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Research Article

Postoperative urinary retention after general and spinal anesthesia in orthopedic surgical patients

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KEYWORDS

General anesthesia;
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Abstract *Background:* After general, spinal anesthesia and surgery, urinary retention is common. The aim of the study was to compare the effect of general anesthesia versus spinal anesthesia on postoperative urinary retention

Patients and methods: After obtaining local ethics committee approval and written consent, 60 male patients, aged 16–40 years, ASA – physical status I and II were divided into two groups (S) 40 patients and (G) 20 patients undergoing surgery of the lower limb lasting up to 90 min (knee arthroscopy, internal tibial fixation with plate and screws). Group (S) was taken spinal anesthesia, this group was divided into two groups (S_1) 20 patients, who were taken plain bupivacaine and group (S_2) 20 patients who were taken plain bupivacaine plus fentanyl. Group (G) 20 patients were anesthetized by general anesthesia.

Results: There were statistically significant differences among groups S1, S2 and G regarding spontaneous micturition, residual volume and time since spinal or general anesthesia till micturition. The percent numbers of patients with retention were 20% in group S1, 35% in group S2 and 8% in group G.

Conclusion: Urinary retention is more common after spinal than general anesthesia in orthopedic patients. Adding narcotics to the local anesthetics intrathecally causes more incidence of postoperative urinary retention, which may delay patients discharge and transabdominal ultrasonography is a reliable, noninvasive, inexpensive and simple method to measure bladder volume postoperatively.

1. Introduction

Postoperative urinary retention (POUR) is common after anesthesia and surgery. The control of micturition is a complex process involving multiple afferent and efferent neural pathways, reflexes, and central and peripheral neurotransmitters. The perioperative period includes myriad insults that may interrupt this process and promote the development of urinary retention [1]. In a meta-analysis done by Baldini, and his colleagues, reviewing the impact of anesthesia on the incidence of postoperative urinary retention revealed that the overall incidence of POUR after general anesthesia was found to be significantly lower in comparison with conduction blockade [2].

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Spinal anesthetics bupivacaine and tetracaine delay the return of bladder function beyond the resolution of sensory anesthesia, and may lead to distention of the bladder beyond its normal functioning capacity. This may cause urinary retention, or possibly even bladder damage [3].

Ultrasound has been used as a diagnostic tool for postoperative urinary retention as well as an imaging modality to evaluate bladder function [1]. In the postoperative period, urinary retention has two main causes. The first is mechanical obstruction of the urinary outflow tract, and the second is altered neural control of the bladder and detrusor mechanism, most commonly due to analgesic drugs [4].

The present study hypothesized that adding narcotic analgesics to spinal anesthesia would increase the incidence of postoperative urinary retention The aim of the study was to compare the effect of general anesthesia versus spinal anesthesia with and without narcotics on postoperative urinary retention.

2. Patients and methods

After obtaining local ethics committee approval and written consent, 60 male patients, aged 16–40 years, ASA – physical status I and II were divided into two groups (S) 40 patients and (G) 20 patients undergoing surgery of the lower limb lasting up to 90 min (knee arthroscopy, internal tibial fixation with plate and screws). Group (S) was anesthetized by spinal anesthesia, this group was divided into two groups (S_1) 20 patients, who were taken heavy plain bupivacaine and group (S_2) 20 patients who were taken plain bupivacaine plus Fentanyl while group (G) 20 patients were anesthetized by general anesthesia.

Exclusion criteria include prostate hyperplasia or urogenital pathologies (incontinence, cysto-ureteric reflux, known bladder retention and patients with renal impairment), intraoperative blood loss 200 ml or more, alcohol or drug abuse.

Patients were allowed to drink water up to 2 h before induction of anesthesia. All patients voided before transfer to the operating area. After application of routine monitoring equipment (ECG, oscillometric arterial pressure cuff, pulse oximetry), an intravenous infusion with ringer's lactate fixed volume (1000 ml) for all cases was commenced and an initial bladder ultrasonography scan was performed to measure bladder content before and after spinal anesthesia or general anesthesia, scan set was LOGIQ, TM, P_5, IA_5, (version 4).

