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Original Research Article

ASSESSING THE ROLE OF REGIONAL ANALGESIA IN POSTOPERATIVE COMPLICATIONS FOLLOWING URETHROPLASTY FOR HYPOSPADIAS IN CHILDREN

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ABSTRACT

Background: Hypospadias is one of the most common congenital anomalies affecting the male external genitalia. Urethroplasty remains the definitive treatment; however, postoperative complications such as urethrocutaneous fistula (UCF), glans dehiscence (GD), and wound infection continue to present major clinical challenges. Regional analgesia techniques, particularly caudal and epidural blocks, are frequently used in pediatric urologic surgeries for perioperative pain management. Nevertheless, their influence on postoperative complications remains controversial. Aim:To evaluate the impact of central neuraxial regional analgesia (caudal/epidural block) on postoperative complications—specifically urethrocutaneous fistula and glans dehiscence in children undergoing primary urethroplasty for distal and mid-penile hypospadias.

Materials and Methods: This retrospective cohort study was conducted over a 10-year period at a tertiary-care teaching hospital in India. A total of 112 children younger than 12 years who underwent primary urethroplasty for distal or mid-penile hypospadias were included. Patients were categorized into regional analgesia and no regional block groups. Demographic data, anesthetic details, surgical techniques, and postoperative complications were analyzed. Statistical analysis was performed using Chi-square test, Fisher's exact test, and binary logistic regression were used for analysis, with $p < 0.05$ considered statistically significant.

Results: Among the 112 children included, 77 received regional analgesia while 35 underwent surgery without regional block. Postoperative complications occurred in 25.5% of children receiving regional analgesia and 18.4% of those without block; however, the difference was not statistically significant ($p = 0.38$). UCF occurred in 14.3% of the regional block group and 8.6% of the no-block group, while GD occurred in 9.1% and 5.7%, respectively. Tubed urethroplasty demonstrated the highest complication rate and was identified as an independent predictor of postoperative complications (OR 3.18, 95% CI 1.12–8.94, $p = 0.02$). Regional analgesia was not an independent predictor of complications (OR 1.42, 95% CI 0.54–3.71, $p = 0.46$).

Conclusion: Central neuraxial regional analgesia, including caudal and epidural blocks, did not significantly increase postoperative complications following primary urethroplasty in children. Surgical technique and severity of deformity appeared to have greater influence on postoperative outcomes than anesthetic technique. Regional analgesia may therefore continue to be safely used as part of multimodal perioperative pain management in pediatric hypospadias surgery.

Keywords: Hypospadias, urethroplasty, caudal analgesia, epidural analgesia, regional block, urethrocutaneous fistula, glans dehiscence, pediatric urology**.**

INTRODUCTION

Hypospadias is one of the most common congenital anomalies of the male urethra, occurring in approximately 1 in 250 live male births.[1] Surgical correction is typically performed during early childhood and includes several established techniques such as tubularized incised plate (TIP), meatal advancement and glanduloplasty (MAGPI), and variousforms of tube urethroplasty.Despite technical refinements,postoperativecomplications—including glans dehiscence (GD) and urethrocutaneous fistula (UCF)—continue to pose significant challenges.[6]

Children undergoing hypospadias repair experience substantial perioperative pain, necessitating multimodal analgesic strategies.[2] Central neuraxial blocks such as caudal and epidural anesthesia are widely used for both intraoperative and postoperative analgesia in pediatric lower abdominal and perineal surgeries.[3] Caudal block, in particular, has been a long-standing and reliable method of analgesia in pediatric urological procedures and remains the standard of care in many institutions.[3]

Despite its widespread use, concerns persist regarding a possible association between central neuraxial blocks and increased postoperative complications—especially urethroplasty-related issues such as UCF and GD. Several retrospective studies, systematic reviews, and meta-analyses have investigated whether caudal block increases penile edema or alters postoperative tissue perfusion, thereby contributing to adverse surgical outcomes.[4,5,7-9] However, the available evidence remains conflicting, with some studies reporting increased complication rates and others demonstrating no significant association.[4,5,7-9] Consequently, no clear consensus exists regarding whether regional analgesia should be avoided during hypospadias repair.

Given this ambiguity, our center which routinely employs caudal analgesia for distal and mid-penile hypospadias repair—undertook a comprehensive 10-year retrospective evaluation. The objective was to assess whether the use of regional analgesia (caudal or epidural) influences postoperative complication rates and to identify additional surgicalor patient-related factors that may predispose children to unfavorable outcomes following urethroplasty.

