Original Article

The Use of Preputial Dartos Flap in the Primary Repair of Distal Hypospadias: A Single-centre Experience

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Abstract

Background: An additional flap during the tubularization of incised urethral plate urethroplasty (TIPU) is believed to minimize the postoperative complications. It is still debatable whether using an additional flap is worth the risk given the hazards associated with doing so. This study aims to re-evaluate the benefits and drawbacks of TIPU with or without a preputial dartos (PD) flap. **Materials and Methods:** We assessed the results of patients with distal hypospadias who underwent surgery in our institute over the past 2 years. The urethral plate's width, thickness, and depth, the periurethral tissue's quality, and the width of the glans at the mid-glans level determined whether the neourethra was covered with a PD flap or left uncovered. Data on intra-operative blood loss, operating time, length of hospital stay, postoperative complications, and outcome were analysed. **Results:** There were 96 patients: 58 received an extra PD flap, whereas the other 38 did not. In the flap group, ventral skin necrosis was a prevalent problem, whereas meatal stenosis predominated in the no-flap group. Both the flap group (25.66%) and the no-flap group (23.86%) experienced comparable postoperative complications ($P = 0.503$). In comparison to the no-flap group, the flap group showed statistically significant differences ($P<0.001$) in intra-operative blood loss (22.10 ± 6.96 vs. 10.34 ± 3.02 mL), operating time (96.34 ± 6.661 vs. 71.39 ± 9.76 min), and hospital stay (10.04 ± 0.87 vs. 8.47 ± 1.64 days). **Conclusion:** The additional PD flap does not always affect the result of TIPU in terms of complications.

Keywords: *Complications, dartos, distal, flap, hypospadias, neourethra, preputial, urethroplasty*

Introduction

Hypospadias is one of the surgically correctable congenital urological conditions with an incidence of 1 in 250–300 live births.[1] For coronal and distal penile hypospadias/distal hypospadias (DH), tubularization of incised urethral plate urethroplasty (TIPU) is the preferred surgical procedure. Snodgrass and Bush in 1994[2] described this comparatively simple one-stage surgery. Since then, this technique has evolved from a single- to a double-layer tubularization with the use of reinforcing interpositional flap coverage to neourethra using dorsal preputial dartos (PD) flap, spongiosum, or tunica vaginalis (TV) flap. This additional reinforcing vascularized flap is believed to minimize the complications, especially the urethrocutaneous fistula (UCF). Unfortunately, the procedure of isolating the flap from the prepuce compromises the blood supply to the skin, causes skin deficiency for closure, and may predispose to penile torsion. Moreover, it has its own hazards; operative time is extended by 30–45 min, bleeding is more, and higher standards of surgical skill are required. A debate regarding the use of the flap is there as the outcomes of TIPU are directly or indirectly affected by the status of the urethral plate, periurethral tissue, and other perioperative factors. Here, we retrospectively analysed the results and tried to reassess the pros and cons of TIPU with or without PD flap.

Materials and Methods

An observational study was conducted from October 1, 2018 to September 31, 2020 among 96 children with DH at our paediatric surgery department. It is a retrospective evaluation of surgical outcomes of TIPU in children with DH, for which written permission was obtained from the Institution Ethics Committee. The patients with severe chordee (more than 30%) requiring urethral plate transection for straightening, proximal penile hypospadias,

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and redo cases where in previous surgery the prepuce was excised did not undergone TIPU and thus excluded from this study. Parents were counselled about the surgical procedure of TIPU with/without an additional flap, and proper informed consent was taken thereafter. The safety and welfare of the patients are adequately and intrinsically protected as the TIPU with/without an additional flap was described in the literature.

Study design

It was a retrospective longitudinal study.

The procedure of TIPU with or without PD flap

Under general anaesthesia, the native urethral plate, the width of the glans (at the mid-glans level), and associated chordee were assessed. Patients with a urethral plate width less than 8 mm and mid-glans width less than 4 mm (objective criteria), as well as a thin and shallow urethral plate with poor periurethral tissue (subjective criteria), were acknowledged for an additional PD flap. In contrast, patients with a urethral plate width 8 mm or more and mid-glans width 4 mm or more (objective criteria) with the well-grooved and thickened urethral plate, as well as healthy periurethral tissue (subjective criteria), were approved for TIPU without an additional PD flap [Chart 1].

