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Is there a relationship between TP-e/QT ratio and cardiovascular events due to spinal anesthesia in pregnant women?

Gebelerde TP-e/QT oranı ile spinal anesteziye bağlı gelişen kardiyovasküler olaylar arasında ilişki var mıdır?

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Abstract

Purpose: Prolonged TPe interval has been reported to reflect the abnormal distribution of ventricular repolarization which can be used as a marker of ventricular arrhythmias. Since prolonged TPe/QT ratio is associated with cardiac pathologies, it is thought that it may also be associated with cardiovascular adverse events that occur during and after spinal anesthesia. The aim of this study is to investigate whether there is a relationship between prolonged TPe/QT ratio, which is routine preoperative non-invasive patient data that can be evaluated easily, and perioperative adverse cardiovascular events during cesarean section in pregnant women undergoing spinal anesthesia.

Materials and methods: Voluntary consent was obtained for our study in which 144 pregnant women who were planned for elective cesarean section were included. QT interval was measured based on the initial point where the Q wave or the R wave in the absence of the Q wave started to the last point where the T wave ended. TPe interval measurement was based on the peak point of the T wave and the end point of the T wave convexity. Lead V5 was primarily used for TPe measurement. TPe/QT ratios were calculated in Microsoft office excel program. Patients' demographic characteristics, heart rate, systolic, diastolic and mean arterial pressures were recorded every five minutes intraoperatively.

Results: A weak positive correlation was found between the height variable and the Tpe/QT ratio (p=0.022, r=0.191). As the height increased, the TPe/QT ratio increased. Although it did not reach the level of statistical significance, we found that the TPe/QT ratio was longer in cases with intraoperative bradycardia and hypotension than in cases without complications. The TPe/QT ratio was above 0.21 in patients who developed bradycardia and hypotension. Examination of the correlation between the amount of ephedrine use and TPe/QT ratio revealed a weak positive correlation (p=0.012, r=0.208).

Conclusion: TPe/QT ratio is a novel cardiac marker with high predictive power, is non-invasive, quite inexpensive, and very practical to measure in the early detection of cardiac events, especially arrhythmia. This novel predictive marker can be used in anesthesia practice, preoperative examination and patient follow-up in the intraoperative operating room to predict fatal cardiac arrhythmias or intraoperative hypo/hypertension.

Keywords: Spinal anesthesia, pregnancy, TPe/QT ratio, cardiovascular event.

Coskun I. Is there a relationship between TP-e/QT ratio and cardiovascular events due to spinal anesthesia in pregnant women? Pam Med J 2023;16:662-671.

Öz

Amaç: Tp-e süresinin uzaması, ventriküler repolarizasyonun anormal dağılımını yansıttığı ve ventriküler aritmilerin belirteci olarak kullanılabileceği bildirilmiştir. Uzamış TP-e/QT oranının kardiyak patolojiler ile ilişkisinin olması nedeniyle spinal anestezi sırasında ve sonrasında meydana gelen kardiyovasküler istenmeyen olaylar ile de ilişkisinin olabileceği akla gelmektedir. Bu çalışmadaki amacımız; noninvazif ve kolay değerlendirilebilen rutin bir preoparatif bir hasta verisi olan uzamış TP-e/QT oranı ile spinal anestezi uygulanan gebelerde sezaryen sırasında perioperatif istenmeyen kardiyovasküler olaylar arasında bir ilişki olup olmadığını araştırmaktır.

Gereç ve yöntem: Çalışmamıza gönüllü onamı alınmış, 144 elektif sezaryen operasyonu planlanan gebe dahil edilmiştir. QT intervalinin ölçümü, Q dalgasının veya Q dalgası yokluğunda R dalgasının başladığı ilk nokta ile T dalgasının bittiği son nokta baz alınarak yapılmıştır. Tp-e süresi ölçümü için, T dalgasının en zirve noktası ile T dalga konveksitesinin bittiği son nokta baz alınmıştır. Tp-e ölçümü için öncelikle V5 derivasyonu kullanılmıştır. Tp-e/QT oranları Microsoft office excel programında hesaplanmıştır. Hastaların demografik özellikleri, intraoperatif dönemde her beş dakikada bir olmak üzere nabız, sistolik, diastolik ve ortalama arter basınç değerleri kaydedilmiştir.

