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# An Observational Study Of Urinary Problems In Paediatric Orthopaedic Patients In Lower Limb Procedures Under Central Neuraxial Blockade- A Prospective Analysis

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**Abstract**

Post operative complications following anaesthesia and surgery are generally anticipated but with the advent of improvised surgical approaches, drugs and techniques adopted in providing anaesthesia, early recovery after surgery is in vogue. Urinary retention is common after anesthesia and surgery, reported incidence of between 5% and 70% respectively.[1] Comorbidities, type of surgery, and type of anesthesia influence the development of postoperative urinary retention (POUR).[1] Single-center studies have reported the incidence of urinary retention at 29% among children undergoing lower extremity surgery and 46% among young patients who underwent posterior spinal fusion.[2] Ultrasound has been shown to provide an accurate assessment of urinary bladder volume and a guide to the management urinary retention or delayed voiding. With an increase in outpatient and fast-track surgical procedures, per urethral catheterization is restricted to fewer procedures and for a limited time. Identification of patients at risk of developing postoperative delayed voiding helps in avoiding unwanted catheterization and bladder emptying at the right time to overcome retention and distention issues. POUR has been defined as the inability to void in the presence of a full bladder. Three methods have been used to diagnose POUR: history and physical examination, the need for bladder catheterization, and more recently, ultrasonographic assessment [1]. We conduct the study to analyze factors for delayed voiding in paediatric patients undergoing orthopedic surgeries involving the hip and the knee joints under general anaesthesia along with central neuraxial analgesic techniques like single shot and continuous epidural analgesia. The association between urinary retention or delayed bladder voiding following central neuraxial analgesia to be assessed.

**Keywords**: post operative delayed voiding, bladder ultrasound, paediatric anesthesia, central neuraxial analgesia in paediatric

## Introduction

Post operative urinary complication like retention or delayed voiding are common due to various surgical and anaesthetic factors. Post operative urinary retention (POUR) has been defined as the inability to void in the presence of a full bladder [1]. The overall incidence of postoperative urinary retention was 0.38%. According to Belthur et al[2], children with complex chronic neuromuscular conditions (OR 11.54 (95% CI 9.60–13.88), p = < 0.001) and complex chronic non-neuromuscular medical conditions (OR 5.07 (95% CI 4.11– 6.25), p ≤ 0.001) had a substantially increased incidence of urinary retention. Surgeries on the spine (OR 3.98 (95% CI 3.28–4.82, p ≤ 0.001) and femur/hip (OR 3.63 (95% CI 3.03–4.36), p ≤ 0.001) were also associated with an increased incidence[2].

Brenn et al[3]. found a 70% incidence of post operative urinary retention (POUR) among pediatric cerebral palsy patients after use of epidural analgesia, and it seems likely to be a risk factor for urinary retention after orthopedic procedures[3]. The presence of chronic medical conditions has also been documented in the literature as associated with post operative urinary retention (POUR) in adults, particularly renal failure and diabetes mellitus with diabetic complications.[4]

Lior et al[5] in 2022 conducted a single-center, retrospective observational study reviewing the post-operative course of children after orthopedic surgery of the lower extremity with and without epidural analgesia regarding their urinary catheter management. The data retrieved for the study included all surgical pediatric (< 18 years) patients admitted to the pediatric orthopedics department following hip or lower extremity surgeries between January 2019 and December 2021. Based on these findings, they hypothesized that it is justifiable to routinely place a urinary catheter intra-operatively in children who undergo hip or lower extremity surgery and are treated with epidural analgesia, and caution is advised for early urinary catheter removal in orthopedic children with neuromuscular diseases or other comorbidities.

Three methods have been used to diagnose POUR: history and physical examination, the need for bladder catheterization, and, more recently, ultrasonographic assessment. The clinical Examination involves complains of pain and discomfort in the lower part of the abdomen which are used as conventional indicators of urinary retention. Then assessment by palpation and percussion in the suprapubic area is another method for diagnosis of urinary retention or delayed voiding. The studies were found to show that clinical evaluation has been found to overestimate the bladder volume compared to ultrasound evaluation. Pavlin et al [6] showed that 61% of day-case surgical patients admitted to the post anesthesia care unit after general anesthesia did not report any symptoms of bladder distension, despite a bladder volume greater than 600 ml as measured by ultrasonography.

