20 Acute Postoperative Complications of Hypospadias Repair

Amilal Bhat

20.1 Introduction

Complications in surgical procedures are inevitable, which holds specially true in hypospadias repair with a higher incidence than other reconstructive surgeries. Acute complications occur within the first 7–10 days after the primary surgery. The reported incidence varies from 6 to 30%. The complications correlates with the hypospadias severity, the surgical technique chosen, the penis size, child's age, and the operating surgeon's experience. Common errors are in the initial evaluation of the patient, choice of the technique and peri- and postoperative care [1, 2]. Complication rates are higher in replacement urethroplasties such as skin flap/graft tube or inner prepucial tube than the plate preservation procedures like tubularized urethral plate urethroplasty [3] and a single-stage repair as compared to two-staged procedures. Plate preservation procedures like TIPU and onlay flap are the commonly chosen procedure for distal hypospadias. Fistula and flap necrosis are seen less frequently. The surgery is convenient and has a better cosmetic result in tubularized urethral plate urethroplasty than Mathieu repair [4]. The tubularized incised plate urethroplasty is feasible even in re-do cases with a supple urethral plate. Though the incision in the urethral plate during previous surgery is not a contraindication, but redo TIPU repair is better avoided in patients with a scarred or resected urethral plate [5]. The inner prepucial tube repair is technically more demanding, and complications are higher than onlay flap repair [6, 7]. The most critical risk factor for complications is the severity of the hypospadias, because a severe malformation is often more challenging to treat and requires a long reconstruction. Additionally, the curvature, shortage of tissue, and extensive surgery generally require a staged reconstruction in these cases. Other factors are of lesser importance [8]. Though the results reported in both pediatric age and adulthood are similar. But a few of them have reported variation in wound healing, infection, complication rates, and overall success in cases operated in adult age. The patient undergoing surgery in adulthood should be informed regarding all of these variables to avoid unreasonable expectations [9, 10]. There is a significant learning curve in surgical repair of hypospadias, and results improve with the surgeon's experience [11, 12]. Results are poor in re-operative cases [13] and free graft [3]. Type of

A. Bhat (✉)
Bhat's Hypospadias and Reconstructive Urology Hospital and Research Centre, Jaipur, Rajasthan, India

Department of Urology, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India

Department of Urology, Dr. S.N. Medical College, Jodhpur, Rajasthan, India

Department of Urology, S.P. Medical College, Bikaner, Rajasthan, India

P.G. Committee Medical Council of India, New Delhi, India

Academic and Research Council of RUHS, Jaipur, Rajasthan, India

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urinary diversion, the period of urinary diversion, type of dressing, catheter size, and the anesthetic regime did not influence the outcome significantly. Proper preoperative assessment and planning are essential for good results. An erroneous attempt to apply a minor hypospadias repair to a major deformity would lead to complications and failure. To provide insight into the learning curve for hypospadias repair among fellowship-trained pediatric urologists in the United States, Horowitz and Salzhauer examined complications rates in 231 consecutive patients over 5 years [14]. These investigators demonstrated a significant decrease in fistula rates in each year following completion of fellowship training. Titley and Bracka studied the hypospadias complication rates among plastic surgery trainees and found that the likelihood of complication decreased as the experience was accrued [15]. In a single-institution study, Snyder and associates found a marked discrepancy in success rates between pediatric urologists and other surgical specialists in repairing hypospadias complications (87% vs 33%) [16]. Frimberger and colleagues concluded that among fellowship-trained pediatric urologists in practice for <3 years, fistula rates of <3% should be achievable for distal hypospadias defects [17]. These data imply that the likelihood of success after hypospadias repair is more closely related to the surgical experience of the surgeon than to the specific technique employed. Although this statement is intuitive, technical expertise, training, and judgment play pivotal roles in determining the outcome. Moreover, a better understanding of the factors predisposing to complications helps in their prevention.

20.2 Common Early Postoperative Complications

Common early complications occurring within 7 days of surgery are:

Per operative Bleeding and hematoma, edema

Perioperative Hematoma wound infection, wound dehiscence, fistula, penile torsion, penile erections, skin necrosis, flap necrosis

Catheter-related Inadvertent urethral stent removal, bladder spasms, catheter blockade, catheter knot, and urinary retention.

In order of frequency, immediate postoperative fistula is the commonest complication, followed by edema and penile torsion. Though wound dehiscence is rare & disastrous, only a few cases are reported [1].

