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Effects of Warmed Fluid Irrigation Intervention and Forced-Air Warming Intervention on Hypothermia in Transurethral Operation Under Spinal Anesthesia

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ABSTRACT

Background/Objectives: The purpose of this study was to investigate an effective nursing intervention for prevention of hypothermia and thermal discomfort in patients undergoing transurethral procedure under spinal anesthesia.

Method/Statistical Analysis: A total of 63 patients were randomly assigned to one of 3 groups. During the procedure, the warmed fluid irrigation group received warm irrigation fluid at 37°C, while the forced-air warming group received forced-air warming by means of Bair Hugger set at 38°C. The control group received room-temperature irrigation fluid.

Findings: Body temperature measured immediately after the procedure showed a significantly higher in the warmed fluid irrigation group than in the control group. The level of thermal discomfort on arrival at the recovery room was significantly lower for the warmed fluid irrigation group than for the other two groups.

Improvements/Applications: The present results suggest that warmed fluid irrigation is more effective than forced-air warming for preventing hypothermia and thermal discomfort during a transurethral procedure under spinal anesthesia.

Keywords: *Warmed fluid irrigation, Forced-air warming, Hypothermia, Body temperature, Thermal discomfort, transurethral operation, spinal anesthesia*

Introduction

Humans have properties of homoeothermic animal that can maintain their core temperature within 37^0C ± 0.2^0C even when the ambient temperature changes, and can maintain active life even under a wide range of climatic conditions by keeping their core temperature constant[1]. However, during surgery, it is difficult to maintain a patient's body temperature due to various factors including indispensable body exposure, application of cold disinfectant, use of cleansing solutions for internal organs, injection of saline solution, loss of blood and low temperature of operating room for prevention of infection. These cause hypothermia during surgery at 50 to 90 percent of surgical patients[2]. Transurethral operation can give off body heat from the surgical site and lower core temperature caused by injecting a large amount of irrigation fluid without heating up in order to secure visibility and prevent bleeding[3], which is particularly prone to hypothermia. In such case, the temperature of irrigation fluid is set to room temperature, which can cause heat loss, hypothermia and tremble to the patient during surgery if using a temperature lower than the body temperature[4]. In fact, patients who underwent a transurethral resection of prostatic hypertrophy suffered a heat loss of approximately 0.98^0C during surgery[5]. Especially, most of patients who underwent transurethral operation are elderly patients. The elderly is more likely to suffer from heat loss due to the reduced ability to maintain body temperature, the reduced basal metabolic rate, decreased cardiovascular ability, thin skin and decreased muscle mass.

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Since transurethral operation has a high incidence of hypothermia as mentioned above, it is recommended to apply warming intervention to patients during surgery in order to prevent hypothermia[6]. In case of partial anesthesia such as spinal anesthesia, ASPAN's(American Society of PeriAnesthesia Nurses) evidence-based clinical practice guideline recommends to measure body temperature, tremble and thermal discomfort of each patient at regular intervals and to provide patient with a waterbed, insulated thermal blanket, radiant warmer and forced-air warming system to be circulated according to patient's body temperature when hypothermia occurs. However, it is true that patients subject to transurethral operation with spinal anesthesia have a short surgical time, do not appeal the cold and are negligent in managing their body temperature. Other inconveniences such as lack and difficulties in application of heating equipment result in using such equipment selectively in actual clinical circumstances only when a prolonged large operation is anticipated or a serious hypothermia is concerned during surgery. There is no exact protocol for application of warming, and warming intervention is being done by preference of medical staff.