In contrast to the study by Lior et al[5], our present study is about the association of post operative delayed urinary voiding in paediatric orthopedic patients posted for hip and knee surgeries under general anaesthesia with central neuraxial blockade viz single shot caudal and single shot epidural anaesthesia. This is a single center Prospective observational study. The objectives of the study included 1) the patient related factors like age and comorbidities 2) the procedure related factors causing urinary retention 3) the duration of analgesia postoperatively and 4) need for bladder catheterization when the voiding occurs 8 hours post operatively.

## Material And Methods

The study was conducted as single center Prospective observational which included children from age group 5 to 18 years. The children under 5 years of age were excluded as it was difficult to assess the urine output due to varying bladder habits. The study was conducted from January 2023 to December 2023.

The children over the age of 5 years up to 18 years who undergo elective orthopedic surgeries involving the knee and the hip joint with central neuraxial block like single shot epidural and continuous epidural for analgesia were included in the study prospectively.

A written informed consent/assent will be sought from the parent and their children (above 10 years) for the study after approval from the Institutional Review Board (IRB) for the planned study.

A cohort of 60 children were taken into the study, in which about 30 children who underwent orthopedic (knee and hip) surgeries with general anaesthesia were given single shot lumbar epidural analgesia- 0.5ml/kg of 0.125% levobupivacaine along with tramadol 1mg



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/kg as an additive. The other 30 patients were given continuous lumbar epidural infusion analgesia- 0.2-0.3ml/kg/hour of 0.125% levobupivacaine without any additive using Smiths© Neo fuser Vario Multi Rate Elastomeric Pump. The pumps were auto infusing type once the flow is set and the drug flows continuously at set rate regulated by one-way valves. The volume of the pumps available were 100 ml and 200 ml with maximum flow up to 14 milliliter per hour.

After shifting the patient to the operating room and connecting the monitors according to the American Society of Anesthesiology (ASA), the general anaesthesia given was having standard intravenous induction agents like thiopentone and propofol along with inhalational agent isoflurane 1-2%. The initial analgesic coverage was given with injection fentanyl 2 micrograms per kilogram and the muscle relaxant used was atracurium with loading dose at 0.5 milligram per kilogram and maintenance dose at 0.1 milligram per kilogram. The airway was maintained using either supraglottic airway devices like Igel or intubated with micro cuffed or cuffed endotracheal tubes. Central neuraxial block was provided after general anaesthesia.

The parents were informed about the study before the planned surgery and all data were collected up to 12 hours postoperatively. The assessment is done as 0-4 hours,4-6hours, 6 to 8 hours and 8 to 12 hours post operatively. In case of delayed voiding of bladder post operatively as to more than 6 hours and ultra sound examination of the bladder was done (more than 8 hours post operatively). Sherburne et al[7] in 2007, showed that Postsurgical urinary retention, typically defined as the inability to void spontaneously more than 8 hours after return to the postsurgical unit, is a well-documented postoperative risk, although the incidence in children is not well known. The bladder volume was calculated ([age in years + 2] × [30 ml] to a maximum of 450 ml), and then the estimated time to void (calculate bladder volume/ hourly intravenous rate) and time for first bladder scan were determined. If the child had not voided by the calculated time of 6 hours, a bladder scan was performed. The aim of the study was to reduce the need for bladder catheterization in paediatric population and thereby to reduce the incidence of urinary tract infections and unwanted bladder catheterization. So only patients who have not voided for 8 hours post operatively were planned to be emptied by straight catheters.

The prerequisites for the study, the population involved should not have any condition involving the bladder viz neurogenic bladder. The children were advised to void once prior to shifting inside operating theatre. The amount of intravenous fluid used during the intraoperative period was standardized using Holiday Segar's formula with minimal variation of 10ml – 15ml /kg boluses which were given according to changes in the hemodynamics. Loss of more than 10% total blood volume was replaced with 10 ml/kg of packed red blood cell volume promptly. Those patients requiring blood transfusion were excluded from the study. The surgeries taken into consideration were less than 2 hours. All the patients who underwent surgery under the study were discharged within 72 hours post operatively.

