



An Updated Systematic Review Of Skin Grafts In Urethral Stricture Disease

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Abstrak

Uretra pada pria memiliki fungsi ganda yaitu sebagai jalur urin dan jalur air mani dari organ reproduksi, Tujuan dari tinjauan literatur ini adalah untuk mengetahui beberapa perawatan yang tepat untuk masalah penyakit Striktur Uretra. Metode penelitian ini menggunakan deskriptif kualitatif dengan pendekatan systematic literature review (SLR). Merupakan jenis artikel review yang bertujuan untuk menemukan bukti-bukti kemanjuran klinis (evidence-based) dari suatu masalah, sehingga didapatkan suatu saran pemecahan masalah. Metode pengumpulan data melalui dokumentasi, pencarian dan penggalian data dari dokumen jurnal/buku terkait terkait skin graft pada penyakit struktur uretra. Analisis data menggunakan analisis anotasi bibliografi. Hasil literatur yang ditemukan antaranya; Teknik urethroplasti dianggap sebagai teknik bedah yang minimal invasif dan lebih efisien daripada uretrotomi dan jenis cangkok, mukosa mulut dan mukosa gelniltal telah menjadi matelrilal substiltutel standar emas untuk relokasi struktur uretra, meskipun telah mengalami perkembangan pesat dalam pengembangan cangkok uretra. Ahli urologi relkonstruksi harus terbiasa dengan berbagai jenis alat bantu untuk memastikan bahwa alat bantu yang dipilih sesuai dengan kebutuhan yang disebabkan oleh endapan lumpur.

Abstract

The urethra in men has a dual function, namely as a pathway for urine and a pathway for semen from the reproductive organs. The purpose of this literature review is to find out some appropriate treatments for the problem of Urethral Stricture disease. This research method uses descriptive qualitative with a systematic literature review (SLR) approach. It is a type of article review that aims to find evidence of clinical efficacy (evidence-based) of a problem, so that a problem-solving suggestion is obtained. Data collection method was through the documentation of searching and digging data from relevant journals/ books documents related to skin grafts in urethral structure disease. Data analysis used the analysis of bibliographic annotations . The results of the literature found include; The urethroplasty technique is considered a minimally invasive surgical technique and is more efficient than urethrotomy and the type of graft, oral mucosa and gelniltal mucosa have become the gold standard matelrilal substiltutel for relocation of urethral structures, although there has been rapid progress in the development of urethral grafts. The reconstructive urologist should be familiar with the different types of assistive devices to ensure that the selected assistive device is suitable for the needs caused by siltation.

Keywords:

PENDAHULUAN

The kidneys are the organ of the body and the urinary tract with the main function of forming urine output of substances that are not used by the body (Ginanjar, 2017). The kidneys have the function to remove toxic substances and the rest of the body's metabolic results in the form of urine. It also has a function in producing and regulating hormone secretion, regulating the metabolism of calcium ions and vitamin D, and also maintaining the balance of body fluids. Urine from the kidneys is then passed to the bladder through a small tube called the ureter. If there is a urinary blockage, so there is excessive muscle contraction to push it from the ureter. Its excessive contraction is called colicky pains, the pain of which corresponds to the rhythm of peristaltic movements of the ureter (Gliselda, 2021).

The urethra is the last pathway in the urine output of the body. The urethra in men has a dual function as a urine pathway and a semen pathway from the reproductive organs. The male urethra anatomically is divided into two parts, in which the posterior urethra and the anterior urethra (Lumen et al., 2009). The posterior urethra consists of the prostatic pars urethra, which is the part of the urethra that is enclosed by the prostate gland, and the membranous pars urethra which located more inferior to the prostatic pars. Meanwhile, the anterior urethra is the longest part of the urethra wrapped by the corpus spongiosum of the penis. The urethra is equipped with two sphincter muscles that are used for holding the rate of urine. The internal urethra, located on the border of the bladder and urethra, is innervated by the sympathetic system, so that the sphincter will open if the bladder is full. The external urethral sphincter is located on the border of the posterior urethra with the anterior urethra, innervated by a somatic system that can be directed as someone's urge (Chris Tanto & Hustrini, 2020).