2.1. Spinal anesthesia method

In the lateral or setting position, the subarachnoid space was punctured with a 25 G Whitacre needle at L3/4 or L4/5 using a median or paramedian approach until there was free backflow of cerebrospinal fluid, and 3 ml of hyperbaric bupivacaine 0.5% in group (S_1) and 3 ml hyperbaric bupivacaine 0.5% plus 20 μm fentanyl in group (S_2) were administered. After 3 min, patients will be returned to the supine position. Perioperatively, ephedrine, midazolam, or both were administered intravenously if required.

2.2. General anesthesia method

Intravenously, induction was done by fentanyl 1 μg/kg, propofol 2 mg/kg and atracurium 0.5 mg/kg to facilitate tracheal intubation. Controlled ventilation was maintained in a closed valvular system using 50% air and 50% oxygen. Anesthesia was achieved by the administration of 2% isoflurane and maintained until the end of surgery. During surgery, one liter ringer lactate was given intravenously. Postoperative pain was measured on a numeric rating scale (0–10). Ketorolac 30 mg i.m. was used as bolus dose if required. Ultrasound scans of the bladder were performed hourly after surgery until spontaneous micturition or catheterization occurs. It should be noted that ultrasound bladder scans were used to diagnose urinary retention. Urinary retention was defined as a bladder volume $\geqslant$ 500 ml together with the inability to micturate or post-residual volume > 500 ml. Patients were catheterized when these criteria were met.

2.3. Statistical methodology

Analysis of data was done by IBM computer using SPSS (statistical program for social science, version 16) as follows:

Description of quantitative variables as mean ± SD.
Description of qualitative variables as number and percentage.
Patients with postoperative urinary retention expressed by percentage.

ANOVA was used to compare between groups regarding urine volume and time. Paired t-test was used to compare between urine volume before spinal anesthesia and before spontaneous micturition, and before spontaneous micturition and posturination residual volume. P value < 0.05 is considered significant.

3. Results

According to demographic data (Table 1), there were no statistical significant differences among groups S1, S2 and G related to age, weight, and duration of surgery.

Regarding urine volume measured before spontaneous micturition (Table 2), there were statistically significant differences between group S1 (575.9 ± 84 ml) and group S2 (691 ± 104 ml) and also significant differences between group G (383.5 ± 78 ml) and both group S1 and group S2. Concerning residual volume, there was statistically significant difference between group S1 (141.4 ± 36 ml) and group S2 (172.9 ± 42 ml), and also significant differences between group G (67 ± 38 ml) and both group S1, and group S2. There were statistically significant differences between urine volume before spinal anesthesia and before spontaneous micturition, and before spontaneous micturition and posturination residual volume. The percentages of patients with retention were 20% in group S1, 35% in group S2 and 8% in group G.

Time since spinal or general anesthesia till micturition was shown in Table 3. There were statistically significant differences between group S1 (344.2 ± 44 min) and group S2 (501.7 ± 59 min), and also significant difference between group G (199 ± 65 min) and both group S1 and group S2.

4. Discussion

The main finding in the present study is that postoperative urinary retention is common complication after general or

Table 1 Demographic data of patients undergoing knee arthroscopy/tibial fixation.

	Group S1	Group S2	Group G
Number of patients	20	20	20
Age (year)	31 ± 8.9	35 ± 7.8	37 ± 6.9
Body weight (kg)	79 ± 6.9	73 ± 7.8	80 ± 8.8
Duration of surgery (min)	60 ± 5.7	55 ± 6.8	64 ± 7.5
Knee arthroscopy/tibial fixation	16/4	15/5	14/6
Fluid taken intraoperatively (ml)	1000	1000	1000

S1 = patients with spinal anesthesia (hyperbaric bupivacaine), S2 = patients with spinal (hyperbaric bupivacaine) + fentanyl anesthesia, G = patients with general anesthesia. Data of age, body weight and duration of surgery were presented as mean ± SD.