20.2.1 Bleeding and Hematoma

Bleeding during hypospadias surgery is inevitable, but sometimes it may occur in the immediate postoperative period. A significant big hematoma is hazardous and may cause wound infection and/or flap and graft devascularization and destroy the repair [18]. There are only a few cases reports in the literature, so hematoma's exact incidence is unavailable. Bleeding and hematoma are more common in adults than in the pediatric age group because of frequent penile erections. Various causes of bleeding are an improper plane of dissection, bleeding from damage to corpus spongiosum and cavernosum or resection of spongiosum for chordee correction, inadequate hemostasis, and rarely bleeding diathesis/dyscrasia. A bloodless operative field is required during hypospadias repair to have a better cosmetic outcome and decrease the failure of the surgery. It remains a challenge to the surgeon to create and maintain a proper plane of dissection and to prevent injury to the corpus spongiosum and cavernosum [1].

Bleeding can be minimized by applying a tourniquet, local injection of adrenaline, using adrenaline-soaked gauze pieces, and bipolar pinpoint cauterization preventing tissue damage. Very fine and least reactive sutures are used for ligating the bleeding vessels. Longer tourniquet and higher pressure to achieve a bloodless surgical field may lead to ischemia and/or reperfusion injury of the urethral wall. Injection of epinephrine may result in more prominent cellular changes as compared to tourniquet techniques [1]. Kajbafzadeh et al. reported that the ultrastructural injuries, apoptotic damages, tissue fibrosis, and cellular damage in the urethral wall were more prominent following epinephrine hemostasis in a rabbit model of hypospadias

repair [19]. Cakmak et al. documented the effect of tourniquet application and epinephrine injection on penile skin. They concluded the epinephrine injection to penile skin exerts a deleterious effect on wound healing [20].

Treatment Fibrin sealants are the useful hemostatic agent and wound healing promoters in urethral reconstructive procedures [21]. Hafez and colleagues reported a fibrin sealant layer with angiogenesis and cellular infiltrate at 2 weeks and the regeneration of normal tunica albuginea without scarring at 6 and 12 weeks on histopathologic examination. In addition, they found no hematomas, no evidence of corporal narrowing, and no venous leakage on cavernosography [22].

Lahoti et al. in 2010 also reported that feracrylum is an effective and safe topical hemostatic agent which reduces the frequency of cauterization and tissue damage, blood loss during surgery, postoperative hematoma, wound edema, and post-surgical complications [23]. In addition, it significantly minimizes diffuse capillary oozing and surface bleeding and thus obtains a clear field during surgery of hypospadias. These agents are not in routine use.

Effective compression dressing and putting in a small drain helps in preventing the hematoma. The sustained and significant bleeding may require exploration to remove the hematoma and coagulate; if any, the bleeding point is identified and ligated or cauterized. A few skin sutures are removed if recognized late to allow the hematoma evacuation and hydrogen peroxide dressing to dissolve adherent clots [1]. Such cases should be evaluated for bleeding diathesis/dyscrasias [24]. Excessive use of cautery or ligature and residual clots may lead to excessive fibrosis and postoperative chordee. Extreme pressure in dressing and hematoma may lead to skin/flap necrosis [1].

20.2.2 Edema

Dartos is commonly used to cover the repair. Dartos is loose, fragile tissue and is susceptible to edema and infection. Neuropeptide's release from the skin nerve sensory endings influences wound healing, and hypospadiac prepuce has less sensory innervations compared to the normal. Nazir et al. found hypo-innervated for PGP 9.5 & CGRP positive nerves compared with the normal prepuce immunohistochemistry results ($P < 0.05$). SP-positive nerves were increased in the prepuce, but the increase was not found to be statistically significant ($P = 0.06$, confidence interval >95%). These differences in the tissue environment partially explain postoperative edema, poor wound healing leading to complications such as urethrocutaneous fistula (UF), and increased analgesia requirement in patients undergoing hypospadias surgery [25]. Postoperative edema reported in the literature is about 11.11% [26]. Edema due to inflammatory response may involve the penis and the scrotum. Typically, edema is seen after the removal of a pressure dressing. Prepucial edema is more common in hypospadias repair with prepucioplasty (Fig. 20.1). The swelling may be aggravated by hematoma or urinary extravasation due to bladder spasm or accidental urethral stent removal. Meatus involvement may lead to splaying of the urinary stream but is rarely of long-term significance [1].

Edema can be prevented by minimal tissue handling using microsurgical instruments and stay sutures, avoiding the lymphatic disconnection, utilizing the suction drain, compressive dressing, and anti-inflammatory drugs.

