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The Effects of Irrigation Solution Temperature on Body Temperature in Transurethral Surgeries

Transüretral Cerrahide İrrigasyon Solüsyonunun Sıcaklığının Vücut Sıcaklığına Etkileri

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ABSTRACT Objective: The aim of this study was to determine the effects of the temperature of irrigation fluid on core body temperature in patients undergoing transurethral resection (TUR) in urology. **Material and Methods:** 70 patients undergoing TUR under spinal anaesthesia were enrolled in this prospective randomized study. Group I consisted of 35 patients who received room temperature irrigation fluid during surgery; Group II consisted of 35 patients whose procedure was performed with warmed irrigation fluid. The core body temperature was determined with the use of an infrared tympanic thermometer and was expressed as the change from baseline. **Results:** There were no statistically significant differences between groups for demographical data, amount of irrigation and of iv fluids used, length of operation and hemodynamic parameters. The temperature drops at the 90th minute (P=0.001) and at the end of the operation (P=0.008) were lower in Group II, which were statistically significant. Patient thermal comfort scores were significantly higher in Group II (P=0.018). **Conclusion:** We concluded that the use of warm irrigation fluids during TUR reduces the degree of temperature drop, which helps to prevent hypothermia.

Keywords: Transurethral resection of prostate; hypothermia; L 40 irrigating solution

ÖZET Amaç: Bu çalışmanın amacı ürolojide transüretral rezeksiyon (TUR) uygulanan hastalarda irrigasyon sıvısının sıcaklığının vücut sıcaklığı üzerine etkisini belirlemektir. **Gereç ve Yöntemler:** Spinal anestezi ile TUR uygulanan 70 hasta bu prospektif randomize çalışmaya dahil edildi. Grup I, ameliyat sırasında oda sıcaklığında irrigasyon sıvısı kullanılan 35 hastadan; Grup II ise, cerrahi işlemleri ısıtılmış irrigasyon sıvısı ile yapılan 35 hastadan oluşuyordu. Merkezi vücut sıcaklığı, kızılötesi timpanik termometre kullanılarak belirlendi ve bazal değere göre değişim olarak ifade edildi. **Bulgular:** Gruplar arasında demografik veriler, kullanılan irrigasyon sıvıları ve iv sıvıların miktarı, operasyon süresi ve hemodinamik parametreler açısından istatistiksel olarak anlamlı farklılık yoktu. 90. dakikadaki sıcaklık düşüşü (P=0.001) ve operasyonun sonundaki düşüş (P=0.008) Grup II'de istatistiksel anlamlı olarak daha düşüktü. Hasta termal konfor skorları Grup II'de anlamlı derecede yüksekti (P=0.018). **Sonuç:** TUR sırasında, sıcak irrigasyon sıvılarının kullanılmasının, sıcaklık düşüşünü azaltarak hipotermiyi önlemeye yardımcı olacağı kanısındayız.

Anahtar Kelimeler: Prostatın transüretral rezeksiyonu; hipotermi; L 40 irrigasyon solusyonu

Hypothermia is still a common and serious problem in the practice of anaesthesiology.[1,2] Clinically relevant hypothermia is defined as core temperature below 36°C and it leads to many major adverse effects such as wound infection, morbid cardiac side effects or coagulation disorders.[3]

Perioperative risk factors for hypothermia are defined as: age (> 60 years), Body mass index (BMI), American Society of Anesthesiologists (ASA)

grade II-IV, preoperative body temperature, operating room temperature, operation time, type of operation, amount and temperature of the intravenous and irrigation fluids.[1]

Patients undergoing transurethral resections (TUR) are generally older in age and have comorbid diseases. Generally these procedures are performed under spinal anaesthesia that impairs the central thermoregulatory control. Therefore they are at great risk for hypothermia. In addition, large amounts of irrigation fluids that are used for the operation lead to a great volume of liquid shifts and also to TUR syndrome, which worsened the problems, secondary to hypothermia.[4,5] Hence, heat loss could be much greater if the solutions were not warmed.[6,7] There are many studies about the effects of the temperature of irrigation fluids on core body temperature in the literature and also a systemic review about these studies was published by Campbell et al. in 2015. In this review, authors pointed out that qualities of the available studies were moderate to low, due to the unclear designs of the trials.[8]

In this context, we aimed to determine the effects of the temperature of the irrigation fluid on core body temperature changes in patients undergoing TUR surgeries, with a standardized and carefully designed study.

