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Original article

The Effects of Intrathecal Dexamethasone *versus* Fentanyl on Post-Spinal Shivering in Patients Undergoing Transurethral Prostatectomy

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Abstract
Shivering is a common complication of spinal anesthesia (incidence 40-70%), particularly problematic during transurethral prostatectomy (TURP) due to perioperative hypothermia and elderly patients' comorbidities. This randomized controlled trial compared intrathecal dexamethasone (8mg) and fentanyl (20µg) as adjuvants to bupivacaine for preventing post-spinal shivering in 51 ASA I-II patients undergoing TURP. Patients were allocated to dexamethasone (Group D), fentanyl (Group F), or saline control (Group C). Shivering incidence was significantly lower in Group D (11.8%) and Group F (23.5%) *versus* Group C (52.9%) ($p<0.05$). Shivering severity (measured via Crossley scale) and meperidine rescue doses were significantly reduced in intervention groups. Core temperature decline was attenuated in Groups D/F *versus* C ($p<0.05$ at 15-45min). Sensory/motor block duration was prolonged in intervention groups without hemodynamic differences. Both dexamethasone and fentanyl effectively reduced shivering incidence and severity without significant adverse events, providing safe alternatives for TURP patients.
Keywords. Spinal Anesthesia, Shivering, Dexamethasone, Fentanyl, Transurethral Prostatectomy.

Introduction

Shivering is a random, spontaneous, and asynchronous skeletal muscle contraction that increases basal metabolism and is considered a defense mechanism for temperature regulation in adults. It is a common post-spinal complication with an incidence of 40-70% [1]. Various mechanisms have been suggested for post-anesthesia shivering, including intraoperative heat loss, postoperative increased sympathetic tone, pain, and systemic release of pyrogens [2].

Shivering during spinal anesthesia is a common complication in patients undergoing transurethral prostatectomy (TURP). The high incidence of shivering may be due to decreased core temperature secondary to peripheral vasodilation from sympathetic blockade and/or a large amount of irrigation fluid [3]. Shivering has many complications, such as lactic acidosis, increased oxygen consumption, carbon dioxide production, and a metabolic rate up to 400%. So, it may cause harm in TURP patients with low cardiac and pulmonary reserve, as most patients undergoing TURP are elderly and have co-morbid cardiac or pulmonary disease [4]. There are two methods to reduce shivering: non-pharmacological and pharmacological [5,6]. The non-pharmacological method involves the use of moisturizers, preventing hypothermia using warm blankets, and warm oxygen inhalation [7]. The pharmacological method uses drugs that have anti-shivering properties.

Several studies showed that intrathecal fentanyl is an appropriate method to reduce the incidence and severity of shivering during spinal anesthesia. Intrathecal dexamethasone has been used for many years and has been given in combination with bupivacaine to improve the quality and intensity of spinal anesthesia and prolong the duration of postoperative analgesia [8]. Dexamethasone has been found to reduce the gradient between skin and body core temperature. It could reduce shivering by regulating immune responses. A recent study showed that intrathecal dexamethasone, besides prolonging analgesia, is effective in reducing the incidence and severity of postoperative shivering following prostate surgery [3,8]. This study aims to compare the effects of intrathecal dexamethasone and intrathecal fentanyl on the incidence and severity of shivering in patients undergoing TURP.

Methods

Study Design and Participants

A prospective randomized controlled trial enrolled 51 ASA physical status I-II males (50-70 years) scheduled for TURP. Exclusions included contraindications to spinal anesthesia, neuropsychiatric disorders, thyroid dysfunction, fever, or corticosteroid use.

Randomization and Interventions

Computer-generated randomization allocated patients to: Group D (n=17): 8mg dexamethasone + 10mg hyperbaric bupivacaine 0.5%. Group F (n=17): 20µg fentanyl + 10mg hyperbaric bupivacaine 0.5%. Group C (n=17): 2ml saline + 10mg hyperbaric bupivacaine 0.5%. Drugs were diluted to 4ml total volume.

