Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2017/173

Original Article

Comparative Study of Urinary Retention in Lower Limb Surgeries between General and Spinal Anesthesia

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Abstract

Introduction: Urinary retention is very common after general anesthesia (GA) or spinal anesthesia (SA) especially following lower abdominal and lower limb surgeries.

Aim: Aim of the study is to study the incidence and duration of urinary retention following general and SA and to compare the effects of these two types of anesthesia on it.

Materials and Methods: A total of 84 patients with physical status I and II were divided into two groups; 42 each. All the patients undergoing orthopedic surgery (arthroscopy, tibia shaft fracture fixation, and screws fixation in ankle fractures) of the lower limb lasting above 60 min were divided into groups. Group A was administered GA and Group B was given SA.

Results: The incidence and duration of urinary retention, residual volume, spontaneous micturition, and mechanisms presumed were different in both groups and were statistically significant.

Conclusion: Urinary retention was found to be more common after spinal than GA in the study. Abdominal ultrasound examination was found to be a reliable, noninvasive, inexpensive, and simple method to measure bladder volume postoperatively.

Key words: Anesthesia, Bladder reflexes, General anesthesia, Neurotransmitters, Post-operative urinary retention, Spinal

INTRODUCTION

Post-operative urinary retention (POUR) is defined as the inability to voluntarily empty the bladder after anesthesia and surgery.[1] POUR is usually treated by catheterization of the bladder, but at what volume of urine in bladder one should definitely catheterize is not known which has resulted in different criteria for catheterization.[2] Balderi and Carli reported the incidence of POUR in elective total hip arthroplasty and elective total knee arthroplasty patients as ranging from 0% to 75%.[3] POUR poses a challenge to the surgeon and prolongs the morbidity and hospital stay in patients undergoing all surgeries especially lower limb operations.[4] According to Baldini's meta-analysis, the overall incidence of POUR following general anesthesia (GA) was lower when in compared with conduction blockade.[2] Bupivacaine and tetracaine used in spinal anesthesia (SA) delay the return of bladder function even after the resolution of sensory anesthesia which leads to distention of the bladder beyond its normal functioning capacity resulting in POUR or even bladder damage.[5] A close workup by urology specialists and other surgeons is required to create evidence-based guidelines for POUR and its treatment.

POUR is common after any type of anesthesia and surgery on lower limbs and lower abdominal. Multiple afferent, efferent neural pathways, reflexes and central and peripheral neurotransmitters play a role in the process of micturition physiology. During the pre-operative period, the patient experiences a myriad of insults which may interrupt this physiological process leads to the development of urinary retention.[6] The two main causes of POUR are mechanical obstruction of the urinary outflow tract and the altered

Access this article online

www.ijss-sn.com

Month of Submission : 02-2017
Month of Peer Review : 03-2017
Month of Acceptance : 03-2017
Month of Publishing : 04-2017

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neural control of the bladder and detrusor mechanism, most commonly due to analgesic drugs.[7] This study aims to study the clinical parameters of patients, incidence and time periods of urinary retention following general and SA and to compare.

MATERIALS AND METHODS

This study was a prospective clinical study conducted in a Tertiary Teaching Hospital; Kannur Medical College, Anjarakandy, Kannur, Kerala. The study period was conducted between February 2013 and January 2014. 84 consecutive patients undergoing orthopedic surgeries on the lower limbs (arthroscopy, tibia shaft fracture fixation, and screws fixation in ankle fractures) were allotted. They were divided into two groups. Group A was operated under GA and Group B was operated under SA. Allotment of the patients to the above groups was done by first (and original) generator which randomizes each subject to a single treatment by using the method of randomly permuted blocks available online: Www.randomization.com. Ethical Committee Clearance Certificate obtained before starting the study. Ethical Committee Cleared Consent form was used for the patients.

Inclusion Criteria

1. Patients aged between 18 and 55 years were included,
2. Patients undergoing lower limb surgeries were included,
3. Patients with the American Society of Anesthesiologists – physical status I and II were included.

Group A was performed surgery under GA and Group B was performed under SA using bupivacaine.

Exclusion Criteria

1. Patients aged below 20 years and above 55 years were excluded,
2. Patients with prostate hyperplasia, genitor-urinary disease were excluded,
3. Patients with intraoperative blood loss of more than 200 ml were excluded,
4. Patients giving a history of alcohol abuse and narcotic abuses were excluded.

All patients were allowed to micturate before entering the operating theater. During the procedure, all the patients were transfused with 1000 ml of ringer's lactate. Portable ultrasonography was used to estimate the urine volume in the bladder before and after the surgery.

