e interval is an index of the transmural dispersion of ventricular repolarization [1]. Intubation and laryngoscopy may result in lead to sympathetic response changes in cardiac repolarization and an increase in QT interval length [2,3].

Video laryngoscopes which have high-definition cameras and flat monitors, yielding a wide laryngeal view are alternatives to direct laryngoscopes [4]. Video laryngoscopes provide a a much better laryngeal view, a higher intubation success level on their first try, and also less difficult intubation score, and better correct positioning on double-lumen tube (DLT) intubation [5]. There is a lack of evidence on sympathetic response to different laryngoscope types and QT interval length, especially in DLT intubation.

One of the goals of the present study is to make comparison on McGRATH MAC 5 video laryngoscope to direct Macintosh laryngoscope and their effects on Tp-e interval, QTc and Tp-e/QTc ratios in those patients who are scheduled for thoracic surgery which requires intubation with a DLT for one-lung ventilation.

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The primary goal of the present work is to compare McGRATH MAC 5 video laryngoscope to direct Macintosh laryngoscope in terms of their impact on Tp-e interval, QTc and Tp-e/QTc ratio. The secondary aim was to evaluate hemodynamic status and intubation conditions.

Materials and Methods

The present prospective work has been approved by the Ethical Committee of Malatya Clinical Research Institute (Protocol no: 2016/131) and also a written consent form has been received from those patients involving to this work. A total of 94 patients who are scheduled for thoracic surgery which requires intubation with a DLT for one-lung ventilation, American Society of Anesthesiologists (ASA) Grade I-II whose ages are between 18 and 65 years are included in the present study. Patients having cardiovascular, renal, hepatic, and/or hematologic diseases, patients having a history of difficult airway, limited mouth opening, Mallampati score 3-4, Cormack-Lehane class 3-4, congenital long QT interval (>440 ms) or taking medications which elongate QT interval (i.e. tricyclic antidepressants), patients with allergy to drugs used in anesthesia induction (fentanyl, propofol, rocuronium), and patients without optimal ECG were excluded.

The patients are divided into two groups in a random way using a web-based program. The intubated patients with a Video laryngoscope (McGrath MAC) were allocated to Group V (n=41) and patients who were intubated with a direct Macintosh Laryngoscope were allocated to Group L (n=42).

Patients are taken into operating rooms without any premedication. Noninvasive blood pressure, ECG, pulse rate, and peripheric oxygen saturation were monitored and a basal ECG was obtained. After preoxygenation, standardized general anesthesia was given to all patients. Anesthesia induction was made with 2.5 mg/kg propofol, and 2 µg/kg fentanyl. Rocuronium 1 mg/kg was used for muscle relaxation. Anesthesia is maintained by 50% oxygen and 50% sevoflurane. Neuromuscular Blockade is monitored with a Train-of-Four (TOF watch S monitor; Organon, Dublin, Ireland) monitor. Patients are intubated when the TOF ratio was 0/4. All of the intubations were carried out by the same anesthesiologist who was experienced in Macintosh direct laryngoscope and with at least 20 DLT intubation with McGRATH MAC video laryngoscope. A size 3 blade was used for intubation of both groups. Modified Cormack-Lehane glottic view grading was performed with a Macintosh direct laryngoscope before the intubation in all of the patients. Modified Cormack-Lehane glottic view (Grade 1 (glottic opening seen clearly) and Grade 2a (glottic opening partially seen)) was used in this study. After Cormack-Lehane grading, patients were ventilated with masks again. In group V, patients were intubated with DLT which was explained in a previous study [6]. The correct positioning of the DLT has been controlled with capnography, osculation, and fiberoptic bronchoscopy. Intubations that took more than 180 seconds and tube placement was not achieved after 3 attempts were excluded from the study. Appropriately sized tubes were chosen according to patients' sex and height, namely 39-41 F for men and 37-39 F for women. After the placement of tube, the correct positioning is confirmed with capnography, osculation, and fiberoptic bronchoscopy.

SBP, HR, MAP and DBP that is systolic blood pressure, heart rate, mean arterial pressure and diastolic blood pressure and values, respectively are recoded and ECG has been obtained.

Intubation time, intubation attempts, DLT type, and size were also recorded. Intubation time was taken as time from placement of the laryngoscope inside the mouth to the moment when $EtCO_2$ waveform was seen on the capnograph. Failed attempt times were added and recorded together.

HR, SBP, DBP, MAP, and ECG are recorded just before anesthesia induction (basal T0), after induction (T1), 2 minutes after induction (T2), 1 minute after intubation (T3), 3 minutes after intubation (T4), 5 minutes after intubation (T5) and 10 minutes after intubation (T6).