A perimeatal incision followed by degloving of penile skin up to the level of the penoscrotal junction was made. Penile tourniquet was used before degloving and assessment of the chordee. The degree of chordee was reassessed, whether to proceed for TIPU or not. Then, a standard TIPU was performed by interrupted subcutaneous suturing with 6/0 polydioxanone, over a no. 6 or no. 8 Nelaton's catheter, and the tourniquet was removed. The neourethra was then covered with a PD flap before proceeding to glanuloplasty and preputioplasty in 58 patients (group A). In 38 patients (group B), the neourethra was not covered by an additional interpositional flap. Closure of glandular wings and preputioplasty were performed with 5/0 interrupted polyglactin sutures in both groups. No subcutaneous adrenaline infiltration or bipolar cautery was used during the surgery. A closed dressing was applied using Elastoplast wrapping. Postoperative (PO) bladder drainage was instituted for 7–10 days on average, and analgesia was provided with oral paracetamol. Oral feeding was started 4–6 h after the operation. The dressing was removed on the 5th PO day or earlier if excessive soakage occurred and was kept open thereafter. The open wound was cleaned with only normal saline on a regular basis. No topical antibiotic lotion or ointment was applied to the wound area. Intravenous antibiotics were administered for at least 5 days. Urethral calibration was started after 3 weeks from the day of surgery in all cases and continued for 3–6 months according to the neo-meatus status. Patients were followed up for 1 year. PO complications (meatal stenosis, ventral skin necrosis, and penile rotation) including the number of UCF and cosmetic appearances in both groups were assessed and analysed.

Sources of information

All relevant data were obtained from the patient registry, surgical register of hospital, operative photographs from the concerned surgeons, patient's treatment cards, and Indoor Patient Department (IPD) as well as Outdoor Patient Department (OPD) medical records.

Study variables

Age at operation, anaesthesia used, operative time, intra-operative bleeding, duration of per-urethral catheter drainage, length of hospital stays, complications, and outcome as well as cosmetic result were all statistically assessed.

Statistical analysis

The data regarding intra-operative blood loss, operating time, duration of hospital stay, and PO complications were noted and analysed accordingly. Data were analysed using IBM SPSS Statistics 1.0.0.1447 (IBM, Armonk, NY, USA) and presented as mean ± standard deviation or median (range). Continuous variables were presented as mean ± standard deviation or interquartile region. Categorical variables were presented as frequency or percentage. And, to compare proportions, χ^2 test/Fisher's exact test was used. In our study, the two groups were not comparable by the virtue of the selection criterion. Student's *t*-test/Mann–Whitney *U*-test was applied to compare averages. A *P*-value of less than 0.05 was considered statistically significant.

Results

In group A (flap group), the median age at the time of operation was 29.50 months (range 12 months to 11 years 4 months). Eight patients had a urethral opening at the coronal level with glandular tilting, and 50 had at the distal penis with ventral chordee (less than 30°). The mean operative timing was 96.34 ± 6.661 min and the mean per-operative blood loss was 22.10 ± 6.96 mL. PO complications were observed in 15 (25.86%) patients. Skin flap necrosis occurred in five cases, glandular dehiscence in four cases, and penile torsion in two cases. All had superficial necrosis and were managed with dressing and intravenous medication. UCF was developed in two cases. The mean hospital stay was 10.04 ± 0.87 days for patients without ventral skin necrosis and 13.80 ± 1.48 days for those with ventral skin necrosis.

In group B patients (no flap group), the median age at the time of operation was 42 months (range 13 months to 11 years 5 months). Six had the urethral opening at the coronal level and 32 had at the distal penis level with ventral chordee less than 30°. The mean operative timing was 71.39 ± 9.76 min. The mean per-operative blood loss