Most of researches related to 'warming intervention for the surgical patients' conducted in Korea were for the general anesthesia patients[7-9], and researches for patients who underwent spinal anesthesia were those using warmer(Bair-hugger Warming Unit) before surgery and electro-circulating water blanket(Blankroll) during surgery[10], and those applying warmed saline solution, forced-air warmer and warmed blanket[11]. However, there is little research on warming intervention for patients with spinal anesthesia using a large amount of irrigation fluid. Whereupon, this study applies an irrigation fluid warming intervention which was proven to significantly reduce the body temperature drop[5] and a forced-air warming intervention which is the most recommended clinical practice in recent days with advantages of maintaining normal body temperature in a wide range of operations[12], in a transurethral operation whose operation time is relatively short but uses a large amount of irrigation fluid and shows discomfort resulting from body temperature change after surgery, and then presents the effects, and provides basic data for the development of nursing interventions and protocols for the management of body temperature of patients who will undergo transurethral operation in the future.

Materials and Method

This research is a randomized control group pretest-posttest design that randomly assigns research targets to two experimental groups and one control group for patients undergoing transurethral operations under spinal anesthesia.

Research Subjects: Research subjects are persons for whom preoperative treatment (Mobinul 0.2mg, Midazolam 1mg IM) and anesthesia method(spinal anesthesia) are the same and whose vitals sign is under normal condition, out of patients who underwent transurethral operations under spinal anesthesia for the period from October 2013 to January 2016 in a hospital. Using G*Power 3.1 Program based on the preceding research[13], the sample counts were calculated at significant level(α) .05, power(1-β) .80 and effect size .40, and finally, a total of 63 patients were included: 21 patients in each experimental group respectively and 21 patients in control group.

Research Tools

Body Temperature: The central body temperature was measured using a tympanic thermometer(Infrared Thermometer IRT 4520, Braun GmbH, Germany).

Thermal Discomfort: A tool developed by [14] was used. The higher the score on 7-score scale, the higher the degree of thermal discomfort.

Intervention

Warmed Irrigation Fluid Group: 3L of physiological saline solution was maintained at 37^0C using a digital heating cabinet(DHT-1800, Donghwa System, Incheon, Korea) and then used as a cleansing solution.

Forced-air Warming Group: 38^0C temperature, which is most similar to the temperature of warming irrigation fluid, was applied using a forced-air warmer(Warming unit model 505, Arizant Healthcare Inc. Minnesota, USA). The application method was to cover a patient removed operating gown with a cotton sheet, and to apply a warmed air blanket thereon from shoulder to belly button except the face.

Control Group: As usual, the patient was covered with a cotton sheet under the condition of removing operating gown, and the irrigation fluid of physiological saline solution at room temperature(23~24^0C) was used as a bladder cleansing solution when conducting surgery.

Ethical Consideration: This study was approved by the research ethics committee of a general hospital(***IRB 2013-039), and then the researcher collected data in collaboration with nurses of anesthesiology and pain medicine, urology and operating room. The researcher selected patients who were suitable for the selection criteria of research targets, explained them the research purpose, method and research ethics when wiring a surgery consent form, and then received a documented consent to participate in the research.

Data Analysis

The collected data were analyzed using IBM SPSS Statistics 21 program. The general properties and the surgical-related characteristics of research targets were analyzed with real number, percentages, mean and standard deviations, and the homogeneity test for three groups was analyzed using –test, One-way ANOVA, respectively. Further, the body temperature and thermal discomfort of the experimental group and the control group were analyzed using One-way ANOVA. Post-test was conducted with Tukey HSD(honestly significant difference). All statistical significant levels are adopted at <.05.

Results and Discussion

Homogeneity Test: As a result of conducting homogeneity test on the general characteristics of experimental group and control group in this study, there was no significant difference among three groups, and homogeneity of three groups was secured. As a result of conducting homogeneity test on surgery-related properties, there was no significant difference among three groups in ASA score, spinal anesthesia level, average operation time, average amount of fluid, cleansing volume, and homogeneity of three groups was secured. As a result of conducting a preliminary investigation on body temperature and thermal discomfort immediately after entering into the operating room, there was no statistically significant difference among three groups, and homogeneity of three groups was secured[Table 1].

