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Original Article

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Perioperative Hypothermia after Transurethral Surgeries: Is it Necessary to Heat the Irrigation Fluids?

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Abstract

Objective: To investigate the role of heated irrigation fluids in the risk of hypothermia and related complications in patients undergoing transurethral procedures.

Methods: The medical records of all patients who underwent transurethral procedures between 2000 and 2016 at the VA Hospital were reviewed. Irrigation fluids have been heated to 42°C since 2013, as per the institutional policy (Group II). Prior to this date, room temperature solutions were used (Group I). The perioperative body temperature, use of warming devices, procedure length, and anaesthesia type were extracted from records and compared for both groups. In addition, demographic and anthropometric data, preoperative comorbidities, laboratory data, admission information and postoperative complications were obtained from the quality improvement database.

Results: There were 1,363 patients in Group I and 269 patients in Group II. Perioperative temperature was decreased by 0.10°C in Group I compared to a temperature gain of 0.32°C in Group II ($p<0.001$). Three hundred and forty-eight (21%) patients undergoing transurethral procedures developed hypothermia <36°C. There was no difference in the incidence of postoperative mortality or complications between the normothermic and hypothermic patients.

Conclusion: The replacement of room temperature solutions with warmed solutions for irrigation during transurethral procedures reduced the risk of temperature loss and hypothermia following these procedures. Available heating strategies effectively prevented the perioperative heat loss; however, such strategies did not affect the incidence of postoperative complications.

Keywords: Complications, hypothermia, transurethral resection

Introduction

Numerous studies have shown increased risk of postoperative complications, including infections, cardiac risks, coagulopathies and increased hospital stay in patients who had decreased body temperatures during the perioperative period (1). Suggested mechanisms of hypothermia-induced complications included the vasoconstriction of the blood vessels, impairing oxygen delivery through altered chemotaxis, and impairment of neutrophil and platelet function (2). For example, Schmeid et al. (2) showed a trend towards increased blood loss in patients experiencing mild hypothermia. Of note, patients undergoing endoscopic urology procedures were often aged >65 years and received irrigation fluids. Advanced age was shown to be a risk factor for perioperative hypothermia in several studies including a review performed by Blatteis et al. (3, 4) By studying patients undergoing transurethral procedures, Pit and Singh demonstrated the increased risk of a low body temperature with room temperature irrigation fluids (5, 6).

However, only relatively recently after a growing body of literature showed increased risks associated with decreased body temperature perioperatively did it become standard in most hospitals to measure and maintain body

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temperature above 36°C intraoperatively (7, 8). Additionally, in many hospitals, protocols were only implemented if a patient's body temperature fell below a specific temperature or if the length of procedure exceeded a set length of time (9). At the Veteran's Affairs Western New York (VAWNY) Medical Center, strategies such as warming blankets and warmed intravenous fluids were implemented when a procedure was projected to last longer than 1 hour or if body temperature dropped below 36°C. However, implementation of warmed irrigation fluids instead of room temperature fluids became a standard of care towards the end of 2013 for all transurethral procedures.

The goal of this study was to examine if hypothermia prevention strategies reduced the risk of decreased body temperature and the subsequent risk of postoperative complications. The primary endpoint of this study was the frequency of mild hypothermia as it was defined by body temperatures <36°C upon arrival of the patients at the postoperative anaesthesia care unit. We hypothesised that heated irrigation fluids would lower the incidence of hypothermia compared to those in whom unheated solutions were used and thereby decreasing postoperative complications.