**Statistical Analysis:**

Data was entered in MS excel and analyzed using SPSS software version 23. Descriptive data is represented as frequencies; test of significance used was Chi square test. Level of significance was taken at P value <0.05.

**Results**

A total of 60 patients were fulfilling the criteria during the study period from January 2023 to December 2023. The mean age group was 9.45±3.33. The majority of the study participants in belonged to the age group 5 to 8 years (43.3%) of age group followed by 9 to 12 years (22%), 13 to 16 years (16.7%) and >16 years (3.3%). Table 1 and figure 1

**Table 1: Distribution of study participants according to Age**

| Age Group | Frequency | Percentage |
|---|---|---|
| **5-8years** | 26 | 43.3% |
| **9-12years** | 22 | 36.7% |



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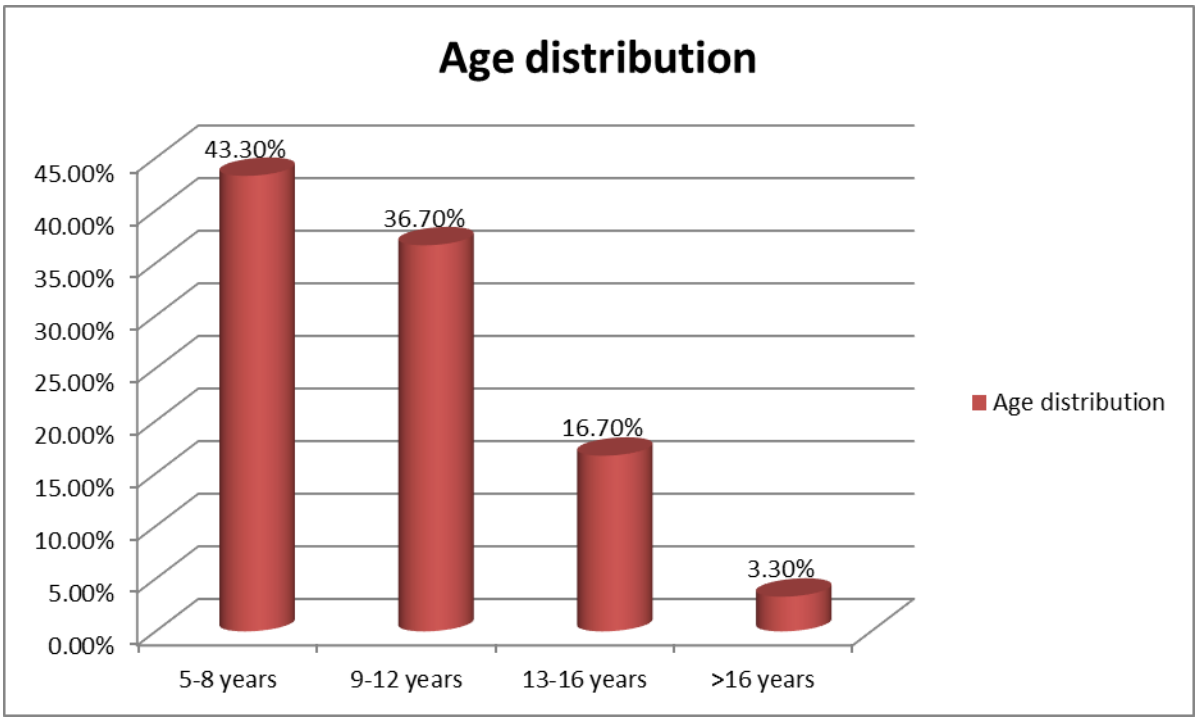
| | | |
|---|---|---|
| **13-16years** | 10 | 16.7% |
| **>16years** | 2 | 3.3% |
| **Total** | 60 | 100% |

**Figure 1: Bar diagram showing distribution of study participants according to age**




Majority of the study participants were males i.e., 51.7% and 48.3% of the study participants were females. Table 2 and figure 2