GA Method

Preanesthetic medication injection atropine 1 amp was given. Patients were induced by intravenous (IV) method using injection fentanyl 1 mg/kg, propofol 2 mg/kg and atracurium 0.5 mg/kg to induce muscle relaxation for 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, 1000 ml ringer lactate was given IV. Post-operative 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.

SA Method

Patient in the lateral or sitting position, the subarachnoid space was punctured with a 25 G spinal 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%. After 3 min, patients were returned to the supine position. During surgery wherever required ephedrine, midazolam, or both were administered IV. Urinary retention was diagnosed by ultrasonography; the POUR being defined as a bladder volume P500 ml together with the inability to micturate or post-residual volume >500 ml. The patients were catheterized when these criteria were met. All the data were analyzed by online http://www.socscistatistics.com as follows: Description of quantitative variables as mean ± standard deviation. Description of qualitative variables as number and percentage. The patients with POUR were expressed by percentage alone. Paired *t*-test was used to compare between urine volume before SA and before spontaneous micturition, and before spontaneous micturition and post-urination residual volume. $P < 0.05$ is considered significant.

RESULTS

A total of 84 patients who underwent lower limb orthopedic surgery in a tertiary teaching hospital were included in this study. In Group A (GA), there were 42 patients, and in Group B (SA), there were 42 patients. In Group A, there were 36 males and 6 females and in Group B 35 males and 7 females. The mean age in Group A was 33 ± 7.6 and in Group B it was 37 ± 8.2. The mean weight Group A was 76.4 ± 2.8 and in Group B it was 73 ± 4.1. The duration of surgery in Group A was 69 ± 6.8 min and in Group B it was 71 ± 2.6. In both, the groups IV fluids given was 1000 mL ringer lactate. In Group A, arthroscopy was done in 42.85% of the patients and in Group B 35.71%. In Group A, tibia shaft fracture fixation was done in 38.09% and in Group B 21.50%. In Group A, screws fixation in ankle fractures was done in 19.04% and in Group B 14.28%. Chi-square calculator

for 5 × 5 contingency table was used, and there were no statistically significant differences among two Groups A and B related to age, sex, weight, and duration of surgery. The Chi-square statistic was 0.3883 and the $P = 0.983$ (Table 1).

The volume of urine in the bladder was measured using ultrasonography at the time before surgery (Group A: 31 ± 6.3, Group B: 30 ± 5.5), before micturition (Group A: 598 ± 4.8, Group B: 503 ± 3.4) and the residual volume (Group A: 119 ± 2.2, Group B: 128 ± 3.6) and found that there were no statistically significant differences among two groups A and B related to urine volume before operation, before micturition and residual volume. The Chi-square statistic was 0.087, and the *P* value was 0.957 (*P* significant at 0.05) (Table 2). Patients presenting with POUR were 11.90% in Group A and 30.95% in Group B (Table 2).

The time lapse between the spinal or GA till micturition was observed in both groups and found that in Group A it was 176 ± 3.8 min and in Group B it was 414 ± 7.4 min. The results were statistically significant between the two groups with *P* value at 0.0482 ($P < 0.05$) (Table 3).

Table 1: The gender, weight, duration of surgery and types of surgeries undertaken in the study Groups A and B (*n*=84)

Observation	Group A (GA)-42	Group B (GA)-42
Males	36	35
Females	6	7
Age	33±7.6	37±8.2
Weight	76.4±2.8	73±4.1
Duration of surgery	69±6.8	71±2.6
Fluids given intra-operatively	1000 ml	1000 ml
Arthroscopy	18-(42.85%)	15-(35.71%)
Tibia shaft fracture fixation	16-(38.09%)	21-(50%)
Screws fixation in ankle fractures	08-(19.04%)	06-(14.28%)

Data of age, gender, body weight and duration of surgery were presented as mean±SD, *P* value was 0.983 with *P* significant at 0.05. GA: General anesthesia, SA: Spinal anesthesia, SD: Standard deviation

Table 2: The volume of urine at different point of times in both the Groups A and B (*n* = 84)

Observation-volume of urine on U/S examination	Group A (GA)-42 in mL	Group B (SA)-42 in mL
Before operation	31±6.3	30±5.5
Before micturition	598±4.8	503±3.4
Post-operative residual volume	119±2.2	128±3.6
Patients with POUR%	5-(11.90%)	13-(30.95%)

Means compared statistically showing significant difference at $P<0.05$; results for urine volume before operation, before micturition and residual volume were presented as mean±SD. GA: General anesthesia, SA: Spinal anesthesia, SD: Standard deviation, POUR: Post-operative urinary retention

Table 3: The time lapse between anesthesia and micturition in Groups A and B (*n*=42)