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Bulgular: Boy değişkeni ile Tpe/QT oranı arasında pozitif yönde zayıf düzey korelasyon tespit ettik (*p*=0,022, r=0,191). Boy arttıkça Tp-e/QT oranı artmaktaydı. İstatistiksel anlamlılık düzeyine ulaşmasa da intraoperatif bradikardi, hipotansiyon gelişen olgulardaki TPe/QT oranının, komplikasyon gelişmeyen olgulara göre daha uzun olduğunu tespit ettik. Bradikardi ve hipotansiyon gelişen olgularda TP-e/QT oranı 0,21'in üzerinde idi. Efedrin kullanım miktarı TPe/QT oranı arasındaki korelasyon incelendiğinde yine pozitif yönde zayıf düzey korelasyon tespit ettik (*p*=0,012, r=0,208).
Sonuç: Tp-e/QT oranı en başta aritmi olmak üzere, kardiyak olayların erken tespitinde prediktivite gücü yüksek, non-invazif, oldukça ucuz, ölçüm yapılması oldukça pratik, yeni bir kardiyak markırdır. Bu yeni prediktif markır; anestezi pratiğinde, preoperatif muayenede ve intraoperatif ameliyathanede hasta takibinde, fatal kardiyak aritmileri ya da intraoperatif hipo/hipertansiyonu öngörmede kullanılabilir.

Anahtar kelimeler: Spinal anestezi, gebelik, TPe/QT oranı, kardiyovasküler olay.

Coşkun İ. Gebelerde TP-e/QT oranı ile spinal anesteziye bağlı gelişen kardiyovasküler olaylar arasında ilişki var mıdır? Pam Tıp Derg 2023;16:662-671.

Introduction

Regional and general anesthesia techniques are used in cesarean section operations. Neuraxial blocks are preferred the most to avoid general anesthesia complications in pregnancy. Despite the rapid increase in the number of cesarean section operations, the low rate of anesthesia-related complications is due to the use of spinal and epidural anesthesia [1]. Spinal anesthesia is a form of anesthesia that is frequently used in all infraumbilical surgeries and has been shown to be effective due to some advantages such as preserving cognitive functions, reducing the amount of intraoperative bleeding and the risk of postoperative thromboembolism, and providing effective postoperative analgesia [2]. However, it may also bring disadvantages such as hypotension, bradycardia and delayed mobilization [3]. Hypotension secondary to vasodilation may increase perioperative mortality due to the sympathetic blocking effects of spinal anesthesia, especially in elderly patients [3]. Although elective cesarean section cases are young, female patients of reproductive age, bradycardia and hypotension that may develop after spinal anesthesia may disrupt the placental perfusion and cause undesirable effects on the fetus. Even in young female patients with long QT syndrome or Brugada syndrome, bradycardia and hypotension may result in sudden cardiac death. Preoperative detection of patients who are at risk to develop hypotension during surgery provides significant facilitation for the physician in terms of both preoperative and intraoperative intervention and surgical safety [4]. The depth of hypotension that may occur after spinal anesthesia mainly depends on 3 parameters. These include patient's intravascular volume, the amount of sympathetic activity, and peripheral vasomotor tone [5]. Of these, the intravascular volume value seems to be the parameter of the greatest significance due to both the feasibility of its measurement and the possibility of intervention [6]. Intravenous volume assessment, which can be measured both by various static (thermodilution, echocardiography, central venous pressure) methods and dynamic (arterial pressure, plethysmography, pulse change index) measurements, provides us with advantages in the prediction and treatment of hypotension [7]. It is thought that dynamic measurements can better detect volume by evaluating the effects of respiratory changes [8]. However, intravascular volume can be determined using hemodynamic monitoring devices that require expensive hardware equipment. These devices are difficult to obtain in daily practice, time-consuming, and disadvantageous due to expensive probes, which has paved the way for clinicians to find a simple, practical, and non-invasive method to predict bradycardia hypotension. Electrocardiography (ECG) is a simple and non-invasive test used in the diagnosis of diseases or conditions associated with the heart. As an example of ECG changes, QT dispersion (QTd), which is thought to show local heterogeneity in myocardial repolarization, has been shown to cause severe ventricular arrhythmias and sudden cardiac death [9]. QT dispersion defined as the difference between the longest (maximum) and shortest (minimum)