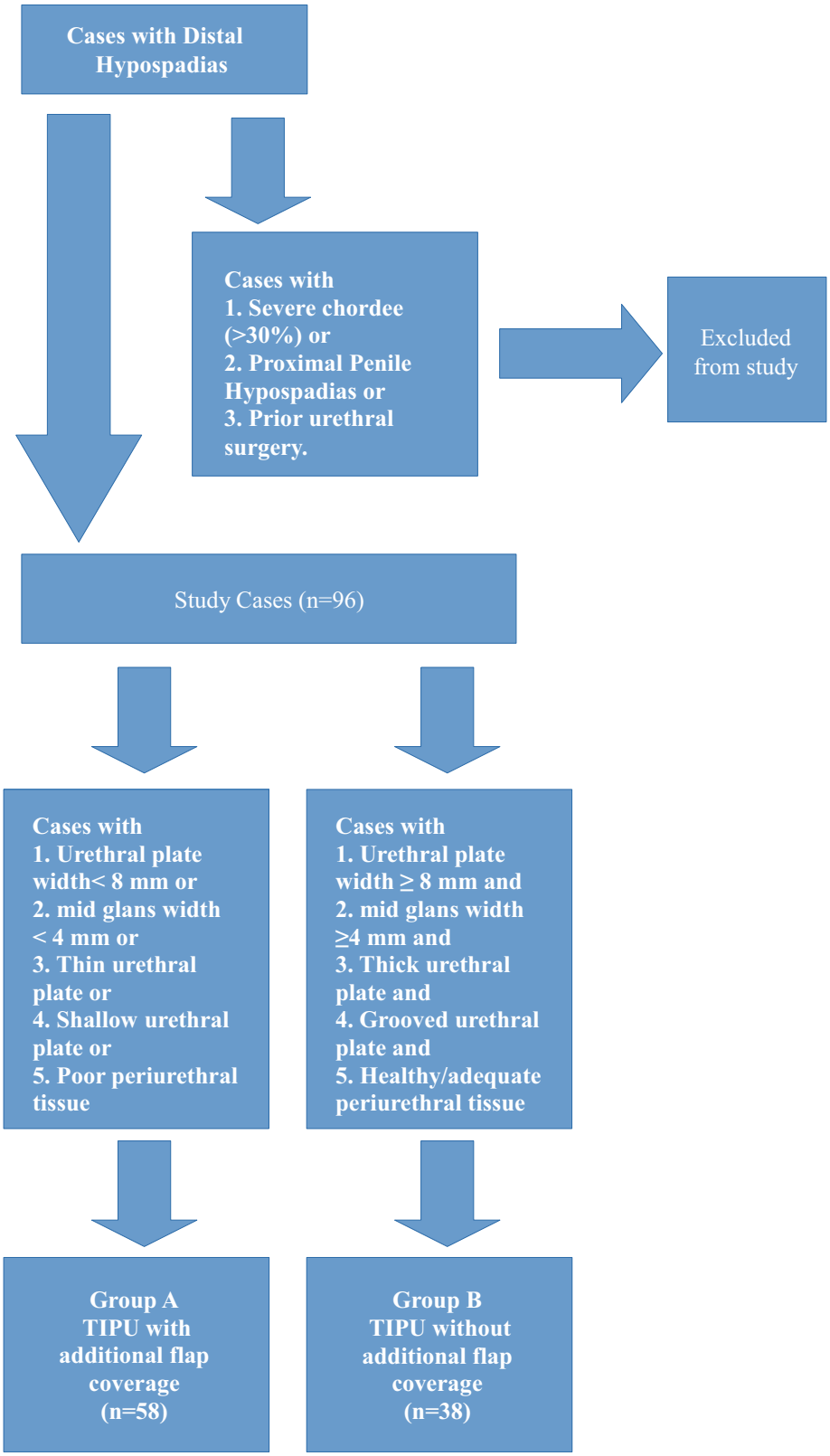

Chart 1: Inclusion and exclusion of the cases for TIPU with/without PD flap

was 10.34 ± 3.02 mL. PO complications were seen in nine (23.86%) patients. Meatal stenosis was the most common complication seen in this group. No ventral skin necrosis or penile torsion was observed. Mean hospital stay was 8.47 ± 1.64 days. However, cosmetic appearances were more or less the same in both the groups [Table 1].

