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Effect of perioperative inadvertent hypothermia on the ECG parameters in patients undergoing transurethral resection

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Abstract. – OBJECTIVE: Perioperative inadvertent hypothermia (PIH) (core body temperature to < 36 °C) is a common event during surgery. PIH may result from multiple factors. Elderly urology patients are at greater risk than other patients for hypothermia. PIH may cause adverse postoperative cardiac clinical manifestations. Our study aimed to determine the effects of postoperative alteration of core body temperature on the ECG parameters in patients undergoing transurethral resection.

PATIENTS AND METHODS: Fifty-nine patients, 40-83 years of age, who were scheduled for elective Transurethral Resection Prostate and/or Bladder (TUR-P and/or TUR-B) were enrolled in the study. Patients with operation times more than 30 minutes were included. Core temperatures were measured and standard 12-lead ECG readings were taken before surgery and immediately upon arrival in the postanesthesia care unit.

RESULTS: 59 patients were included this study. Prevalence of PIH (< 36°C) was (57.6%). The postoperative temperature was found to be significantly lower than the preoperative of all patients (preop 36.46±0.39; postop 35.68±0.59, paired sample *t*-test, $p<0.001$). Also in all patients, postoperative QTc dispersions were found to be significantly longer than the preoperative QTc dispersions (preop 59.66±32.69; postop 74.57±37.47 ms, $p<0.05$). When we divided the patients; hypothermic and normothermic, postoperative QTc dispersions were significantly different between two groups (68.23±33.43 ms, and 83.20±41.50 ms; $p=0.009$).

CONCLUSIONS: The prevalence of inadvertent intraoperative hypothermia in patients undergoing transurethral resection is relatively high. QTc dispersion of mild hypothermic patients was significantly longer than normothermic patients'.

Key Words:
Transurethral resection, Perioperative hypothermia, QT interval.

Introduction

Perioperative inadvertent hypothermia (PIH) is a common and serious complication of anesthesia and surgery[1-3]. PIH can be defined as an inadvertent drop in the core body temperature to < 36°C[4,5]. Despite the precautions and guidelines incidence of PIH is still high[1,6-8]. PIH may result from anesthesia-induced impairment of thermoregulation, fluids used during surgery and exposure to a cold operating room environment[9]. Both general anaesthesia and regional anaesthesia (spinal, epidural) can impair normal thermoregulatory mechanism of the body and may result in hypothermia[10]. PIH is associated with an increased incidence of perioperative complications and may affect the postoperative course[2,11]. PIH have several known adverse effects on the pharmacokinetics of agents used during anaesthesia, on the myocardium, on surgical site infection rates and the clotting system, and is associated with mortality and morbidity increase[2,5,12,13]. Hospital stay of patient is also affected adversely from hypothermia[1].

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Elderly patients are at greater risk than other patients for hypothermia because the thermoregulatory capacity decreases with age[3,14,15]. Urology patients mostly consisting of elderly patients are at higher risk of perioperative complications. The use of inadequately warmed irrigation and intravenous fluids can increase drops in temperature. Additionally, anesthesia especially regional anesthesia may impair the thermoregulation in these elderly patients[16-18].

It is reported that perioperative hypothermia could lead to severe cardiac complications and the maintenance of normothermia is associated with a reduced incidence of morbid cardiac events in the perioperative period[19]. Hypothermia may lead to increased circulating catecholamine levels, as a result of this tachycardia, hypertension and systemic vasoconstriction may be seen in elderly patients. The increase in plasma norepinephrine concentrations can enhance the cardiac irritability and promote the development of ventricular arrhythmias[13]. Furthermore, hypothermia triggers alterations in electrocardiographic (ECG) parameters and is associated with prolongation of PR, QRS, and QT intervals[20].

Therefore, the aim of the present study was to investigate the effects of postoperative alteration of core body temperature on the ECG parameters in patients undergoing transurethral resection.

Patients and Methods

After receiving approval from the Institutional Ethics Committee, we obtained written informed consent from all participants. Fifty-nine patients, with American Society of Anesthesiologists (ASA) physical status I-III and 40-83 years of age, who were scheduled for elective Transurethral Resection Prostate and/or Bladder (TUR-P and/or TUR-B) were enrolled in the study. Patients with operation times more than 30 minutes were included into the study for a four-month period.

Patients received no premedication. On arrival in the operating room, heart rate (HR), mean arterial pressure (MAP), oxygen saturation as measured by pulse oximetry (SpO_2) were recorded using standard, noninvasive monitors. Operating room (OR) temperature was maintained at 22°-24°C during the surgery.