Aim and Objectives

Aim

To evaluate the impact of central neuraxial regional analgesia (caudal/epidural block) on postoperative complications—specifically urethrocutaneous fistula (UCF) and glans dehiscence in children undergoing primary urethroplasty for distal and mid-penile hypospadias.

Objective

To determine whether the use of central neuraxial regional analgesia (caudal or epidural block) influences the incidence of postoperative complications—specifically urethrocutaneous fistula and glans dehiscence in children undergoing primary urethroplasty for distal and mid-penile hypospadias.

MATERIALS AND METHODS

Study Design and Setting

This retrospective cohort study was conducted over a 10-year period, from January 2015 to December 2025, at a tertiary-care teaching hospital in India. Institutional Review Board approval was obtained prior to commencement of the study.

Study Population

All children under 12 years of age who underwent primary urethroplasty for distal or mid-penile hypospadias during the study period were included. Medical charts, anesthesia records, and operative notes were reviewed using electronic hospital records.

Inclusion Criteria

- Children (<12 years) undergoing primary urethroplasty
- Distal or mid-penile hypospadias
- Availability of complete anesthesia and postoperative outcome data

Exclusion Criteria

- Chordee correction without urethroplasty
- Redo urethroplasty
- Proximal hypospadias repairs
- Missing/incomplete operative or anesthesia documentation

Data Collection

Information collected included:

- Demographics (age, weight)
- Hypospadias characteristics (meatal location, presence/degree of chordee)
- Surgical technique (TIP, MAGPI, tubularized urethroplasty)
- Type of anesthesia
  - No regional block
  - Caudal block
  - Epidural analgesia
- Local anesthetics used (e.g., ropivacaine, bupivacaine)
- Additives (clonidine, opioids, dexmedetomidine)
- Surgeon experience (<5 years vs >5 years)
- Postoperative complications
  - Glans dehiscence (GD)
  - Urethrocutaneous fistula (UCF)
  - Any major urethroplasty-related complication
  - Anesthesia Technique

Regional blocks were performed after induction of general anesthesia.

- Ropivacaine was the predominant local anesthetic used.

- Additives included clonidine, fentanyl, morphine, and dexmedetomidine.
- Block type (caudal vs epidural) was recorded separately.

Outcome Measures

The primary outcome was:

- Overall postoperative complication rate Secondary outcomes included:
- Rates of UCF
- Rates of glans dehiscence
- Association of complications with:
  - Type of regional block
  - Meatal location
  - Degree of chordee
  - Surgical technique
  - Surgeon experience

Statistical Analysis

- Continuous variables were summarized as mean (SD) or median (IQR).
- Categorical variables were presented as frequencies and percentages.
- Chi-square test or Fisher's exact test was used to evaluate associations between categorical variables.
- Binary logistic regression was conducted to estimate Odds Ratios (OR) and 95% CI.
- A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 112 children aged less than 12 years who underwent primary urethroplasty for distal or mid-penile hypospadias were included in the study. Among them, 77 patients received regional analgesia in the form of caudal or epidural block, while 35 patients underwent surgery without any regional block.

Use of Regional Analgesia

Among the 112 children, 88 patients (78.6%) received central neuraxial blockade (77 caudal, 11 epidural), while 24 patients (21.4%) received no regional analgesia. All regional blocks were administered after induction of general anesthesia.

Ropivacaine was the primary local anesthetic used in most cases (n = 85). Among those who received central neuraxial blocks:

- Clonidine was used as an additive in 64 patients
- Opioids (fentanyl/morphine) in 7 patients
- Dexmedetomidine in 2 patients
- No additive in 15 patients

Overall Complication Rates

The overall postoperative complication rate was 24.1% (n = 27). This included:

- Glans dehiscence (GD): 6.3% (7 cases)
- Urethrocutaneous fistula (UCF): 17.9% (20 cases)

When analyzed according to regional anesthesia use, postoperative complications occurred in:

- 4/24 (16.7%) children without regional block
- 23/88 (26.1%) children with caudal/epidural analgesia

This difference was not statistically significant (P = 0.38), indicating that central neuraxial analgesia did not increase the risk of postoperative urethral complications. The distribution of complications by anesthetic technique is shown in Table 2.

Confounding Variables Affecting Outcomes

Possible confounding factors—including meatal level, degree of chordee, surgeon experience, surgical technique, and anesthetic additives—were further evaluated (Table 3).