Urinary blockage system is a medical emergency since it can cause mortality for the patient. Blockages can occur in both the upper urinary tract and the lower urinary tract. Obstructions of the upper urinary tract involve the kidney and ureter organs. These can give clinical manifestations in the form of colicky pain or anuria. Whereas, the blockage of the lower urinary tract in the bladder and urethra causes urinary retention (Dornbier et al., 2019; Suardani, Nasokha, & Majidah, 2021).

Urinary retention is the inability to excrete urine in accordance with the urge, so that the urine collected in the bladder exceeds to the maximum limit (Fuller et al., 2019). One of the causes is a constriction of the urethra lumen due to fibrosis of its walls, which is called urethral stricture. Curative treatment of this disease is through surgery. However, not infrequently some surgical techniques can cause high disease recurrence for patients. Therefore, proper and adequate treatment are needed to avoid the risk of recurrence of urethral stricture disease (Watkin & Patel, 2020).

The urethral stricture due to constriction of the urethral lumen is because scarring and contraction. This disease more commonly happens in men than women due to the difference in the length of the urethra. The adult male urethra ranges from 23-25 cm, while the female urethra is about 3-5 cm. That is why the male urethra is more susceptible to infection or trauma than women. Several other risk factors are known to have a role in the incidence of this disease, including having been exposed to sexually transmitted diseases, African race, aged over 55 years, and living in urban areas (Frisch & Simonsen, 2018).

Strictures can occur in all parts of the urethra, but the most frequent in adults is in the part of the pars bulbosa-membranasea, while in the pars prostatic, it affects children more often (Ansari, Yadav, Srivastava, Kapoor, & Ashwin Shekar, 2019; Podesta & Podesta, 2019). The infection that most often causes urethral stricture is infection by gonococcal germs, which have previously infected the urethra (Furr & Gelman, 2020). The trauma that can cause urethral stricture which is blunt trauma to the groin (straddle injury), pelvic bone fractures, or post-surgical injuries resulting from insertion of surgical equipment during transurethral surgery, catheter insertion, and cystoscopic procedures. In this case, congenital strictures are extremely rare. This stricture is caused by an inadequate connection between the anterior and posterior ureters, in the absence of trauma or inflammatory factors (Lazzeri, Sansalone, Guazzoni, & Barbagli, 2016).

One action to the rethral stricture management is urethral dilatation, direct visual internal urethrotomy (DVIU), urethral stents, and urethroplasty. Based on the results of the study, urethroplasty is the most optimal surgical option (Mershon & Baradaran, 2021). In substitution urethroplasty, a graft is performed on the stricture tissue. Grafting was performed using graft taken from the prepuce, oral mucosa, or skin of the upper thigh. The oral mucosa is graft which is more

suitable than leather. Some studies show that the use of lingual mucosa has lower complications than buccal mucosa (Anonymous., 2020; Chung & Suarez, 2020).

There are several studies related to grafting. One study examined the surgical outcomes of augmentation urethroplasty (AU) using penile skin graft (PSG) compared to buccal mucosa graft (BMG) in anterior urethral stricture disease (Tyagi et al., 2022). This study found that this grafting was quite effective and successful by using both skin sources. Unlike the research conducted by Tyagi* et al., (2020) which pointed out that the first attempt is to determine the non-inferior and comparable success rates after SU with IPG v/s BMG through a prospective randomized methodology. Results showed that: Mean follow-up was 12 months (3-19). The overall success rate was 83% (84% in the BMG and 81% in the IPG arm). At 18 months, Mean Qmax was comparable between two arms (22ml/s in BMG and 19ML/s in IPG arm), Mean IPSS (2.4 v/s 2.6), and Mean IIEF (21.60 v/s 21). These were also comparable between BMG v/s IPG arm respectively. Intraoperative blood loss (35 v/s 53ml) and Hospital stay (3.37 v/s 4.50 days) were significantly less in IPG arm. Orgasmic Domain of IIEF was surprisingly better in IPG arm at 6 months. This study was different with those studies. This study aims to get news updates related to skin grafts in urethral stricture disease through literature review journals.