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Procedures

Standard spinal anesthesia was administered at L3/4/L4/5. Operating room temperature was maintained at 23-25°C with warmed irrigation fluids. Hemodynamics, tympanic temperature, sensory block (pinprick), and motor block (Bromage scale) were recorded preoperatively and at 0, 15, 30, and 45min post-induction. Shivering was assessed using Crossley' s 5-point scale (0=no shivering; 4=whole-body shivering) [6]. Grade ⩾3 shivering received IV meperidine (25 – 50mg).

Outcomes

Primary: Shivering incidence. Secondary: Shivering severity, core temperature, hemodynamics, block characteristics, and adverse events.

Statistical Analysis

SPSS v25 analyzed data using ANOVA, chi-square, and repeated-measures ANOVA (significance: $p<0.05$). Sample size was calculated with EPI Info (power=80%, CI=95%) based on prior shivering incidence data.

Results

All 51 enrolled patients completed the study without attrition (Figure 1). The three groups demonstrated comparable baseline characteristics, including age (Group D: 64.94 ± 3.31; Group F: 62.53 ± 4.58; Group C: 62.71 ± 2.91 years; p=0.113), prevalence of diabetes (11.8% vs. 23.5% vs. 17.6%), hypertension (23.5% vs. 23.5% vs. 35.3%), and smoking (64.7% vs. 53% vs. 47.1%), with no significant differences (p>0.05). Surgical duration was similarly consistent across groups (49.67 ± 3.61 vs. 49.29 ± 2.8 vs. 49.71 ± 3.89 min; p=0.911) (Table 1).

Table 1. Patient Characteristics and Surgical Duration

Parameter	Group D (n=17)	Group F (n=17)	Group C (n=17)	p-value
Age (years)	64.94 ± 3.31	62.53 ± 4.58	62.71 ± 2.91	0.113
Diabetes, n (%)	2 (11.8)	4 (23.5)	3 (17.6)	0.784
Hypertension, n (%)	4 (23.5)	4 (23.5)	6 (35.3)	-
Surgery Duration (min)	49.67 ± 3.61	49.29 ± 2.8	49.71 ± 3.89	0.911

Regarding the primary outcome, shivering incidence diverged significantly: 52.9% (9/17) in Group C (control) compared to 23.5% (4/17) in Group F (fentanyl) and 11.8% (2/17) in Group D (dexamethasone) (p=0.025). Shivering severity followed this pattern, with Grade 3 (muscular activity in >1 muscle group) observed in 52.9% of Group C versus 23.5% of Group F and 11.8% of Group D (p=0.025). Consequently, meperidine rescue requirements were higher in Group C, where 35.3% (6/17) required 50 mg doses, whereas Groups D and F required only 25 mg doses (11.8% and 17.6%, respectively; p=0.024) (Table 2).