MATERIAL AND METHODS

After the approval of the local ethical committee (KOU KAEK 2013/26) and written consent of patients, 70 patients between the age of 50-85 years with an ASA score I to III, which were scheduled for TUR surgery, were enrolled in this prospective randomized study due to the calculated sample size and power analyses. The study was held in Kocaeli University Hospital. Patients with comorbid diseases such as diabetes mellitus, peripheral arterial disease, cardiac failure, abnormal body mass index (< 18 or > 40) or patients who had a contraindication for spinal anaesthesia were excluded.

Patients were randomly assigned to two groups by sealed opaque envelope technique. Group I received irrigation fluids at room temperature (RTIF) and Group II received warmed irrigation fluid (WIF) at 40°C.

Room temperatures were set to 23°C preoperatively and every patient in the study received forced-air warming blanket and also warmed intravenous fluids at 40°C (by enFlow®, GE Healthcare) for standardization. Irrigation fluids were warmed in an incubator and administered with Astoflo® eco plus (Stihler Electronic, Stuttgart, Germany) heating system during the operation to maintain the temperature at 40°C. The temperature of the irrigation fluids were measured randomly during operations and confirmed that they were at 40°C.

Following standard monitoring in the operating room, the core temperature of the patients were taken with a calibrated infrared tympanic thermometer (Genius™ 2, Covidien) and recorded as starting temperature. Temperatures were taken every 30 minutes during surgery and at the end. Mean arterial pressure (MAP), heart rates (HR) were collected as well. The time from the first measurement to the end of the surgery was recorded. The amounts of irrigation and iv fluid used were recorded as well.

In the recovery room after the operation, patients were observed for the occurrence of shivering and asked to give a point value to their satisfaction for thermal comfort from 1 to 5 (1 very bad, 5 excellent). Their core temperatures were also measured just before transferring to the surgical ward.

STATISTICAL ANALYSIS

The data was analysed using the IBM SPSS 20 (Statistical Package for Social Sciences). After examining the study and the data in the literature, Alfa 5%, Beta 10%, it was predicted that the variance between the average would be 0.5 (°C) and with the accepted 0.6 standard deviation (SD), the minimum sample size was 30 patients for each group. With this data, the investigative data were calculated as 90% accurate.

The numeric variables are shown as mean (±SD) or median (25^{th} percentile-75^{th} percentile) as the categorical variable frequency (%). The verifi-

cation of numeric variable distribution suitability was completed by using the Kolmogorov-Smirnov test; it was determined that it did not show normal distribution. Differences between the groups were determined by using the Mann -Whitney U test. Differences between categorical variables were determined by using the Fisher's x2 test and the Monte Carlo x2 test. By using the Spearman correlation analysis, the numerical variables of temperature change were evaluated. $P < 0.05$ was accepted as sufficient data for statistical significance.

RESULTS

There were no significant differences for demographical data, ASA scores, and preoperative MAP, HR and body temperatures between the two groups ($P > 0.05$). Groups were compared for operation times, irrigation and iv fluids used and it was found that there were not any significant difference ($P > 0.05$) (Table 1).

Mean temperature changes at the 30th, 60th, 90th and 120nd minutes and also temperature change between the beginning and until the end (ΔT) were examined. We found that the temperature drop in the 90th minute was significantly higher in Group I than Group II ($P < 0.001$). Also ΔT in Group I was greater than Group II ($P < 0.008$) (Figure 1).

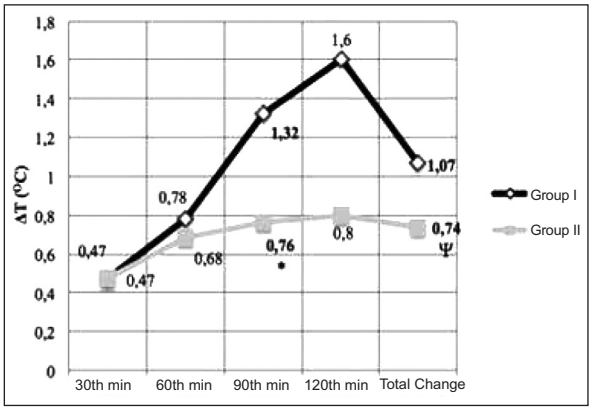

FIGURE 1: Temperature changes between the groups. There were significant differences at 90th min (* P=0.001) and at the total change (Ψ P=0.008).