QT interval measured on a superficial 12-lead ECG. As another example of such ECG changes, Tpeak-Tend (TPe), which has been shown to be an arrhythmogenic marker in recent years, and the proportionally calculated TPe/QT ratio increase significantly. According to the QT interval, this interval is associated with ventricular arrhythmias, ventricular tachycardia, and ventricular fibrillation, both of which are life-threatening [10]. The TPe interval is the interval between the projection of the peak of the T wave on the isoelectric line (Tp) and the point where the line drawn tangentially to the descending part of the T wave intersects the isoelectric line (Te). The duration of this interval, the TPe interval, is suggested to indicate transmural dispersion of ventricular repolarization. It has been reported that prolonged TPe interval reflects the abnormal distribution of ventricular repolarization and can be used as a marker of ventricular arrhythmias [11-13]. Since prolonged TPe/QT ratio is associated with this type of pathologies, it is also thought to be associated with cardiovascular adverse events that occur during and after spinal anesthesia. In this study, our aim is to investigate whether there is a relationship between TPe/QT ratio, which is a non-invasive and easily evaluated routine preoperative parameter, and perioperative adverse cardiovascular events in elective cesarean section operations in pregnant women undergoing spinal anesthesia.

Materials ve methods

Ethical approval was obtained from Ordu University Clinical Research Ethics Committee (KAEK) for the study. Our prospective, observational and cross-sectional study was carried out between 01.12.2022 and 01.07.2023 in the operating room of Ordu University Training and Research Hospital, Gynecology and Children's Hospital. Voluntary consent was obtained and 144 pregnant women who were planned for elective cesarean section were included in the study. Power analysis was not performed and patients within a certain time interval were included in the study. Our study design was prepared in accordance with the Declaration of Helsinki and good clinical practice guidelines. Participating pregnant women were asked to fill in and sign the informed consent form. The inclusion and exclusion criteria in our study were as follows: cases over the age of 18, under the age of 50, who were planned for elective cesarean section, and whose ECGs were taken during the preoperative examination were included in the study, while cases under the age of 18, over the age of 50, who refused to participate in the study, who were morbidly obese (a body mass index of 35 kg/m^2), who had congenital heart disease, severe heart valve disease, advanced chronic kidney disease, severe respiratory disease, and chronic systemic inflammatory disease, who had a history of malignancy, who had complete and/or incomplete bundle branch block, atrial fibrillation, antiarrhythmic drug use and who underwent general anesthesia were excluded from the study. The patients' ECGs and intraoperative vital signs were evaluated by different people, thus providing blindness for the study. Patients' ECGs were scanned with an Epson brand Workforce DS-770 model device and transferred to the computer environment. Images transferred to the computer environment were enlarged with the help of Windows photo viewer and recorded by calculating the P wave, QT interval, T wave, TPe interval for each ECG with the help of the Pixel-Ruler program. P wave measurement was based on the first point where the P wave convexity started and the last point where it ended. T wave measurement was based on the first point where the T wave convexity started and the last point where it ended. QT interval was measured based on the initial point where the Q wave or the R wave in the absence of the Q wave started to the last point where the T wave ended. TPe interval measurement was based on the peak point of the T wave and the end point of the T wave convexity. On the 12-lead ECG, P wave, T wave and QT interval were calculated individually for each lead. TPe measurement was initially performed using lead V5, and if not suitable, lead V4 or V6. TPe/QT ratios were calculated in Microsoft office excel program. These measurements were calculated and recorded. ECG wave, interval and segments are shown in Figure 1, and QT interval and TPe interval are shown in Figure 2.