Table 2 Urine volume of patients undergoing knee arthroscopy/tibial fixation.

	Group S1	Group S2	Group G
Before operation	27.9 ± 5.9	27.2 ± 9.6	27.7 ± 8
Before micturition	575.9 ± 84*	691 ± 104*	383.5 ± 78*
Residual volume	141.4 ± 36*	172.9 ± 42*	67 ± 38*
Patients with postoperative urinary retention%	20	35	8

S1 = patients with spinal anesthesia (hyperbaric bupivacaine), S2 = patients with spinal (hyperbaric bupivacaine) + fentanyl anesthesia, and G = patients with general anesthesia.

* Means statistically significant difference at P value < 0.05. Results for urine volume before operation, before micturition and residual volume were presented as mean ± SD.

Table 3 Time since spinal or general anesthesia.

	Group S1	Group S2	Group G
Time since spinal or general anesthesia till micturition (min)	344.2 ± 44*	501.7 ± 59*	199 ± 65**

* Means statistically significant difference P value < 0.05. Results were presented as mean ± SD.

spinal anesthesia. In this study before micturition the bladder volume was (575.9 ± 84 ml) which is comparable to bladder volume (405 ± 145 ml) measured before voiding after intrathecal injection of levobupivacaine according to Breebaart et al. [5] finding. Regarding postoperative voiding residual volume, they were (141.4 ± 36, 172.9 ± 42 ml), in group S1 and, group S2 respectively, which were comparable with Kreutziger and his colleagues results [6], which were (123 ± 19 ml) in patients received spinal anesthesia. In the present research, the postoperative voiding residual volume in patients anesthetized generally was less than that in patients taken spinal and spinal plus Fentanyl respectively. The increment in postoperative urinary retention in patients received spinal anesthesia in comparison with those taken general anesthesia is contradict to results observed by Chu and his colleagues [7] that the incidence of postoperative urinary retention in patients taken general anesthesia followed by postoperative intravenous patient-controlled analgesia was more than patients taken spinal-epidural anesthesia followed by postoperative epidural infusion analgesia. This contradiction may be due to the difference in neuroaxial techniques used.

The percentage of urinary retention after general and spinal anesthesia were 8% in group G, 20% and 35% in groups S1 and S2 respectively. These results were contradictable with Lingaraj et al. [4], who found the percentage of urinary retention was 5.3% in general anesthesia group, 0% in spinal anesthesia group but 21.4% in epidural group this disagreement may be due to the preponderance of females, who are at low risk for mechanical obstruction (as a cause of postoperative urinary retention). The results of urinary retention in group S2 (35%) is not comparable with the result of Gupta [8], which was 20% urinary retention after spinal anesthesia added Fentanyl. This difference may result from the use of the low dose of bupivacaine which was 1.5 ml of 0.5% bupivacaine + 0.5 ml fentanyl (25 μg) but in the present study dose used was 3 ml of bupivacaine 0.5% + 20 μg Fentanyl. In the spinal anesthesia group S1 results, 20% incidence of urinary retention was contradictable to results of Esmaoglu et al. [9], which was 4.2% and different from results of Kotwal et al. [10], who found postoperative urinary retention percentage as 38% of patients received spinal anesthesia and 22% of patients received general anesthesia. The difference may be due to the patients' age. They were older (the median patients age was 68 years, range 34–89 years) but in this study the age was from 16 to 40 years .

The time to first urination since spinal (bupivacaine + fentanyl) injection was (335 min) according to Gupta et al. [8] study which is less than results in this research (501 ± 59 min). This may be due to the difference between doses used in both studies, where they use 6.0 mg bupivacaine plus 25 μg fentanyl resulting in 15% urine retention needing urinary catheter but on the other group 7.5 bupivacaine was given plus 25 μg fentanyl and the result was 20% needing urinary catheter.

