Original Article

Analysis of factors associated with postoperative complications after primary hypospadias repair: a retrospective study

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Background: To determine the risk factors for postoperative complications after primary hypospadias repair. Hypospadias has a high postoperative complication rate, and the risk factors of postoperative complications have attracted extensive attention.

Methods: A total of 857 children who received primary surgical repair for hypospadias in our center between 3 January 2017 and 29 January 2021 were retrospectively analyzed. The collected data included age at time of surgery, type of hypospadias, body mass index (BMI), surgeon, operation time, length of reconstructed urethra, method of anesthesia (general anesthesia or general anesthesia combined with caudal anesthesia), and postoperative constipation. The risk factors for postoperative complications were analyzed by multivariate analysis.

Results: The follow-up time in this study was 6–54 months, with a mean follow-up time of 29 months. A total of 96 (11.2%) of the 857 pediatric patients had postoperative complications, including 44 (45.8%) cases of urethral fistula, 14 (14.6%) cases of urethral stricture, 5 (5.2%) cases of urethral diverticula, 5 (5.2%) cases of distal dehiscence, 3 (3.1%) cases of poor exposure, 2 (2.1%) cases of residual curvature, 1 (1.0%) case of penoscrotal transposition, 6 (6.3%) cases of urethral stricture and diverticulum, 6 (6.3%) cases of urethral fistula and diverticulum, 3 (3.1%) cases of urethral fistula and postoperative residual curvature, 2 (2.1%) cases of urethral fistula and distal dehiscence, and 1 (1.0%) case each of urethral fistula and transposition, urethral diverticulum and poor exposure, urethral stricture and poor exposure, distal dehiscence and transposition, and residual curvature and transposition. After univariate analysis, type of hypospadias (P=0.038), operation time (P<0.001), length of reconstructed urethra (P=0.007), and postoperative constipation (P=0.019) were included in the multivariate logistic regression analysis. The results showed that postoperative constipation was an independent risk factor for complications [P=0.027, odds ratio (OR) =1.793, confidence interval (CI): 1.067 to 3.012].

Conclusions: Postoperative constipation is an important influencing factor for postoperative complications following primary hypospadias repair. Therefore, defecation management should be strengthened for hypospadias patients during the perioperative period.

Keywords: Hypospadias; complications; risk factor; postoperative constipation

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Introduction

Hypospadias is the most common congenital deformity in the reproductive system of children and is primarily characterized by abnormally positioned urethral opening, chordee, and abnormal foreskin distribution. A multinational and multiregional study (1) showed that the prevalence of hypospadias has increased by 60% from 1980 to 2010, and the condition affects about 0.2% of newborn males worldwide. Surgery is the only effective treatment for hypospadias, but the incidence of postoperative complication is 5–70% (2-4). Therefore, hypospadias repair remains a great challenge for pediatric urologists (5).

Numerous studies have investigated the risk factors for postoperative complications of hypospadias repair, and most of them focused on the age at time of surgery, type of hypospadias, method of anesthesia, length of reconstructed urethra, and postoperative constipation (3,6-13). In this study, we reviewed the clinical and follow-up data of 857 pediatric patients who underwent primary hypospadias repair and explored the factors associated with postoperative complications. We present the following article in accordance with the STROBE reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-22-691/rc).

Methods

Clinical data

The clinical data of 1,249 pediatric hypospadias patients who underwent surgery in our hospital between 3 January 2017 and 29 January 2021 were collected. The inclusion criteria were as follows: (I) primary treatment for hypospadias; (II) complete clinical data. The exclusion criteria were as follows: (I) incomplete clinical data; (II) less than 6 months of follow-up. A final total of 857 patients were included, and information on the age at time of surgery, type of hypospadias, body mass index (BMI), operation time, surgeon, method of anesthesia, length of reconstructed urethra, postoperative constipation, and complications were collected. Hypospadias was classified as distal (glandular, coronal, and subcoronal), midshaft, or proximal (penoscrotal, scrotal, and perineal) (14) according to the opening of the urethra after penile curvature correction. Postoperative constipation was defined as the absence of defecation, difficult defecation, or painful defecation within 3 days after surgery (15-18). Complications included urethral fistula, urethral stricture, urethral diverticula, residual curvature, distal dehiscence, poor exposure, and penoscrotal transposition. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Sichuan Academy of Medical Sciences & Sichuan Provincial People's Hospital (No. Ethics 2020-152). Individual consent for this retrospective analysis was waived.

Statistical analysis

Data were analyzed using SPSS 21.0 (IBM Corp., Armonk, NY, USA). Univariate analysis was first performed to determine the correlation between postoperative complication and age at time of surgery, type of hypospadias, BMI, surgeon, operation time, length of reconstructed urethra, method of anesthesia, or postoperative constipation. A multivariate logistic regression model was then constructed based on the results of univariate analysis. All tests were 2-tailed and a P value <0.05 was considered statistically significant.