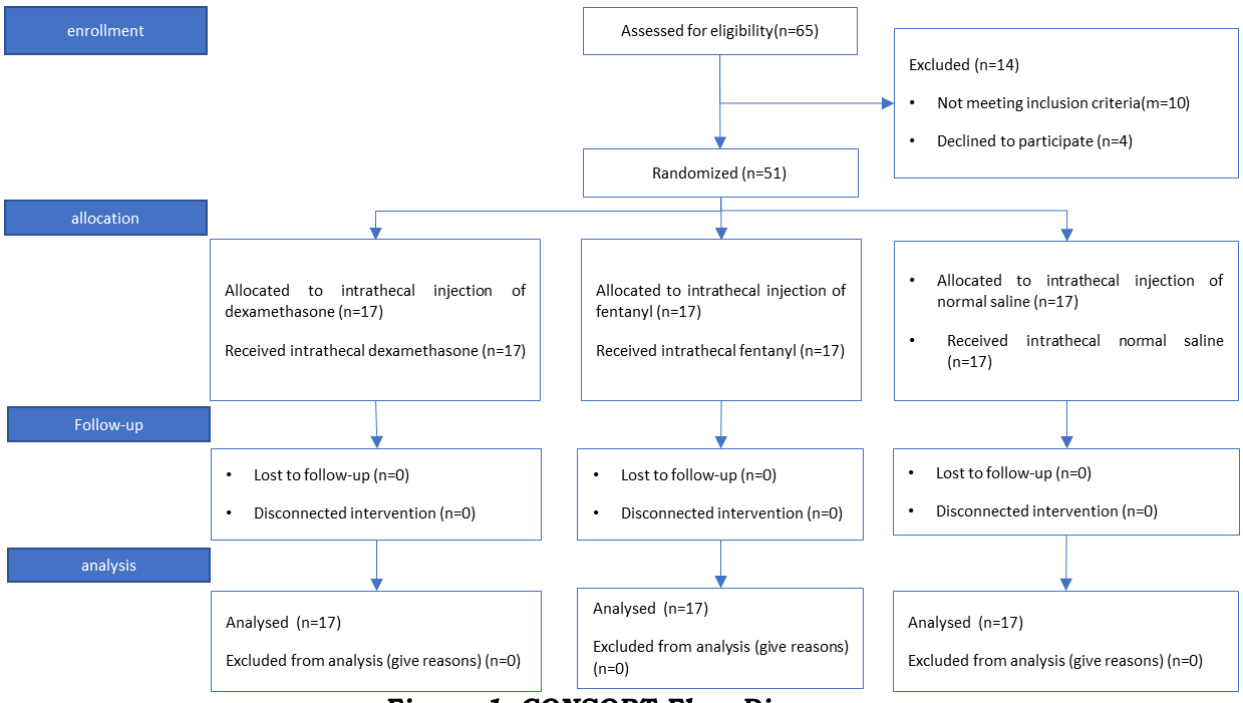

Figure 1. CONSORT Flow Diagram

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Table 2 Core Temperature (°C) Over Time

Time	Group D	Group F	Group C	p-value
Preoperative	37.05 ± 0.07	37.04 ± 0.05	37.05 ± 0.05	0.746
15min post-induction	36.90 ± 0.07	36.84 ± 0.08	36.79 ± 0.17*	0.035
45min post-induction	36.80 ± 0.08	36.75 ± 0.11	36.65 ± 0.21*	0.015
**p<0.05 vs. Groups D/F*				

Core temperature declined significantly in all groups over time (p<0.001), but intervention groups maintained better thermoregulation. At 45 min post-induction, Group C exhibited lower tympanic temperatures (36.65 ± 0.21°C) than Group D (36.80 ± 0.08°C) and Group F (36.75 ± 0.11°C; p=0.015) (Table 3).

Table 3 Core Temperature Trends (°C)

Timepoint	Group D	Group F	Group C	p-value
Baseline	37.05 ± 0.07	37.04 ± 0.05	37.05 ± 0.05	0.746
45 min Post-block	36.80 ± 0.08	36.75 ± 0.11	36.65 ± 0.21*	0.015*
**p<0.05 vs. Groups D/F*				

Sensory and motor blockade profiles also differed: Groups D and F achieved peak sensory blocks faster (6.62 ± 0.98 min and 6.19 ± 0.64 min, respectively) than Group C (7.15 ± 0.93 min; p=0.009), with prolonged two-segment regression (73 ± 1.06 min and 72.18 ± 1.46 min vs. 68 ± 8.4 min; p=0.011) and extended motor block duration (135.29 ± 1.61 min and 134.32 ± 2.01 min vs. 133.41 ± 2.29 min; p=0.006) (Figure 2).