Methods

A retrospective review of patient records consisting of 2,559 male patients who underwent endoscopic urology procedures between August 2000 and December 2016 was conducted using the Veterans Affairs Surgical Quality Improvement Program (VASQIP) database and computerised patient record system. Study design and protocol were reviewed by the institutional review board at the VAWNY Healthcare System

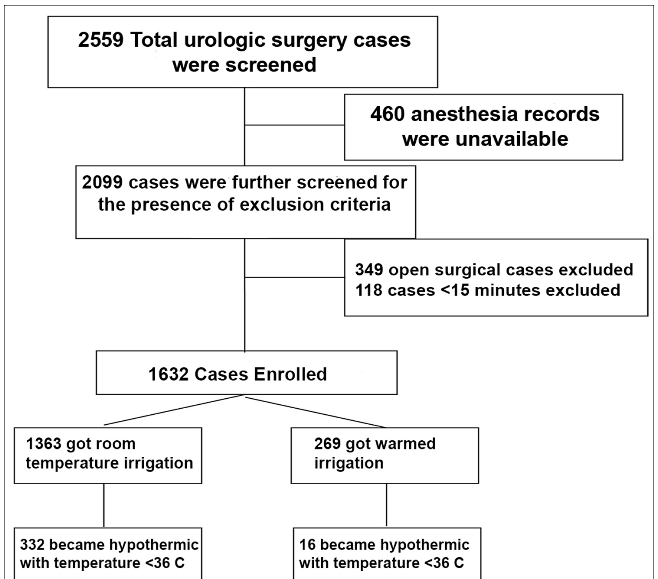

Figure 1. PRISMA flow diagram of the study

(Buffalo) and were approved for their scientific and ethical merit. Due to its retrospective design, the study was exempted from obtaining informed consent form from each individual participant; however, extreme care was given to ensure patient privacy and confidentiality.

A total of 2,559 urologic surgery procedures were performed. Four hundred and sixty anaesthesia records from 1998, 1999 and parts of 2000 were not available due to changes within the computerised record management protocol at the hospital. A total of 349 open surgical cases along with 118 cases <15 minutes in length were excluded from the data (Figure 1). Inclusion criteria for the study included all patients who underwent endoscopic urology procedures with the implementation of general or local anaesthesia methods along with either room temperature or heated irrigation fluids. Exclusion criteria included all surgical procedures that began or converted into open surgical procedures and procedures <15 minutes in length. Anaesthesia warming methods such as warming blankets and warmed intravenous fluids were recorded as well. In addition, anaesthesia computer records allowed for the collection of both postoperative and preoperative temperatures along with the intraoperative temperature trends and medications used during the case.

Prior to 2013, room temperature irrigation fluids were consistently used for transurethral procedures. Starting in January 2014 all patients received warmed irrigation fluids. These patients were separated into two groups and evaluated. Group I incorporated the use of room temperature irrigation fluids while Group II used heated irrigation fluids. Throughout both time periods, the anaesthesia department instituted warming blankets or warmed intravenous fluids if patient's body temperature fell below 36°C or if cases went beyond 60 minutes. A multi-regression analysis was used to analyse the data. Primary endpoints included risk of hypothermia and a temperature drop below 36°C, while secondary endpoints included postoperative complications such as death, myocardial infarctions, cerebrovascular accidents, pulmonary embolus, infections, transfusion complications and returns to the operating room.

If preoperative or postoperative temperature values were missing on the anaesthesia records, baseline temperatures (from the prior week preoperative visit) and PACU temperatures were implemented respectively. Samples were then analysed based on the groups that were normothermic or hypothermic at the end of the procedures to evaluate postoperative risk factors for comorbidities due to such temperature drops.

The presence of a normal distribution was tested using the Kolmogorov–Smirnov test. Normally distributed data were represented as a mean±standard deviation, and variables that were not normally distributed were represented as a median (interquartile range). Data that were not normally distributed were analysed using the non-parametric Mann–Whitney U test for intergroup comparison. A sample size of 278 patients was calculated using the power analysis based on results of the incidence of hypothermia from another study (6), in which the overall incidence of hypothermia after the implementation of warmed irrigating fluids was 15%. To detect a drop in the rate of hypothermia to 10%, 232 patients with Type I error (an alpha error of 0.05) and a Type II error (a beta error of 0.2) were required. To account for potential losses, 269 patients were included within the warmed irrigation fluids group. A total of 1,369 patients had room temperature irrigation fluids used during surgery. Paired and unpaired t-tests were used to compare the mean temperatures for both normothermic and hypothermic patients with the incorporation of either heated or room temperature irrigation fluids. Chi-squared tests were implemented to evaluate categorical data, such as preoperative risk factors and postoperative outcomes secondary to temperature changes. A p-value <0.05 was determined as statistically significant.

