

**Research Article**

**A comparative study of caudal epidural anaesthesia versus general anaesthesia for lower abdominal and lower limb surgery in paediatric patients**

Himanshu Shah<sup>\*1</sup>, Jaishree S B<sup>2</sup>, Mrugank Bhavsar<sup>1</sup>, Prerna Attal<sup>1</sup>, Subir Ghosh<sup>1</sup>, Mansi Gandhi<sup>1</sup> and Varsha Sarvaiya<sup>3</sup>

<sup>1</sup>Associate Professor and Consultant Cardiac Anaesthetist, SBKS MI & RC, Waghodia, Baroda, India

<sup>2</sup>Assistant Professor, GCS MC, Ahmedabad, India

<sup>3</sup>Head of Department, VSGH, Ahmedabad, India

**\*Correspondence Info:**

Dr. Himanshu Shah

Associate Professor and Consultant Cardiac Anaesthetist,

SBKS MI & RC, Waghodia, Baroda, India

E-mail: [sh1311@yahoo.in](mailto:sh1311@yahoo.in)

**Abstract**

**Background:** Our aim is to compare caudal epidural versus general anaesthesia in paediatric patients and to check safety and efficacy of caudal epidural technique with providing better post-operative analgesia.

**Material and Methods:** 50 paediatric patients up to 12 years of ASA grade I and II posted for lower abdominal and lower limb surgery were randomly divided in to two groups. Group C (n=25) received caudal epidural anaesthesia using Lignocaine with adrenaline, Bupivacaine and Tramadol. Group G (n=25) received general anaesthesia with Thiopentone, Succinylscoline as induction agent and O<sub>2</sub>, N<sub>2</sub>O, Isoflurane and incremental doses of Atracurium as maintenance. They were extubated in a usual manner after surgery.

**Observation and Results:** Consent rate was higher for caudal block. Onset of caudal block achieved in average 6.6 minutes with higher success rate. Surgeon's acceptance was good in group C. Cost was very less in group C as well. Time for pre-operative preparation was less in Group G. Hemodynamic variation and duration of rescue analgesia was significant in group G. Rate of post-operative complication was higher in group G.

**Conclusion:** Caudal epidural is quite inexpensive with excellent anaesthesia and satisfactory post operative analgesia with lesser complication rate.

**Keywords:** Caudal epidural, Tramadol, Lignocaine, Bupivacaine, General Anaesthesia

**1. Introduction**

Caudal epidural anaesthesia is a form of epidural block obtained by blocking spinal nerves in the epidural space in sacro-coccygeal region as they emerge from dura and pass in to the inter-vertebral foramina causing segmental block .

Caudal anaesthesia may be used as the sole anaesthetic technique when general anaesthesia represents a risk or it may be used in association with light general anaesthesia to decrease intra- operative reflexes and above all, to relieve post-operative pain.<sup>1</sup>

Caudal anaesthesia can be given as single injection or continuous infusion. But in pediatric patients, as volume of sacral canal is small, catheter insertion for continuous technique can lead to trauma. Unpredictable catheter placement inside the epidural space also raises doubt about the level of anaesthesia achieved .

Onset of caudal anaesthesia is gradual. It first noted on the buttocks around the sacral hiatus. Loss of sensation proceeds over buttocks and up the sacrum within 5 minutes. First pain was to be lost followed by touch and temperature. Level of analgesia was governed by 1. Quantity of solution 2. Speed of injection 3. Gravity 4. Age and height of the patient. Analgesia is two segments higher than the level of muscular relaxation. Motor fibers are affected last. Muscular relaxation is less as compared with intrathecal anaesthesia. Effect of block is reached in 20 minutes to its maximum.

Combination of Lignocaine and Bupivacaine has been used for quicker onset, longer duration of block and to decrease toxicity of each. Plasma concentrations of Bupivacaine and Lignocaine after caudal injection as a mixture of the local anesthetics is well studied in children.<sup>2</sup>

Tramadol has a low affinity for opioid receptors and exerts its effect by direct modulation of central monoaminergic pathways. Tramadol is well tolerated and an effective analgesic after operation, with adverse effects similar to those of other opioids.<sup>3</sup> Because of its negligible effect on respiration,<sup>4</sup> it may offer an advantage over traditional opioids for relief of post-operative pain in day-case surgery. Tramadol is also quite effective through caudal route in paediatric patients.<sup>5</sup>

