Autologous saphenous vein graft as a urethral substitute for recurrent and proximal hypospadias

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Introduction
Hypospadias is a congenital anomaly occurring in 0.3–5% of newly born males. Techniques for reconstructions of the urethra are: operations using local tissue flaps especially the prepuce or operations using distant flaps such as: skin, oral mucosa, bladder mucosa, intestinal mucosa, and tunica vaginalis or vein graft.

The aim
The aim of this study is to evaluate the efficacy of autologous saphenous vein graft as a urethral substitute in recurrent and proximal hypospadias.

Study design
This is a case series study which involved 11 patients (4–15) years old with recurrent or proximal hypospadias who presented to Mansoura university hospital during the period from January 2013 to September 2014. All patients underwent a vein graft as a urethral substitute.

Results
The follow-up range: (6–19 months), with a median of 10.3 months. Complications developed in 4/11(36%). 1 case suffered from early postoperative penile hematoma, another patient developed early fistula and 2 cases developed meatal stenosis.

Discussion
There are various urethral replacement by extra genital tissue which may be needed especially in circumcised infants and those with proximal or recurrent hypospadias. Veins used as urethral substitute usually are: saphenous, external jugular or the internal jugular because of their accessibility, available length and good caliber when compared with the urethral diameter. Although the study has the limitations of small number of cases and short follow up period we believe that it can pave the way for large multicenter studies which may give a new tool adding to our armamentarium in our struggle for the optimum cure for hypospadias especially recurrent and proximal case.

Conclusion
autologous saphenous vein urethroplasty is a simple, safe, and effective procedure for hypospadias.

Keywords:
autologous vein, hypospadias, urethral substitute

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Introduction

Hypospadias is a rather common congenital anomaly occurring in 0.3–5% of new-born boy babies [1]. It is due to incomplete formation of the urethra usually during the 10th–14th week of gestation [2].

There is a family incidence of 12–14% in first-degree relatives, which may suggest genetic predisposition in some cases [3]. Usually, hypospadias occurs as an isolated anomaly, despite being described as a part of more than 200 different congenital anomaly syndromes [4]. Hypospadias has a large psychological impact on the parents of the child as regards its disfigurement and its future impact on the patient's sexual ability [1]. There are many factors that can affect the time of surgery, such as patient environment, anesthetic risks, and the parents' expectations for the genital surgery [5]. After 6 months of age, provided there are specialist anesthetists and a dedicated pediatric facility, usually there is not much added risk compared with older children [6].

Many studies have attempted to define the optimum time for surgical intervention in hypospadias and have reported varying results, ranging from 2 to 11 months [7], before 15 months [8], and before 18 months of age [9]. American Academy of Pediatrics, in 1996, suggested that the optimal age for surgical intervention in hypospadias is between 6 and 12 months of age [10]. Administration of testosterone hormone may be beneficial in small-size penis [11].

First successful repair was reported in 1874 by Anger [12]. Since then, many different techniques have emerged and may reach up to more than 200 different distinct techniques [1].

At these early times, it was rather a standard to perform the surgery in a staged manner, such as CECIL three-

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staged approach for complicated hypospadias cripple, which was introduced in 1940 [13].

In 1959, Devine and Horton [14] suggested one-stage repair for hypospadias, and nowadays the trend is to perform the surgery even in proximal or complicated cases in single repair to decrease the incidence of complications.

The techniques for reconstructions of the urethra can be classified into two main categories: the first involves operations using local tissue flaps, especially the prepuce; and the second involves operations that entail the use of distant flaps such as skin, oral mucosa, bladder mucosa, intestinal mucosa, and tunica vaginalis [15].

Obviously, the prepuce is the most convenient substitute for urethra as it is from the same locality, with no skin appendages; thus, we do not have the problem of subsequent hair growth, and this will decrease the incidence of stone formation. Moreover, it has good elastic properties and so will cope well with the erectile function. However, it may be deficient in circumcised infants and in re-do cases; in addition, it may not give the desired length in proximal cases [15].

Therefore, the search continues for the ideal urethral substitute that would provide enough length in proximal types and good elasticity to cope with erection without curvature. It also should be pretubularized to avoid a longitudinal suture line, thus decreasing the possibility of fistula formation [1].

The aim of this study was to evaluate the efficacy of autologous saphenous vein graft as a urethral substitute in hypospadias cases, especially recurrent and proximal cases.

Figure 1

Creation of the tunnel.