ECG recordings: ECGs were obtained at 50 mm/sec speed in supine positioning in 12 derivations. (Nihon Kohden, Tokyo). Every ECG recording was assessed by an experienced and blinded anesthetist. The starting point was taken as the deflection of the QRS complex from the isoelectric line. The endpoint is taken as the arrival of the wave T into the isoelectric line. These were assessed in 3 different derivations and the mean value of this recording was taken as QT interval. If the U wave is present, the lowest merging point of U and T waves are taken as the end of the T wave. Patients were excluded if it is not possible to assess the end of the T wave. Fridericia formula was used to calculate the QTc interval [7].

Statistical analysis

During Analysis calculations, IBM SPSS 24.0 for Windows software package has been used. Data are assessed in terms of both means and standard deviations. To assess normal distribution Kolmogorov Smirnov test has been utilized. A T-test is utilized for the analysis of the independent samples between the two groups. The T-test was used for repeated analysis of dependent data in every group. Categorical variables were assessed with Yates' corrected chi-square test. $P<0.05$ has been used as statistically significant.

Power Analysis Report: In terms of the findings obtained from the theoretical power analysis, when the level of significance is taken as 5%, if the power of the test is 80%, then the effect size is 0.8 and the alternative hypothesis (H1) is two-way, and the size of the sample to be reached for finding a statistically significant difference among the laryngoscope groups utilizing independent samples t-test should be at least 26 for each group and at least 52 in the total. Related calculations were performed using the Web-Based Sample Size and Power Analysis Software (WSSPSAS) tool developed by Inonu University, Faculty of Medicine, Biostatistics Department [8].

Results

In the present study, while 94 patients are included 5 patients are excluded because the total time passed 180 seconds and a further 2 patients were excluded after 3 failed intubation attempts. Four patients were excluded because

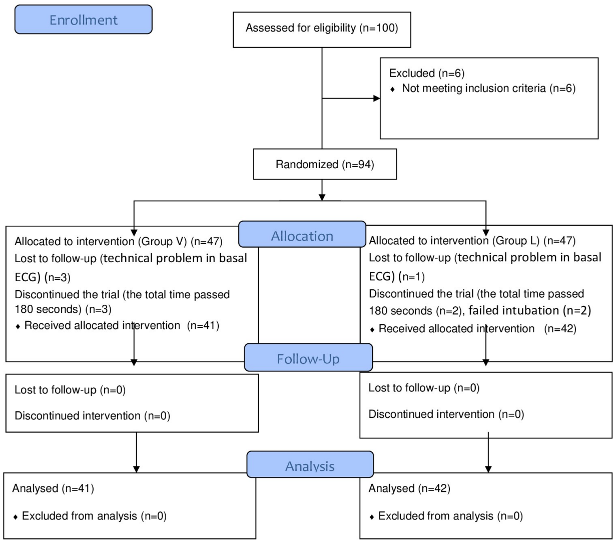

Figure 1. The CONSORT 2010 Flow Diagram.

Table 1. Demographic data of the patients. Data are presented as mean (SD) or number.

	Group L (n=42)	Group V (n=41)	P-value
Age (years)	46.43 ± 12.41	42.41 ± 15.57	0.190
Weight (kg)	71.43 ± 9.54	71.34 ± 12.15	0.971
Height (cm)	169.88 ± 10.31	170.66 ± 8.18	0.710
Gender (M/F)	24/18	31/10	0.122
Body mass index (kg/m^2)	24.66 ± 2.81	24.45 ± 3.66	0.773

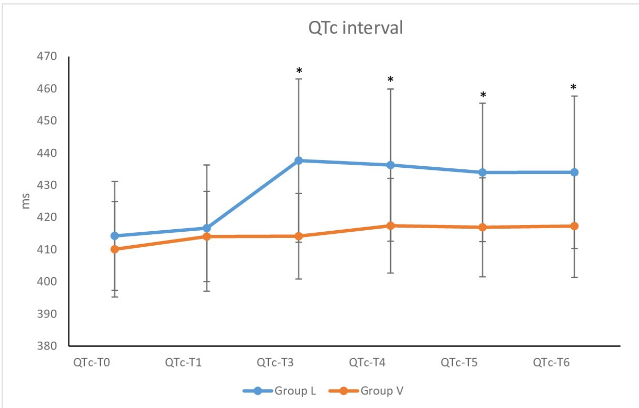

Figure 2. QTc interval. *Indicates significantly difference compared to Group V with Group L, $p<0.05$. Values are mean (SD).

of technical problems with basal ECG. The remaining 83 patients are included in the study (Figure 1).