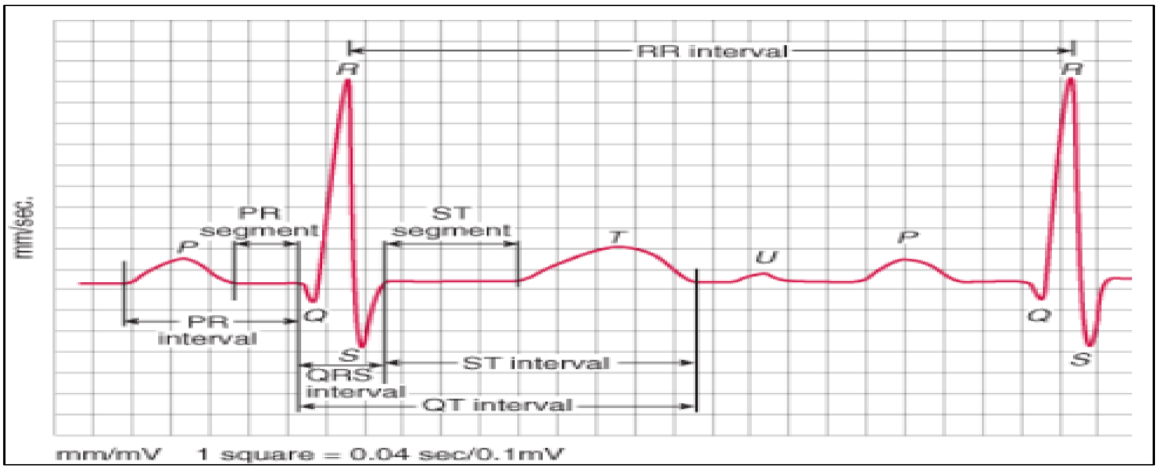

Figure 1. ECG wave, interval and segments

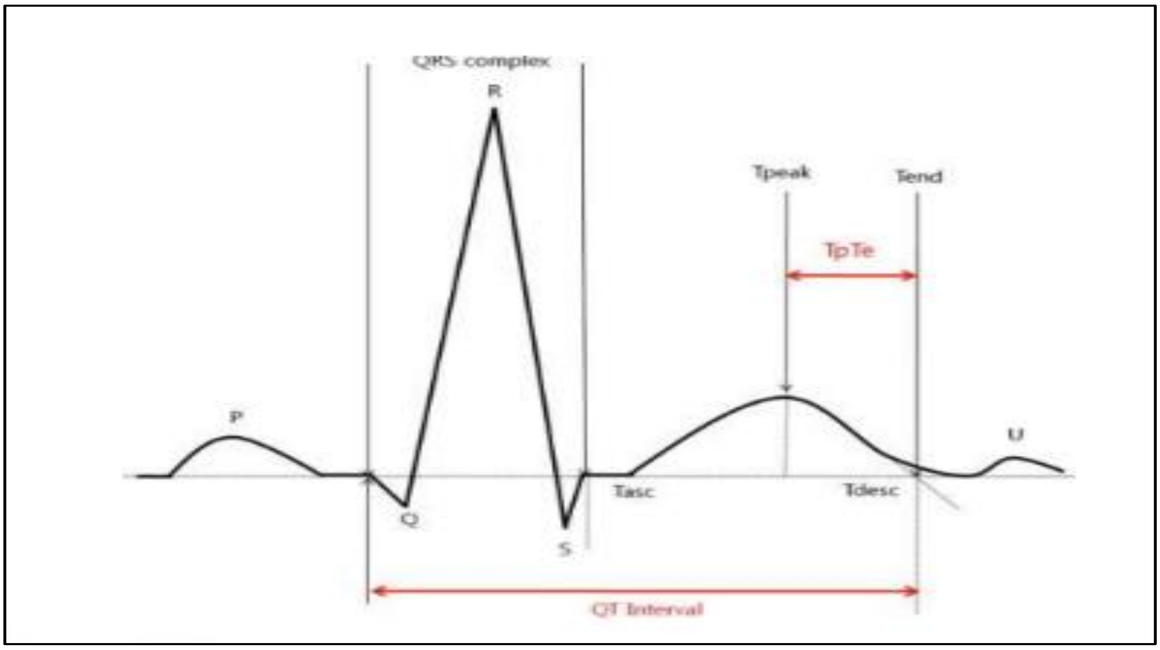

Figure 2. QT interval and TPe interval

When the patients were taken to the operating room, they were monitored with standard monitoring methods (ECG, pulse oximeter, pulse, and non-invasive blood pressure). None of the cases were premedicated. Vascular access was provided with a 22 Gauge intravenous cannula from the back of the right hand. Preoperative preload, that is, fluid loading, was not performed on the pregnant women. Hydration was achieved with 0.9% NaCl solution at a rate of 4 ml/kg/hour in the operating room environment. Pregnant women were placed in a sitting position, after the necessary treatment and covering procedures, spinal anesthesia was performed with a 25 Gauge Quincke spinal needle from the L3-L4 range. 12.5 mg of hyperbaric bupivacaine (Buvasin® 0.5% Spinal heavy ampoule, Vem İlaç, Istanbul, Türkiye) was given to the intrathecal (spinal) space when a clear flow of CSF was observed. Homogenization was achieved by applying the same local anesthetic and the same volume of bupivacaine to all cases. When the patient was taken to the operating room table, the vital findings (pulse, mean arterial pressure) were accepted as 0 minutes, and the vital findings immediately after spinal anesthesia were accepted as 1 minute. Then, following spinal anesthesia, pulse and mean arterial pressure (MAP) were intraoperatively recorded up to 40 minutes, every 5 minutes. In addition, the demographic characteristics of each patient (age, weight, height, body mass index, gestational week, family history of heart disease, accompanying systemic diseases) were recorded. During the follow-up of intraoperative vital findings, if the heart rate fell below 50 beats/min, bradycardia was accepted, 1 mg of atropine was planned to be administered and whether atropine was administered or not was recorded. The mean arterial pressure (MAP) was recorded at 0 minutes and, following spinal administration, a 20% decrease based on the initial MAP at each measurement time up to minute 40 (every 5 minutes), was accepted as hypotension, and 10 mg of ephedrine was administered. The amount of ephedrine was recorded in mg. Those who developed intraoperative bradycardia and hypotension complications were recorded as "complication developed". At the end of the operation, the patients were followed up in the recovery room for 30 minutes. The patients were sent to the service in the event that the block level decreased to T10, the Modified Bromage Scale was 2 and the Modified Aldrete score was 9-10.