Isolated edema settles with time unless associated with infection or hematoma and does not cause permanent damage. The dressing plays a crucial role in postoperative edema prevention. Inadequate pressure may cause hematoma, edema, infection and increase the incidence of complications. However, excessive pressure may compromise the blood supply of the flap and skin, which may lead to tissue necrosis [1, 27].

20.2.3 Wound Infection

Mild and localized infections may be due to the decreased vascularity, humidity, high temperature, and proximity to a potentially contaminated area, and serious sepsis is rare after hypospadias repair. Sanders C et al. found a very high 90.90% infection in the swabs from the foreskin but cleared in 82% cases after local

Fig. 20.1 (**a**, **b**) Showing the prepucial edema

preparations swabs. The most commonly grown organisms were Coliforms, and Staphylococcus aureus; was sensitive to cephalosporins and aminoglycosides. Preoperatively taken peri meatal swabs help to choose postoperative antibiotic therapy awaiting hypospadias repair [28]. Bacterial colonization was commonly seen before and after surgery in hypospadias surgery with prepucioplasty. Prepucial hood and glans cleansing at the time of surgery reduces pathogens under the foreskin. Usually, bacterial presence did not impact wound healing, but sometimes the wound infection can be a potential disaster to the repair [1].

Infection is better prevented by prophylactic antibiotics, antibiotic solution use during surgery, povidone-iodine scrubbing, prevention of hematoma, and the Mercurochrome local application [29]. Gentle tissue handling, using skin hooks and stay sutures are helpful in infection prevention. Suprapubic diversion is preferable to intubated perineal urethrostomies in cases of urinary and wound infection [1].

Treatment of infection Obvious sepsis (Fig. 20.2) requires to be treated vigorously with the opening of sutures to let out suppuration drain, irrigation with antibiotic solution, debridement of necrotic tissue, and supplementing with local and systemic antibiotics. Suprapubic urinary diversion is preferred in severe infection, wound disruption, and urinary leak from the open wound. Urethral stent seen through open wound better be removed. However, it can be left in situ if there is a little breakdown in healthy tissue coverings. A rapidly progressive infection in the skin, subcutaneous tissue, and superficial fascia (Necrotizing fasciitis) are rare in hypospadias surgery, and only one such case is reported [30]. Prophylactic antibiotics are advisable to reduce infective complications [31, 32]. Urinary tract infection after hypospadias surgery is not very

Fig. 20.2 Wound infection with fistula trickling the pus from the wound

Fig. 20.3 Prepucial dehiscence

common. and antibiotics are rarely required beyond 7–10 days. The persistence, recurrent and chronic urinary tract infection may be due to urine stagnation in the urethra. It may be because of Urethral diverticula, enlarged prostatic utricle, urethral stone, and dilated urethra in skin tube urethroplasty.

Urethrogram and endoscopy are done in suspected cases to confirm the diagnosis and resection of the utricle, remove urethral stones, and reduction urethroplasty is needed to control the infection [1].

20.2.4 Wound Dehiscence

Wound dehiscence is a rare complication, and the reported incidence is 3.28% [5, 33]. But Lee et al. reported a high incidence (26%) of wound dehiscence [32]. Glans dehiscence is more common in TIP than Mathieu, but flap necrosis is more common in Mathieu [5]. The causes of wound dehiscence are edema, hematoma, infection, erections, diminished blood supply, tension at suture line, weakened suture material, and vigorous removal of dressing [33]. Such type of wound dehiscence may lead to complete failure of the repair. Partial wound dehiscence is noted in cases of prepucioplasty (Fig. 20.3). Wound dehiscence can be prevented by choosing the right technique with its systematic application, dartos fascia cover the urethroplasty, everting the skin edges, and proper postoperative management. Immediate treatment includes removing the devitalized, necrotic tissue, suprapubic urinary diversion, and dressings with antibiotic ointment.

Steristrips approximation of the skin margins will encourage wound closure and minimize scarring in large defects. Secondary suturing of the wound is not advisable. A small raw area is likely to granulate and re-epithelize, but large defects require second surgery after 6 months to 1 year [1].

20.2.5 Skin and Flap Necrosis

The flap or graft devascularization is a crucial complication of hypospadias surgery, and the incidence reported is 7% [7, 34]. Flap necrosis is seen less frequently in pediatric hypospadias repair than in adult hypospadias repair. The causes

ofskin and flap necrosis are damage to vascular supply while raising the flap, hematoma, infection, edema, vascular spasm, and tight pressure dressing leading to the loss blood supply of the flap and skin. Most of the time, the necrosis is superficial and dermal (Figs. 20.4a and 20.5b) and heals without permanent damage to the repair (Figs. 20.4b and 20.5b). In double island urethroplasty, the viability of the neourethra can be evaluated by only looking at the outer face of the flap. The skin and flap necrosis can be prevented by applying a proper surgical technique, maintaining the dissection plane, suitable graft design, adequate hemostasis to avoid hematoma by using pinpoint cautery and broad-spectrum antibiotics to prevent infection [1]. If suspected, the local application of nitroglycerin ointment may prevent vasospasm, and excessive pressure during dressing is avoided.