It has been observed that the groups present similar demographic properties ($p>0.05$) (See Table 1).

In Group V, QTc, Tp-e, and Tp-e/QTc ratios are significantly lower than in Group L except in basal (T0) and post-induction (T1) measurements ($p<0.05$) (Figure 2, Figure 3, Figure 4).

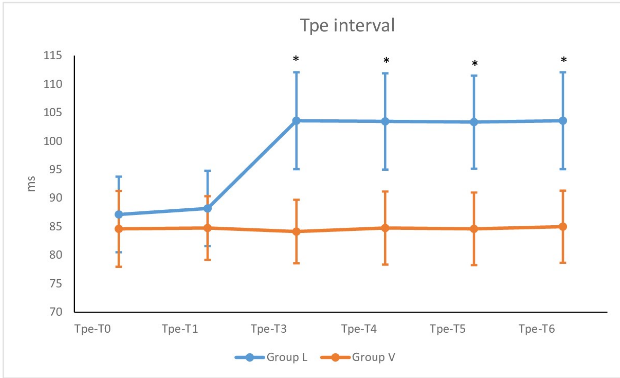

Figure 3. Tpe interval. *Indicates significantly difference compared to Group V with Group L, $p<0.05$. Values are mean (SD).

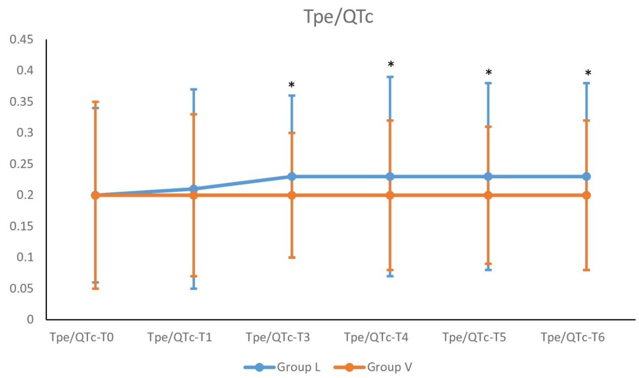

Figure 4. Tpe/QTc ratio. *Indicates significantly difference compared to Group V with Group L, $p<0.05$. Values are mean (SD).

Table 2. Airway management variables (number, mean ± SD).

	Group L (n=42)	Group V (n=41)	P-value
Cormach-Lehane Views (grade1/2)	12/30	17/24	0.223
Intubation Time (second)	60.57±18.68	54.68±13.34	0.103
Tube Shape (Left/Right)	27/15	19/22	0.102
Tube Size (37F/39F/41F)	17/23/2	9/32/0	0.218

There has been no statistically significant difference in terms of hemodynamic assessment among those two groups at all measurement periods ($p>0.05$). The oxygen saturation throughout the intubation procedure was within normal limits.

Cormack-Lehane scores, intubation times, DLT types, and sizes were similar among the studied two groups ($p>0.05$) (As it is seen in Table 2).

Discussion

In the present randomly organized clinical study which was conducted in patients undergoing elective thoracic surgery which requires intubation with a DLT for one-lung ventilation, McGrath 5 video laryngoscope significantly reduced Tp-e interval, QTc and Tp-e/QTc ratios compared with direct Macintosh laryngoscope. Hemodynamic response and intubation conditions were similar in both groups.

Ventricular repoliraziton is measured as QT interval on ECG. Elongation of QT interval is related to syncopes and/or sudden cardiac deaths [9]. On a 12 derivation ECG, the distance among the T-wave and the peak-point value return of the wave T to the isoelectric line (T peak and T end distance, Tp-e) is the left ventricular repolarization transmural distribution index. When this distance is elongated, it may show a tendency to repeat ventricular arrhythmias. It has been illustrated that Tp-e interval prolongation has resulted in an increased mortality in congenital and acquired long QT syndromes, troponin I mutation, hypertrophic cardiomyopathy, and primary percutaneous coronary intervention for myocardial infarction. Gupta et. al illustrated the fact that the Tp-e/QT ratio has to be between 0.15 – 0.25 in healthy populations [10]. Panikkath et. al showed significant elongation of Tp-e distance in sudden cardiac death patients when compared with the corresponding control group. It is not related to age, sex, QTc, QRS time, and left ventricular dysfunction. In addition, when QTc was not predictable in sudden cardiac death patients who had normal QTc or elongated QRS time due to intraventricular conduction delays or blocks, Tp-e prolongation was also significantly associated with sudden cardiac death. For this reason, we included Tp-e, QTc, and Tp-e/QTc in the present study in order to assess cardiac risk in the present study [9].