The paediatric population is very dynamic group of patients. Difficult intubation, small trachea, limited respiratory reserve, easy fatigability of diaphragm, heart rate dependent cardiac output, high parasympathetic activity, immature hepatic metabolism, poorly formed blood brain barrier, different psychology from adults make paediatric age group more specialized as per anaesthesia is concerned. Due to greater volume of extracellular fluid, smaller body fat and muscle mass, response to drugs is altered in neonates and children. Since the physiologic processes that determine drug disposition undergo rapid changes as children grow and mature. Therefore the use of pharmacologic agents in paediatric patients warrants special consideration. Most common side effects or complications post general anaesthesia are mainly post operative nausea and vomiting, oral trauma, cardiorespiratory complication, thermoregulation issues, over sedation etc.

Phases of general anaesthesia include pre-anaesthetic preparation, induction, maintenance and reversal. In induction Thiopetone is the preferred drug of choice. Induction can be done by using volatile inhalational anaesthetics such as Sevoflurane. All of the volatile inhalational agents depress ventilation. They also commonly induce apnoea and hypoxia in premature infants and newborns; thus, these anaesthetics are cautiously used in paediatric anaesthesia practice. N<sub>2</sub>O is a potent inhalational analgesic agent used routinely for paediatric anaesthesia. The neuromuscular blocking agents are used primarily for muscle relaxation during general anaesthesia. Succinylscoline is a depolarizing agent with rapid onset and shorter duration of action, mainly used as intubating agent. Atracurium is a non-depolarizing muscle relaxant which is widely accepted in paediatric anaesthesia as a maintenance agent.

Post operative analgesia was given as rectal suppository of Paracetamol or with Inj. Tramadol or Inj. Paracetamol.

## 2. Methods

This study has been carried out at VSGH, Ahmedabad with approval and informed written consent from the parents' of the patients.

### 2.1 Inclusion criteria

1. Age less than 12 years.
2. Patients posted for lower abdominal and lower limb surgery.
3. Patients under ASA grade I and II as per pre-anaesthetic evaluation done for all the patients before the day of surgery.

### 2.2 Exclusion criteria

1. Emergency surgery
2. ASA III & IV
3. Known hypersensitivity to any drug under study
4. Known history of active renal, hepatic, respiratory or cardiac disease.
5. History of stroke, seizures, neurological or neuromuscular disorders.
6. History of chronic pain and routine analgesic drug use.
7. Infection at the site of block and infected pilonidal sinus.
8. Sacral abnormality and child with congenital abnormality.
9. Probable duration of surgery exceeding 180 minutes.

### 2.3 Caudal Anaesthesia Technique

Caudal anaesthesia requires identification of the sacral hiatus. The sacrococcygeal ligament ( an extension of ligamentum flavum ) overlying the sacral hiatus lies between the sacral cornu. To facilitate locating the cornu, the posterior superior iliac spines should be located and by using the line between them as one side of an equilateral triangle, the location of the sacral hiatus approximated. Once the sacral hiatus is identified, the index and middle finger of the palpating hand are placed on the sacral cornu and the caudal needle is inserted at an angle of approximately 45 degrees to the sacrum. While advancing the needle, a decrease in resistance to needle insertion should be appreciated as the needle enters the caudal canal. The needle is advanced until bone ( the dorsal aspect of the ventral plate of the sacrum) is contacted, and then slightly withdrawn and the needle redirected so that the angle of insertion relative to the skin surface is decreased. In males this angle is almost parallel to the coronal plane, in females slightly steeper angle (15 degree) is necessary. During redirection of the needle, the needle is advanced approximately 1 to 2 cm in to the caudal canal. Further advance is not attempted because of risk of dural puncture and unintentional intravascular cannulation become more likely. One method of increasing the likelihood of correct caudal needle placement is to inject 5 ml of saline rapidly through the caudal needle while palpating the skin overlying the sacrum. If no midline 'bulge' is detected, the needle is probably correctly positioned.

Amount of the solution injected in to caudal space as per following formula:

1. Lumbosacral region block - 0.5 ml /kg
2. Thoracolumbar region block – 1 ml /kg

Drug concentration was used under following formula:

- Inj. Lignocaine with Adrenalline 7 mg/kg  
 Inj. Bupivacaine 2 mg/kg  
 Inj. Tramadol 1 mg/kg.

