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REVIEW

Penile prosthesis surgery in the management of erectile dysfunction

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KEYWORDS

Erosion;
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Glans bowing

ABBREVIATIONS

AMS, American Medical Systems;
ED, Erectile dysfunction;
PD, Peyronie's disease;
IIEF, International Index of Erectile

Abstract ***Introduction:*** We reviewed retrospectively the use of penile prostheses, including the indications and complications of penile prosthesis surgery.

Methods: We identified publications and the reported advances in penile prosthesis surgery between 1987 and 2012 in Pub-Med, and published information from American Medical Systems, Inc. (Minnetonka, MN, USA) and Coloplast Corporation (Humlebaek, Denmark), using the keywords 'penile prosthesis', 'erectile dysfunction', 'mechanical reliability', 'complications' and 'infection'.

Results: We describe the novel indications for the use of penile prostheses, the significant advances in implant designs with improved mechanical reliability, the changing landscape of device infection, and the current management of complications. Sixty-eight publications with a grade A, B and C level of evidence are cited.

Conclusion: The clinical indications to implant a penile prosthesis have expanded beyond organic erectile dysfunction. With the many different devices currently available, the choice of which device to implant can be tailored based on an individual's unique medical conditions, manual dexterity and expectations, and surgeon preference. There must be a conscious effort to prevent device infection, in the light

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Function;
EDITS, Erectile Dysfunction Inventory of Treatment Satisfaction;
ICI, Intracavernous injection;
RP, Radical prostatectomy;
PVP, Polyvinylpyrrolidone

of the development of increasingly virulent organisms. Penile prosthesis surgery is an integral part of the treatment of erectile dysfunction when non-surgical options fail or are contraindicated.

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Introduction

Despite the rapid rise in the popularity of medical treatments for erectile dysfunction (ED), the penile prosthesis has a vital role in the options available for patients and the urological surgeons who manage them. In many instances an implanted prosthesis might be the only option for men with refractory ED. In the USA the number of patients with a penile prosthesis increased from 17,540 in 2000 to 22,420 in 2009 [1]. Prosthesis surgery is used in the management of patients with organic ED, including iatrogenic ED from radical prostatectomy (RP) and other radical pelvic surgery, as well as Peyronie's disease (PD) and ischaemic priapism.

Mulhall et al. [2] assessed the efficacy and patient satisfaction for men having a penile prosthesis implanted by comparing scores on the International Index of Erectile Function (IIEF) and Erectile Dysfunction Inventory of Treatment Satisfaction (EDITS) questionnaires before and after surgery. Both the IIEF and EDITS scores were statistically significantly greater at the 12-month follow-up than the baseline scores. Also, the 12-month follow-up scores were significantly higher than the 6-month scores, suggesting that marked improvements can be continuously maintained after surgery.

Another study by Rajpurkar et al. [3] compared the EDITS and IIEF scores for patients with ED who were treated with either sildenafil, an intracavernous injection (ICI) with prostaglandin E1, or penile implant surgery. There was no difference in the scores between the sildenafil and ICI groups, but the scores were significantly higher for patients who had a penile prosthesis implanted than for the other two groups.

Similarly, Sexton et al. [4] compared ICI therapy with penile prosthesis surgery in the treatment of ED. At the follow-up, only 41% of the patients were still using ICI, whereas 70% of patients were still using the penile prosthesis for sexual intercourse. Those authors underscored the finding that the main reasons for discontinuing ICI therapy are insufficient erections and lack of spontaneity, concerns that are typically mitigated with a penile prosthesis.

Penile prosthesis surgery is safe and effective in patients with ED that is related to prostate cancer therapies such as RP and external beam radiotherapy [5]. While some patients can recover spontaneous erections after a nerve-sparing RP or respond to pharmacological therapy, there remain some patients for whom a penile prosthesis is an excellent option. In a recent study comparing the penile prosthesis with tadalafil therapy, surgery was superior in terms of erection frequency, firmness, ability to penetrate, maintenance of erections and confidence in achieving an erection [6]. In a comparison between patients after RP and those with vasculogenic ED who received penile prostheses, the overall improvement in sexual function was lower for the RP group, but nevertheless the overall satisfaction rate for this group was high, at 86.1% [7].