Congenital and acquired causes (drugs, abnormal electrolyte balance, or other medical conditions) may lead to prolonged QT intervals associated with potentially fatal ventricular arrhythmias for example Torsades de pointes. It is a well-known fact that laryngoscopy and tracheal intubation can cause hypertension and tachycardia due to sympathetic stimulation, which may lead to changes in cardiac repolarization [11]. Therefore, it was reported that esmolol can be used to suppress the hemodynamic response by the sympathetic system secondary to tracheal intubation in patients with high risk of arrhythmias or with uQTS. Ay et al. proposed that the interval QT was significantly prolonged during the intubation period in the patients having coronary artery disease, independent of the anesthetic agent (Thiopental and Etomidate) used in induction [3]. However, the effect of the type of laryngoscope (direct laryngoscopy or video laryngoscopy) that could lead to sympathetic response during tracheal intubation has not been adequately investigated on QT interval dispersion in the literature. Especially, the effect of direct laryngoscopy and video laryngoscopy on QT interval dispersion in intubation with double lumen endotracheal tube is not investigated clearly. It is observed that important reductions Tp-e interval, QTc and Tp-e/QTc ratio in the McGrath MAC 5 video laryngoscope group compared to the direct macintosh laryngoscope group. This can be related to acquiring a better laryngeal view with a video laryngoscope, therefore the DLT which is bigger than a single-lumen tube may be more easily oriented.

Video laryngoscopes can help in several situations, especially in known or predicted difficult airways. It possibly improves the glottic view and reduces laryngoscopies in which a good view cannot be obtained, thus reducing failed intubation rates [12-14].

DLT is necessary for many types of surgeries that require the isolation of lung ventilation. DLT intubation is obviously more difficult when compared with a single-lumen tube both in terms of normal and difficult airways due to their shapes and diameters which are large [15-18].

Also, Campos et. al showed that there was a high incidence of placement failure to properly place DLT among limited experienced and experienced anesthesiologists in thoracic anesthesia, respectively 39% and 36% [19]. Purugganan et al. demonstrated that video laryngoscopes provided a better laryngeal view compared to direct laryngoscopes for intubation with a DLT [5]. Video laryngoscopes were superior to direct laryngoscopy for the placement of double-lumen. In addition, It was shown that maneuvers that are required to obtain a better glottic view, such as applying force to the epiglottis, thus traumatizing soft tissue, are reduced with a videolaryngoscope [17-20]. Lin et al. showed better results with a video laryngoscope compared to a direct Macintosh laryngoscope in DLT intubation. They linked the results with a better laryngeal view, better first-attempt success, less difficult intubation score, and higher correct positioning ratios [21]. It is known that fiberoptic bronchospin prolongs the duration of endotracheal intubation. In a study comparing video laryngoscope and fiberoptics used for intubation, it was reported that the video laryngoscope provided an advantage in terms of the time required to obtain a glottic view and successful placement of the tracheal tube [22]. The results which are found out in this work are different from those of the previous ones. In this study; laryngeal view, first attempt success, intubation time, and correct positioning ratios were similar in both groups. It is possibly because our patients were Cormack-Lehane Grade 1 and 2a and the same experienced anesthesiologist performed intubations. The effects of a video laryngoscope may be shown better for the patients having difficulty in their airways.

There have been some limitations for the present work. Firstly, intubation with DLT was performed by experienced the same anesthesiologist; so it may not be translatable for an anesthetist with limited experience. Secondly, the anesthetists who performed intubation are not blinded to the device utilized in the intubation; but, it is difficult to prevent the issue due to evaluating different intubation devices. Third, for technical reasons, the ECG measurements have been carried out by manual instead of computer-based software.

Conclusion

McGrath MAC video laryngoscope decreased Tp-e interval, QTc and Tp-e/QTc ratio compared to direct Macintosh laryngoscope in patients scheduled for thoracic surgery who require intubation with a DLT for one-lung ventilation. Hemodynamic response and intubation parameters were similar in both groups. There has been also a need for prospective, randomized, controlled trials in known or predicted difficult airway intubation situations with DLT.

The present research study is not supported by any special grant from funcding organizations in public, commercial and also non-profit sector.

We, authors, declare that there has not been any conflict of interest.

Main points

QT interval is related to the increased risk of polymorphic ventricular tachycardias and ventricular arrythmias.

Intubation and laryngoscopy may change in cardiac repolarization and an increase in QT interval length.

There is no study to comparison video laryngoscope with the direct Macintosh laryngoscope on effects Tp-e interval, QTc and Tp-e/QTc ratio for intubation on double-lumen tube.

Ethical approval

Ethical approval was obtained for this study from the Malatya Clinical Research Ethics Committee (Protocol no: 2016/131).

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