Table 1: A survey of perioperative findings and statistical analysis of postoperative complications in both groups A and B

Parameters	Mean ± SD		*P*-value
	TIPU with separate flap (groups A) (*n* = 58)	TIPU without separate flap (groups B) (*n* = 38)	
Operative time (min)	96.34 ± 6.66	71.39 ± 9.76	<0.001
Operative blood loss (mL)	22.10 ± 6.96	10.34 ± 3.02	<0.001
PO hospital stay (days)	10.36 ± 1.41	8.47 ± 1.64	<0.001
Total complications, *n* (% within assigned group)	15 (25.9)	9 (23.7)	0.503
Ventral skin necrosis, *n* (% within assigned group)	5 (8.6)	0 (0.0)	0.075
Glandular dehiscence, *n* (% within assigned group)	4 (6.9)	2 (5.3)	0.553
Meatal stenosis, *n* (% within assigned group)	2 (3.4)	5 (13.2)	0.084
Urethrocutaneous fistula, *n* (% within assigned group)	2 (3.4)	2 (5.3)	0.519
Penile torsion, *n* (% within assigned group)	2 (3.4)	0 (0.0)	0.362

PO: postoperative

Group B had lower operative time ($P < 0.001$), lower perioperative blood loss ($P < 0.001$), and shorter duration of hospital stay ($P < 0.001$) but comparable PO complication rates ($P = 0.503$).

Discussion

The term "hypospadias" was first coined by Galen early in the second century AD.[3] More than 300 surgical techniques have been evolved from the distal amputation of the penis which was the only treatment option for hypospadias repair (Heliodorus and Antyllus 100–200 AD).[3] Tubularization of the urethral plate was initially described by Thiersch in 1869 and Duplay in 1874.[4] Later, Snodgrass modified it as tubularization of the incised plate (TIP).[5] The TIP is a relatively straightforward but safe, reliable, and relatively quick technique that continues to expand in applicability and popularity due to its proven success, durability, and versatility. However, many surgeons have encountered very high complications (up to 53%) and fistula rates with the Snodgrass technique.[5] An unhealthy urethral plate that appears thin or is insufficiently widened after incision with small glans was said to be detrimental for TIP. Though, Snodgrass claimed that TIPU does not require a deep urethral groove or wide urethral plate (more than 8 mm) as the dorsal incision consistently widens and deepens even a narrow and flat plate to 13–16 mm regardless of its configuration. On the basis of these, we selected patients (group A) who underwent TIP with an extra PD flap. Snodgrass also added that the wide proportion of the urethral plate to the glans serves as an independent factor influencing TIPU outcomes.[6]

Many surgeons now prefer a second vascular cover on the neourethral tube to minimize the PO complications. These flaps are transferred from tissues in the vicinity of the penis that contains vascularized pedicles (spongiosum or dartos or TV). Many surgeons appreciated the use of a de-epithelialized preputial skin flap (PD flap) cover, whereas many others prefer spongiosum or TV flap.[7] The use of additional flap, however, is not absolutely safe as was historically appreciated. The procedure increases the operative time by 30–45 min for isolating the flap and covering the neourethra. Zaidi *et al*.[8] showed that a prolonged surgery and subcutaneous epinephrine use have additional inimical effects on the PO outcome of urethroplasties. Moreover, the procedure causes more bleeding from the harvested area and/or the isolated flap. It is a technically demanding procedure needing excellent surgical expertise too. Bakal *et al*.[9] reported ventral skin necrosis (about 7% of cases) following a PD flap harvesting. They stated that neourethra coverage with PD may prevent UCF but causes necrosis in the preputial skin which itself may progress to UCF in about 2% of the cases.

In our series, we selectively used the PD flap only where the quality of the urethral plate was poor (group A). We encountered ventral epidermal necrosis in 5 out of 58 patients and all recovered well with conservative therapy [Figure 1]. We did not encounter any unwanted complications related to flap necrosis [Figure 2]. In our experience, flap necrosis is well managed with conservative therapy, superficial necrosis is healed on a short course (< 15 days), and full-thickness skin flap necrosis takes a longer time (> 15 days) to heal. The full necrosis of the flap occurs due to damage to the vascular supply while raising the flap. An aggressive attempt to freeing the dartos from the prepuce and the penile shaft leads to vascular failure and, consequently, necrosis of the flap. The other possible causes are haematoma, infections, vascular spasms, and tight dressings.[10] Many surgeons believe that the presence of a good urethral plate, wide glans penis, and adequate local healthy tissue is sufficient to get the best outcome. Cimador *et al*.[11] mentioned that