**Table 2: Gender distribution:**

| Gender | Frequency | Percentage |
|---|---|---|
| **Male** | **31** | **51.7%** |
| **Female** | **29** | **48.3%** |



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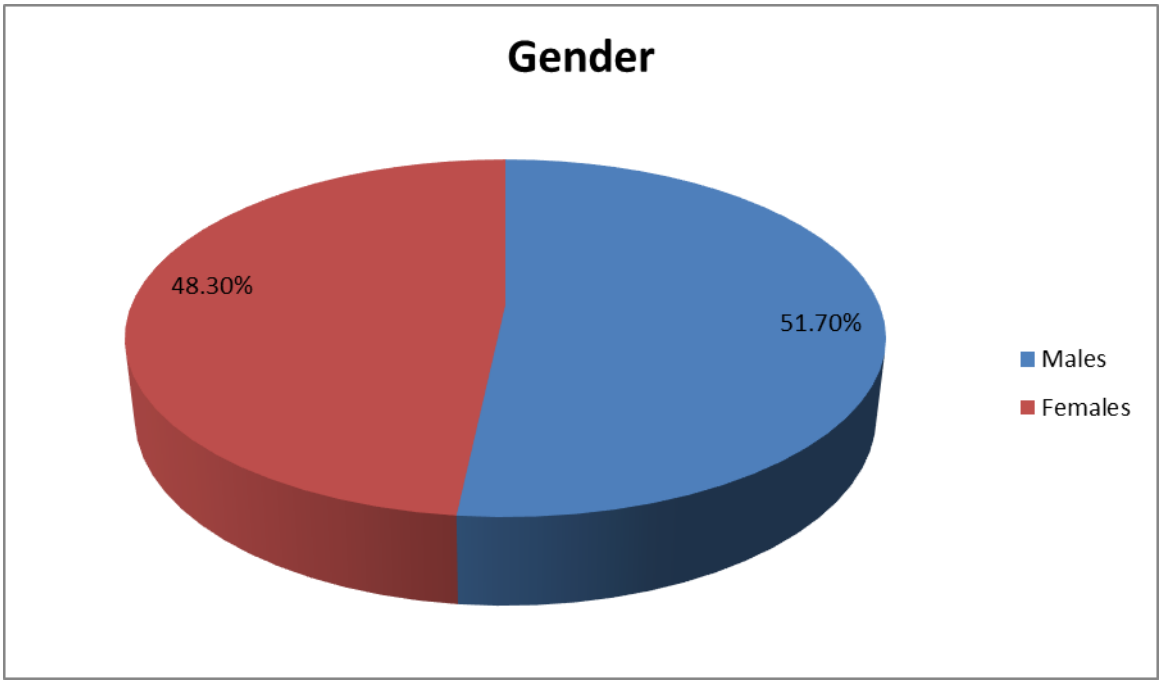
**Figure 2: Pie diagram showing distribution of study participants according to gender**




Different risk factors compared with post operative delayed voiding. About 41.9% of the males and 44.8% of the females had delayed voiding but no statistical significance(p=0.821) was observed. When site of surgery was compared with the delayed voiding 53.65% of the study participants with hip surgeries had post operative delayed voiding while only 21.05% of them with knee surgeries had post operative delayed voiding which was statistically significant(p=0.01). About 71% of the study participant having, Global Developmental Delay (GDD) with Cerebral Palsy (CP) shown to have post operative delayed voiding significantly (p=0.0001) when compared to other comorbidities like AMC (Arthrogryposis Multiplex Congenita), Ewing sarcoma. About 71% of the study participants who has given single shot epidural analgesia had post operative delayed voiding with statistical significance(p=0.03). There is significant association between site of surgery, comorbidities, type of analgesia and post operative delayed voiding of bladder. Table 3 and figure 3

**Table 3 Comparison of risk factor and post operative urinary retention**

| Risk factor | | Postoperative urinary retention | | |
|---|---|---|---|---|
| | | Present | Absent | Pearson Chi-square test |
| **Gender** | Males | 13 | 18 | $X^2$= 0.051 |
| | Females | 13 | 16 | P=0.821 |
| **Site of surgery** | Hip | 22 | 19 | $X^2$= 5.621 |
| | knee | 4 | 15 | P=0.01 |
| **Comorbidities** | AMC | 2 | 1 | $X^2$= 39.134 |