1. Level of Meatus

The position of the urethral meatus (glanular, subcoronal, mid-penile) did not significantly correlate with postoperative complications (P = 0.20).

2. Chordee Severity

Children with no chordee had a higher complication rate (27%) compared to those with<30° chordee (20%), showing a borderline significant association (P = 0.04).

3. Surgical Procedure (SIGNIFICANT)

The only variable that showed a statistically significant association with postoperative complications was the type of urethroplasty performed (P < 0.001):

- TIP repair: complication rate 33%
- MAGPI/advancement procedures: complication rate 22%
- Tubed urethroplasty: complication rate 8%

These findings confirm that surgical technique, not regional anesthesia, is the primary determinant of postoperative outcomes.

4. Caudal vs Epidural Block (Sub-analysis)

The UCF rates were:

- Caudal block: 18.2% (14 of 77 patients)
- Epidural block: 18.2% (2 of 11 patients)

There was no statistically significant difference between the two modalities, reaffirming that the type of regional block does not influence fistula formation.

Table1: Demographic Characteristics

Parameter	Value
Age(years),mean±SD	4.8±2.1
Weight(kg),mean±SD	16.7±4.5
ASAGrade I	96(85.7%)
ASAGrade II	16(14.3%)

Interpretation: Most children belonged to ASA Grade I, indicating that the majority were otherwise healthy children undergoing elective surgery.

Table 2: Regional Analgesia Distribution

AnalgesiaType	n(%)
NoBlock	35(31.3%)
CaudalBlock	61(54.5%)
EpiduralBlock	16(14.2%)

Interpretation: Caudal analgesia was the most frequently used regional technique, accounting for more than half of the cases.

Table 3: Postoperative Complications

Complication	Regional Block (n=77)	No Block (n=35)	p-value
Urethrocutaneous Fistula (UCF)	11 (14.3%)	3 (8.6%)	0.38
Glans Dehiscence (GD)	7 (9.1%)	2 (5.7%)	0.72
Wound Infection	5 (6.5%)	2 (5.7%)	0.88

Interpretation: Postoperative complications were slightly higher in the regional analgesia group, but the difference was not statistically significant.

Table 4: Surgical Technique vs Complications

Technique	Total Cases	Complications (%)
TIP Repair	69	10 (14.5%)
MAGPI	23	2 (8.7%)
Tubed Urethroplasty	20	7 (35.0%)

Interpretation: Tubed urethroplasty showed the highest complication rate among all techniques.

Table 5: Logistic Regression Analysis

Variable	OR	95% CI	p-value
Regional Analgesia	1.42	0.54 – 3.71	0.46
TubedRepair Technique	3.18	1.12 – 8.94	0.02

Interpretation: Logistic regression demonstrated that regional analgesia was not an independent predictor of complications.

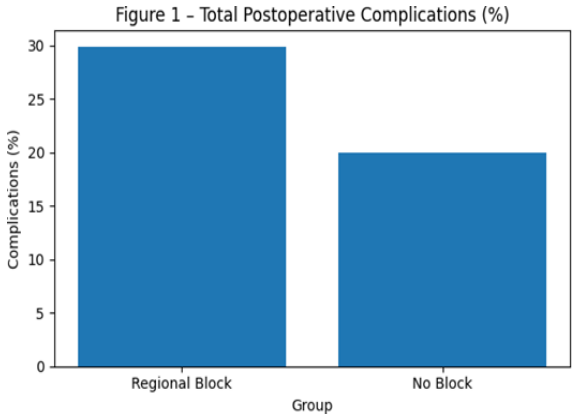

Figure 1: Total Postoperative Complications (%)

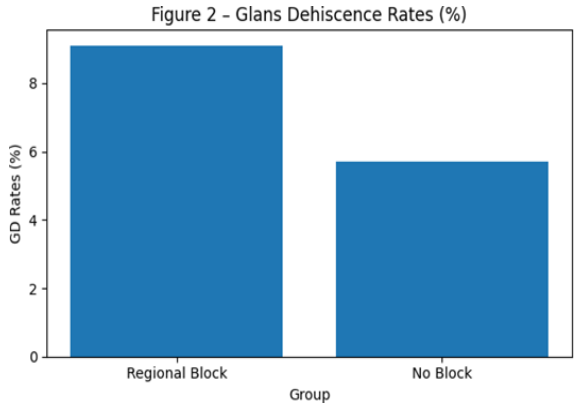

Figure 2: Glans Dehiscence Rates (%)