Demographical data of the patients, method of anesthesia, type and duration of surgeries were recorded. In the Post Anesthesia Care Unit (PACU), standard 12-lead ECG readings were taken and temperatures of patients measured from the tympanic membrane with the same thermometer before surgery and immediately upon arrival. Core temperatures below 36°C were accepted as hypothermia. ECG recordings were performed at a speed of 25 mm/sec. The longest QT interval in the ECG records of all derivation was measured by two researchers blinded to the patient's group. QTd was recorded as the difference between the maximum and the minimum QT values (QTd = maximum QT – minimum QT). QTc, the heart rate-corrected QT interval, was calculated with Bazett's Formula.

Patients preoperatively detected hypothermia or fever were excluded. Additionally, patients with atrial fibrillation (AF), pacemaker rhythm, right bundle branch block, left bundle branch block, any sign of ischemia on the initial ECG and echocardiographic evidence of LV hypertrophy, systolic dysfunction, wall motion abnormalities, pericardial disease or who have serious hemodynamic instability because of large fluid shifts, and/or blood loss were also excluded from the study. Postoperatively all patients were monitored and covered with one cotton blanket and were actively warmed in the PACU.

Statistical Analysis

The data analysis was performed using the Statistical Package for the Social Sciences software, version 20 for Windows (SPSS Inc., Chicago, IL, USA). The data are shown as mean ± standard deviation for continuous variables, medians (minimum-maximum) for ordinal variables, and frequencies with per cent for categorical variables. Comparisons between groups were performed using one-way ANOVA with post hoc analysis by Tukey's HSD or independent samples t-test and the Kruskal-Wallis tests or Mann-Whitney U test for normally and abnormally distributed data, respectively. The categorical variables between groups were analyzed using the chi-square test. A p-value of < 0.05 was considered statistically significant.

Results

A total of 59 patients (67.01±10.71 year, 89.8% (n=53) men) were included this study. All of the patients had their operations performed under spinal anesthesia. When all patients were evaluated, the postoperative temperature was found to be significantly lower than the preoperative

Table I. Patient demographics and anesthesia/surgery data.

Characteristics		Value
Gender, (male/female)		53/6
Age (years, mean± SD)		67.01±10.71
Type of surgery, TUR-P/TUR-B		12/47
History	HT (n, %)	26, (44.1%)
	KOAH (n, %)	10, (16.9%)
	DM (n, %)	8, (13.6 %)
Duration of surgery (n:59) (min, mean± SD)		49.13±21.30
Preoperative temperature (n:59) (ºC, mean± SD) (in recovery unit)		36.49±0.35
Postoperative temperature (n:59) (ºC, mean± SD) (in recovery unit)		35.71±0.59

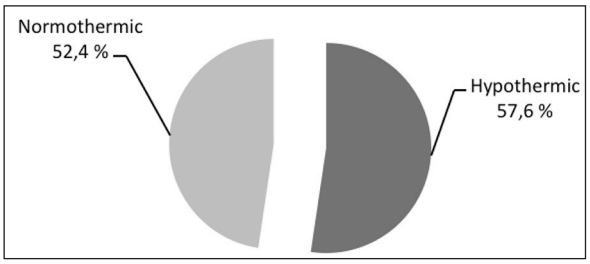

Figure 1. The incidence of postoperative hypothermia (Core temperatures below 36°C were accepted as hypothermia).

(preop 36.46±0.39; postop 35.68±0.59, paired sample t-test, p<0.001). Also in all patients, postoperative QTc dispersions were found to be significantly longer than the preoperative QTc dispersions (preop 59.66±32.69; postop 74.57±37.47 ms, p<0.05). Baseline, clinical and surgery characteristics of this study were presented in Table I.

Inadvertent hypothermia was developed in 57.6% (n=34) during the surgery (Figure 1). When we divided the patients; hypothermic and normothermic; there were no statistically significant differences between the groups in terms of baseline, and clinical characteristics (p>0.05, Table II).

Comparing patients with hypothermia to normothermic patients, there was no statistical difference regarding preoperative temperature (36.38±0.35, 36.64±0.30; p=0.101), but the value of the postoperative temperature of patients was significantly different (35.34±0.47, 36.21±0.29; p=0.001). Surgery times were found to be statistically insignificant between two groups (52.97±21.38, 43.52±20.38; p=0.69) (Table III). The preoperative QTc dispersion in the group with hypothermia was 56.47±32.33, and 54.00±32.65 ms in other group (p=0.387). However, postoperative QTc dispersions were significantly different between two groups (68.23±33.43 ms, and 83.20±41.50 ms; p=0.009).