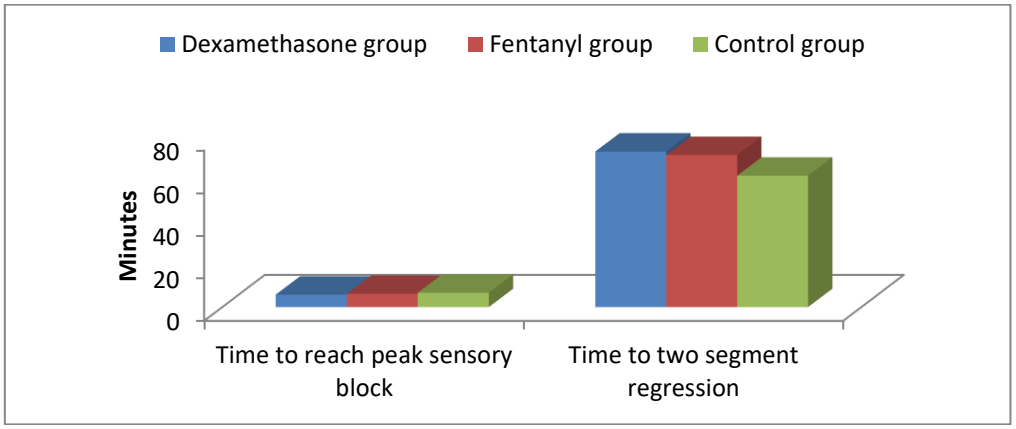

Figure 2. Time to Sensory Regression and Motor Block Duration

Hemodynamic parameters (heart rate, mean arterial pressure) remained stable across groups (p>0.05). Adverse events—including hypotension (Group C: 29.4%; Group D: 11.7%) and bradycardia (Group C: 17.6%; Group D: 5.8%)—did not differ significantly (p>0.05). No respiratory depression, TURP syndrome, or severe complications occurred.

Discussion

Prevention and treatment of post-anesthesia shivering is an important aspect of patients' care as it may be associated with a number of deleterious sequelae, including sympathetic stimulation, increasing oxygen consumption, and carbon dioxide production. In this study, we compared the efficacy of intrathecal dexamethasone and intrathecal fentanyl in the prevention of post-spinal shivering in patients undergoing transurethral resection of the prostate.

Intrathecal dexamethasone has been used for many years and has been given in combination with bupivacaine to improve the quality and intensity of spinal anesthesia and prolong the duration of postoperative analgesia [9]. Dexamethasone has been found to reduce the gradient between skin and body core temperature and could reduce shivering by regulating immune responses [10]. Opioids are the most commonly used adjuvants added to bupivacaine in spinal anesthesia to obtain a sufficient intraoperative analgesia and increase the duration and quality of postoperative analgesia with less sympathetic block and hemodynamic effect. Fentanyl was used as an adjuvant to intrathecal bupivacaine to reduce the incidence and severity of shivering during spinal anesthesia [11].

In our study, the results were comparable between the three groups with regard to hemodynamics, which are consistent with the study of Khezri et al, 2014, who evaluated the effect of adding 25 µg fentanyl to bupivacaine intrathecally in patients undergoing cesarean section and found no significant difference between the fentanyl and placebo group regarding hemodynamics[12]. In our study, the time taken till peak sensory block was significantly longer in control group when compared with the other two groups and time to two segment regression was significantly shorter in control group when compared with the other two

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groups and that agrees with the results of Franklin, 2017 who evaluated the effect of adding 25 µg fentanyl to bupivacaine in patients undergoing TURP and found that fentanyl group showed a significant shorter time to reach peak sensory block and a significant longer time to reach two segment regression when compared with control group [13]. Elzayyat et al, 2014 who evaluated the effect of adding dexamethasone to bupivacaine in spinal anesthesia in patients undergoing lower abdominal surgeries found that time to two segment regression was significantly longer in dexamethasone group compared with control group and that agrees with our study but their results regarding time to peak sensory level were comparable between the groups and that disagrees with our study and that can be explained by that they used a smaller dose of dexamethasone (4mg) than we used in our study(8mg) [14].