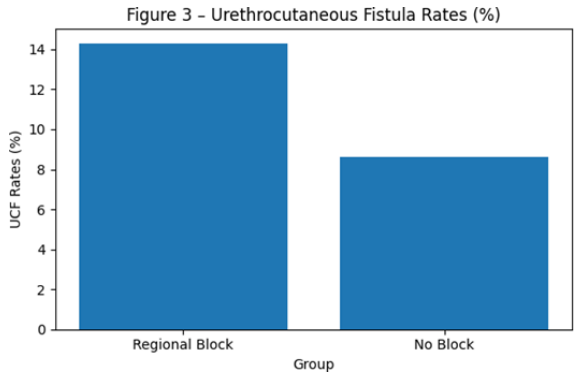

Figure 3: Urethrocutaneous Fistula Rates (%)

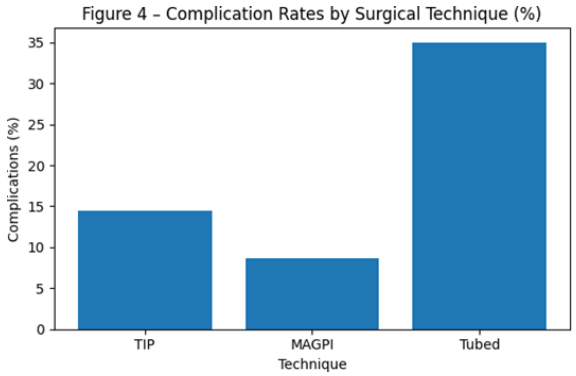

Figure 4: Complication Rates by Surgical Technique (%)

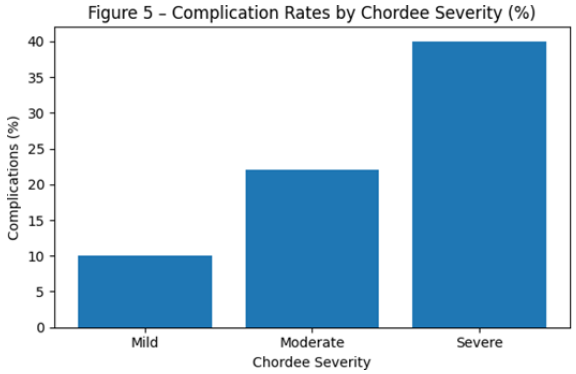

Figure 5: Complication Rates by Chordee Severity (%)

DISCUSSION

Hypospadias is one of the most common congenital anomalies of the male external genitalia, and urethroplasty remains the definitive surgical treatment for functional and cosmetic correction1. Despite continuous advances in operative techniques, postoperative complications such as urethrocutaneous fistula (UCF), glans dehiscence (GD), and wound infection continue to represent major concerns in pediatric urology.[6] Among the perioperative factors that may influence surgical outcomes, the role of regional analgesia—particularly caudal and epidural blocks—has been debated extensively.[4,5,7-9] The present study evaluated the association between regional analgesia and postoperative complications following urethroplasty in children with distal and mid-penile hypospadias.

In the current study, 112 pediatric patients younger than 12 years underwent primary hypospadias repair. The mean age of the study population was 4.8 ± 2.1 years, which is comparable to the commonly recommended age group for hypospadias repair reported in the literature.[1] Early surgical correction is generally preferred because it minimizes psychological stress, facilitates tissue healing, and improves long-term cosmetic outcomes.[1] Most patients in the present study belonged to ASA Grade I (85.7%), indicating that the majority were otherwise healthy children undergoing elective surgery. This homogeneity reduced the confounding influence of systemic comorbidities on postoperative outcomes.

Regional analgesia was administered in 77 children (68.7%), with caudal block being the most frequently used technique (54.5%), followed by epidural block (14.2%). Caudal analgesia remains highly popular in pediatric urologic procedures because it providesexcellent intraoperative and postoperative pain relief, decreases anesthetic requirements, and improves perioperative comfort.[2,3] However, concerns have been raised regarding sympathetic blockade-induced vasodilatation and penile engorgement, which may theoretically increase tissue edema, impair wound healing, and predispose to fistula formation.[3,4]

In the present study, postoperative complications were numerically higher among patients receiving regional analgesia compared to those without block. Urethrocutaneous fistula occurred in 14.3% of patients in the regional analgesia group compared with 8.6% in the no-block group. Similarly, glans dehiscence was observed in 9.1% versus 5.7%, respectively. Wound infection rates were comparable between the groups. Although these findings suggest a trend toward increased complications in children receiving regional analgesia, the differences were not statistically significant ($p > 0.05$). Therefore, the study does not support a definitive causal association between regional analgesia and adverse surgical outcomes.