METODE

This research method used qualitative descriptive with using systematic literature review (SLR) approach. It is a type of review article that aims to find evidence of clinical efficacy (evidence-based) of a problem, in order to get a suggestion for problem-solving. Data sources used secondary sources (Sugiyono, 2010). Data collection method was through the documentation of searching and digging data from relevant journals/ books documents related to skin grafts in urethral structure disease. Data analysis used the analysis of bibliographic annotations (Moleong, 2018).

HASIL DAN PEMBAHASAN URETHRAL STRICTURE

Inflammatory processes due to trauma or infection of the urethra will lead to the formation of scar tissue in the urethra (Frisch & Simonsen, 2018). This scar tissue contains collagen and fibroblasts. When it begins to heal, this tissue will contract throughout the space in the lumen and cause a reduction in the diameter of the urethra. Thus, it creates an obstacle to the urine flow. Due to the obstacles, the flow of urine looks for a way out to the other places and eventually collects in the periurethral cavity. Because of the urine extravasation, the area will be susceptible to infection cause periurethral abscess which can form urethrocutaneous fistula later (arising from the connection of the urethra and skin). In addition, the risk of formation of bladder stones also increased, then symptoms appear with the difficulty of ejaculation and kidney failure. The degree of narrowing of the lumen of the urethra is divided into 3 levels. A mild degree occlusion occurs less than 1/3 the diameter of the lumen. Then, a moderate degree occlusion reaches the lumen of the urethra, and a severe degree of occlusion is more than the lumen diameter of the urethra (Cohen et al., 2021).

We can establish the diagnosis of urethral stricture by means of anamnesis, physical examination, and supporting examinations. Symptoms of this disease are similar to symptoms of other causes of obstructive type urinary retention (Lumen et al., 2021). It starts with difficulty urinating or the patient should push to start urinating but urine only comes out a little. That symptom should be distinguished from overflow incontinence, namely the discharge of urine drip, unnoticed, or unable to hold the patient. Other symptoms that should be asked of the patient are the presence of dysuria, increased urinary frequency, hematuria, and a painful feeling of urge to urinate. If possibility that the cause is an infection, it is necessary to ask for signs of inflammation, such as fever or discharge of pus. Physical examination was carried out through inspection and palpation. On inspection, we noted the external urethral meatus, there is a swelling or fistel around the penis, scrotum, perineum, and suprapubic. Then, we palpate whether there is scar tissue along the anterior urethra on the ventral penis. If found the fistel, then we massage his mouth to remove the pus in it. A digital rectal examination is useful to rule out other diagnoses, such as prostate enlargement (Chung & Suarez, 2020).

Supporting examinations are useful for confirming the diagnosis and ruling out differential diagnoses. Uroflowmetry is a device to objectively determine the emission of urine. The jet velocity is

measured by dividing the urine volume when urinating divided by the length of the urination process. The normal jet speed is 20 ml/sec. If the jet velocity is less than 10 ml/sec, it indicates an obstruction. However, the photo examination of Retrograde Uretrogram combined with Voiding Cystourethrogram was still used as a standard examination to establish the diagnosis. This radiograph can determine the length and location of the stricture. The use of ultrasonography (ultrasound) is quite useful in evaluating strictures in the pars bulbosa. Through this tool, we can also evaluate the length of the stricture and the degree of extent of scar tissue, for example spongiofibrosis. This helps us to select the type of surgery to be carried out on the patient. We can know the residual urine amount and stricture length in real time, thus it can improve the accuracy during surgery. A more advanced examination is using urethroscopy and cystoscopy, which is the use of fiberoptic cameras into the urethra up to the bladder. We are able to acquire the cause, location, and character of strictures directly. Imaging using magnetic resonance imaging is good to do before surgery because it can measure exactly the length of the stricture, the degree of fibrosis, and prostate enlargement. But this tool is not yet widely available and it has high cost so it is rarely used. Laboratory tests, such as urinalysis or complete blood tests, are routinely carried out to see the patient's progress and remove other diagnoses (Furr & Gelman, 2020; Watkin & Patel, 2020)