Statistical method

Data were analyzed with IBM SPSS v23. Kolmogorov Smirnov and Shapiro Wilk tests were used to test normal distribution. Mann Whitney U test was used to compare the data that did not show normal distribution. The relationship between the measurements was analyzed with Spearman's rho test. The results of the analyses of quantitative data were obtained with mean ± sd. Significance level was accepted as $p<0.05$.

Results

Examination of the relationship between patients' demographic characteristics and TPe/QT is presented in Table 1.

Table 1. Examination of the relationship between demographic characteristics and TPe/QT

	r	***p***
Age	0.081	0.332
Weight	0.017	0.842
Height	0.191	**0.022**
BMI	-0.090	0.285

r: Spearman's rho (Correlation analysis of demographic characteristics and Tpe/QT ratio)

There is no statistically significant relationship between TPe/QT and age, weight, and BMI ($p>0.05$). There is a positive and weak statistically significant relationship between height and TPe/QT (r=0.191; $p=0.022$). As the height increases, the TPe/QT ratio also increases.

The comparison of TPe/QT values according to complications, comorbidities, and drug use is presented in Table 2.

The median TPe/QT value was determined as 0.2 in patients without intraoperative complications, and 0.222 in patients with complications with no statistical difference ($p=0.166$). While the median TPe/QT value was 0.2 in patients without postoperative complications, it was 0.225 in patients with complications with no statistical difference ($p=0.096$). While the median value was 0.214 in patients without co-morbidities, it was 0.2 in patients with co-morbidities with no statistical difference ($p=0.578$). While the median value was 0.2 in patients with a family history of cardiac diseases, the median value was 0.214 in patients without a family history, with no statistical difference ($p=0.690$). While the median value was 0.2 in patients who did not use ephedrine, it was 0.222 in patients who used it, with no statistical difference ($p=0.151$). While the median value was 0.2 in patients who did not use atropine, it was 0.235 in patients who used it, with no statistical difference ($p=0.169$).