Observation	Group A (GA)-42	Group B (SA)-42
Total time lapse from the starting of anesthesia till micturition (min)	176±3.8	414±7.4

Means compared statistically showing significant difference at $P<0.05$; results for urine volume before operation, before micturition and residual volume were presented as mean±SD. GA: General anesthesia, SA: Spinal anesthesia, SD: Standard deviation

DISCUSSION

This study is a prospective clinical analysis of incidence and burden of POUR in two groups of patients undergoing surgeries on the lower limb in a tertiary teaching Hospital at Kannur, Kerala. The incidence of POUR is common among lower abdominal and lower limb surgeries either performed under GA or SA. The urinary volume in patients with POUR before voiding among the GA (Group A) patients was 598 ± 4.8 ml and 503 ± 3.4 ml in Group B. The results were comparable to the similar study by Breebaart *et al.*[8] Post-operative residual urine volume in this study was 119 ± 2.2 ml in Group A and 128 ± 3.6 in Group B; comparable with Kreutziger *et al.*[9] In this study, the post-operative voiding residual volume in Group A patients was less than that in patients of Group B. Contrary to this the study conducted by Chu *et al.*[10] showed higher residual urine volume in patients undergoing surgeries under GA than under SA. Most probably this difference may be due to the difference in neuroaxial techniques used. The incidence of POUR in Group A was 11.90% and in Group B 30.95%; lower in GA group and higher in SA group. This was contradicted in the study by Lingaraj *et al.*[7] Who found the percentage of POUR 5.3% in GA group, 0% in SA group. The results of Kotwal *et al.*[11] showed POUR in 38% of patients receiving SA and 22% of patients receiving GA. 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 mean age of Group A was 33 ± 7.6 and in Group B it was 37 ± 8.2. Total time lapse from the starting of anesthesia till micturition was 414 ± 7.4 min following administration of SA. In a similar study by Gupta *et al.*,[12] it was 501 ± 59 min (higher), which may be due to the usage of 6.0 mg bupivacaine plus 25 mg fentanyl causing urine retention increase by 15%. In the study by Kreutziger *et al.* micturition since spinal (hyperbaric prilocaine) anesthesia was (276 ± 59 min); in this study, it was 414 ± 7.4 ml. The incidence of POUR may depend on the type of anesthesia, anesthetic technique used and the anesthetic drugs used. The bladed walls are constituted by detrusor muscle, and two sphincters. It has a capacity of 400-600 ml. 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 the autonomic regulation of detrusor tone. *In vitro* studies have shown that clinical doses of halothane and thiopentone decrease bladder response to stimulation.[13] Volatile anesthetics and sedative-hypnotics inhibit the pontine micturition center and voluntary cortical control of the bladder, suppressing detrusor contraction, and the micturition reflex.[5] Other drugs given with GA may produce POUR; anticholinergic agents like atropine used for premedication or reversal of neuromuscular blockade may impair detrusor contractility and facilitate passively overfilling the bladder; atropine acts at cholinergic receptor sites in the smooth muscle of the bladder and urethra.[14] POUR can be caused by prolonged duration of surgeries.[15,16] Administration of fluids during such prolonged procedures would also play a role in the urine volume. Pavlin *et al*.,[15] *in their study*, found a significant correlation between bladder volume and the duration of surgery but no relationship between the bladder volume and the total amount of fluids administered.[15] While Peterson[17] did not find any correlation between the duration of surgery and the risk of POUR. The bladder analgesia is due to the blocking transmission of the afferent nerve fibers from the bladder to micturition center in the brain.[14] After 30-60 s of spinal anesthetic injection, the sensation of urgency to void disappears, 2-5 min the detrusor contraction is completely abolished and its recovery depends on the duration of the 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.[14] With the use of longer-acting local anesthetics, the duration of detrusor blockade allows the bladder volume to significantly exceed pre-operative bladder capacity.[18] The patients experience increased rates of POUR when intrathecal local anesthetics are administered with opioids, and the addition of fentanyl to SA and the choice of spinal over epidural anesthesia were found to significantly increase time to discharge ambulatory surgical patients.[19]

CONCLUSION

POUR is common after spinal than GA in patients undergoing lower limb surgeries. Post-operative bladder volume could be measured by transabdominal ultrasonography as it is a reliable, noninvasive, inexpensive, and simple method.

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How to cite this article: Valsalan, Chandran PS. Comparative Study of Urinary Retention in Lower Limb Surgeries between General and Spinal Anesthesia. Int J Sci Stud 2017;5(1):134-137.

Source of Support: Nil, **Conflict of Interest:** None declared.