Table 1: Homogeneity Test of Study Variables for Groups

Characteristics		EI (n = 21)	EII (n = 21)	Control group (n = 21)	F/χ^2	p
		M ± SD or n(%)	M ± SD or n(%)	M ± SD or n(%)		
Age		69.71 ± 8.10	69.19 ± 7.75	69.90 ± 6.70	0.05	.951
Height(cm)		162.53 ± 5.69	165.17 ± 5.90	163.04 ± 6.59	1.11	.335
Weight(kg)		66.5 ± 8.33	62.56 ± 6.70	67.03 ± 8.01	2.11	.130
Cold*	often feel	6(9.5)	7(11.1)	8(12.7)	1.06	.973
	normal	13(20.6)	13(20.6)	12(19.0)		
	do not feel	2(3.2)	1(1.6)	1(1.6)		
ASA score*	1	2(9.5)	5(23.8)	1(4.8)	3.88	.433
	2	13(61.9)	9(42.9)	13(61.9)		
	3	6(28.6)	7(33.3)	7(33.3)		
Level of spinal anesthesia	under T9	15(23.8)	9(14.3)	15(23.8)	4.84	.089
	over T10	6(9.5)	12(19.0)	6(9.5)		
Anesthetic time(min)		78.10 ± 27.68	80.71 ± 21.87	77.14 ± 22.67	0.72	.696
Operating time(min)		51.19 ± 27.79	49.29 ± 19.58	47.38 ± 20.77	0.12	.940
Infusion fluid(ml)		552.38 ± 237.42	566.67 ± 189.30	561.90 ± 165.76	0.03	.973
Irrigation fluid(ml)		17,260.95 ± 8,172.90	20,074.76 ± 9,445.24	18,876.19 ± 9,096.24	0.53	.594
Body Temperature(℃)		36.48 ± 0.29	36.62 ± 0.35	36.62 ± 0.32	1.31	.276
Thermal discomfort		3.86 ± .73	4.29 ± 1.01	3.76 ± 0.77	2.30	.109

Note: EI: Experimental groupI=warmed fluid irrigation group, EII: Experimental groupII=forced-air warming group Control group=room temperature irrigation fluid group, *Fisher exact test

Research Hypothesis Test

Hypothesis 1

Hypothesis 1: Postoperative body temperature of experimental group to which the warmed irrigation fluid and forced-air warming applied will be different from that of control group.

There was a statistically significant difference among groups in body temperature immediately after surgery(F=3.50, p=.037). The warmed irrigation fluid group showed a higher body temperature than the control group[Table 2]. Therefore, the first hypothesis was supported.

As I could not find any study applying air worming therapy and warmed irrigation fluid to patients who had undergone transurethral prostatic resection under spinal anesthesia, the timing of these changes in body temperature was difficult to directly compare with results of each research, but similar to the result of research applying warming intervention to patients who underwent transurethral operation. However, the difference with this study was that study[7] was targeting at patients who underwent transurethral operation under a general anesthesia, and intervention was applied to this study from the beginning of actual surgery, but to study[7] from the beginning of anesthesia. Also, there was a difference in intervention application method that study[7] applied water-circulating pad to both experimental group and control group. As for the research results, the study[7] showed that the body temperature of airway warming group and control group continued to decrease from 30 minutes after staring surgery, but this study showed a significant difference at the end of surgery. This is because study[7] applied intervention immediately after the general anesthesia, that is, including pre-operative preparation time, but this study applied intervention from the beginning of actual surgery, as it was an operation under spinal anesthesia. In the study[5] on intravenous injection of warmed irrigation fluid and warmed saline solution at 38^0C for patients who underwent prostatectomy, the results were consistent with this study, showing that the average body temperature decrease was greater in the group using irrigation fluid and saline solution at room temperature at the end of prostatectomy than the group using warmed irrigation fluid and saline solution at room temperature. Further, the average body temperature of the group using warmed irrigation fluid and warmed saline solution was increased by 0.12^0C from the beginning of surgery, but was not significant. The study used both saline solution and irrigation fluid for intravenous injection, which was different from this study. This study also showed that there was significantly less temperature variation in the warmed irrigation fluid group than the forced-air warming group immediately after surgery, compared with the control group. This is in contrast to the result of study[15] on existing in vivo warming method and in vitro warming method. In the study[15], the result of comparing the warming therapy with 37^0C saline solution and 37^0C skin warming therapy for the laparotomy patients showed that the skin warming therapy combined with the radiant heat had a higher body temperature retention and a less body temperature drop than the warming therapy with saline solution. It is judged this is due to the fact that study[15] combined radiant heat to the skin warming group, and the amount of saline solution in the warming saline solution therapy was 2,273ml on average, which was considerably less than the average cleansing amount of warming irrigation fluid group in this study, 20,075ml.