Table 2. Comparison of TPe/QT values by complication, comorbidity, and drug use

	Mean ± s.s.	Median (min-max)	Test Statistics	*p**
Intraoperative Complication				
No (n=45)	0.202±0.07	0.2 (0.074-0.333)	1907.5	0.166
Yes (n=99)	0.222±0.084	0.222 (0.074-0.583)		
Postoperative Complication				
No (n=132)	0.212±0.078	0.2 (0.074-0.583)	562.5	0.096
Yes (n=12)	0.258±0.098	0.225 (0.143-0.526)		
Co-morbidity				
No (n=112)	0.215±0.071	0.214 (0.074-0.5)	1676.5	0.578
Yes (n=32)	0.219±0.108	0.2 (0.074-0.583)		
Familial Heart Disease				
No (n=118)	0.212±0.078	0.214 (0.074-0.526)	1457.5	0.690
Yes (n=26)	0.23±0.09	0.2 (0.1-0.583)		
Ephedrine Use				
No (n=52)	0.203±0.072	0.2 (0.074-0.333)	2048	0.151
Yes (n=92)	0.223±0.085	0.222 (0.074-0.583)		
Atropine Use				
No (n=141)	0.215±0.081	0.2 (0.074-0.583)	113.5	0.169
Yes (n=3)	0.248±0.026	0.235 (0.231-0.278)		

*Mann Whitney U

When the literature is examined, the TPe/QT ratio was found to be less than 0.21 among healthy volunteers and 0.21 and above among patients with cardiac disease in the studies comparing healthy volunteers and populations with cardiac problems [14, 15]. In our study, although it did not reach a statistically significant level, it was found to be above 0.21 in cases who developed intraoperative bradycardia and hypotension (patients who used intraoperative ephedrine and atropine due to hypotension), as well as in cases with a family history of heart disease.

Vital parameters during measurement times and TPe/QT ratio were analyzed by Sperman correlation test. Our results are presented in Table 3.

There is a positive and weak significant relationship between the amount of ephedrine use and TPe/QT (r=0.208; *p*=0.012). MAP differences and Pulse differences do not show a significant relationship with TPe/Qt ratio (*p*>0.05).

Descriptive statistical values of our patients are presented in Table 4.

The comparison of the vital signs measured before and after spinal administration in patients with and without prolonged TPe/QT ratio is presented in Table 5.

Table 3. Examination of the relationship between measurement values and TPe/QT ratio

	r	*p*
Amount of ephedrine# (mg)	0.208	**0.012***
PSMBP-POSMBP difference	0.034	0.689
PSMBP-POSMBP difference	0.191	0.135
PSMBP-POSMBP difference	-0.049	0.564
PSPulse-POSPulse difference	-0.158	0.059
PSPulse-PS5Pulse difference	-0.145	0.082
PSPulse-PS10Pulse difference	-0.121	0.147

r: Spearman's rho correlation analysis (Correlation analysis of vital signs and Tpe/QT ratio), mg: miligram, #: PSMBP: Pre-spinal mean blood pressure, POSMBP: Post-spinal mean blood pressure, POS5MAP: Post-spinal mean 5-minute blood pressure, POS10MAP: Post-spinal mean 10-minute blood pressure, PSPulse: Pre-spinal pulse, PSPulse: Post-spinal pulse, PS5Pulse: Post-spinal 5-minute, PS10Pulse: Post-spinal 10-minute pulse, Cases using intraoperative ephedrine were compared

Table 4. Descriptive Statistics

	Mean ± s.s.	Median (min-max)
Age (year)	28.556±5.419	28 (16-50)
Weight (kg)	78.931±13.374	76 (55-140)
Height (cm)	161.84±6.376	160 (149-178)
BMI (weight/heightxheight)	30.146±4.866	29.68 (20.7-48.04)
Gestational week	37.88±1.691	38 (29-42)
Operation time (minute)	38.958±9.75	40 (25-65)
TPE (ms)	2.215±0.931	2 (1-7)
QT (ms)	10.42±2.43	10 (5-22.5)
Amount of ephedrine (mg)	11.91±13.779	10 (0-100)
TPe/QT (ms)	0.216±0.081	0.205 (0.074-0.583)
PSMBP-POSMBP difference (mmHg)	9.035±13.47	8 (-42-52)
PSMBP-POSMBP difference (mmHg)	-25.917±584.453	21 (-6987-77)
PSMBP-POSMBP difference (mmHg)	20.528±15.801	19 (-11-73)
PSPulse-POSPulse difference (mmHg)	-0.847±15.505	-1 (-46-60)
PSPulse-PS5Pulse difference (mmHg)	4.653±23.203	4 (-52-62)
PSPulse-POSPulse difference (mmHg)	4.042±20.25	5 (-58-52)