Onset of action checked by skin analgesia, tested with needle. Disappearance of anal tone (S4-S5), ankle jerk (S1-S2), Knee jerk (L2-L4) and tone of abdominal muscles (T8-L1) was noted in group C. If caudal anaesthesia found inadequate, it was supplemented with Inj. Ketamine 2 mg/kg or by general anaesthesia with endotracheal intubation. After completion of surgery, complain of pain or crying (if patient was too young) was considered as a sign of having pain.

### 2.4 General Anaesthesia Technique

All the patients were pre-medicated with Inj. Glycopyrrolate 4 µg/kg, Inj. Ondansetron 0.1 mg/kg. They were pre-oxygenated with 100% O<sub>2</sub> for 3 minutes. All the patients were induced with Inj. Thiopentone 5 mg/kg, Inj. Succinylcholine 2 mg/kg. They were intubated with appropriate size tube. Tube fixed after confirming bilateral air entry. All the patients were maintained with O<sub>2</sub>, N<sub>2</sub>O and Isoflurane in varying concentration along with Inj. Atracurium 0.5 mg/kg bolus dose followed by 0.1 mg/kg incremental dose as per the Train of Four (TOF) response. Inj. Paracetamol 15mg/kg iv. given as an additional analgesic during surgery. At the end of surgery, patients were reversed after complete neuromuscular blockade recovery with Inj. Neostigmine 0.05 mg/kg and Inj. Glycopyrrolate 8µg/kg.

All the patients of both the groups were compared in terms of hemodynamic stability, patients' as well as surgeon's acceptance, time required to prepare patient, complications rate, duration of anaesthesia and need of rescue analgesia and mean VAS score in postoperative period.

### 2.5 Statistical Analysis

All data were analyzed statically using T- test and a value of P<0.05 was considered significant. The data's were presented as Mean ± SD and percentage.

## 3. Results

Total of 50 patients were recruited for the study. There were no significant differences between the two groups in demographic data and duration of surgery (Table 1).

**Table 1: Demographic Profile**

Parameters	Group C (n=25)	Group G (n=25)	P Value	
Mean Age (years)	6.6 ± 1.9	7.1 ± 1.2	p>0.05	NS
Sex (m/f)	14/11	13/12		
Duration of surgery (min)	128.6 ± 17.2 (70-204)	131.3 ± 13.4 (70-204)	p>0.05	NS

NS – Non Significant ; S- Significant

**Table 2: Comparison of surgeon’s satisfaction in both the groups**

Surgeon’s Satisfaction	Group C (N=25)	Group G (N=25)
Yes	24 (96%)	23 (92%)
No	1 (4%)	2 (8%)

In Group C , one patient had delayed onset of action of the block , which had to be supplemented by Inj. ketamine 2 mg /kg iv up to effect achieved . In Group G , two patients had delayed recovery with no other abnormal outcome.

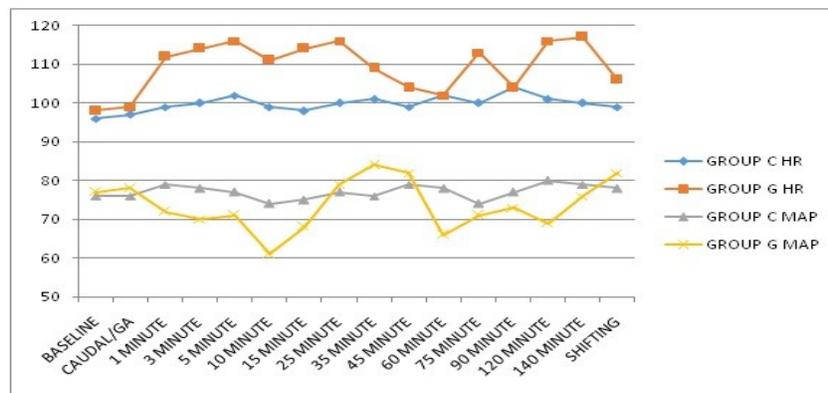
**Table 3: Comparison of mean time for pre-operative preparation in both the groups**

	Group C	Group G	P Value
TIME FOR PRE-OPERATIVE PREPARATION (min)	13.6 ± 3.7	8.4 ± 4.9	P<0.05

Time of pre-operative preparation is considered as the time since the start of procedure till the patient was handed over to surgeon. Average time taken in Group C patient for effect of block to be achieved was 6.6 minutes .