Results

Univariate analysis of postoperative complications

A total of 96 (11.2%) of the 857 pediatric patients had postoperative complications, including 44 (45.8%) cases of urethral fistula, 14 (14.6%) cases of urethral stricture, 5 (5.2%) cases of urethral diverticula, 5 (5.2%) cases of distal dehiscence, 3 (3.1%) cases of poor exposure, 2 (2.1%) cases of residual curvature, 1 (1.0%) case of penoscrotal transposition, 6 (6.3%) cases of urethral stricture and diverticulum, 6 (6.3%) cases of urethral fistula and diverticulum, 3 (3.1%) cases of urethral fistula and postoperative residual curvature, 2 (2.1%) cases of urethral fistula and distal dehiscence, and 1 (1.0%) case each of urethral fistula and transposition, urethral diverticulum and poor exposure, urethral stricture and poor exposure, distal dehiscence and transposition, and residual curvature and transposition. Univariate analysis showed that type of hypospadias (P=0.038), operation time (P<0.001), length of reconstructed urethra (P=0.007), and postoperative constipation (P=0.019) were risk factors for postoperative complications. On the other hand, age at the time of surgery, BMI, surgeon, and method of anesthesia were not significantly different between patients with and without complications (P>0.05) (*Table 1*).

Table 1 Univariate analysis of risk factors for postoperative complications of hypospadias repair

Variables	Patients with complication (n=96)	Patients without complication (n=761)	P value
Age (years), median (P25, P75)	2 [1, 3]	2 [2, 3]	0.058
≤2, n [%]	63 [13]	431 [87]	
>2, n [%]	33 [9]	330 [91]	
BMI, median (P25, P75)	15.97 (14.82, 17.19)	15.70 (14.71, 17.10)	0.353
Type, n [%]			0.038
Distal	4 [5]	78 [95]	
Midshaft	50 [10]	432 [90]	
Proximal	42 [14]	251 [96]	
Surgeon, n [%]			0.224
Number of surgeries per year >100	80 [12]	593 [88]	
Number of surgeries per year ≤100	16 [9]	168 [91]	
Operation time (min), median (P25, P75)	145 [110, 170]	115 [85, 160]	0.000
Method of anesthesia, n [%]			0.755
General anesthesia	44 [12]	336 [88]	
General plus caudal anesthesia	52 [11]	425 [89]	
Postoperative constipation, n [%]			0.019
Yes	23 [17]	112 [83]	
No	73 [10]	649 [90]	
Length of reconstructed urethra (cm), median (P25, P75)	3 (1.7, 4)	2 (1.3, 3.55)	0.007
<2, n [%]	39 [9]	386 [91]	
2–3, n [%]	14 [13]	95 [87]	
3–4, n [%]	25 [13]	161 [87]	
>4, n [%]	18 [13]	119 [87]	

BMI, body mass index.

Multivariate analysis of postoperative complications

A multivariate logistic regression analysis was performed based on the univariate analysis results. The findings showed that postoperative constipation is an independent risk factor for complication [P=0.027, odds ratio (OR) =1.793, confidence interval (CI): 1.067 to 3.012], and the presence of postoperative constipation increased the risk of postoperative complication by 79% (*Table 2*).

Discussion

Surgery is the only effective treatment for hypospadias and mainly consists of curvature repair, urethroplasty, and cosmetic surgery. Hypospadias repair is a complex and meticulous reconstructive surgery with a relatively high incidence of postoperative complication. Common complications of this procedure include urethral fistula, urethral stricture, urethral diverticula, and residual penile curvature (19). Some pediatric patients may simultaneously experience 2 or more complications, and most complications require revision surgery (4). Since the number of surgeries performed and penile appearance satisfaction are key factors affecting hypospadias repair and psychosexual outcome (20,21), identifying risk factors associated with complications is of particular importance

Table 2 Multivariate analysis of postoperative complications after hypospadias repair

Variables	B	S.E.	Wals	Df	P	OR	95% CI of OR	
							Lower limit	Upper limit
Length of reconstructed urethra (cm)	–0.005	0.108	0.002	1	0.963	0.995	0.805	1.230
Type	0.333	0.267	1.554	1	0.213	1.395	0.826	2.356
Operation time (min)	0.003	0.002	2.352	1	0.125	1.003	0.999	1.006
Postoperative constipation	0.584	0.265	4.870	1	0.027	1.793	1.067	3.012

S.E., standard error; Df, degree(s) of freedom; OR, odds ratio; CI, confidence interval.

in guiding clinical practice.