Results

A total of 1,632 patients (median age, 71 years) underwent anaesthesia for endoscopic urology procedures between August 2000 and December of 2016 at the VAWNY hospital. Preoperative patient characteristics can be seen in Table 1, showing no significant differences between all groups; in addition, all patients included were found to be normothermic (with a temperature recording of at least 36°C) in the preoperative stage, without documented preoperative warming efforts. The median age within the normothermic group versus our hypothermia group was 72 (56–88) and 70 (57–83) years, respectively (p=0.114). There was no difference between the normothermic and hypothermic patients in body mass index (p=0.423) and body surface area (p=0.784). Haemoglobin A1C levels were on average 0.2% lower in the hypothermic patients, while fasting glucose levels were 5 mg dL^{-1} lower than in the normothermic patients (Table 2).

In terms of predicted risk of death within 30 days of surgery, the normothermic versus the hypothermic group had equal risks of death, both 0.97% (p=0.127). The risk of develop-

Table 1. Patient characteristic and the presence of comorbid conditions according to postoperative development of hypothermia with body temperature <36.0°C

	Normothermia (n=1,382)		Hypothermia (n=368)		Odds Ratio	
	Observed	Expected	Observed	Expected	[95% Confidence interval]	p
Hypertension	830	816.6	204	217.4	0.83 [0.66–1.04]	0.109
Diabetes mellitus	389	375.9	87	100.1	0.79 [0.61–1.03]	0.084
Insulin injection	80	74.2	14	19.8	0.64 [0.36–1.15]	0.133
Oral hypoglycaemic drugs	309	301.7	73	80.3	0.86 [0.65–1.14]	0.298
benzodiazepines	844	877.9	268	234.1	1.70 [1.32–2.19]	<0.001
Propofol	1218	1216.2	322	323.8	0.94 [0.67–1.34]	0.74
Inpatient status	381	387	109	103	1.11 [0.86–1.42]	0.436
Prior myocardial infarction	26	23.7	4	6.3	0.57 [0.20–1.65]	0.297
Prior coronary revascularisation	204	197.4	46	52.6	0.83 [0.59–1.16]	0.271
Congestive heart failure	48	46.6	11	12.4	0.86 [0.44–1.67]	0.648
Prior cerebrovascular event	183	189.5	57	50.5	1.20 [0.87–1.66]	0.265
Chronic obstructive pulmonary diseases	293	294.6	80	78.4	1.03 [0.78–1.37]	0.823
Active smoking	377	375.9	99	100.1	0.98 [0.76–1.27]	0.885
Chronic kidney disease	6	6.3	2	1.7	1.26 [0.25–6.24]	0.782
Haemodialysis	7	6.3	1	1.7	0.54 [0.07–4.36]	0.553
Alcohol use	67	71.9	24	19.1	1.37 [0.85–2.22]	0.199
Peripheral vascular disease	43	41.1	9	10.9	0.78 [0.38–1.62]	0.504
Transfusion-related issues	10	10.3	3	2.7	1.13 [0.31–4.12]	0.856
Previous sepsis	5	3.9	0	1.1	0.79 [0.77–0.81]	0.248
Emergent surgery	16	16.6	5	4.4	1.18 [0.43–3.23]	0.753
Operating room time greater than 60 minutes	383	394.9	117	105.1	1.04 [0.99–1.10]	0.124

Table 2. Laboratory values of the patients according to the status of hypothermia as defined by body temperature <36°C