TREATMENT OF URETHRAL STRICTURE WITH URETHROPLASTY

Healing therapies for urethral stricture are urethral dilatation, direct visual internal urethrotomy (DVIU), urethral stents, and urethroplasty. Urethroplasty is a standard treatment for urethral stricture, but it is still rarely done because not many medical experts master this surgical technique. Studies have shown that urethroplasty is considered a minimally invasive and more efficient surgical technique rather than urethrotomy. Urethroplasty is an open urethra reconstruction in the form of a cut of fibrosis tissue (Anonymous., 2020). There are two types of urethroplasty, anastomotic and substitution urethroplasty. Anastomotic urethroplasty was carried out through excision of part of the stricture and then the urethra was fixed by grafting tissue or a flap from the surrounding tissue. This technique is especially appropriate for urethral strictures of the pars bulbosa with a stricture length of 1-2 cm. Substitution urethroplasty is the grafting of dissected stricture tissue with mucosal tissue of the lips, genital mucosa, or prepuce. This is done by graft removal of an organ or tissue to another part of the body, which relies heavily on the patient's blood supply to survive. The graft process consists of two stages, namely imbibition and inosculation. Imbibition is the stage of nutrient absorption from the patient's blood vessels in the first 48 hours. After that, it is followed by inosculation stage, in which graft vascularization by blood and lymph vessels. The networks types that can be used are buccal mucosal graft, full thickness skin graft, bladder epithelial graft, and rectal mucosal graft. From all grafts above, the most preferred are buccal mucosal graft or mucosal tissue of the lips, because the tissue has a thick epithelium elastic, resistant terhadap infection, and there are many blood vessels of lamina propria. The source place of graft also heals quickly and rarely experiencing complications. The success rate is very high reaching 87%. However, urinary tract infections, urethrocuteaneous fistulas, and chordee can occur as postoperative complications (Lumen et al., 2009; Professionals, 2021).

TYPE OF GRAFT

Various grafts, including genital or extragenital skin, oral mucosa, bladder mucosa, and colonic mucosa have been used for urethral reconstruction. In the last few decades, oral mucosa and genital skin have emerged as the gold standard substitute materials for the repair of urethral stricture, although there has been rapid progress in the development of engineered urethral graft. Use of genital skin is contraindicated in cases with local sclerosis since the condition tends to recur in skin, and in this setting, oral mucosa represents the tissue of choice. This mucosa is adapted to constant moistness and resiliency to skin distension, in addition to having a privileged immunology.

A buccal mucosa graft harvests from the cheek and is currently recognized as the best urethral substitute for a long urethral stricture amenable to excision and primary anastomosis. Oral mucosa grafts may also be harvested from the tongue (lingual mucosa), providing a good alternative with an equivalent outcome to urethroplasty. Tissue characteristics of both buccal and lingual mucosa are similar: thick epithelium, thin lamina

propria, rich vascularization, and good elasticity. Additional advantages of these materials include excellent graft take and small contracture, as well as the fact that they are readily available and easily harvested (Song, Xu, Lazzeri, & Barbagli, 2009). Harvesting of long lingual mucosa grafts (excised length 7 cm), however, is associated with long-term speech morbidity.

Urethral reconstruction in patients with long segment stricture disease remains a complicated surgical problem especially in men with previous hypospadias surgery and those with LS as an etiology. Segment strictures of variable etiology have been reported stricture disease after previous hypospadias repair has men with long-segment stricture disease secondary to LS appear to have a higher recurrence rate secondary to one of the critical elements for urethral reconstruction of long-segment strictures involves obtaining the appropriate tissue for urethral defect substitution. Harvest of tissue from the surrounding penile skin is difficult, some authors have used composite repairs with buccal or penile skin grafts. Berglund and Angelini described the use of a combined penile or these authors were able to obtain good results from these techniques for long-segment strictures some of the potential drawbacks include the need to harvest graft tissue from multiple sites, the risk of suture line infection secondary to incorporation of multiple grafts into the anastomosis, the risk of hair growth on genital may predispose to an LS related stricture recurrence.