Patients and methods

This study included 11 patients between 4 and 15 years of age, with a mean of 7 years, with recurrent or proximal hypospadias, who presented to Mansoura University Hospital during the period from January 2013 to September 2014 (Table 1). All patients underwent vein grafts for urethral substitute. Preoperative history taking, general and local examination, and routine investigations, including duplex assessment of great saphenous vein diameter and patency, were carried out. Those with anterior penile hypospadias or vein diameter less than 3 mm were not chosen for this technique. Informed written consent was obtained from the parents. The study was approved by the local ethical committee of Mansoura university hospitals.

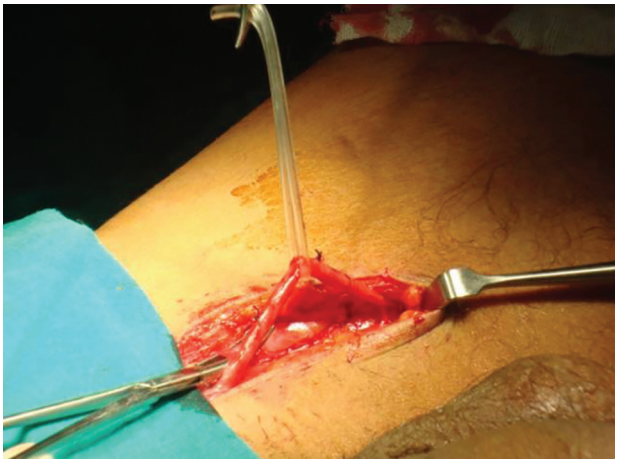
Procedure

All cases were performed under general anesthesia in a supine position. A nelaton catheter of 8–10 Fr was inserted into the urethra and sutured to the glans. The urethral opening is mobilized with freshening of the edge. A tunnel for the neourethra was created in the ventral skin (Fig. 1) from the location of the proximal urethra to the distal, along the penile length. A longitudinal midline deep incision on the glans was made to avoid the narrowing of neourethra. The saphenous vein was exposed and harvested as a double length of the stretched urethra to be reconstructed to counteract the possibility of graft contracture and morning erection (Fig. 2). Ligation of the vein branches and marking of the caudal end of

Table 1 Types of hypospadias

Types of hypospadias	Number of cases
Proximal penile	4
Penoscrotal	2
Recurrent	5

Figure 2



Great saphenous vein harvest.

harvested vein were carried out. Then the vein was dilated by occluding one end with bulldog clamp and injecting heparinized saline from the other end with checking for any leaks from side branches that was managed by either ligature with 4/o absorbable (vicryl) suture if there is enough length of the cut stump or sutured with 6/0 non-absorbable (prolene) in case of short or no stump (Fig. 3). The catheter was passed through the tunnel from distal to proximal; the harvested vein was inserted into the catheter from its cranial end; and the catheter tip was inserted into proximal urethra to the bladder. Thereafter, suturing the caudal end of the harvested vein with the proximal urethra in oblique manner ,with continuous nonabsorbable 7/0 under loupe magnification, and the cranial end with the skin at the tip of the glans were performed (Figs. 4 and 5). Two wings of the glans were closed with 5/0 absorbable sutures. The urethral catheter was removed after 3 weeks.

Results

None of the patients showed familial incidence or gave history of maternal risk factors. Only one patient showed right undescended testis as an association.

The follow-up period ranged between 6 and 19 months, with a median of 10.3 months. Complications developed in 4/11 (36%) cases. One case suffered from early postoperative penile hematoma, which was clinically insignificant and resolved spontaneously. Another patient developed early fistula, which requires re-exploration and repair. Two cases developed meatal stenosis after 5 and 6 months of follow-up, which was treated with application of urethral catheter for another 2 weeks. No early postoperative infection was noted. The parents were satisfied with this repair and reported normal urination with good healing.

Discussion

There are various urethral replacement with extragenital tissue that may be needed as we have mentioned earlier, especially in circumcised infants and those with proximal or recurrent hypospadias.

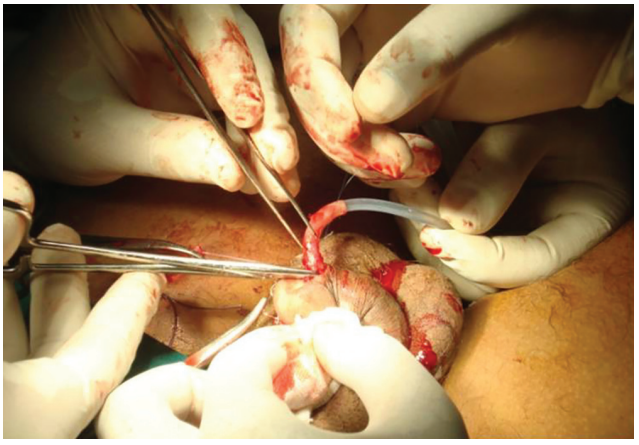
The extragenital replacing tissue may be ureter [16], vermiformappendix[17],skingraft[18],oralmucosa[19], bladder mucosa [20], tunica vaginalis [21], intestinal, and colonic mucosa [22,23].