Results of analysis Mean ± sd for quantitative data, BMI: Body Mass Indexmg, mg: miligram, mmHg: millimeters of mercury, PSMBP: Pre-spinal mean blood pressure, POSMBP: Post-spinal mean blood pressure ms: milliseconds, POS5MAP: Post-spinal mean 5-minute blood pressure POS10MAP: Post-spinal mean 10-minute blood pressure, PSPulse: Pre-spinal pulse, PSPulse: Post-spinal pulse, PS5Pulse: Post-spinal 5-minute, PS10Pulse: Post-spinal 10-minute pulse

Table 5. Comparison of vital signs measured before and after spinal administration in patients with and without prolonged TPe/QT ratio

	TPe/QT ratio <0.21		TPe/QT ratio >0.21		Test statistics	*p*
	Mean ± s.s.	**Median (min-max)**	**Mean ± s.s.**	**Median (min-max)**		
PSSBP	134.3±16.2	134 (105-171)	132.1±14.9	132 (102-174)	2421.000	0.494
POSSBP	122±17.9	124 (72-169)	120.1±17.7	120 (71-174)	2411.000	0.469
POS5SBP	107.1±21.4	109.5 (58-157)	108.4±20.1	109.5 (52-148)	2521.500	0.778
POS10SBP	113.9±16.4	114 (69-152)	113.1±16.7	113.5 (77-152)	2510.500	0.745
POS15SBP	115.7±13.3	114.5 (87-150)	114.1±15.8	115.5 (75-161)	2533.500	0.815
PO20SBP	113.9±13.4	114 (92-155)	114.9±13.7	113.5 (81-154)	2496.000	0.701
POS25SBP	114.1±13.3	113 (87-157)	117.9±13.4	117 (80-154)	2019.000	**0.030**
POS30SBP	116±13.6	116 (87-160)	118.2±12.3	119 (85-154)	1718.500	0.121
POS35SBP	116.7±14.1	114 (93-166)	117.6±12.3	115.5 (96-158)	1170.500	0.395
POS40SBP	117.4±12	117.5 (99-155)	121.7±11.5	122.5 (95-158)	441.000	**0.049**
POS25DBP	56.8±12.1	54 (35-101)	61.3±12.2	61 (37-92)	1932.500	**0.012**
POS30DBP	58.7±12.4	58 (34-96)	60.3±11.5	61 (27-85)	1766.000	0.185
POS35DBP	61.2±12.2	60 (40-104)	63.7±9.6	63 (44-87)	1018.500	0.062
POS40DBP	62.2±13.4	62 (28-95)	67.4±9.8	68.5 (42-91)	457.000	0.053
POS45DBP	57.1±10.7	56 (28-74)	69.6±11	70 (46-91)	78.000	**0.001**
POS40MBP	77.1±11.8	77 (55-110)	82.9±10.9	84 (59-110)	444.500	**0.017**
POS45MBP	73.2±10	72 (52-91)	84.9±10.4	82.5 (63-103)	88.500	**0.002**
PS50MBP	75.1±10.6	75.5 (56-90)	85.3±13.5	89 (52-101)	47.000	**0.023**

*Mann Whitney UResults of analysis Mean ± sd for quantitative data, POS: Post-spinal SBP: Systolic blood pressure DBP: Diastolic blood pressure, MBP: Mean blood pressure (All the lines that were significant were taken so that the table was not too long, some of the lines that were not, significant were included in the table)

Discussion

As a result of our study, we found a weak positive correlation between the height variable, which is one of our demographic characteristics, and the Tpe/QT ratio. As the height increased, the TPe/QT ratio increased. Although it did not reach the level of statistical significance, we found that the TPe/QT ratio was longer in cases with intraoperative bradycardia and hypotension than in cases without complications. The TPe/QT ratio was above 0.21 in cases with bradycardia and hypotension. Ephedrine, a short-acting non-selective beta-mimetic agent, is used in the operating room for the treatment of cases with intraoperative bradycardia and hypotension. When the correlation between the amount of ephedrine use and TPe/QT ratio was examined, we found a weak positive correlation. As the use of ephedrine increased, the TPe/QT ratio increased. When the vital findings were compared in the measured time periods, the systolic and diastolic blood pressures of the cases with a TPe/QT ratio above 0.21 were found to be higher and therefore the mean blood pressures were higher.