	Normothermia (n=1,382)				Hypothermia (n=368)				
	Preoperative		Postoperative		Preoperative		Postoperative		
	Median	IQR	Median	IQR	Median	IQR	Median	IQR	p
Haematocrit (percentage)	40.6	6.6	35.1	6.4	41.3	5.9	35.2	5.2	0.055
White blood cell (count nL^{-1})	7.2	2.9	10.5	5.7	7.1	2.6	9.9	4.4	0.975
Serum creatinine (mg dL^{-1})	1.1	0.5	1.47	1.18	1.2	0.4	1.50	0.88	0.876
Prothrombin time (sec)	12.9	1.8			12.5	4.6			0.166
Partial thromboplastin time (Sec)	30.6	10.0			29.5	12.0			0.881
Serum sodium (mEq L^{-1})	140	3			139	3			0.061
Potassium (mEq L^{-1})	4.1	0.6			4.0	0.6			0.186
Blood glucose (mg dL^{-1})	103	45			127	105			0.053
Haemoglobin A1C	7.6	1.8			6.9	0.9			0.022
Blood urea nitrogen (mg dL^{-1})	20.3	9.0			21.9	13.0			0.032
Serum albumin (g dL^{-1})	3.6	0.5			3.7	0.5			0.108
Serum bilirubin (mg dL^{-1})	0.56	0.30			0.52	0.23			0.039
Serum alkaline phosphatase (IU L^{-1})	92	43			99	62			0.065
Aspartate-glutamate transaminase (IU L^{-1})	23	16			21	10			0.094

The top panel (measurements for haematocrit, white blood cell count and serum creatinine concentrations) were measured both before and after surgery, and analysis was performed with repeated measures. The p-values for these variables indicated the effect of hypothermia on the operative changes of these laboratory parameters. The remaining variables were measured only prior to surgery, and they were compared using independent t-tests

Table 3. Adverse postoperative outcomes secondary to the development of hypothermia with body temperature <36.0°C

	Normothermia (n=1,382)		Hypothermia (n=368)		Odds Ratio	
	Observed	Expected	Observed	Expected	[95% Confidence interval]	p
Overall deaths	470	479.4	137	127.6	1.03 [0.98–1.09]	0.249
Deaths within 30 days	10	11.1	4	2.9	1.11 [0.79–1.54]	0.487
MACE-30[a]	19	19	5	5	0.10 [0.81–1.23]	0.981
Cardiac arrest	3	3.2	1	0.8	1.05 [0.60–1.86]	0.845
Troponin leak	5	4.6	1	1.4	0.91 [0.64–1.31]	0.676
Myocardial infarction	4	3.9	1	1.1	0.99 [0.64–1.53]	0.955
Cerebrovascular accident	4	3.2	0	0.8	—	0.301
Renal failure	7	6.1	1	1.9	0.87 [0.67–1.13]	0.447
Acute kidney injury	111	114.5	34	30.5	1.03 [0.94–1.14]	0.455
Transfusion-related issue	10	10.3	3	2.7	1.13 [0.31–4.12]	0.856
Return to the operating room	98	98.1	31	30.9	1.01 [066–1.54]	0.980
Other bleeding complications	2	1.6	0	0.4	—	0.465
Haematocrit drop <30	138	135	33	36	0.98 [0.90–1.06]	0.559
Failure-to-wean	8	7.9	2	2.1	0.99 [0.72–1.35]	0.936
Re-intubation	5	5.5	2	1.5	1.11 [0.69–1.77]	0.624
Wound infections	3	3.2	1	0.8	1.05 [0.60–1.86]	0.845
Urinary tract infections	66	70.3	23	18.7	1.07 [0.94–1.21]	0.253
Clostridium difficile infection	4	4.7	2	1.3	1.19 [0.67–2.09]	0.459
Systemic sepsis	22	21.3	5	5.7	0.97 [0.81–1.16]	0.747
Organ-specific sepsis	4	3.2	0	0.8	—	0.324
Outpatient pneumonia	9	8.7	2	2.3	0.97 [0.73–1.28]	0.816
New sepsis	23	22.5	5	5.5	0.98 [0.82–1.17]	0.823
Pulmonary embolus	1	1.6	1	0.4	1.58 [0.40–6.32]	0.314
Deep venous thrombosis	2	2.4	1	0.6	1.19 [0.53–2.64]	0.601
PACU length of stay (min)	108±62		114±65		3.8 [−12.7–2.4]	0.182
Total hospital length of stay (Day)	7.5±18.8		5.0±22.7		2.5 [−1.5–6.5]	0.225