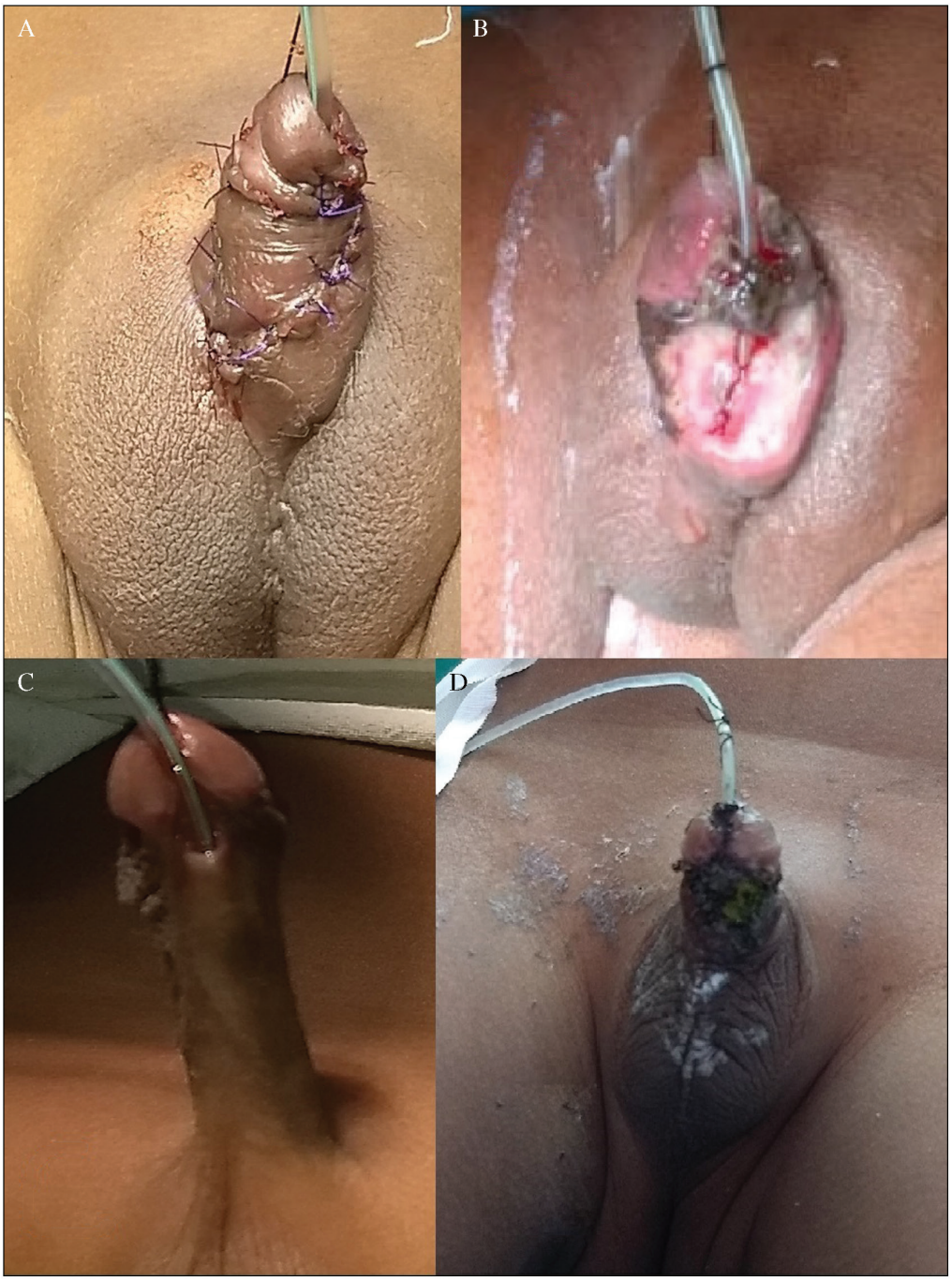

Figure 1: A and B: Postoperative penile rotation and ventral skin necrosis following TIPU with PD flap in a 1-year-7-month-old child. C and D: Picture of a 2-year-old boy with ventral skin necrosis after TIPU with PD flap on the sixth postoperative day

paucity of healthy local tissue plays an important role in the surgical outcome. Considering these, we created objective and subjective criteria and selected our cases. We did not apply extra flaps in cases that had fulfilled the criteria and observed a good outcome [Figure 3].