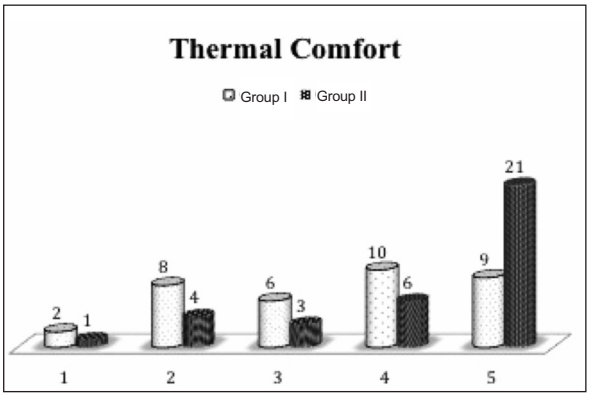

FIGURE 2: Patient answers for their thermal comfort. 1: very bad, 5: excellent. n=number of patients for that answer.

TABLE 1: Demographical data and data that could affect perioperative hypothermia were examined. All data were shown as mean ± standard deviation.

	I. Group (n : 35)	II. Group (n : 35)	P
Age (year)	68.2 ± 7.7	67.5 ± 7.2	> 0.05
Height (m)	1.71 ± 0.7	1.71 ± 0.5	> 0.05
Weight (kg)	78.1 ± 11.5	78.7 ± 13.7	> 0.05
BMI (kg/m2)	26.8 ± 4.5	26.5 ± 3.3	> 0.05
ASA I/II/III	9 / 24 / 2	8 / 20 / 7	> 0.05
Preoperative Temperature (°C)	36.3 ± 0.6	36.1 ± 0.6	> 0.05
Preoperative MBP (mmHg)	76.5 ± 12	78.4 ± 13	> 0.05
Preoperative HR	103 ± 13	103 ± 15	> 0.05
Operation Time (minute)	97 ± 29	90 ± 31	> 0.05
Mean Irrigation Fluids (mL)	14186 ± 8255	15742 ± 9347	> 0.05
Mean iv Fluids (mL)	1706 ± 476	1661 ± 601	> 0.05

BMI: Body mass index; HR: Heart rate; MBP: Mean blood pressure; ASA: American Society of Anesthesiologists.

There was no difference between groups for the occurrence of shivering in the recovery room ($P > 0.05$). Patients' answers for their thermal comfort were analysed and were found to be higher in Group II ($P=0.018$) (Figure 2).

The relationship of the other variables to temperature drop was evaluated with Spearman correlation analysis. ASA scores, age, BMI, operation time, amount of irrigation and iv fluids were included in the model. We found a correlation between the temperature drop and the operation time. In addition, there was a correlation with the amount of irrigation fluid. The correlation between the amount of fluids used and the temperature change was calculated as $r=0.428$ and $P < 0.001$; and the correlation for the duration of the operation was found to be $r=0.552$ and $P <0.001$.

DISCUSSION

Hypothermia remains a serious problem in the practice of anaesthesiology; it is a challenge that we have to overcome.[9-12] Trying to prevent hypothermia before it occurs is a more proactive approach than trying to treat the complications that can occur as a result hypothermia. It is known that higher ASA scores in older patients, operations that lasts longer and can cause significant liquid shifts are major risk factors for hypothermia. Patients undergoing TUR surgery tend to have all of these conditions, which put them in a relatively high-risk patient group, requiring that we have to be more careful about temperature management.[13-15]

All the predicted risk factors for hypothermia, including age, BMI, ASA score, operation time, amount of iv and irrigation fluids used, and preoperative body temperature, MAP and HR were not significantly different between groups. In addition, room temperatures were set to 23°C for standardization in this study. These conditions allowed us to observe the effects of the temperature of the irrigation fluids related to hypothermia, objectively.