Ultrasonography has been reported to have high sensitivity and specificity for the estimation of postoperative bladder

volume and postvoid residual volume. Kreutziger and his colleagues [6], found that the time till micturition since spinal (hyperbaric prilocaine) anesthesia was (276 ± 59 min) which is approximately comparable with the research results (300 ± 59 min).

The incidence of postoperative urinary retention is affected by anesthetic technique. The bladder is composed of detrusor muscle, internal and external urethral sphincters. It has a capacity of 400–600 ml and innervated by efferent somatic, sympathetic and parasympathetic fibers. The parasympathetic fibers cause contraction of the detrusor and relaxation of the sphincter, permitting micturition. The sympathetic fibers produce detrusor relaxation and internal urethral sphincter closure. The two systems are governed by spinal reflexes and two pontine brain stem centers. The voluntary control of the bladder, involves the coordination among the frontal cortex and the pontine centers. At bladder volume of 150 ml, when voiding threshold is reached, the first urge is felt and at 300 ml sense of fullness is created [2].

General anesthetics cause bladder atony by acting as smooth muscle relaxants and by interfering with autonomic regulation of detrusor tone. In vitro work, clinical doses of halothane and thiopentone decrease bladder response to stimulation [11]. Volatile anesthetics and Sedative-hypnotics inhibit the pontine micturition center and voluntary cortical control of the bladder, suppressing detrusor contraction and the micturition reflex [12]. Other drugs given with general anesthesia may produce postoperative urinary retention. Anticholinergic agents as atropine used for premedication or reversal of neuromuscular blockade may impair detrusor contractility and facilitate passive overfilling of the bladder by acting at cholinergic receptor sites in the smooth muscle of the bladder and urethra [13].

Intrathecal injection of bupivacaine will block the afferent and efferent neural transmission from and to spinal segments S2–S4. But, on maximal filling of the bladder, the feelings of tension are present. So, bladder analgesia is due to the blocking transmission of the afferent nerve fibers from the bladder to micturition center in the brain. After 30–60 s of spinal anesthetic injection, sensation of urgency to void disappears, 2–5min the detrusor contraction is completely abolished and its recovery depends on the duration of sensory block above S2 and S3 sacral segments, which is 7–8 h. Complete normalization of detrusor strength occurs 1–3.5 h after ambulation. With the use of longer-acting local anesthetics, the duration of detrusor blockade allows the bladder volume to significantly exceed preoperative bladder capacity [14]. Intrathecal injection of Opioid decreases the urge sensation and detrusor contraction, increasing the bladder capacity and residual volume, altering sphincter function, and resulting in impaired coordination between the detrusor contraction and internal urethral sphincter relaxation. The urodynamic effects of intrathecal opioid are mainly caused by the action on the opioid receptors in the spinal cord (μ and δ receptors) that decrease the parasympathetic firing in the sacral region and decrease the afferent inputs from the bladder to the spinal cord, and the rostral spread of opioid through the cerebrospinal fluid to the pontine micturition center [15]. Opioids interrupt the micturition reflex by several mechanisms, opioid analgesics reduce parasympathetic tone within the bladder, decreasing detrusor tone and permitting passive filling, They also impair perception of bladder fullness and the urge to void, decrease activity in the pelvic nerves by depressing preganglionic neurons in the sacral parasympathetic nucleus, cause detrusor-sphincter dyssynergy secondary to failure of sphincter relaxation [16], Opioid-mediated depression of bladder motility is largely secondary to action at the m-opioid receptor, and can be reversed by intravenous naloxone, which promotes detrusor contraction and sphincter relaxation [15].

Patients experience increased rates of POUR when intrathecal local anesthetics are administered with opioids. The addition of fentanyl to spinal anesthesia and the choice of spinal over epidural anesthesia were found to significantly increase time to discharge ambulatory surgical patients [17].

In conclusion, urinary retention is more common after spinal than general anesthesia in orthopedic patients. Adding narcotics to the local anesthetics intrathecally causes more incidence of postoperative urinary retention, which delay patients discharge. Postoperative bladder volume could be measured by Transabdominal ultrasonography because it is a reliable, noninvasive, inexpensive and simple method.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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