Reported complications of oral mucosa harvesting include pain, perioral numbness, tightness of the mouth, persistent mouth opening difficulty, changes in salivary function, and motor deficit (Dublin & Stewart, 2004; Markiewicz, DeSantis, Margaroni III, Pogrel, & Chuang, 2008; Rourke, McKinny, & Martin, 2012). Nevertheless, Barbagli et al. concluded that harvesting from the cheek, followed by donor site closure, represented a safe and simple procedure and reported high patient satisfaction. In a survey of 295 patients, 98.4 % reported that they would undergo the surgery again. Similar results were reported in the latest multivariable analysis of a cohort of 553 patients who underwent oral mucosal graft harvesting. Late complications analysis showed that 95.5 % of patients declared that the surgical closure of the wound had not caused any difficulty in mouth opening or problems with smiling (98.2 %) and/or dry mouth (95.8 %). Overall, 98.2 % of patients were satisfied with the procedure (Guido Barbagli et al., 2014).

However, full reconstruction of the long urethral stricture cannot be accomplished through the use of oral mucosa alone, as the size and total length of the grafts are quite limited. Meeks et al. (Meeks et al., 2010) showed that in long limb sclerosed stricture, non-genital skin – such as abdominal skin – provides a useful alternative graft for urethroplasty when the oral mucosa is unavailable or insufficient. Xu et al. (Y. T. Lee, Cho, Jeong, Lee, & Hong, 2005) reported success in 85.7 % of 36 patients with long urethral stricture using colonic mucosa. Similarly, Mundy and Andrich (Mundy & Andrich, 2010) described the use of grafts from the stomach, ileum, and colon in complex bulbomembranous stricture. Urethral tissue engineering is an emerging field, and acellular matrix grafts made from porcine small intestinal submucosa offer a promising alternative to current grafts. Some authors have reported high success rates at relatively short follow-up periods (Y. Xu et al., 2013). Palminteri et al. (Palminteri, Berdondini, Colombo, & Austoni, 2007; Palminteri, Berdondini, Fusco, De Nunzio, & Salonia, 2012) reported long-term expander (mean follow-up period, 71 months) with 25 patients who underwent small intestinal submucosa graft urethroplasty for bulbar strictures. Although there were no complications such as infection or rejection, the reported success rate was only 76 %, and for strictures excised length 4 cm, the failure rate was 100 %. The authors suggested that this graft was useful only in short- or medium-length bulbar strictures with mild spongiositis. Because long-term follow-up data has demonstrated less effective results than those achieved with oral mucosa grafts, the use of small intestinal submucosa grafts should be considered an option for patients who refuse oral mucosa harvesting or who have undergone an oral mucosa grafting procedure that failed. Lastly, Mangera and Chapple (Li, Xu, Liu, & Li, 2013; Mangera & Chapple, 2013) evaluated the progress that has been made in finding a tissue-engineered substitute for the human urethra, discussed different approaches to developing these grafts, and reviewed their results in human studies. They concluded that tissue-engineered grafts may facilitate the management of lengthy urethral strictures requiring oral mucosa substitute urethroplasty.

Buccal mucosa alone has been demonstrated to be a good choice for extra-genital graft tissue with its long segmental structure reconstruction involves the stage urethroplasty. B) Rolled urethral tube after second stage urethroplasty. Abdominal Wall Skin Graft requires harvest from both cheeks and potentially the lower lip. Complications reported with oral harvest from just one site include neurosensory deficits, the buccal mucosa graft harvest postoperatively with harvest site morbidity and limited patient complaints related to the abdominal wall harvest for long-segment previously been described in several smaller series for urethral reconstruction with reported success been related, in part, to the widespread use of tube grafts for reconstruction at this time, and the choice of single versus two-stage repair for complicated skin for long-segmental structure reconstruction has not been clear that it provides extra-genital tissue origin, and the limited graft site morbidity observed in this series. Furthermore, the abundance and width of the abdominal skin graft allows for harvest of a single graft segment as compared to buccal mucosa or penile skin grafts which require multiple harvest sites and suture lines between grafts within an anastomosis for long-segmental structure defects. While abdominal skin until long-term outcomes are known, the availability of this tissue offers the reconstructive surgeon an additional option for substitution urethroplasty of long-segmental structures.