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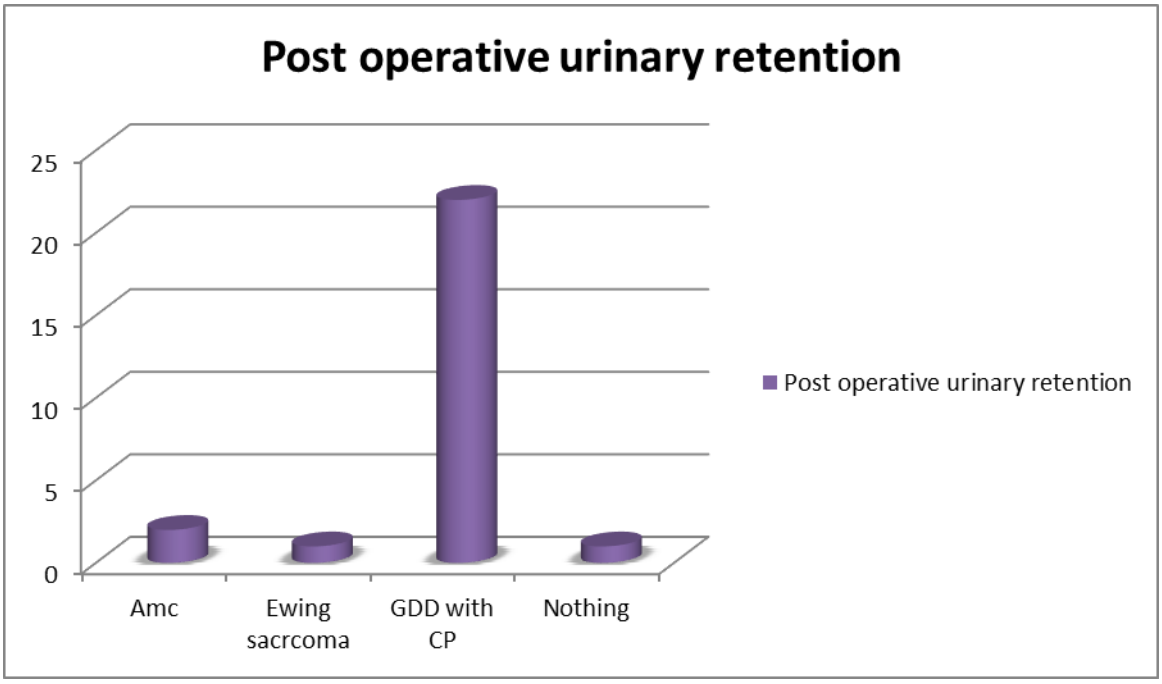
| | | | | |
|---|---|---|---|---|
| | Ewing sarcoma | 1 | 6 | P=0.0001 |
| | GDD with CP | 22 | 9 | |
| | Nothing | 1 | 24 | |
| **Anaesthesia** | Single shot epidural | 17 | 13 | $X^2$= 4.344 P=0.03 |
| | Continuous epidural | 9 | 21 | |

**Figure 3: Bar diagram showing comparison of comorbidities and post operative urinary retention mm**




Majority (43.3%) of the study participants had the post operative voiding time as 6 to 8 hours, followed by 4 to 6 hours (35%) and 0 to 4 hours (21.7%).

**Table 4: Bar diagram showing distribution of study participants according to post operative voiding time.**

| Post operative voiding time | Frequency | Percentage |
|---|---|---|
| **0 to 4 hours** | 13 | 21.7% |
| **4 to 6 hours** | 21 | 35% |
| **6 to 8 hours** | 26 | 43.3% |
| **Total** | 60 | 100% |



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**Figure 4: Bar diagram showing distribution of study participants according to post operative voiding time**