[a]Major adverse cardiac event within 30 days

ing postoperative complications as predicted by the VASQIP model was not different in the normothermic and hypothermic patients (5.9%; p=0.930). Regardless of the trend in increasing the risk of death and perioperative complications, the actual frequency of all postoperative complications and mortality was similar between the hypothermic and the normothermic patients (Table 3). Cox regression model also demonstrated a similar hazard risk of death over an average of 140 months (follow-up period) for both normothermic and hypothermic patients regardless of heating the irrigation solutions (Figure 2).

In Group I, 1,369 patients received room temperature irrigation fluids between 2000 and 2013, while 264 patients between 2014 and 2016 received heated irrigation fluids. There was a temperature loss of 0.10°C in Group I, while body temperature increased by 0.32°C in Group II in which patients were operated after the heated irrigating fluids protocol was implemented (p<0.001) (Figure 3a). Despite decreasing the risk of hypothermia, there was no difference in the frequency of postoperative complications between the two groups (Table 4). Similarly, patients in whom warming blankets were applied (n=479 total; n=332 in Group 1 and n=16 in Group 2) had increases in body temperature by 0.22°C, while those in whom warming blankets were not used (n=1,153), had a temperature loss of 0.14°C (p=0.015) (Figure 3b).

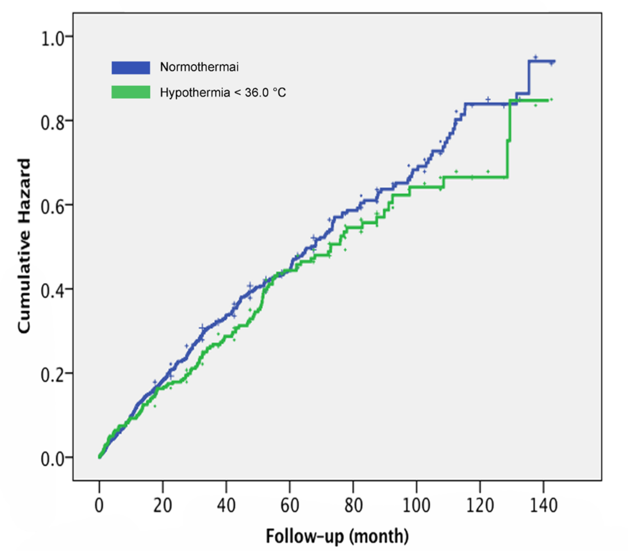

Figure 2. Hazard function of postoperative hypothermia and normothermia over the study follow-up period

From all potential factors that may have led to development of hypothermia <36°C, a multivariate regression model revealed that the duration of operation was an independent factor that affected the changes in body temperature during transurethral procedures, with a rise in 0.002°C per minute of procedures (Table 5). In addition, it was discovered that the implementation protocols for heating irrigation fluids in Group II significantly reversed the perioperative heat loss when compared to Group I using room temperature fluids (p<0.001).

Discussion

Anaesthesia literature has shown that the management of core body temperatures is vital to limit iatrogenic outcomes in patients, especially in the hospital setting (2, 10). According to these findings, advanced age, length of procedure and implementation of room temperature irrigation fluids during endoscopic procedures each increased the risk of perioperative hypothermia (3, 5, 6). Numerous studies also showed that decreased body temperatures increased the risk of postoperative complications (2, 10). As a result, many investiga-