PELVIC URETHRAL STRICTURES

Penile strictures are differentiated from bulbar urethral strictures. In the penile urethra, excision of the stenotic segment and direct anastomosis is almost impossible without postoperatively penile curvature. With regard to the repair of penile or penile urethral strictures, the debate revolves around the issues of one- versus two-stage procedure and ventral versus dorsal approach. One- stage graft urethroplasty has been suggested in patients with a remaining urethral plate or acceptable width, normal penile, penile skin, corpus spongiosum and dartos fascia. Conversely, in patients with severe failed penile and/or urethral surgeries, where penile elements are not available for urethral reconstruction, a multistage urethroplasty is generally recommended. The choice of reconstructive technique is based on the etiology of the disease and the condition of the penis and urethra (Guido Barbagli & Lazzeri, 2006). Repeated internal urethrostomies or open surgery can lead to severe spongiositis, penile curvature, and sometimes complete closure of the urethral lumen. The situation is probably worst in hypospadias, as these usually also involve a deficiency in corpus spongiosum, and the available penile skin is often insufficient for the repairs needed. A small glans can also make the reconstruction more difficult. There have been numerous discussions on the positioning of the buccal mucosal graft in urethral reconstruction. The graft could be placed on the dorsal or the ventral side of the urethra. Although ventral placement was described first, dorsal placement has been gaining popularity since Barbagli et al. reported their approach. Enlargement of the urethral plate can usually be achieved using the Asopa, Barbagli, or Kulkarni technique. The Asopa technique consists of dorsal grafting through the ventral urethrostomy (Asopa et al., 2001). It is based on the principle described by Hayes and Malone (Hayes & MAL, 1999), who recommended laying a buccal mucosa graft into the longitudinally incised urethral plate in patients after failed hypospadias repair. In this approach, the strictured urethra is opened by a ventral midline incision, the urethral plate is longitudinally incised on the dorsal side, the graft is positioned in place to enlarge the plate, and graft-augmented urethra is ventrally closed. This technique was also reported by four other authors (Aldaqadossi et al., 2014; Palminteri et al., 2007; Pisapati et al., 2009; Singh et al., 2008). A total of 111 cases have been described, with an average follow-up of 27.6 months and an average success rate of 87.34 %.

Barbagli described a dorsal approach to the stenotic urethra. In the original dorsal graft techniques, the urethra is circumferentially mobilized from the cavernous bodies to expose its dorsal surface, and the graft is fixed over the underlying tunica albuginea. Proponents of the dorsal approach argue that it offers the best conditions for graft survival since the buccal mucosa is stretched and fixed to the cavernous bodies, which promotes survival and prevents retraction of the graft. In ventral grafting techniques, there is no firm support for the buccal mucosal graft. Thus, retraction or sacculation is theoretically more likely, although

well-vascularized spongy tissue provides good nutritional support to the graft (G Barbagli, Selli, Di Cello, & Mottola, 1996). In a modification of the original technique described by Barbagli, Reichardt et al. were able to achieve better visualization of the mucosal margins during the creation of the anastomosis, thus simplifying the procedure (Reichardt, Pfalzgraf, Dahlem, & Fisch, 2009). Success rates of this novel technique were compared to those of the original Barbagli procedure in 47 patients over a three-year period (Pfalzgraf et al., 2013) to determine whether the Barbagli or Asopa approach was preferable for the management of long anterior urethral strictures. Aldaqadossi et al. concluded that success rates were comparable between the two approaches. Pahwa et al. (Pahwa, Gupta, Pahwa, Jain, & Gupta, 2013) reported similar results in their comparative study, but with a short follow-up of 12 months. However, Asopa's technique was found to be easy to carry out, had a shorter operative time and less blood loss, and was associated with fewer complications for anterior urethral stricture repair (Aldaqadossi et al., 2014). Xu et al. (Y.-M. Xu et al., 2014) recently reported excellent success rates (88.9 %) using the Barbagli approach in the treatment of 54 patients with long urethral strictures (median, 12.5 cm; range, 6–18 cm) and long median follow-up of 38.7 months. Hudak et al. (Hudak, Lubahn, Kulkarni, & Morey, 2011; Tausch & Morey, 2014) described an additional approach that utilized overlapping dorsal and ventral buccal mucosa grafts, without ballooning or dilatation, reporting a success rate of almost 90 %.