Patients with PD and synchronous ED might also be candidates for a penile implant [8]. Building on Scott's original idea, Wilson et al. [9–11] provided the modern outline for implanting a penile prosthesis combined with penile modelling in the treatment of PD associated with ED. This dual approach allows for penile straightening and a decreased need for re-operations.

Ralph's group from the UK [12,13] popularised the early insertion of the inflatable penile prosthesis for managing intractable ischaemic priapism. This idea has slowly gained acceptance worldwide and was also addressed by Sedigh et al. [14]. In that series, all patients were satisfied with the surgical outcome, as they were all able to engage in sexual intercourse with no significant loss of penile length.

Inflatable prostheses

The American Medical Systems (AMS, Minnetonka, MN, USA) and Coloplast (Humlebaek, Denmark) three-piece prostheses have essentially the same design, with two intracavernous cylinders, an intra-abdominal fluid reservoir and a scrotal pump to allow fluid transport from the reservoir to the cylinders via silicone tubing connections. All penile prosthetic devices offered by these two companies are listed in Table 1.

Table 1 Types of penile prostheses.

Company	Model	Type
AMS	700 CX	3-piece inflatable
	700 CXR	3-piece inflatable
	700 LGX	3-piece inflatable
	Ambicor	2-piece inflatable
	Spectra	Semi-rigid
	Dura II	Semi-rigid
	650/600M	Semi-rigid
Coloplast	Titan	3-piece inflatable
	Titan narrow	3-piece inflatable
Genesis		Semi-rigid

AMS

The AMS 700 CX provides controlled girth expansion via its unidirectional weave of Dacron-Lycra™. This prosthesis is preferable to the other AMS models in patients who require penile straightening. The device also features a Parylene™ coating, introduced in 2001, that provides lubrication, decreased friction and increased durability. Salem et al. [15] showed, in a series of 775 patients who had the AMS 700 CX implanted, that Parylene-coated devices have a significantly higher 3-year revision-free survival, by 8.8% (78.6% uncoated vs. 87.4% Parylene-coated) and improved mechanical reliability, by 8.3% (89.2% vs. 97.5%, respectively). The AMS 700 CXR is a similar model with smaller components and a very narrow proximal profile that provides controlled girth expansion for narrow or scarred corporal bodies.

The AMS 700 LGX provides controlled length and girth expansion through its bidirectional weave of Dacron-Lycra. This model allows for penile lengthening of 1–4 cm (mean 1.9 cm) compared to other devices [16], and is the only model that provides for such lengthening. However, the AMS 700 LGX is not ideal for penile straightening in scarred corporal bodies, because the lengthening property of these cylinders does not allow for the development of sufficient axial rigidity [17]. The inflatable AMS devices are coated with a rifampin-minocycline antibiotic (Inhibizone™) to reduce prosthesis infections (see below).

For cases in which avoidance of the retropubic space (i.e. due to previous surgery and scarring) is desirable, AMS offers the Ambicor two-piece inflatable prosthesis. By activating the scrotal pump, fluid is transferred from the proximal to the distal aspect of the cylinders, to provide ample rigidity. In 1998, the device was revised with improved rear tip extenders and tubing connections to decrease fluid leakage. A study of 146 patients from 1999 to 2004, which assessed long-term survival, ease of use and satisfaction rates of patients with the improved device implanted, showed that 91% had freedom from re-operation, 95% found it simple to operate, and 85% of patients were satisfied [18].

These devices have been available with different pumps that include the standard pump, 'Tactile' pump and the 'Momentary Squeeze' pump. The Tactile pump (not offered with the AMS 700 LGX), is a larger and more easily manipulated pump that is ideal for older patients who desire a simple and accessible pump. The newer Momentary Squeeze pump provides one-touch deflation and a smaller design that is more subtle, but requires manual dexterity. The implant is inflated by repeated compression of the pump, while application of pressure on a small release button on the pump for 4 s deflates the device.

Coloplast

The Coloplast inflatable implants include the Titan and Titan Narrow. 'Bioflex' polyurethane material is used for the cylinders and reservoir, in addition to the traditional silicone tubing and pump. Bioflex has a higher tensile strength than silicone and allows for girth expansion while preventing aneurysm of the cylinder [19]. This feature of the Coloplast devices makes these inflatable prostheses ideal for penile straightening procedures (modelling) in patients with PD.