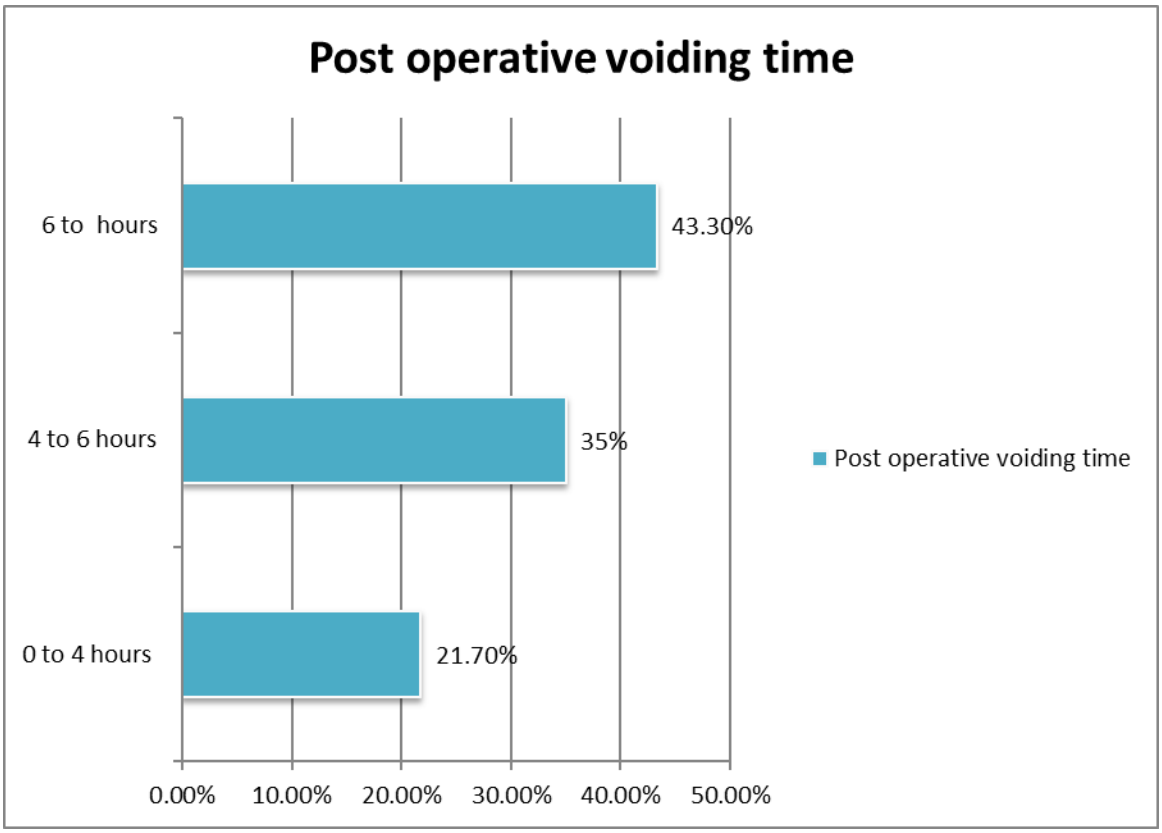


**Figure 5 Ultrasound examination of bladder volume**

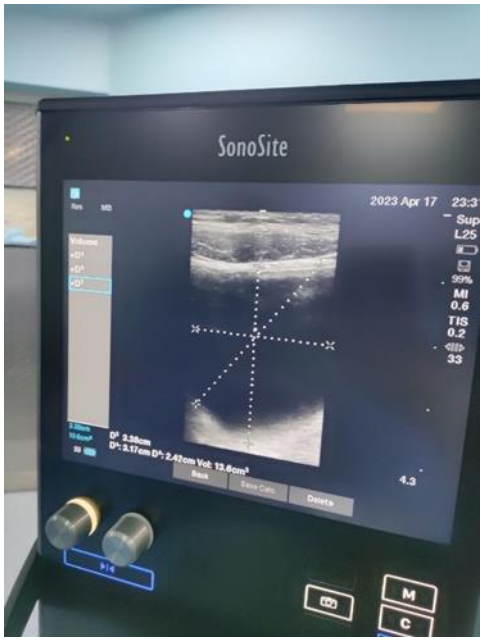




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**Figure 6 Elastomeric infusion pumps and epidural kits**