The Kulkarni technique presented the use of a one-stage anterior urethroplasty utilizing the oral mucosa to avoid circumferential urethral mobilization and to preserve the lateral vascular supply to the urethra. Using this approach, Kulkarni et al. reported 92 % successful outcome at a median follow-up of 22 months (Kulkarni, Barbagli, Sansalone, & Lazzeri, 2009).

BULBAR URETHRAL STRICTURES

Stricturectomy with oral mucosal grafting remains the gold standard for the treatment of a long bulbar urethral stricture with relatively well-preserved urethral lumen and limited spongiositis, demonstrating a success rate of almost 90 %. In a comparison of reconstructive approaches, there is no significant difference between the average success rates of the dorsal and the ventral onlay procedures (88.4 % and 88.8 % at 42.2 and 34.4 months in 934 and 563 patients, respectively) (Mangera, Patterson, & Chapple, 2011). The primary question in this repair procedure is whether or not to transect the bulbar urethra during bulbar stricture repair. While high rates of success were reported with transecting techniques, this was called into question when sexual disturbances were described by some authors (Fisch, 2012; Y. J. Lee & Kim, 2013). To dissect or not to dissect remains the subject of ongoing debate, with no general recommendations having been formulated thus far (Guido Barbagli, Sansalone, Romano, & Lazzeri, 2012). Al-Qudah and Santucci (Al-Qudah & Santucci, 2006) reported that oral mucosal graft urethroplasty showed superior success and fewer complications, including sexual dysfunction, than anastomotic repair. The incidence of sexual dysfunction after anastomotic repair is related to the proximity of the bulbar urethra to the cavernous nerves (Erickson, Granieri, Meeks, Cashy, & Gonzalez, 2010). Palminteri et al. (Palminteri et al., 2013) evaluated the pre- and postoperative parameters of quality of sexual life in 52 patients who underwent ventral graft urethroplasty, with none of the patients reporting post-operative problems with erection or ejaculation. Since there is no need for urethral mobilization or urethral transection during ventral graft urethroplasty, postoperative erection dysfunction and other sexual disorders are avoided.

Another dilemma is whether to place the graft – ventrally or dorsally. Ventral placement of the graft has the advantage of limited urethral mobilization and preservation of cavernous spongiosal arteries. Disadvantages include increased blood loss, incidence of dilatation, failure rate. Dorsal placement provides a more stable, well-vascularized recipient location for the graft, but requires a more extensive mobilization of the urethra, which may lead to injury of neurovascular components. Two retrospective single-institution series have compared the two approaches. Andrich et al. (Andrich, Leach, & Mundy, 2001) concluded that dorsal onlay was associated with a higher rate of success in 71 patients with bulbar stricture. Conversely, Barbagli (Guido Barbagli et al., 2005) reported no difference in success rates between the two procedures. In a review of 103 patients who underwent bulbar urethroplasty,

Filgler et al. (Figler, Malaeb, Dy, Voelzke, & Wessells, 2013) were unable to conclude whether the dorsal or ventral graft position was inherently superior. They also found that patients with dilated ureters may be more likely to require additional procedures after primary bulbar reconstruction. Chen et al. (Chen, Odom, Johnson, & Santucci, 2013) recommended the use of a double-sited graft technique for very long bulbar urethral strictures. They combined a ventral onlay buccal mucosa graft and a dorsal inlay full-thickness skin graft, and found improved success rates compared to buccal mucosa urethroplasty alone. Following ventral opening, if the bulbar urethral plate is found to be narrow, this could pose a problem, especially with regard to suturing an oral graft to such a narrow plate. Barbagli et al. (Guido Barbagli et al., 2013) recommended anastomosing the graft only to the left side of the remaining urethral mucosa. On the right side, the graft was sutured directly to the spongiosal tissue.