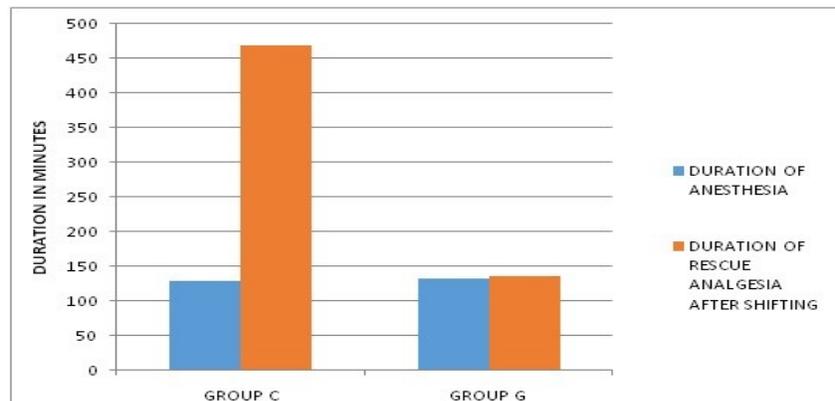
We have observed better acceptance by patients’ relatives for caudal procedure as compared to general anesthesia procedure when we have explained both the procedures pre-operatively. As fear of not waking up after surgery was the most common concern in most of the patients’ relatives.

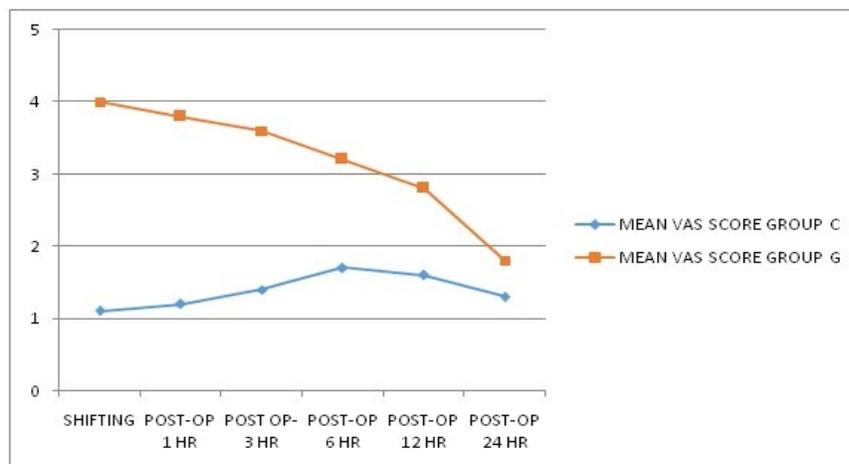
**Figure 1: Change in heart rate and mean arterial pressure in both the groups**



SpO<sub>2</sub> remained stable throughout the surgery in both the groups. In one patient of Group G, patient had developed low saturation associated with wheezing (92-94%) while extubation because of discomfort of endotracheal tube and patient was in lighter plane of anesthesia.

**Figure 2: Duration of anaesthesia and duration of rescue analgesia**



**Figure 3: Mean vas score in post-operative period in both the groups****Table 4: Complication related with caudal anaesthesia technique**

Complications	Group C (n=25)
Dural puncture	0
Failed technique	0
Hypotension	1 (4%)
Convulsion associated with Local Anaesthetic Agent	0
Urinary retention	2 (8%)
Neurological complications	0

**Table 5: Complication related with general anaesthesia technique**

Complications	Group G (n=25)
Gastric inflation	6 (24%)
Laceration of oral cavity	1 (4%)
Perioperative hypotension	2 (8%)
Post-operative nausea and vomiting	7 (28%)
Hoarseness of voice	1 (4%)
Delayed recovery	2 (8%)
Post-operative irritability	2 (8%)
Urinary retention	1 (4%)

#### 4. Discussion

Caudal anaesthesia versus general anaesthesia was not studied much previously. We have compared acceptance of either techniques by the parents in pre-operative period. All the patients' parents preferred to go for caudal anaesthesia as the patient remains awake throughout the surgery.

In children, caudal space contains fat which is loosely packed gelatinous material. So less resistance to spread of solution. Premila Bajaj<sup>8</sup> also found caudal epidural more appropriate for children due to easily palpable sacral hiatus and more predictable spread of local anaesthetics due to loosely packed fat. So we have selected children as our study subjects.