Postoperative constipation

Although there are currently no diagnostic criteria for postoperative constipation, this phenomenon is very common and is mainly associated with the use of opioids, reduced postoperative activity, long operation time, heavy bleeding, and surgical trauma (15,22). Postoperative constipation has been more commonly reported in adult patients undergoing surgery, with an incidence of 18–72% in hip replacement, 50% in thoracic surgery, 8% in anorectal surgery (15), and 39.2% in heart surgery (18). A systematic review of postoperative follow-up for cloacal malformation showed that 51% of patients experienced constipation (23). López *et al.* (16) reported that the incidence of constipation was 46.7% in critically ill pediatric patients and 3 times higher in surgically treated pediatric patients than in pediatric patients who have not undergone surgery. Furthermore, Mantegazzi*et al.* (17) reported that the incidence of constipation was up to 77.7% in pediatric patients who underwent orthopedic surgery. It is worth noting that the authors thought reduced defecation, abdominal pain, abdominal distension, or poor appetite (at least 2 symptoms must be present) and whether enema was provided and recorded should be included in the definition of acute constipation. Our study showed that the incidence of postoperative constipation was 15.8%, and postoperative constipation accounted for 24% of all patients with complications. We found that constipation is an independent risk factor for postoperative complication (P=0.027, OR =1.793, 95% CI: 1.067 to 3.012). By combining clinical observations, we speculate that postoperative constipation was caused by reduced peristalsis in pediatric patients due to prolonged bed rest after surgery. In addition, defecation may cause pain and discomfort in the surgical area, leading to resistance to defecation, accumulation of dry feces in the rectum, and hence more painful defecation. Due to involuntary contractions of the external sphincter muscle and puborectalis muscle, forceful defecation in constipated pediatric patients can increase pelvic floor venous pressure and lead to wound bleeding, increased urine extravasation, and infection and compression-induced ischemia caused by local hematoma. Urine extravasation can gradually develop into chronic urethritis, which ultimately increases the incidences of urethral fistula and stricture (24-27). Careful management of postoperative defecation is favorable for reducing complications following hypospadias repair (2,9,10). In a study by Grobbelaar *et al.* (10), patients were given oral lactulose 48 hours before surgery to avoid postoperative constipation. Likewise, Mantegazzi*et al.* (17) asserted that preventative measures for postoperative constipation should begin 1 week before surgery and should focus on privacy during defecation, increased fluid uptake, use of stool softeners, reduced use of medications that cause constipation, and reasonable diet. The authors found that such interventions decreased the incidence of postoperative constipation to 50.8%. Although high-quality randomized controlled studies are currently lacking in pediatric enhanced recovery after surgery, routine preoperative mechanical bowel preparation is not recommended for the prevention of constipation (28-31). Therefore, patients should ensure sufficient dietary fiber and fluid intake and avoid foods to which they are intolerant (decreased consumption of fructose and lactose) during the perioperative period to avoid postoperative constipation (27). Moreover, meticulous surgical procedures and secure bandaging can decrease trauma and pain and are important measures for promoting early recovery and preventing postoperative constipation in pediatric patients. In this study, we wrapped a diaper around the urinary catheter (*Figure 1*) to free the patients from the restraint

Figure 1 Wrapping of diaper around the urinary catheter after surgery.

of a drainage bag, thereby shortening the time required for pediatric patients to get out of bed and reducing the incidence of constipation after surgery.

Anesthesia

General anesthesia combined with regional anesthesia not only provides the best pain relief, reduces insulin resistance, increases gastrointestinal peristalsis, and decreases opioid dosage and adverse reactions, but it also allows rapid arousal, effectively reduces stress response, and hence accelerates recovery. Caudal block is a regional anesthesia widely used in urethral, perineal, and anal surgeries due to its ability to relax the pelvic floor and perineal muscles, decrease stress response, and reduce the dosage for general anesthesia (32,33). It was previously shown that caudal block improved postoperative pain in pediatric patients but also increased the risk of urethral fistula compared with control patients (34). Similar findings were also reported by Kim *et al.* (35) and Taicher *et al.* (36), researchers have speculated that the reason for caudal anesthesia to increase the incidence of postoperative complications after hypospadias repair is associated with penile sinus nerve block and vasodilation. Nerve block reduces the activity of sympathetic nerves, decreases angiotensin secretion, and leads to venous blood pooling in the perineum and lower half of the penis. Alternately, vasodilation results in penile venous sinus congestion and penile swelling, which in turn increases wound suture tension, negatively impacts healing, and increases the risks of urethral fistula or stricture. However, similar studies conducted by other groups found that the method of anesthesia was not associated with surgical outcome (7,32,37). Consistent with previous findings, we observed postoperative complications in only 11% of pediatric patients who had general plus caudal anesthesia, which was comparable to the 12% incidence in patients who had general anesthesia alone.