FAILED HYPOSPADIAS REPAIR

Management of urethral stricture after failed hypospadias repair represents a major challenge, and there is a continual search for new and better solutions. Urethral strictures caused by infection, trauma, instrumentation, or a urinary catheter predominantly involve normal penile tissues, and are usually suitable for urethral reconstruction. Conversely, patients with failed hypospadias usually do not have a sufficient amount of local tissue that can be used for reconstruction, meaning that an extragenital substitution graft must be applied. The most common problems after failed hypospadias repair are inadequate vascular supply and deficient spongiosal tissue necessary for better graft survival. The post-hypospadias urethra is often thin, vulnerable, and firmly attached to the cavernous bodies. Firm scar formation and the paucity of gelatinous spongy tissue make urethral mobilization a hazardous, problematic procedure.

In light of these facts, the majority of studies have focused on staged urethral repair for failed hypospadias. Gill and Hameed performed staged repair in 100 patients, using different types of grafts. With a minimum of one year follow-up, recurrent strictures were registered in six patients (Gill & Hameed, 2011). Barbagli et al.

reported a higher success rate using buccal mucosa (82 %) than skin grafts (50 %). In another study, Barbagli et al. (Guido Barbagli, Perovic, Djindjic, Sansalone, & Lazzeri, 2010) analyzed 1,176 patients after over a period of 10 years. They found that failed hypospadias repair was corrected in 65 % of the patients in a one-stage procedure and 35 % in a staged procedure using oral or skin grafts. Djordjevic et al. (Djordjevic et al., 2011) reported one-stage urethroplasty in 15 patients with urethral stricture after failed hypospadias repair. Hanging of the buccal mucosal graft to penile urethral tissue was found to prevent graft folding; only one fistula was reported postoperatively.

Staged urethroplasty may occasionally be inevitable in patients with severe failed attempts. Excision of all scar tissue and use of buccal mucosal or skin grafts are critical for a successful outcome. Generally, urethral strictures after hypospadias repair are among the most difficult complications to treat, which underscores the importance of long-term follow-up in children with post-hypospadias repair.

Staged Urethroplasty

Most cases of urethral reconstruction may be managed with single-stage surgery. However, strictures caused by inflammation, atrophy, or obliteration of the penile sclerotic may be best managed with staged urethroplasty (Mangera & Chapple, 2010; Mangera et al., 2011; Palminteri, Brandes, & Djordjevic, 2012; Riechardt, Dahlem, & Fisch, 2012). This is especially effective for anterior urethral strictures, applying the previously described principles. Bulbar urethral strictures are usually repaired in a one-stage procedure. Rarely, complications such as bulbar urethral necrosis, urethral stone infection, or migration and incorporation of the mental urethral stents from previous repairs present indications for staged correction. The principle remains the same: the affected urethra is opened, present foreign bodies are removed; a new "urethral plate" is created with either local flaps or grafts, followed by the creation of urethrostomy. The key to successful repair is waiting long enough so that the skin is supple, and a classic error is performing the second stage too early. The second stage should be

perform the graft has healed, which usually takes four to six months. The procedure is then completed by mobilizing the urethral plate from the surrounding skin to allow tubularization of the neourethra over the catheter.

Johanson's surgical principles, which were introduced in 1953 (Johanson, 1953), are still in use today either directly or indirectly. The original Johanson approach involved marsupialization of the urethral stricture and joining it with surrounding penile skin to create a urethral plate. The second stage included tubularization of the dorsal urethral plate. In addition, sufficient skin was turned inward to create a urethra with an acceptable lumen. The technique by Schreiter, which is a modification of original Johanson's technique, uses a meshed skin graft fixed to the dartos and urethral edges to create the urethral plate (Schreiter, 1984). After 6–12 months of graft maturation, the urethral plate is tubularized in the standard fashion. Buccal mucosa grafts represent the optimal solution in staged urethroplasty using the Johanson principle (Guido Barbagli, De Angelis, Palminteri, & Lazzeri, 2006).

CONCLUSIONS AND SUGGESTIONS

Surgical treatment of urethral strictures is continually evolving. Although numerous strategies are available, there is still no single optimum solution suitable for all conditions. The clinical selection of stricture recurrence prevention techniques should be carefully tailored to each individual patient. The reconstructive urologist must be familiar with a variety of techniques to ensure the choice of the best procedure as dictated by situation. As current available studies provide insufficient evidence to establish firm guidelines, further efforts are needed to address these interrelated but challenging issues.

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