Discussion

Our data demonstrated that the urology patients presenting for transurethral resection are at a relatively high risk of hypothermia. Hypothermia was detected in 57.6% (n=34) of all patients in our study. Besides this, we found that postoperative body temperature was significantly lower than the preoperative body temperature in all patients. These findings are considerable as hypothermia is a common problem during transurethral resection surgery. Additionally, QTc dispersion of patients with hypothermia was significantly longer than normothermic patients'. To our knowledge, the effect of hypothermia on the duration of QTc among urology patients undergoing transurethral resection has not been investigated and discussed in the literature until now and this investigation is the first to investigate the association between PIH and QTc dispersion.

It is well known that some degree of hypothermia may occur during transurethral resection[21,22]. Au-

Table II. Distribution of data according to the body temperature. Values are mean (SD), number or proportion (%).

Parameters	Hypothermia	Normothermia	*p*-value
Male (n, %)	32 (94.1%)	21 (84%)	=0.280
Female (n, %)	2 (5.9%)	4 (16%)	=0.345
Age (years, mean± SD)	66.29±9.51	68.0±12.34	=0.490
HT (n, %)	13 (38.2%)	13 (52.0 %)	=0.297
KOAH (n, %)	5 (14.7%)	5 (20.0%)	=0.570
DM (n, %)	2 (5.9 %)	6 (24%)	=0.096

*Tukey's HSD, Kruskal-Wallis, Mann-Whitney U and chi-square tests.

thors commonly have investigated the prevalence of hypothermia, the efficiency of warming methods of patients and the effect of the temperature of irrigation fluids[5,11,12,17]. Also, postoperative adverse clinical manifestations of hypothermia have been suggested in previous studies. In a landmark study, Frank et al[19] conducted a randomized, controlled study in 300 high-risk cardiac patients and they reported that perioperative myocardial ischemia and ventricular tachycardia were more prevalent in hypothermic patients. They concluded that the preservation of normothermia was associated with a reduced occurrence of adverse cardiac events in the perioperative period. In another study Evans et al[23] reported that the rapid decrease of the body temperature which occurs during TURP may cause significant cardiac stress[24,25].

On the other hand, electrocardiographic changes related to hypothermia have been most commonly mentioned in studies about therapeutic hypothermia and case reports of accidental environmental emergencies[26-29]. Atrial and ventricular dysrhythmias, prolongation of the PR, QRS, and QT intervals have been reported as the classic ECG findings of moderate and severe hypothermia[26,28]. In an animal study conducted by Van der Linde et al[30] it was reported that hypothermia prolonged the QT interval. However, electrocardiographic changes in patients with hypothermia during the perioperative period have not been investigated previously, particularly in transurethral resection surgeries. In this study, we found that PIH may occur more than half of the patients undergoing transurethral resection and the QTc was significantly prolonged in patients with hypothermia. Assessment of the QT interval is clinically important because prolongation of repolarization is often associated with poor cardiac conditions. The QT interval shows ventricular repolarization, and an increase in the duration of the QT interval is a risk factor for arrhythmia[31].

Multiple factors play a role in the development of perioperative inadvertent hypothermia, including anesthesia-induced impairment of thermoregulatory control, exposure time to an environment with low temperature and infusion of room temperature intravenous and irrigation fluids. It may be also related to risk factors, such as extremes of age, systemic disorders[32]. All the patients of this study had their operations performed under spinal anesthesia. Regional anesthesia is known to impair thermoregulation and lead patients to hypothermia[2,33]. Additionally, elderly patients have decreased the ability to maintain body temperature and are at greater risk than other patients for hypothermia. The mean age of our study population was high (67.01±10.71). But there was no significant difference between hypothermic and normothermic patients in terms of age. Elderly patients presenting for major non-cardiac surgery commonly have coronary artery disease and also mild core hypothermia may result in increased circulating catecholamine levels. Thus, adverse cardiovascular event, such as hypertension, tachyarrhythmia and imbalance between myocardial oxygen supply and demand may be seen in elderly patients. It is very important to maintain normothermia in elderly patients[3,15,34].

Conclusions

The present study demonstrated that a relatively high prevalence of inadvertent hypothermia in a sample of patients undergoing transurethral resection. Additionally, QTc dispersion of patients with hypothermia was significantly longer than normothermic patients'. We recommend that anesthesiologists should be cautious of perioperative hypothermia in elderly patients, especially in transurethral resection surgeries. Prevention of the perioperative hypothermia may reduce the occurrence of adverse cardiac events. Finally, confirmation of our findings by further large studies would be desirable.

Conflicts of interest

The authors declare no conflicts of interest.

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