Length of reconstructed urethra and type of hypospadias

Length of reconstructed urethra and type of hypospadias are important indicators for the severity of hypospadias. Previous studies (3,6,38,39) have demonstrated that the longer the urethral defect, the greater the risk of complications. The incidence of postoperative complications is far higher in patients with proximal hypospadias than in those with midshaft and distal hypospadias (3,6,38,39). In contrast, our results indicated that the length of urethral defect (P=0.963, OR =0.995, 95% CI: 0.805 to 1.230) and type of hypospadias (P=0.213, OR =1.395, 95% CI: 0.826 to 2.356) were not risk factors for complications, which are consistent with the findings of Huang *et al.* (8) and Duarsa *et al.* (40). We speculate that there are 4 reasons for this discrepancy. First, our center has a higher percentage of patients with severe hypospadias and hence it is easier to gain experience in island flap and Koyanagi repair. Second, the surgical approach for midshaft and proximal hypospadias can be selected with greater flexibility in accordance with the shape and size of the head of the penis, length of foreskin, blood supply pattern, and type of curvature. This "customized multi-approach" advantage ensures spacious outflow channel and improves postoperative recovery and satisfaction (41,42). Third, preservation of the urethral plate is the predominant approach for distal hypospadias, and surgical complications are largely associated with the width and quality of the original urethral plate. Last, patients in this study were followed up for 6–54 months, with a mean follow-up time of 29 months. In the studies conducted by Lucas *et al.* (39) and Johnston *et al.* (43), the authors followed up the patients for over a decade and observed the occurrence of <50% of complications within a year after surgery. However, whether prolonged follow-up time, length of reconstructed urethra, and type of hypospadias alters the incidence of complication remain possibilities that cannot be excluded in this case.

Surgeon

It was reported that the more experience the surgeon has the lower incidence of complications following hypospadias repair (2,7). Our results showed that the incidence of postoperative complications was not significantly different between patients treated by surgeons who perform >100

surgeries annually and those treated by surgeons who have perform ≤100 surgeries annually, which was consistent with the findings of Dokter *et al.* (12). This difference may be attributed to selection bias due to the lower number of patients (21.5% of total cases) in the surgeon group with ≤100 surgeries per year and higher percent of mild to moderate cases. Furthermore, surgeons who perform ≤100 surgeries per year in our center have already accumulated experience from 1,000 hypospadias repair surgeries, and their surgical technique has become increasingly stable as they reached the end of the learning curve (44). Nonetheless, we will continue to monitor this indicator in subsequent studies.

Age at time of surgery

The recommended age for hypospadias repair surgery is 6–12 months by the American Academy of Pediatrics, 6–18 months by European Association of Urology, and 6–30 months in China (45). Age has been shown to be a risk factor for complications (8,40,46). Because of the more frequent erections in older children the pulling effect lead the worse recovery in wound healing. Conversely, younger children are believed to experience better recovery after surgery. However, the effect of age was not observed in our study, which is consistent with the findings reported by Dokter *et al.*, Lu *et al.*, and Feng *et al.* (3,6,47).

Operation time

Jiang *et al.* (46) have reported that the risk of postoperative complication increases as operation time increases, especially in first and second surgeries for proximal hypospadias. Univariate analysis indicated that operation time had a significant impact on the incidence of complication (P<0.001). However, multivariate regression analysis, which included factors such as type of hypospadias, length of reconstructed urethra, and postoperative constipation, showed that operation time had no effect on complication. This has led us to question whether the increase or decrease in the number of associated factors can alter the outcome of such analysis.

BMI

BMI is an important indicator for nutritional status, and poor preoperative nutritional status can increase the risk of postoperative complication, prolong hospitalization time, and increase hospitalization cost (48). Consistent with our results, Strine *et al.* (49) reported that the difference in BMI between children and adolescents before urethral reconstruction did not affect surgical outcome.

Limitations

There were several limitations to this study. First, since this was a single-center retrospective study, it was difficult to eliminate all confounding factors such as surgical approach, extent of ventral penile curvature, and urethral plate conditions, resulting in the possibility of selection bias and data bias. Second, this study lacked more long-term follow-up data on postoperative complications. Third, preoperative defecation data were not collected. Last, a multi-center, randomized, controlled prospective study is required to confirm the relationship between postoperative complication and constipation.

In summary, our study demonstrated that postoperative constipation is an important influencing factor for postoperative complications following primary hypospadias repair, and hence more emphasis should be placed on the perioperative defecation management of pediatric patients.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-22-691/rc

Data Sharing Statement: Available at https://tau.amegroups.com/article/view/10.21037/tau-22-691/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-22-691/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related

to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Sichuan Academy of Medical Sciences & Sichuan Provincial People's Hospital (No. Ethics 2020-152). Individual consent for this retrospective analysis was waived.

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