Studies have shown that the QT interval and TPe interval increase linearly with body mass [16]. In the same study, it was observed that the TPe/QT ratio did not change. It was observed that the TPe interval changed in heart rate changes, but the TPe/QT ratio did not change [12]. Therefore, the TPe/QT ratio is accepted as a more valuable parameter than the TPe interval. In our study, no significant relationship was found between the TPe/QT ratio and the weight variable. However, in our study, we found a positive correlation between the height variable and the TPe/QT ratio. As the height increased, the TPe/QT ratio increased. In the literature, the relationship between the age and weight variable and the TPe/QT ratio was examined in available studies. Our study is the first study to examine the height and TPe/QT ratio in the literature.

Tekinalp N. et al. [17] compared the TPe/QT ratios of the control group consisting of healthy volunteers with acute ischemic stroke and acute hemorrhagic stroke cases. They found that the TPe/QT ratios measured from the V5-V6 derivations increased significantly compared to the control group. In our study, the TPe/QT ratio was measured from the V5 derivations of the cases. Tekinalp et al. [17] conducted a study in elderly patients with comorbidities, whereas we conducted our study in pregnant patients consisting of young healthy women of reproductive age. In our study, we found that the TPe/QT ratios of the cases who developed hypotension increased, but it was not statistically significant. This difference may be due to the significant difference between study populations.

In a study comparing healthy volunteers (control group) and patients with coronary artery ectasia, Alsancak et al. [18] found that the TPe/QT ratios of patients with coronary ectasia were increased. In fact, the authors found that TPe/QT ratios were higher in patients with two-vessel-three-vessel ectasia compared to those with single-vessel ectasia. The fact that our results are conflicting is due to the fact that our study included a single group and the study population was very different.

Kayali and Demir [19] compared the TPe/QT ratios of young adults aged 16-19 years who smoked and did not smoke. The authors found the TPe/QT ratios were higher in smokers than in non-smokers. Our study was also conducted in young adult pregnant patients, and our study populations and results are partially similar to the studies of Kayali and Demir.

Hidayet et al. [20] compared the TPe/QT ratios, TPe intervals and TPe/QTc ratios of two groups including healthy volunteers and patients with Behçet's disease. The authors found that other mentioned ratios and TPe/QT ratios increased in patients with Behçet's disease compared to healthy volunteers. The authors emphasized that patients with Behçet's disease should go to cardiology outpatient clinic controls frequently in terms of arrhythmia. In our study, we found that there was a tendency to hypotension in our cases with increased TPe/QT rates.

Ucar et al. [21] compared the TPe/QT and TPe/QTc ratios of patients with acute myocarditis and healthy volunteers. Again, TPe/QT ratios were found to be increased in patients with myocarditis compared to healthy volunteers. The authors emphasized that these rates may have increased due to impaired ventricular repolarization in the heart. Again, our results do not coincide due to the differences in our populations.

In the literature, our study is unique in two aspects. There are no studies on the TPe/QT ratio in pregnant women. In the intraoperative period, no other study in which this rate was studied in the operating room has been found in the literature.

Our study had some limitations. First of all, the fact that there is no gender difference and the recruitment of pregnant female patients alone is the first limitation of the study. The low number of subjects included in the study is the second limitation.

In conclusion, the TPe/QT ratio is a novel cardiac marker with high predictive power, is non-invasive, quite inexpensive, and very practical to measure in the early detection of cardiac events, especially arrhythmia. This novel predictive marker can be used in anesthesia practice, preoperative examination and patient follow-up in the intraoperative operating room to predict fatal cardiac arrhythmias or intraoperative hypo/hypertension. We believe that our study will shed light on long-term studies with large populations to be conducted on this subject.

Conflict of interest: No conflict of interest was declared by the authors.

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