Ru *et al*.[12] highlighted the value of the width proportion of the urethral plate to the glans for objectivity and accuracy in urethral plate evaluation, which in turn serves as an independent factor influencing outcomes in TIPU. We incorporated the mid-glans width in our criteria. Wound infection and/or ischaemia seems to cause migration of the neo-urethral mucosa and skin epithelium into the suture tracts, resulting in UCF. Jumbi *et al*.[13] found that wound infection and meatal stenosis are the most significant factors causing UCF. Patankar *et al*.[14] described an excellent modification "wide skeletonization" of the urethral plate distally in a "V" fashion rather than "U" to avoid the PO meatal stenosis. Jawale[15] enumerated few points as the rule of hypospadias surgery to reduce the complications, such as: (a) use continuous interlocking sutures and

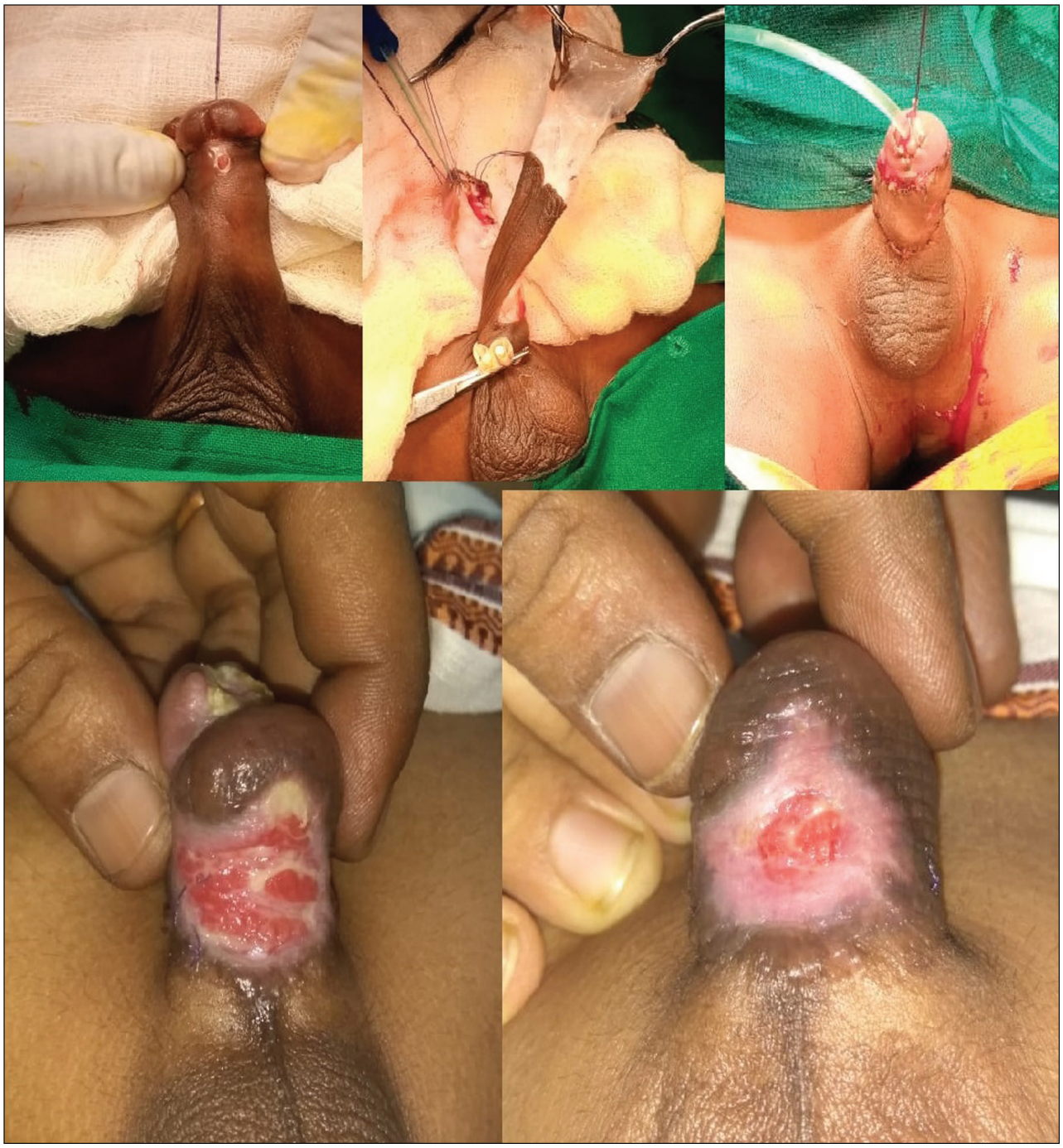

Figure 2: Pictures of postoperative flap necrosis following TIPU with a flap that was healed with conservative therapy