Treatment of skin and flap necrosis requires debridement of the devitalized part of the graft or flap judiciously. A satisfactory result can still be obtained without re-operating in a small area of devascularization and intact flap pedicle. But the major dehiscence, glanular wing & prepucial dehiscence will need further operative intervention [1].

20.2.6 Urethrocutaneous Fistula

Fistula formation is the most common complication of hypospadias repair, and the incidence varies from 0 [35] to 23% [7]. The fistula rate is lower in TIPU, augmented urethral plate urethroplasty (Snodgraft or onlay flap) than the inner prepucial flap and tube urethroplasty [12]. The commonest fistula site is the coronal

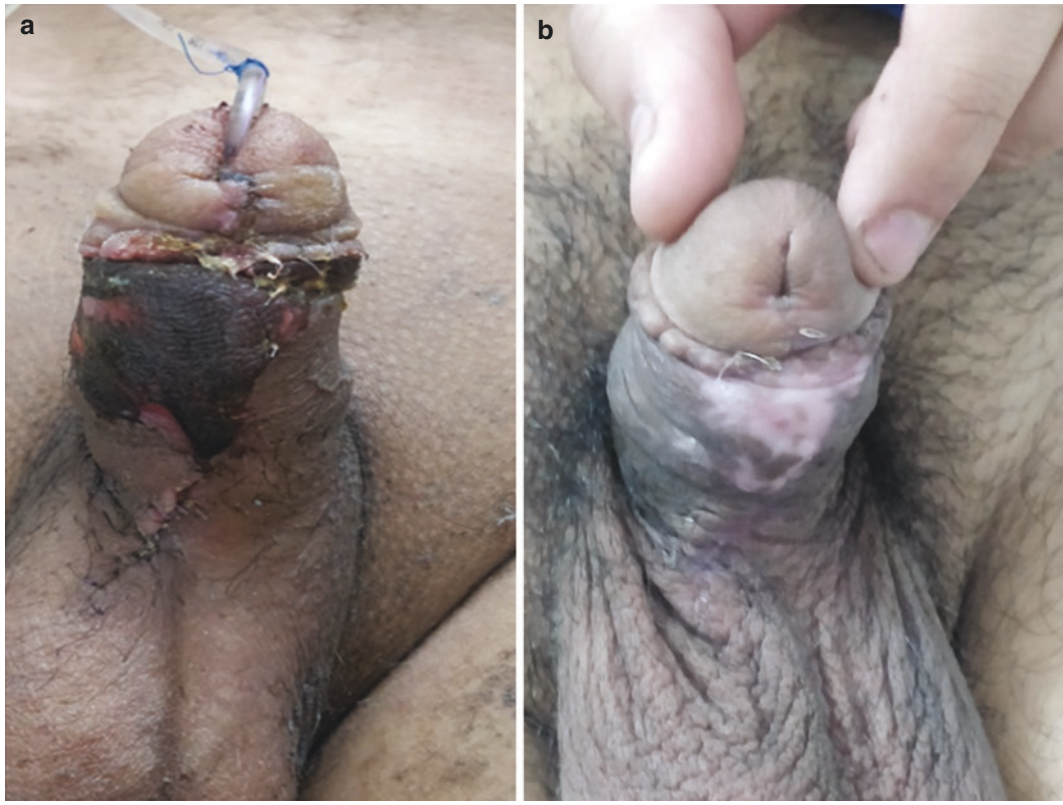

Fig. 20.4 (**a**) Showing superficial skin necrosis. (**b**) Healed with discoloration of the skin

Fig. 20.5 (**a**) Superficial skin necrosis. (**b**) Encrustation

sulcus in incised plate tubularization urethroplasty and anastomosis in flap urethroplasty. But it may occur anywhere in the reconstructed urethra.