## Discussion

Epidural analgesia, an important tool in the management of acute postoperative pain in the paediatric population albeit, not devoid of complications, including post-operative urinary retention (POUR).[8] According to Brenn et al[3] , the incidence of POUR (post operative urinary retention) in children is reported between 17%2 and 70%.[3] Some authors have reported an increased incidence of urinary retention in toilet-trained children albeit not offering an explanation for their findings.[9] POUR was defined as the absence of spontaneous bladder emptying 12 h after the recorded surgical time.[9] Sherburne et al[7] described that post operative self-voiding time could be observed till 8 hours following the procedure. The bladder capacity was calculated according to the age of the child to give a rough estimate of bladder filling before significant signs like lowers abdominal pain and distention occurred. Hence, we conducted a study to assess delayed voiding and its causative factors to prevent further incidence. We also tried to rule out epidural analgesia as a cause for bladder retention needing urinary catheterization in this study as low analgesic dose of local anaesthetic was used.

Recommendations for urinary catheterization in the perioperative setting vary widely, influenced by many factors, including surgical factors, type of anesthesia, comorbidities, local policies, and personal preferences. Urinary tract infection related to bladder catheterization is a well-known postoperative complication in patients undergoing orthopedic surgery. No difference in urinary tract infections has been found when either an indwelling bladder catheterization for 24 h or intermittent catheterization techniques were used.[1] Hence the study was conducted to avoid the catheterization of bladder and the actual safe waiting time permissible in paediatric patients prior to catheterization. We also highlighted the influence of epidural analgesia whether single shot or continuous infusion on voiding time post operatively.

With the above discussed factors, we conducted a single center prospective observational study on kids from 5 to 18 years of age. These patients were chosen randomly who underwent surgeries involving the hip and the knee joint. The dose of the drug used in both groups were standardized according to the age and weight of the child. Thereby the bias which could occur due to dosing and concentration of the drug used were ruled out in view of urinary retention. The kids were made to void prior to shifting to preoperative area.

Smith's Neo fuser Vario Multi Rate Elastomeric Pump© (VL214) (2.0 - 14.0 milliliter/hour) 275 ml and Baxter's elastomeric Pumps© were used for continuous infusion of the drugs in the epidural space



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through the catheters (Figure 5). The catheters used were of 18G, 19G and 20G epidural kits which were chosen according to the age and the weight of the kids. The drug used was 0.125% of levobupivacaine without any additive and the pump was set at 0.2 to 0.3 ml/kg/hour. The catheter was threaded in a way such that the tip of the catheter was found at the level of dermatome involving the skin incision.

Similarly for single shot epidural analgesia the drugs used were 0.5ml/kg/hour of 0.125% levobupivacaine with tramadol 1mg/kg as an additive. Singh AP et al[10] conducted a study where epidurally both 1 mg/kg and 2 mg/kg tramadol as adjuvant to 0.2% ropivacaine were effective for postoperative analgesia in adult patients following upper abdominal surgery but epidural 2 mg/kg tramadol with 0.2% ropivacaine resulted in better quality and longer-duration of analgesia.

In both type of analgesia adopted the patients were found only analgesic coverage and no significant motor blockade. Though there was a slight delay in voiding in the group of patients who were given single shot epidural analgesia along with an extended duration of analgesia.

Pediatric regional anesthesia has emerged as a cornerstone in the multimodal approach to perioperative pain management in children[11,12]. Adjuvants serve as valuable adjuncts to local anesthetics in regional anesthesia techniques, prolonging analgesia duration and enhancing the quality of pain relief.[13] Nonopioid analgesics such as tramadol, ketamine, and magnesium sulfate offer alternative options for adjuvant therapy in pediatric regional anesthesia. Tramadol, a weak opioid agonist and serotonin–norepinephrine reuptake inhibitor, provides analgesia through multiple mechanisms, including mu opioid receptor activation and inhibition of neurotransmitter reuptake [14].