Tissue-engineered grafts and porcine acellular matrix are two new promising techniques that may have a major impact on the future of urethral replacement surgeries [24–26].

Figure 3

Great saphenous vein dilatation.

Figure 4



Proximal anastomosis.

Figure 5

Distal anastomosis.

The vermiform appendix, together with the ureter, as a urethral substitute is a rather historical method with

no recent trials, and has been surpassed by other less invasive methods with less complications.

Skin grafts have low elasticity and may not cope well with the erectile properties needed for the ideal urethral substitute, liable for contracture and hair growth even if harvested from nonhairy areas, which may lead to stone formation [27].

Oral and bladder mucosa are relatively thin so they are more prone to ballooning and they may not provide enough length needed for repair especially in proximal types and this may also may occur with tunica vaginalis. All three substitutes have the disadvantage of not being tabularized, which mandates a longitudinal suture line, thus increasing the incidence of fistula formation [1,15].

Oral mucosal graft can be harvested from buccal, abial, or lingual mucosa [28–31].

The use of autologous vein graft outside the vascular system has been attempted both experimentally and clinically in bile duct replacement [32,33], ureter replacement [34–36], and urethra in both hypospadias and urethral stricture.

Veins used as urethral substitute usually are saphenous, external jugular, or the internal jugular because of their accessibility, available length, and good caliber as compared with the urethral diameter [37].

The internal jugular vein has the advantages of being valveless and of good diameter [38], but the great saphenous vein can provide more length and can be harvested endoscopically unlike the internal jugular vein [39].

Vein graft urethroplasty was described more than a 100 years ago by Tanton and colleagues [40–43].

The results obtained by those pioneer innovative researchers were poor due to lack of magnification and the limited resources in instruments, sutures, and medications.

In the 1970s, Kjaer *et al.* [44] and Breitenecker *et al.* [45] used lypholized vein grafts in urethra and vascular system and they both reported more satisfactory results as regards neoepithelialization, but they had a drawback of crypts and polyps at their anastomotic sites.

Frang *et al.* [46], tried vein graft in a canine model but he reported poor results that were attributed to persistence of valves.

Later, Hubner *et al.* [47] and Foroutan *et al.* [38] tried using everted vein graft, whereas Kim *et al.* [48] incised the vein longitudinally and performed excision of the valves, and Kahveci *et al.* [49] used the vein as urethral substitute. All of them reported good results with low incidence of fistulae and strictures, and some also proved histological changes of vein endothelium into uroepithelium.

In 2006, Shaeer and El-Sadat [15] reported their first experience with vein graft in an 8-year-old child with hypospadias, which showed good results after 1 year, with forward stream, no fistula, and no curvature on morning erection. This motivated Keshk *et al.* [1] 3 years later, in 2009, to publish their report on vein graft in hypospadias in eight patients with promising results, with only two fistula and one meatal stenosis case.

Therefore, we present this study as a next step in searching for the best urethral substitute, especially in recurrent or re-do case, hoping it can pave the way for larger multicenter studies with longer follow-up periods.

In our study, we did not remove the adventitia of the vein and this was also reported in the study by Keshk and colleagues but Shaeer and El-Sadat in their study removed the adventitia of the vein. We believe that the multilayer normal anatomy of the vein is rather an advantage in securing the anastomosis, thereby acting as an additional supporting layer similar to covering urethral repairs with the dartos [50], external spermatic fascia [51], or tunica vaginalis flaps [52]. Moreover, circumferential stenosis can be prevented by spatulation of both the urethral opening and the vein.

On comparing our results with the available two clinical nonexperimental studies, they were found to be promising with only one case of fistula and one case of meatal stenosis, which needed dilatation.

Study limitations

We acknowledge these potential limitations of our study:

(1) Small number of cases.
(2) Short follow-up period.

Conclusion

Autologous saphenous vein urethroplasty is a simple, safe, and effective procedure for hypospadias with acceptable results, especially for proximal type, which needs a long neourethra, and a: for recurrent o or circumcised cases without enough healthy local tissue for repair.

Acknowledgements

Conflicts of interest

None declared.

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