Pathophysiology Exact cause of fistulae remains unknown, but it is likely to be a combination of multiple factors, improper technique selection, local ischemia, infection, poor tissue healing, and distal obstruction due to meatal stenosis/encrustation. Fistula formation starts early in the healing process after ventral urethral repair. The incorporation of urethral mucosa in the ventral repair is an epicenter for the formation of the fistula with rapid migration of urethral mucosa and skin epithelium into the suture tracts. The mucosal or dermal migration along suture tracts can be attenuated or prevented by changing the biochemical environment remains to be investigated [36]. Various factor-like hypospadias and chordee severity, urethral plate and spongiosum development, and the surgeon's experience, contribute to the outcome of the surgery. Urine leakage is a strong risk factor, and local infection is moderate when applying stepwise binary logistic regression [37]. Suture material also has an impact on the fistula rate. The fistula was seen significantly higher with 6/0 polyglactin (Vicryl) in a single layer, full-thickness, and uninterrupted fashion (16.6%) compared to 7/0 PDS in subcuticular and uninterrupted fashion (4.9%, $P < 0.01$). Subcutaneous suturing with PDS is preferred in hypospadias repair [38]. However, Chung et al. (2012) reported that hypospadias repair type, suture materials, and surgical technique have no significant effect on the urinary fistula [39]. Dorsal dartos is the most commonly used interposing tissue, and double dartos reduces fistula by almost 50%. Spongiosum is very vascular, and spongioplasty reduces the

chances of fistula (details are described in Chap. 21 on late complications).

Treatment Prevention of the fistula is of paramount importance to reduce the overall complications of hypospadias repair. Besides technical excellence and proper technique selection, people have tried fibrin sealant and Bio-glue surgical adhesive. Fibrin sealant has a unique characteristic of being a tissue adhesive, a hemostatic agent, and sealant, and its injection over the anastomosis prevents urinary leakage and promotes healing, thus helping in the prevention of urinary fistula. Kinahan and Johnson reported lower fistula rate with fibrin in hypospadias 9% (n = 78) vs. 28% (n = 97) [40]. But Kocherov (2013) did not find BioGlue's benefits in decreasing fistula rate and reconstruction breakdowns [41]. Sometimes supra-pubic urinary diversion may help in spontaneous closure of the fistula. The small fistulae are likely to heal in 2–3 weeks after urinary diversion provided there is no meatal stenosis or inflammation. Spontaneous fistula closure was reported in up to 30% [42]. Application n-butyl cyanoacrylate is also used for the repair of early fistula after hypospadias surgery [43]. The use of it does not affect subsequent fistula surgery adversely. Meanwhile, the meatus can be dilated with an ophthalmic ointment tube tip to ensure a satisfactory meatal caliber. Any attempt of fistula closure immediately is likely to fail and should be undertaken only after 3–6 months. Management of established fistula is discussed in Chap. 21 on late complications of hypospadias repair.

20.2.7 Penile Torsion

Penile torsion after the hypospadias may be either due to the uncorrected congenital torsion associated with the hypospadias or traction on the dartos vascular pedicle due to inadequate mobilization. Penile torque is seen in patients of inner prepucial flap/tube repair, the interposition of dorsal dartos healthy tissue cover, and unequal skin flaps during the closure of skin flaps. Penile torsion is more severe in a single dartos flap (mild glanular torsion 90.7% and moderate glanular torsion 9.3%) interposing tissue than double dartos flap (0%) [44]. It can be prevented by adequate mobilization of vascular pedicle/dartos flap up to the root of the penis, bringing the dartos flap ventrally by making a hole in the flap and proper adjustment of skin flaps at the time of skin closure. Mild torsion of <30° does not require any corrective treatment. But moderate to severe torsion should be corrected at least six months after the initial surgery. The techniques of torsion correction are penile degloving and realignment [45]. Plication/suturing the tunica albuginea to pubic periosteum [46, 47], and de-torque by suturing dorsal dartos opposite to torque in primary cases [48].

20.2.8 Penile Erections

Three to eight nocturnal erections during REM sleep are observed in prepubertal boys and adults. Penile erections after hypospadias surgery are more common in adults than the pediatric age group and may lead to a local hematoma, predispose to infection, subsequent devascularization, and increase the chances of complications, especially the urethral fistula. Many methods are used to prevent, but no single treatment method is useful to prevent nocturnal erections postoperatively. The methods used for erection prevention are compressive penile dressing, estrogens, antiandrogens, continuous noradrenaline infusion, chlorpromazine, dorsal nerve block, and patient-controlled epidural analgesia (PCEA). Diazepam is used in doses of 0.1 mg/kg body weight for 7 days postoperatively; have a sedative effect, but still, patients have erections [1]. Estrogens may hinder erections but are less acceptable because of their possible thromboembolic effects. Ketoconazole 400 mg orally three times daily starting on the day of surgery and cyproterone acetate 300 mg daily, started at least 10 days preoperatively, have been reported to help prevent postoperative erections. Johansen et al. reported effective use of a continuous intra-cavernous injection by a micro-infusion pump in 20 patients [49]. However, most of the above-mentioned methods can have side effects related to

drugs. In authors view anti-erotics do not have much role in pediatric age but may reduce the erections in adolescents and adults.