Hypothesis 2

Hypothesis 2: There will be differences in postoperative thermal discomfort between experimental groups to which warmed irrigation fluid and forced-air warming applied and the control group.

There was statistically significant difference in thermal discomfort between the groups when entering into the recovery room after surgery(F=3.94, p=.025). The warmed irrigation fluid group showed the less thermal discomfort than the control group and the forced-air warming group[Table 2]. Therefore, the second hypothesis was supported.

Even though it is not possible to compare directly due to the different method of surgery, anesthesia and intervention, this result is consistent with the result of study[16] showing that in case of the subjective thermal discomfort of abdominal surgical patients, the application of warmed saline solution(37^0C) was less than the application of the warming blanket(38^0C). But, a study[17] to apply the warmed saline solution therapy(42^0C) and the forced-air warming therapy(43^0C) for the patients who underwent gastric cancer surgery showed that the forced-air warming group had a significantly less thermal discomfort than the warmed

saline solution group when entering into the recovery room, which was in contrast to this study. It is judged that this is because the amount of warmed saline solution was about 500ml in the study[17], which largely differed from the amount of irrigation fluid in this study and 3100ml of saline solution in study[16]. As mentioned above, when a large amount of saline solution is used for intravenous injection or cleansing solution, warming intervention of saline solution and cleansing solution may be effective, and the body temperature control during surgery leads to a decrease in the patient's discomfort after surgery.

Table 2: Comparison of Body Temperature and Thermal Discomfort between Groups

	Body Temperature (Immediately after procedure)	**Thermal Discomfort (Arrival at recovery room)**
EI[a] (n=21) M ± SD	36.00 ± 0.30	4.10 ± 0.54
EII[b] (n=21) M ± SD	35.81 ± 0.56	4.76 ± 1.09
C[c] (n=21) M ± SD	35.64 ± 0.40	4.76 ± 0.94
F(p) Tukey	3.50(.037) a>c	3.94(.025) a<b,c

Note: EI: Experimental groupI=warmed fluid irrigation group,

EII: Experimental groupII=forced-air warming group,

Control group=room temperature irrigation fluid group

Conclusion

Taken together the effect of warming intervention method on the postoperative body temperature and thermal discomfort in the transurethral operation under spinal anesthesia, the warmed irrigation fluid group has a statistically and significantly less body temperature drop and a less thermal discomfort than the control group and the forced-air warming group immediately after surgery. The incidence of hypothermia was also lower in order of control group, forced-air warming group and the warmed irrigation fluid group. Therefore, it is concluded that the warmed irrigation fluid, an in vivo warming method, is more effective than the forced-air warming method, an in vitro warming method, in transurethral operation. This is thought to be due to the characteristics of transurethral operation using a large amount of cleansing solution. In conclusion, the result of this study suggests that the warmed irrigation fluid intervention is more effective than the forced-air warming intervention in transurethral operation under spinal anesthesia.

Ethical Clearance: Obtained written consent from the subjects

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Conflict of Interest: Nil

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