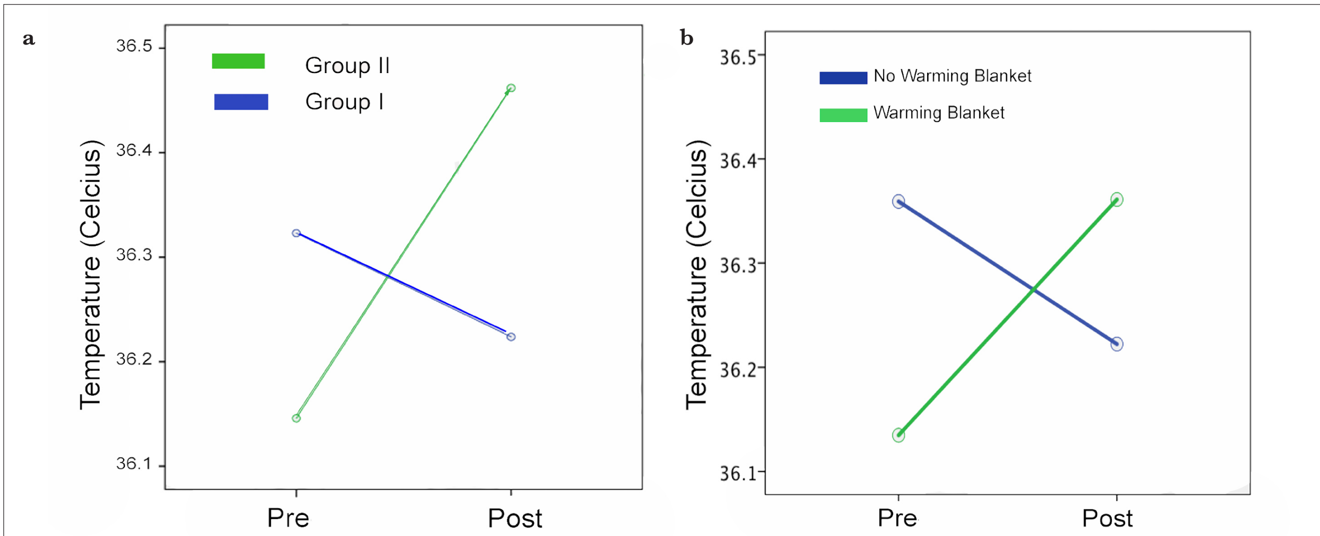

Figure 3. a, b. Changes in body temperature during the procedures (pre and post), comparing Group I and Group II for heating the irrigation fluids (a) and comparing the use of warming blanket (b)

tors have suggested that protocols such as warmed irrigation fluids should be considered when managing patients in the operating room. Few studies have evaluated this specifically in urologic patients and related procedures (6).

This study revealed that warmed irrigation fluids had a significant impact on the prevention of postoperative hypothermia, but failed to present any statistically significant changes in postoperative clinical outcomes. A randomised control trial by Pit et al. (5) found similar outcomes, though it exhibited a much smaller sample size (29 patients receiving warmed irrigation fluids) than this trial included (269 patients receiving warmed irrigation fluids. It is possible that the VA's reactive warming strategies such as warming blankets, which were used both before and after 2014, were enough to prevent temperature decreases significantly enough to impact postoperative outcomes (8, 9).

A longer procedure duration has been also shown to result in larger body temperature losses (9, 11). However, these studies implemented room temperature irrigation fluids, while our study sample was exposed to warmed irrigation fluids during the length of the procedures, possibly explaining the rise in temperature with increasing procedure length within our patient sample. Also, less than one-third of the transurethral procedures at our institution were >60 minutes. Similar to other studies which showed low complication risks associated with transurethral procedures (9, 12), this study demonstrated no differences in complications due to perioperative hypothermia. The overall complication risk remained non-significant despite the average patient age being >70 years, which has been shown to put patients at a greater risk during endoscopic surgeries (13).

As a retrospective review, this study was also limited. One factor that cannot be underappreciated was the fact that the

Table 4. Adverse postoperative outcomes secondary to irrigation fluid temperature selected