We found that mean temperature differences started to differentiate between the groups from the 60th minute of the operation and there was a statistical difference at the 90th minute. Even though there wasn't a statistical difference at 120th minute (P=0.052), we believe that there would be if there were more patients in the sample group. Similar to our study, Singh et al. and Robert et al. reported that long operation times were correlated with heat loss.[16,17]

It has been published that irrigation fluids at room temperature would cause hypothermia while warmed fluids make an advantage for preventing it.[18-21] Evans et al. found that body temperatures of the patients, who had TUR surgery under general anaesthesia; decreased 1.5°C per hour when irrigation fluids at room temperature were used; while it was 0.5°C if irrigation fluids were warmed.[22] Singh et al. demonstrated that mean temperature drop was 2.38°C at the end of the surgery when RTIF were used.[16] Conversely, the drop was 0.8°C with WIF. In another study that Okeke et al. published; the result was the same as Singh et al; but temperature drops were less (0.98°C – 0.42°C). In our study, mean temperature drops were 1.07°C in RTIF group and 0.74°C in WIF group. It was in conformity with the literature.[18] Temperature drops in our study were higher than Okeke et al; we thought the difference was due to mean operation times, which were shorter in their study.

On the other hand, Jaffe et al. claimed that there was no correlation between the temperature of irrigation fluids and hypothermia.[15] However, the temperature of the irrigation fluids was 33°C and all the patients were warmed externally with blankets at 45°C in their study. We thought that their findings were questionable due to their material method.

In other studies; except Singh et al. methods for warming the irrigation fluids were not defined or they mentioned some conventional techniques like boiling and cooling down.[16] Also in these studies there weren't any additional methods to regulate the temperature of the fluids while they were in use. In literature it was shown that the temperature of irrigation fluids would drop by 4°C while they were in use.[23,24] This would be a question for the reliability of the results due to the unpredictable temperature of the irrigation fluids. To overcome these problems, our irrigation fluids were warmed in a special incubator to 40°C and an external heating system (Astoflo® plus eco, Stihler Electronic, Stuttgart, Germany) was used during the operations. Additionally, the temperature of the irrigation fluids were measured randomly during operations and confirmed that they were at 40°C.

We compared the mean body temperatures of the groups at the time when the Aldrete scores were 10 and found out that the patients in Group I had statistically lower body temperatures than Group II. It was in conformity with the findings in literature.[10,12]

Patients' thermal comfort and satisfaction were also measured in our study. Our results showed that patients in Group II were more pleased with their conditions. It's known that pa-

tients complain more about the cold than the pain. Correspondingly, many authors that studied hypothermia also questioned the postoperative thermal comfort of patients.[4,23] For example Pit et al. reported that only 14% of the patients complained about the cold when they used warmed irrigation fluids while it was 50% with the irrigations fluids at room temperature.[21] It reveals to us that hypothermia isn't only important for it's complications; but also for the comfort of patients.

There were some limitations in our study. First limitation was that we used warm blankets and iv fluid warmers for that it's not ethical to let any patients become hypothermic. Our results were above hypothermia level due to this condition. This might cause readers to question the results and to think about the necessity of using WIF, but even 0,5°C degree is important in operating theatres, for preventing unwanted complications of hypothermia. There was also a limitation in temperature monitoring for using a non-invasive temperature monitoring. It was obligatory because the patients were awake and irrigation solutions were used in the surgery.

CONCLUSION

In conclusion, we think that even if it is not necessary to use WIF in shorter operations, such as cystoscopy, it would be effective for avoiding hypothermia in longer TUR operations such as resection of the prostate gland. Secondly, the importance of using WIF is correlated with the amount of irrigation fluids used. We recommend using warmed irrigation fluids in endoscopic urologic operations along with the other methods to prevent hypothermia.

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Conflict of Interest

Authors declared no conflict of interest or financial support.

Authorship Contributions

Writing, Discussion, Data Collection, Idea, and Design of the Manuscriptl: *Can Aksu;* ***Idea, Design, Analysis:*** *Dilek İçli;* ***Critical Review:*** *Kamil Toker, Mine Solak.*

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