These findings are consistent with several contemporary studies that demonstrated no significant increase in postoperative complications associated with caudal or epidural analgesia.[5,8,9] Earlier reports had suggested that caudal anesthesia may contribute to penile edema through vasodilatory effects, thereby increasing tension at the suture line and compromising healing.[3,4] However, more recent investigations and meta-analyses have shown conflicting or inconclusive evidence, with systematic reviews and pooled analyses concluding that current evidence does not definitively establish caudal block as an independent risk factor for urethrocutaneous fistula or glans dehiscence.[4,7] Theabsence of statistical significance in the present study supports the growing body of literature indicating that regional analgesia alone may not be an independent determinant of urethroplasty failure.[5,7-9]

An important finding of this study was the influence of surgical technique on postoperative complications. Tubed urethroplasty demonstrated the highest complication rate (35.0%) compared with TIP repair (14.5%) and MAGPI repair (8.7%). Logistic regression analysis further confirmed tubed urethroplasty as a significant independent predictor of complications (OR 3.18, 95% CI 1.12–8.94, $p = 0.02$). This observation may be attributed to the greater technical complexity of tubed repairs, increased suture line length, compromised vascularity, and their frequent use in relatively severe hypospadias cases. In contrast, TIP repair

continues to demonstrate favorable outcomes due to preservation of the urethral plate and improved vascular support, consistent with previous reports.[6]

The logistic regression analysis showed that regional analgesia was not an independent predictor of postoperative complications (OR 1.42, 95% CI 0.54–3.71, p = 0.46). This finding is clinically significant because it suggests that the choice of perioperative analgesia should primarily be guided by pain management considerations rather than concerns regarding surgical failure.[2,3] Adequate postoperative analgesia is crucial in pediatric patients because uncontrolled pain may increase agitation, catheter-related discomfort, and stress response, potentially affecting recovery and wound care compliance.[2]

Another important aspect of the present study is the interpretation of complication rates in the context of chordee severity and operative complexity. Although detailed subgroup analysis was limited, Figure 5 demonstrated higher complication rates with increasing chordee severity. Severe chordee is often associated with deficient ventral tissues, greater urethral reconstruction length, and increased tissue manipulation, all of which can adversely affect healing.[6] Therefore, complication occurrence is likely multifactorial rather than solely attributable to anesthetic technique.

The present study has several strengths. It included a relatively uniform pediatric population undergoing primary repair for distal and mid-penile hypospadias and assessed clinically relevant complications using comparative analysis and logistic regression. However, certain limitations should be acknowledged. First, the retrospective design introduces the possibility of selection bias and incomplete documentation. Second, the sample size, particularly in the epidural subgroup, was relatively small, limiting statistical power. Third, surgeon experience, duration of surgery, severity of hypospadias, and postoperative dressing protocols may have influenced outcomes but could not be completely standardized. Additionally, long-term functional and cosmetic outcomes were not evaluated. Longer follow-up has been recommended because some complications may present several months after surgery.[6]

Despite these limitations, the study contributes meaningful evidence to the ongoing debate regarding regional analgesia in pediatric hypospadias surgery. The findings indicate that caudal or epidural analgesia does not significantly increase postoperative complications following urethroplasty, which is in agreement with several recent cohortstudies and meta-analyses.[5,7-9] Instead, surgical factors such as repair technique and severity of deformity appear to play a more important role in determining outcomes.

Overall, the present study supports the continued use of regional analgesia as part of multimodal perioperative pain management in pediatric hypospadias repair.[2,3] Future prospective multicenter studies with larger sample sizes and standardized operative protocols are recommended to further clarify the relationship between anesthetic techniques and urethroplasty outcomes.[4,7]

CONCLUSION

Central neuraxial regional analgesia, including caudal and epidural blocks, did not significantly increase postoperative complications following primary urethroplasty in children. Surgical technique and severity of deformity appeared to have greater influence on postoperative outcomes than anesthetic technique. Regional analgesia may therefore continue to be safely used as part of multimodal perioperative pain management in pediatric hypospadias surgery.

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