20.2.9 Urethral Stent-Related Problems and Bladder Spasms

The urethral catheter is likely to kink, block or knot and occasionally may slip out or removed inadvertently. Bleeding and inadequate hydration may block the catheter. The urethral catheter irrigation with sterile normal saline usually solves the problem. Rarely the urethral catheter may be removed inadvertently prematurely, leading to catastrophic complications. The problem becomes twofold as the repositioning of the urethral stent may disrupt the neourethra. It is better to put in suprapubic catheter drainage, especially in patients of flap urethroplasty or proximal hypospadias repair if inadvertent auto-removal of the stent occur within 48 h of repair. But accidental removal of the stent after 5 days in well-done TIP in distal hypospadias may be left as such after a single gentle trial of repositioning the stent fails. Catheter Knotting (Fig. 20.6) is an infrequent complication of the urethral stent [50]. Catheter knotting is suspected at the time of catheter removal if the urethral stent is stuck up and requires force for removal. Forceful removal of the stent with a knot should not be done as it will damage the neourethra. Knotting may result from the coiling of the intravesical catheter. During bladder decompression, the catheter tip can migrate through a coil leading to a knot, or postoperative bladder spasms may aggravate the knotting during longer catheterization [51]. Proper placement of the catheter and optimum duration of catheterization may prevent knotting. The tricks in catheter placement are that the urethral tube is introduced into the bladder, withdrawn slowly till the urine stops dribbling. Now the tip of the feeding tube lies just distal to the bladder neck and then pass the tube slowly in again till urine starts draining (the end is just proximal to the bladder neck); push the tube in a further 2–3 cm and anchor it at this position with the glans traction suture. The maneuver not only prevents knotting but troublesome bladder spasms also. The

Fig. 20.6 Knotting of the urethral stent

percutaneous suprapubic route should be preferred to remove knotted stents. In pediatric cases, knotting of suprapubic catheters has been reported in longer catheterization, bladder decompression and spasms [52, 53]. Despite all, bladder spasms still may be troublesome and require anticholinergics like oxybutynin. Rotation of urosac is likely to kink the urethral stent; this can be prevented by adequately fixing the stent and urine collection bag and educating the mother to avoid tube kinking. Meatal encrustations after removal of the stent may require regular cleaning and application of ointment locally [1].

20.3 Conclusions

1. Complications are higher in severe hypospadias and flap/graft procedures in adults than in childhood plate preservation procedures.
2. Overall, most of the early complications can better be prevented to avoid disasters.
3. Most common complication of hypospadias repair is a fistula, and healing is spontaneous

in about one-third of cases in the absence of distal obstruction.
4. Hypospadias surgery has a long learning curve, and outcomes become better with the surgeon's experience.
5. Surgery should be avoided in acute complications, except exploration for bleeding, infection, or debridement.
6. Preoperative planning can minimize complications (<5% in distal hypospadias and <10% in proximal hypospadias) by choosing an appropriate surgical technique, surgical expertise, operating in childhood, using magnification, fine suture material and judicious postoperative management.