Intrathecal and epidural administration of micro-agonist opioids is associated with urinary retention, a potentially serious adverse-event. In animal studies tramadol has been found not to affect voiding function. Epidural tramadol increases the bladder capacity and compliance and delays filling-sensations, without ill effect on voiding. This seems true even for patients with obstructed outflow; however, due to small number of patients a definite conclusion cannot be derived. These results will guide clinician to avoid catheterization in cases where epidural tramadol is used for postoperative pain [15]. Pandita et al [16] suggested a possible diuretic effect of tramadol which could be blocked by desmopressin. We calculated urine production both before and after the injection of tramadol (urine production = voided volume + PVR-volume filled) and found no diuretic effect of the drug (65.9 ±62.5 ml before injection and 39.4 ± 33.7 ml after the injection; P = 0.159). Hence ideally tramadol used as an additive unlike other opioid was found to not cause any significant urinary retention and is an ideal drug chosen to prolong the analgesic effect of single shot epidural administration. Though few articles suggest nausea and vomiting as a side effect it was not observed in any of the patients included in this study probably due to the use of drugs like ondansetron, dexamethasone and propofol used during anaesthesia which has antiemetic effect. Effective analgesia was observed for approximately 12 hours post operatively without significant motor blockade due to the low concentration of local anaesthetic used. The use of ultrasound to assess the capacity of the bladder further helped in timely management (Figure 6).

The most common surgical locations that subsequently developed POUR (post operative urinary retention) is the spine, femur, and hip [2]. When site of surgery was compared with the urinary retention 53.65% of the study participants with hip surgeries had post operative urinary retention while only 21.05% of them with knee surgeries had post operative urinary retention which was statistically significant(p=0.01) in our study.

About 71% of the study participant having GDD (GLOBAL DEVELOPMENTAL DELAY) with CP (Cerebral palsy) shown to have post operative urinary retention significantly (p=0.0001) when compared to other comorbidities like AMC (Arthrogryposis Multiplex Congenita), Ewing sarcoma in our study. Patients with cerebral palsy comprised 24.8% of all POUR cases in the present study[2]. The patients with cerebral palsy represented one-fourth of all patients with POUR in the study, and the presence of neuromuscular conditions had the highest odds of developing POUR out of any risk factor [14]. Urinary tract dysfunction is common in cerebral palsy patients, with Brenn et al [3] finding a 70% incidence of POUR (post operative urinary retention) among pediatric



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cerebral palsy patients receiving epidural anesthesia [17–20].

Spine and femur or hip procedures in pediatric patients can require long durations of anesthetic and postoperatively be painful and require increased narcotic use [21,22]. Longer surgery time is known to increase complications, including POUR (post operative urinary retention) or delayed voiding, and is likely responsible for the increased rate with which patients who underwent spine and femur/hip operations in this study experienced POUR [23] (post operative urinary retention). Hence surgeries considered under the study were found to be less than 2 hours in duration.

Several anesthetic and non-anesthetic factors contribute to the development of POUR in the surgical patient. The diagnosis of post operative urinary retention is often arbitrary, and its true incidence is unknown due to lack of defining criteria. By carefully identifying patients at risk, adopting appropriate anesthetic techniques and perioperative care principles and accurately monitoring bladder volume by ultrasound, POUR may be prevented and the associated morbidity minimized [6].

The incidence of urinary retention in the postoperative period in a study was 0.38% in children ≤ 18 years of age [2]. The presence of complex chronic medical conditions, and in particular neuromuscular conditions including cerebral palsy and muscular dystrophy, is a strong risk factor for developing post operative urinary retention or delayed voiding in pediatric orthopedic surgery patients. Delayed voiding is associated with a significantly increased length of stay. The delayed voiding time was significant in patients who underwent hip surgeries compared to knee surgeries and it was more in patients who had comorbidities like cerebral palsy with global developmental delay and AMC (Arthrogryposis Multiplex Congenita). Hence to conclude, there was no significant post operative urinary retention for any patients in the study who required bladder catheterization though delayed voiding was noticed in some patients with above mentioned associated factors and almost all patients were discharged with 72 hours following the surgery.

## Conclusion

The study has shown a negligible association between low analgesic dose of epidural viz continuous or single shot epidural analgesia, and the occurrence of post operative retention of urine. There is no need for bladder catheterization. Better communication, anaesthetic plan and post operative monitoring would help in preventing

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