	Group I (n=1,363)		Group II (n=269)		Odds Ratio	
	Observed	Expected	Observed	Expected	[95% Confidence interval]	p
Deaths within 30 days	10	10	2	2	1.01 [0.22–4.65]	>0.999
MACE-30[a]	19	18	2	3.5	0.53 [0.12–2.29]	0.558
Cardiac arrest	3	3.3	1	0.7	1.69 [0.19–16.3]	0.514
Myocardial infarction	6	5	0	1	—	>0.999
Stroke	4	3.3	0	0.7	1.00 [0.99–1.01]	>0.999
Temperature <36°C	332	291	16	57	0.20 [0.12–0.33]	<0.001
Acute kidney injury	126	118	15	23	0.58 [0.33–1.01]	0.057
Bleeding	1	1.7	1	0.3	1.68 [0.42–6.71]	0.303
Transfusion	13	11	0	2	0.99 [0.98–1.00]	0.144
Failure-to-wean	7	8.4	3	1.6	1.20 [0.80–1.80]	0.236
Re-intubation	6	6	1	1	0.98 [0.72–1.32]	>0.999
Wound infections	4	3.3	0	0.7	1.00 [0.99–1.01]	>0.999
Urinary tract infections	78	74	10	14	0.64 [0.33–1.25]	0.236
C.diff infection	4	5	2	1	2.55 [0.46–14.0]	0.259
Systemic sepsis	22	22	4	4	0.92 [0.31–2.69]	>0.999
Organ non-specific sepsis	4	3.3	0	0.7	1.00 [0.99–1.01]	>0.999
Outpatient pneumonia	10	9	1	2	0.51 [0.06–3.96]	>0.999
New sepsis	23	21	4	6	0.66 [0.23–1.94]	0.631
Venous thromboembolism	4	4.2	1	0.8	1.00 [0.99–1.01]	>0.999

[a]Major adverse cardiac cerebral event within 30 days

Table 5. Multivariate linear regression model in predicting the change in body temperature from its preoperative values

	Coefficient	Std. error	Beta	T- Value	p	Lower bound	Upper bound
Constant	−0.515	0.210	−2.450	0.014	−0.928	−0.103	−0.515
Body surface area (M^2)	−0.131	0.067	−1.957	0.051	−0.262	0.0001	−0.131
Age (year)	0.002	0.002	1.244	0.214	−0.001	0.005	0.002
Heating irrigation fluids	0.428	0.047	9.126	<0.001	0.336	0.521	0.428
General anaesthesia	0.013	0.055	0.241	0.809	−0.094	0.120	0.013
Duration of the procedure (minutes)	0.002	0.001	4.485	<0.001	0.001	0.002	0.002

method of both postoperative and preoperative body temperature recordings was not always consistent or available within the anaesthesia or nursing record system. For example, the method and location of collection may have been different depending on whether postoperative temperature recording was taken by the PACU nurses or the anaesthesiologist in the operating room. Anaesthesiologists tend to use forehead temperature stickers, whereas PACU nurses often utilise oral temperature or forehead skin recordings from electronic thermometers (14, 15). The current literature suggests that skin surface temperatures are, on average, 2°C lower than core temperatures, indicating that such routes of body surface temperature procurement do not accurately reflect the patient's core temperature (9). Temperature measurement recorded from the rectal route is still considered the closest reading reflecting the patient's core body temperature, and all other routes are generally compared to the rectal temperature (14). In comparison, oral thermometry obtains more accurate data, and attaining temperatures are, on average, 0.25°C lower than core temperatures (15). Such discrepancies offer a major limitation in the standardisation procedures of this study.

Although similar studies have evaluated the risk of hypothermia in within high-risk patients from the perspective of both anaesthesiologists and urologists, our study demonstrated a positive statistical effect with no clinical significance in terms of implementation of heated irrigation fluids when monitoring for postoperative complications (2, 15). Several studies have focused on the risks for specific medical complications due to the temperature drops during the perioperative period specifically in the urologic patient population; however, such results may have been influenced due to evaluating smaller sample sizes (1, 6). This trial further supports the previously identified hypotheses in the setting of a large sample size.

Conclusion

Rewarming strategies such as heated irrigation fluids effectively raise the body temperature and reduce the risk of developing perioperative hypothermia. Despite the reduced risk of hypothermia observed in patients who received warmed irrigation fluids, no change in postoperative complications within the urologic patient sample was observed. The relatively shorter duration of the transurethral procedures and lower overall risk of postoperative complications might have been the reasons for the benign findings related to hypothermia observed in this study. Heat-preserving policies that incorporate the use of warmed fluids for irrigation, especially in patients undergoing higher risk surgeries may be beneficial in decreasing unwanted events secondary to postoperative hypothermia.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Veterans Affairs Western New York Healthcare System on June 13, 2016 (Study number: 891664).