Mcgowan *et al*<sup>9</sup> noted four deaths after caudal epidural anaesthesia in ASA III patients posted for upper abdominal

surgery. So he suggested that this group was unsuitable for caudal block. So we have also included only ASA I and II patients in our study.

We have given Ketamine in a patients who were unco-operative initially. In this patients, success of caudal block can be observed only after effect of Ketamine wears off. Similar findings observed in previous study as well.

Schulte-Steinberg and Rahlf *et al*<sup>10</sup> used age as a main parameter to calculate volume required for caudal block. They later mentioned that chronological age is misleading. Weight should be used as the predictor for volume calculation so we have used the same in our study.

Surgeons' satisfaction was comparable in both the groups. As both the techniques have their own advantages and disadvantages. So for surgeons' both are good, but delayed recovery from neuromuscular blockade was sometimes considered as the prime issue especially in paediatric age group where prolonged ventilation may lead to respiratory complications. In our study, Group C patient provided comparable operating condition to the surgeon. One patient moved initially because of delayed onset, which was matter of concern for anesthesiologist and surgeon.

Time taken for preoperative preparedness was significantly less in Group G than Group C.

Eyere *et al*<sup>11</sup> mentioned that maximum safe dose of Bupivacaine is 2 mg/kg. If this exceeds then toxic effects can be seen. In this study, combination of Lignocaine with adrenaline and Bupivacaine was used. As lignocaine causes early onset while Bupivacaine provides sustain analgesia for longer duration. In this study concentration of local anaesthetics used was very less than maximum safe dose. For this reason, we have used normal saline for desired volume.

In our study, we have observed tachycardia and blood pressure fluctuation more in Group G than Group C patients, because central neuraxial blockade in group C was associated with complete stress response suppression. Same results have been obtained by Sendasgupta *et al*<sup>12</sup>. In this study, Isoflurane was used as inhalation agent in Group G, inhalational anaesthetics such as Isoflurane causes reduction in systemic vascular resistance (SVR) and so reduces blood pressure and causes tachycardia. So change in heart rate and mean arterial pressure just after induction was significant in group G while it remained stable in group C. (Miller's Anesthesia) Uguralp *et al*<sup>13</sup> demonstrated better hemodynamic stability with caudal block in comparison with general anaesthesia.

Tramadol is a centrally acting analgesic agent with two distinct mechanisms of action. It binds opioid receptors weakly and inhibits the reuptake of norepinephrine and serotonin in the spinal cord. When administered epidurally, tramadol has been demonstrated to provide adequate postoperative analgesia after major abdominal surgery and caesarean section. As epidurally administered opioids exert their analgesic effects via systemic absorption and diffusion into the spinal cord, it is likely that the observed analgesic effect of epidural tramadol may also be due to systemic uptake of tramadol from the epidural space and consequent achievement of therapeutic plasma concentrations of the drug. This justifies duration of rescue analgesia was significantly higher in group C as compare to group G.<sup>14,15</sup>

Pain is thought to be inadequately treated in one half of all surgical procedures. Preemptive analgesia is initiating an analgesic regimen before the onset of the noxious stimulus to prevent central sensitization and limit the subsequent pain experience.

We have also compared mean VAS score in post-operative period in both the groups in our study. Mean VAS was significantly lower in Group C as compared to group G in immediate post-operative period. It remained persistently lower side in group C. Sajjan *et al*<sup>16</sup> have observed similar results in their study as well. Possible reason is sustained prolonged analgesia via caudal route.

In our study, we have compared rate of complications in both the groups. Though both the techniques have their own advantages and disadvantages, overall rate of complication was significantly lower in Group C as compared to Group G. Craven *et al*<sup>17</sup> also demonstrated that regional anaesthesia is associated with lesser magnitude of side effect profiles as compared to general anaesthesia in children undergoing for inguinal hernia repair.

Gupta *et al*<sup>18</sup> mentioned that vomiting and urinary retention were common in caudal group. We have observed urinary retention in our study as well.

Cost was significantly less in group C as compared to group G. Robert Spear in his study mentioned that caudal epidural is a safe and inexpensive alternative to general anaesthesia with eliminating substantial risk.<sup>19</sup>

## 5. Conclusion

Caudal anaesthesia is an inexpensive, simple, and effective technique not only as a single method of anaesthesia but also for post operative analgesia.

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