interrupting suture line by taking a knot every five stitches; (b) use dartos flap raised from the scrotum; (c) supra-pubic diversion for 3 weeks; (d) rotating total preputial skin instead of Byar's skin flaps; and (e) use tourniquet instead of adrenaline infiltration and other minor requirements such as compression dressing by elastoplasts, high-protein diet, using bipolar cautery, oxybutynin to prevent bladder contractions, and ornidazole as prophylactic antibiotics. Sheng *et al*.[16] suggested that UCF following hypospadias repair depends on urethral defect length, condition of the urethral plate, associated chordee, and urethral operation history. We excluded the redo cases, proximal hypospadias with severe chordee. Chung *et al*.[17] believed that only the location of the initial meatus (the type of hypospadias) determines the UCF rate, whereas the type of hypospadias repair, suture materials, and operative techniques have no significant effect on the outcome. Gupta *et al*.[18] did not find any statistically significant effect of the suturing technique

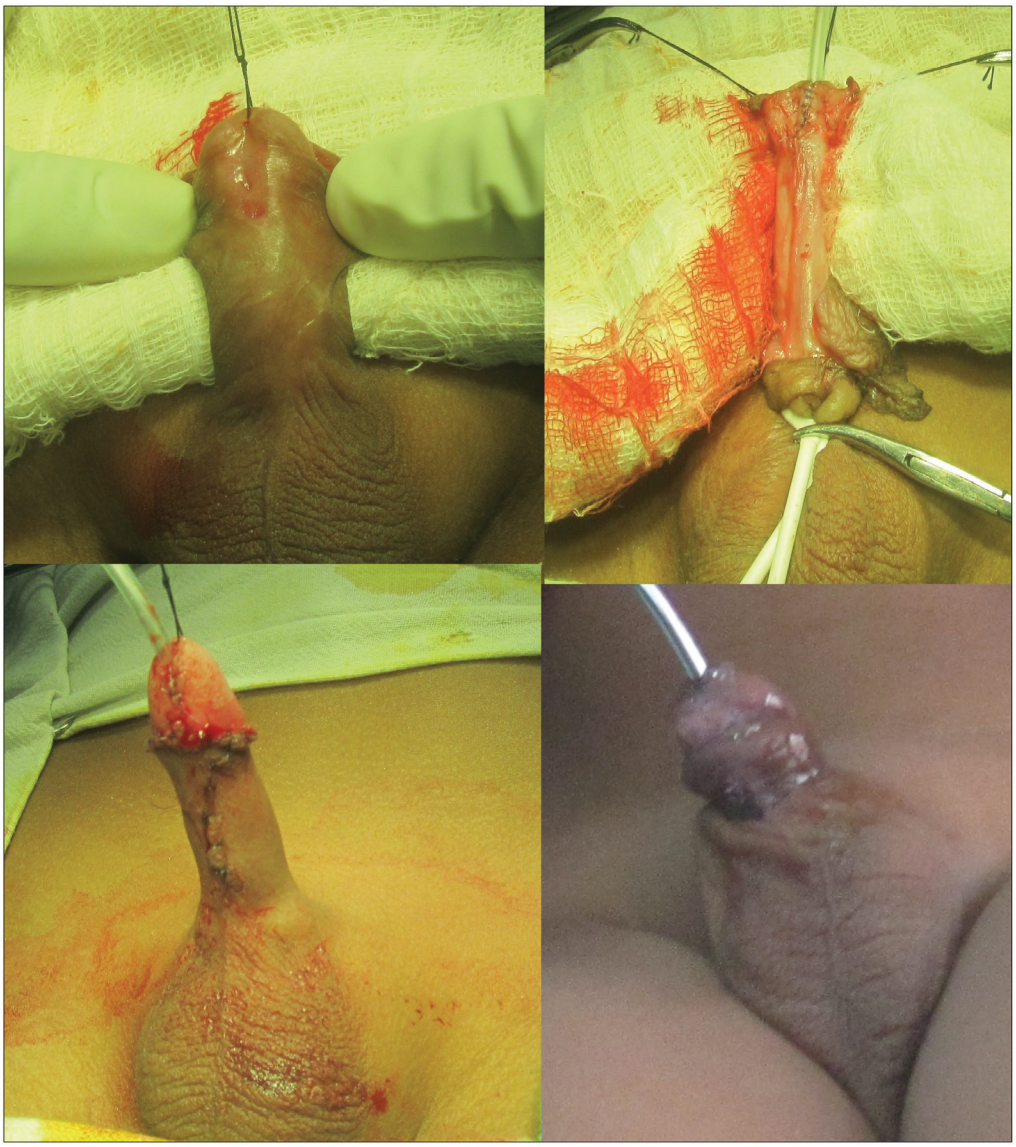

Figure 3: Perioperative pictures of TIPU without a flap in a 1- to 5-month-old boy with distal penile hypospadias who had a healthy urethral plate with enough perimeatal tissue

on the outcome of urethroplasty. Our study was a single surgeon experience with a similar suturing technique that was applied to both groups.

In addition to UCF, surgeons often encounter other complications such as oedema, penile torsion, recurrent curvature, bleeding, haematoma, wound infection, wound dehiscence, preputial dehiscence, glans dehiscence, complete wound breakdown, meatal stenosis, urethral stricture, urethral diverticulum, penile skin deficiency, and abnormal penile skin configuration.[19,20] The rate of PO complications in both the groups in our series is almost the same. It was 25.86% in group A and 23.68% in group B. We experienced that the complications are not prevented by the use of an additional PD flap.

In a questionnaire-based retrospective study by Al-Qudah and Santucci,[21] minor complications (such as scrotal swelling, penile swelling, scrotal ecchymosis, and so forth) occurred in about 39% of the cases and major complications (e.g., urosepsis, chordee, and so on) in 3% of the cases in the early PO period. While in the late PO period, there were 40% of cases and 18% of cases, respectively. However, 97% of the early complications (minor) were resolved but the late complications were resolved only in half of the cases and about 82% of them were minor. Elsherbini[22] mentioned that the success rate of TIPU depends on the integrity of the urethral plate, technical aspects (optical magnification, gentle fragile tissue handling, urethral stenting, avoidance of overlapping suture lines, and excellent suture materials), and surgeon's experiences.[23,24] However, many studies have been carried out regarding the use of the urethral stent in