In our study, there was significant decrease in duration of motor blockage in control group when compared with the other two groups and that disagreed with Kararmaz et al, 2003 who evaluated the effect of low-dose bupivacaine plus 25 µg fentanyl in patients undergoing TURP and found that the results were comparable between the groups as regard duration of motor blockage and that can be explained by using a smaller dose of bupivacaine in fentanyl group (4mg) compared with control group (7.5mg) [15]. El-shourbagy et al, 2019, who evaluated the effect of adding dexamethasone to bupivacaine for spinal anesthesia in patients undergoing cesarean section, found that the duration of motor block was significantly longer in the dexamethasone group compared with the control group (plain bupivacaine), and that agrees with our study [16].

In this study, the occurrence of shivering was 11.8% in the dexamethasone group, 23.5% in the fentanyl group, and 52.9% in the control group, being the highest in the control group. In the study of Sadegh et al, 2012 they evaluated the effect of adding intrathecal fentanyl to bupivacaine on the prevention of post-spinal shivering in patients undergoing cesarean section, and they found that the shivering incidence in the fentanyl group was significantly lower than that in the control group, which is consistent with our study [17]. Techanivate et al, 2005 evaluated the effect of adding intrathecal fentanyl to bupivacaine with 0.2mg morphine on prevention of post-spinal shivering in patients undergoing cesarean section found that the incidence of shivering in fentanyl group was significantly lower than that in control group and that agrees with our study and they also found that the results were comparable between the groups regarding tympanic temperature and that disagrees with our study and that can be explained by that they used morphine in spinal anesthesia while we did not in our study [18]. Moeen and Moeen, 2017 who studied the effect of adding 8mg dexamethasone to bupivacaine intrathecally in prevention of shivering in patients undergoing TURP, found that the incidence of shivering in dexamethasone group was significantly lower than that in control group and that is consistent with our study and they also found a significant decrease of tympanic temperature in control group when compared with dexamethasone group 15min after induction of spinal anesthesia till the end of surgery and that agrees with our study [19].

In our study, there were no reported cases of respiratory depression among groups, which agrees with the study by Kararmaz et al, 2003, who evaluated the effect of adding 25 µg fentanyl to bupivacaine in spinal anesthesia in patients undergoing transurethral prostatectomy [15]. Also, it agrees with it in that there was no significant difference among groups regarding occurrence of bradycardia, nausea and vomiting, however, in their study hypotension was significantly higher in control group compared with fentanyl group and that can be explained by using a larger dose of bupivacaine in control group (7.5mg) compared with fentanyl group (4mg). Bani-Hashem et al, 2011, who evaluated the effect of adding 8mg dexamethasone to hyperbaric bupivacaine in patients undergoing orthopedic surgeries, found that the results were comparable regarding adverse events as compared to the control group, such as nausea, vomiting, hypotension, and bradycardia, and that agrees with our study [20]. In our study we used a significantly higher dose of iv meperidine to treat shivering in control group compared with the other two groups and that agrees with Safavi et al, 2014 who evaluated the effect of adding 20 µg fentanyl to bupivacaine for prevention of shivering in lower limb orthopedic surgeries and found that control group needed a significantly higher dose of iv meperidine to treat shivering when compared with fentanyl group [21] and also agrees with the study of Moeen and Moeen, 2017, who evaluated the effect of adding 8mg dexamethasone to bupivacaine intrathecally in the prevention of shivering in patients undergoing TURP and found that the control group needed a significantly higher dose of IV meperidine to treat shivering when compared with the dexamethasone group [19].

Conclusion

Intrathecal dexamethasone (8mg) and fentanyl (20µg) are equally effective for preventing post-spinal shivering during TURP. Dexamethasone demonstrated marginally better efficacy, but both adjuvants reduced shivering severity, attenuated hypothermia, and prolonged analgesia without compromising safety.

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Conflicts of Interest

The author declares no conflicts of interest.

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