References

1. Bhat A, Mandal AK. Acute postoperative complications of hypospadias repair. Indian J Urol IJU: J Urol Soc India. 2008;24(2):241.
2. Beuke M, Fisch M. Salvage strategies after complications of hypospadias repair. Der Urologe Ausg A. 2007;46(12):1670–5.
3. Powell CR, Mcaleer I, Alagiri M, Kaplan GW. Comparison of flaps versus grafts in proximal hypospadias surgery. J Urol. 2000;163(4):1286–9.
4. Snodgrass W, Lorenzo A. Tubularized incised-plate urethroplasty for hypospadias reoperation. BJU Int. 2002;89(1):98–100.
5. Guo Y, Ma G, Ge Z. Comparison of the Mathieu and the Snodgrass urethroplasty in distal hypospadias repair. Zhonghua nan ke xue=Natl J Androl. 2004;10(12):916–8.
6. Njinou B, Terryn F, Lorge F, Opsomer R, De PG, Veyckemans F, et al. Correction of severe median hypospadias. Review of 77 cases treated by the onlay island flap technic. Acta Urol Belg. 1998;66(1):7–11.
7. Elbakry A. Complications of the preputial island flap-tube urethroplasty. BJU Int. 1999;84:89–94.
8. Hansson E, Becker M, Åberg M, Svensson H. Analysis of complications after repair of hypospadias. Scand J Plast Reconstr Surg Hand Surg. 2007;41(3):120–4.
9. Hensle TW, Tennenbaum SY, Reiley EA, Pollard J. Hypospadias repair in adults: adventures and misadventures. J Urol. 2001;165(1):77–9.
10. Dodson JL, Baird AD, Baker LA, Docimo SG, Mathews RI. Outcomes of delayed hypospadias repair: implications for decision making. J Urol. 2007;178(1):278–81.
11. Castañón García-Alix M, Martín Hortigüela ME, Rodó Salas J, Morales FL. Complications in hypospadias repair: 20 years of experience. Cirugia pediatrica: organo oficial de la Sociedad Espanola de Cirugia Pediatrica. 1995;8(3):118–22.
12. Uygur MC, Ünal D, Tan MÖ, Germiyanoğlu C, Erol D. Factors affecting the outcome of one-stage anterior hypospadias repair: analysis of 422 cases. Pediatr Surg Int. 2002;18(2-3):142–6.
13. Emir L, Germiyanoglu C, Erol D. Onlay island flap urethroplasty: a comparative analysis of primary versus reoperative cases. Urology. 2003;61(1):216–9.
14. Horowitz M, Salzhauer E. The learning curve in hypospadias surgery. BJU Int. 2006;97(3):593–6.
15. Titley OG, Bracka A. A 5-year audit of trainees experience and outcomes with two-stage hypospadias surgery. Br J Plast Surg. 1998;51(5):370–5.
16. Snyder CL, Evangelidis A, Hansen G, Peter SDS, Ostlie DJ, Gatti JM, et al. Management of complications after hypospadias repair. Urology. 2005;65(4):782–5.
17. Frimberger D, Campbell J, Kropp BP. Hypospadias outcome in the first three years after completing a pediatric urology fellowship. J Pediatr Urol. 2008;4(4):270–4.
18. Grobbelaar A, Laing J, Harrison D, Sanders R. Hypospadias repair: the influence of postoperative care and a patient factor on surgical morbidity. Ann Plast Surg. 1996;37(6):612–7.
19. Kajbafzadeh A-M, Payabvash S, Tavangar SM, Salmasi AH, Sadeghi Z, Elmi A, et al. Comparison of different techniques for hemostasis in a rabbit model of hypospadias repair. J Urol. 2007;178(6):2555–60.
20. Cakmak M, Caglayan F, Kisa U, Bozdogan O, Saray A, Caglayan O. Tourniquet application and epinephrine injection to penile skin: is it safe? Urol Res. 2002;30(4):268–72.
21. Hick EJ, Morey AF. Initial experience with fibrin sealant in pendulous urethral reconstruction. Is early catheter removal possible? J Urol. 2004;171(4):1547–9.
22. Hafez AT, El-Assmy A, El-Hamid MA. Fibrin glue for the suture-less correction of penile chordee: a pilot study in a rabbit model. BJU Int. 2004;94(3):433–6.
23. Lahoti BK, Aggarwal G, Diwaker A, Sharma SS, Laddha A. Hemostasis during hypospadias surgery via topical application of feracrylum citrate: a randomized prospective study. J Indian Assoc Pediatr Surgeons. 2010;15(3):87.
24. Horton CE Jr, Horton CE. Complications of hypospadias surgery. Clin Plast Surg. 1988;15(3):371–9.
25. Nazir Z, Masood R, Rehman R. Sensory innervation of normal and hypospadiac prepuce: possible