Informed Consent: The study was waived from obtaining a written informed consent from each individual participant due to the chart review nature of the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – N.D.N., L.P., E.K., J.S.C.; Design – N.D.N., E.K., J.S.C.; Supervision – N.D.N., O.M.D.; Resources – N.D.N., O.M.D.; Materials – N.D.N.; Data Collection and/or Processing – E.K., L.P., L.R.; Analysis and/or Interpretation – N.D.N., L.P.; Literature Search – E.K., L.R., J.S.C.; Writing Manuscript – E.K., J.S.C., L.R.; Critical Review – N.D.N., O.M.D.

Conflict of Interest: The authors have no conflicts of interest to declare.

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References

1. Yi J, Lei Y, Xu S, Si Y, Li S, Xia Z, et al. Intraoperative hypothermia and its clinical outcomes in patients undergoing general anesthesia: National study in China. PLoS One 2017; 12: e0177221. [CrossRef]
2. Schmied H, Kurz A, Sessler DI, Kozek S, Reiter A. Mild hypothermia increases blood loss and transfusion requirements during total hip arthroplasty. Lancet 1996; 347: 289-92. [CrossRef]
3. Blatteis CM. Age-dependent changes in temperature regulation - a mini review. Gerontology 2012; 58: 289-95. [CrossRef]
4. Gunes UY, Zaybak A. Does the body temperature change in older people? J Clin Nurs 2008; 17: 2284-7. [CrossRef]
5. Pit MJ, Tegelaar RJ, Venema PL. Isothermic irrigation during transurethral resection of the prostate: effects on peri-operative hypothermia, blood loss, resection time and patient satisfaction. Br J Urol 1996; 78: 99-103. [CrossRef]
6. Singh R, Asthana V, Sharma JP, Lal S. Effect of irrigation fluid temperature on core temperature and hemodynamic changes in transurethral resection of prostate under spinal anesthesia. Anesth Essays Res 2014; 8: 209-15. [CrossRef]
7. Epstein RH, Dexter F, Hofer IS, Rodriguez LI, Schwenk ES, Maga JM, et al. Perioperative Temperature Measurement Considerations Relevant to Reporting Requirements for National Quality Programs Using Data From Anesthesia Information Management Systems. Anesth Analg 2018; 126: 478-86. [CrossRef]
8. Sessler DI. New surgical thermal management guidelines. Lancet 2009; 374: 1049-50. [CrossRef]
9. Sessler DI. Temperature monitoring and perioperative thermoregulation. Anesthesiology 2008; 109: 318-38. [CrossRef]

10. Hart SR, Bordes B, Hart J, Corsino D, Harmon D. Unintended perioperative hypothermia. Ochsner J 2011; 11: 259-70.
11. Diaz M, Becker DE. Thermoregulation: physiological and clinical considerations during sedation and general anesthesia. Anesth Prog 2010; 57: 25-32; quiz 3-4. **[CrossRef]**
12. Cornu JN, Herrmann T, Traxer O, Matlaga B. Prevention and Management Following Complications from Endourology Procedures. Eur Urol Focus 2016; 2: 49-59. **[CrossRef]**
13. Evrard PL, Mongiat-Artus P, Desgrandchamps F. Morbi-mortality of transurethral resection of the prostate in patients aged 75 and over. Prog Urol 2017; 27: 312-8. **[CrossRef]**
14. Moran DS, Mendal L. Core temperature measurement: methods and current insights. Sports Med 2002; 32: 879-85. **[CrossRef]**
15. de Lucia C, Femminella GD, Rengo G, Ruffo A, Parisi V, Pagano G, et al. Risk of acute myocardial infarction after transurethral resection of prostate in elderly. BMC Surg 2013; 13(Suppl 2): S35. **[CrossRef]**