the repair of distal penile hypospadias, and none has shown its added beneficial effects on the surgical outcome.[25,26] Lack of a healthy or adequate amount of local tissue is equally important and thus urologists prefer to operate in late childhood, giving time to develop the phallus and perimeatal healthy tissue.[27] The concept of local/systemic testosterone therapy has been developed to increase the phallic length and periurethral tissue in selected cases.[28] Garnier *et al*.[29] claimed that delayed surgery may be detrimental in terms of complication rates. In our series, there was no significant correlation between age at surgery and incidence of complications ($P = 0.236$). We did not use spongiosum/tunica flap in either of the groups, which could have a different outcome. But our study reveals that successful outcomes of TIPU do not depend only on the use of an extra PD flap or the status of the urethral plate. Position of the meatus, condition of the native urethral plate, and quality of local tissue are supposed to be independent predictors of TIPU. Additionally, size of the penis, surgical technique, and surgeon's expertise are also important.[30] We feel that the use of extra flap as neourethral coverage in all cases of TIPU is not beneficial. Moreover, urethroplasty without a separate flap is regarded as more beneficial as there is short operating time, less intra-operative bleeding, minimal penile torsion, less PO discomfort, faster recovery, and a comparable well-accepted phallus.

Limitations

One of the limitations in our study may be the limited number of cases ($n = 96$). Other limitations are lack of a multivariable comparison group and retrospective evaluation of the PO outcomes.

Conclusion

We can summarize from our small series that the DH with a good urethral plate and periurethral tissue may not require additional flap during TIPU. The use of an additional flap has its own hazards, and it does not influence the outcome in terms of complications. We assume that the use of an extra flap is not shown to be reasonable in all cases of DH. However, a concrete conclusion could be made only after studying all types of flaps with a multivariable comparison group.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

Authors' contribution

1) P.C.: revising it critically for important intellectual content;
2) K.C.M.: drafting the article;
3) S.R.: analysis and interpretation of data;
4) S.K.T.: data acquisition;
5) P.K.H.: final approval of the version to be published;
6) A.K.: concept and design of the study.

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