implications in hypospadiology. Pediatr Surg Int. 2004;20(8):623–7.
26. Nonomura K, Kakizaki H, Shimoda N, Koyama T, Murakumo M, Koyanagi T. Surgical repair of anterior hypospadias with fish-mouth meatus and intact prepuce based on anatomical characteristics. Eur Urol. 1998;34(4):368–71.
27. Gangopadhyay A, Sharma S. Brief Report-Peha-haft bandage as a new dressing for pediatric hypospadias repair. Indian J Plast Surg. 2005;38(2):162–4.
28. Ratan S, Sen A, Ratan J. Pattern of bacterial flora in local genital skin and surgical wounds in children undergoing hypospadias repair: a preliminary study. Int J Clin Pract. 2002;56(5):349–52.
29. Ratan S, Sen A, Ratan J, Pandey R. Mercurochrome as an adjunct to local preoperative preparation in children undergoing hypospadias repair. BJU Int. 2001;88(3):259–62.
30. Luo C-C, Chao HC, Chiu CH. Necrotizing fasciitis: a rare complication of hypospadias surgery in a child. J Pediatr Surg. 2005;40(4):E29–31.
31. Meir DB, Livne PM. Is prophylactic antimicrobial treatment necessary after hypospadias repair? J Urol. 2004;171(6 Part 2):2621–2.
32. Lee Y-C, Huang C-H, Chou Y-H, Wu W-J, Lin C-Y. The outcome of hypospadias reoperation based on preoperative antimicrobial prophylaxis. Kaohsiung J Med Sci. 2005;21(8):351–7.
33. İmamoğlu MA, Bakırtaş H. Comparison of two methods–Mathieu and Snodgrass–in hypospadias repair. Urol Int. 2003;71(3):251–4.
34. Chin T, Liu C, Wei C. Hypospadias repair using a double onlay preputial flap. Pediatr Surg Int. 2001;17(5–6):496–8.
35. Kass EJ, Bolong D. Single-stage hypospadias reconstruction without fistula. J Urol. 1990;144(2 Part 2):520–2.
36. Edney MT, Lopes JF, Schned A, Ellsworth PI, Cendron M. Time course and histology of urethrocutaneous fistula formation in a porcine model of urethral healing. Eur Urol. 2004;45(6):806–10.
37. Ratan S, Sen A, Pandey R, Hans C, Roychaudhary S, Ratan J. Lesser evaluated determinants of fistula formation in children with hypospadias. Int J Clin Pract. 2001;55(2):96–9.
38. Ulman I, Erikci V, Avanoğlu A, Gökdemir A. The effect of suturing technique and material on complication rate following hypospadias repair. Eur J Pediatr Surg. 1997;7(03):156–7.
39. Chung J-W, Choi SH, Kim BS, Chung SK. Risk factors for the development of urethrocutaneous fistula after hypospadias repair: a retrospective study. Korean J Urol. 2012;53(10):711–5.
40. Kinahan T, Johnson H. Tisseel in hypospadias repair. Can J Surg/Journal Canadien de Chirurgie. 1992;35(1):75–7.
41. Kocherov S, Lev G, Chertin B. Use of bioglue surgical adhesive in hypospadias repair. Curr Urol. 2013;7(3):132–5.
42. Lay L, Zamboni WA, Texter JH, Zook EG. Analysis of hypospadias and fistula repair. Am Surg. 1995;61(6):537–8.
43. Ambriz-Gonzalez G, Velazquez-Ramirez GA, Garcia-Gonzalez JL, de León-Gómez JMG, Mucino-Hernandez MI, Gonzalez-Ojeda A, et al. Use of fibrin sealant in hypospadias surgical repair reduces the frequency of postoperative complications. Urol Int. 2007;78(1):37–41.
44. Kamal BA. Double dartos flaps in tubularized incised plate hypospadias repair. Urology. 2005;66(5):1095–8.
45. Bar-Yosef Y, Binyamini J, Matzkin H, Ben-Chaim J. Degloving and realignment—simple repair of isolated penile torsion. Urology. 2007;69(2):369–71.
46. Hsieh J-T, Liu S-P, Chen Y, Chang H-C, Yu H-J, Chen C-H. Correction of congenital penile curvature using modified tunical plication with absorbable sutures: the long-term outcome and patient satisfaction. Eur Urol. 2007;52(1):261–7.
47. Zhou L, Mei H, Hwang AH, Xie H-w, Hardy BE. Penile torsion repair by suturing tunica albuginea to the pubic periosteum. J Pediatr Surg. 2006;41(1):e7–9.
48. Fisher PC, Park JM. Penile torsion repair using dorsal dartos flap rotation. J Urol. 2004;171(5):1903–4.
49. Johansen L, Kirkeby H, Kiil J. Prevention of erection after penile surgery. Urol Res. 1989;17(6):393–5.
50. Singh R, Pavithran NM, Parameswaran RM. The knotting of the feeding tube is used for bladder drainage in hypospadias repair. 2005.
51. Mayer E, Ankem MK, Hartanto VH, Barone JG. Management of urethral catheter knot in a neonate. Can J Urol. 2002;9(5):1649–50.
52. Arda İS, Özyaylali İ. An unusual complication of suprapubic catheterization with Cystofix: catheter knotting within the bladder. Int J Urol. 2001;8(4):188–9.
53. Gardikis S, Soultanidis C, Deftereos S, Kambouri K, Vaos CG, Touloupidis S, et al. Suprapubic catheter knotting: an unusual complication. Int Urol Nephrol. 2004;36(4):537–9.