The Coloplast components are coated with a hydrophilic substance, polyvinylpyrrolidone (PVP), that reduces bacterial adherence and allows for an enhanced antibiotic coating when the implant is immersed in an aqueous solution of antibiotic [20].

The Titan features a reservoir lockout valve that helps to prevent spontaneous auto-inflation, which is especially useful for ectopic non-retropubic reservoir implantation [21]. Similar to the AMS devices, Coloplast offers a scrotal and infrapubic version of the Titan, varying only in the length of tubing. The Titan cylinders are 14–22 cm in total length, that differ in 2-cm increments, and these are offered with 1.0-, 2.0- and 3.0-cm rear tip extenders.

Similar to the AMS 700 CXR, the Titan Narrow is ideal for patients with fibrotic corpora in difficult reimplantations and after radiotherapy, where corporal dilatation is limited [22].

The Coloplast Titan 'one-touch release' offers a single-squeeze device for simple deflation. Ohl et al. [23] reported a prospective, multicentre international study which assessed patient and surgeon satisfaction, and ease of training patients to use the device. At 12 months after surgery, 90% of the patients were satisfied with the device and 73% of patients found deflation to be simple. Likewise, from the surgeons' perspective, 97% found that implanting the device was uncomplicated, and 96% found training patients to use the device to be the same or simpler than pumps used previously.

Semi-rigid prostheses

Consisting of two separate solid prostheses placed in each corporal body, a semi-rigid implant serves as a suitable

option for patients with poor manual dexterity and who are willing to forego the cosmesis of an inflatable device. These devices have a central core that permits the penis to be bent downward for concealment and bent upward for sexual activity. The devices have low mechanical failure rates and are simple to use, but they have a greater risk of erosion, do not offer expansion of girth or length, and the rigidity is constant, which makes concealing the device difficult [5,24].

To prevent excessive bowing of the device that might result in damage during implantation, the corporotomy incisions for semi-rigid implants must be slightly larger than those used for placing inflatable cylinders [25]. In addition to the penoscrotal and infrapubic incisions for all other penile implants, semi-rigid prostheses can be implanted via a limited subcoronal incision [26].

Patients with pelvic organ transplants are at a greater risk of complications related to placing the retroperitoneal reservoir. Therefore, three-piece prostheses might not be the ideal choice for some surgeons in these patients, and semi-rigid prostheses are often used instead [27]. However, these devices are not ideal for patients who require repeated cystoscopy, because the rods make the procedure technically difficult.

Kim et al. [28] reported a study of 48 patients with spinal cord injury who had a malleable prosthesis placed. With a mean follow-up of 11.7 years, there was a 79% overall satisfaction rate and an added benefit of better urinary management. However, previous reports show that patients with spinal cord injury have a considerably higher rate of erosion with malleable prostheses than has the general population [29].

The AMS Spectra is the newest of the AMS non-inflatable devices and features a segmented design of alternating titanium and polyethylene segments that allow better concealment than other semi-rigid devices. The AMS Dura II also has a segmented design of articulating polyethylene that allows the device to move into any position, yet sustains sufficient rigidity for intercourse [30]. However, this device is not ideal for patients with a larger diameter penis. The older AMS 650/600M models have a stainless-steel core with a silicone elastomer body that provides considerable girth.

Coloplast manufactures the Genesis malleable prosthesis, which features distal-shaft column strength, that helps to prevent buckling, and a hydrophilic PVP coating. This model is offered in 9, 11 and 13 mm diameters, and can be trimmed to customise the fit.

Mechanical reliability

Based on the 2005 AUA Guideline on the Management of Erectile Dysfunction [31], Kaplan–Meier estimates should be used to assess the survival of penile implants. Wilson et al. [32] reported long-term data for 2384 patients receiving an inflatable prosthesis. The estimated 10-year revision-free survival rate was 68.5%, and the 15-year rate was 59.7%, while the rate of freedom from mechanical failure was 79.4% at 10 years and 71.2% at 15 years. However, the enhancements to these devices over time, such as the Coloplast pump reinforcement in 1992 and the AMS Parylene coating in 2001, confounded these results, as the more recent devices offered better mechanical survival.

Carson et al. [33] reported a long-term multicentre study of the AMS 700 CX implant with a median follow-up of 47.7 months, and showed a mechanical reliability rate of 92.1% after 3 years, 86.2% after 5 years, and device malfunction in 17.5% of the cases. Of patients interviewed in the second phase of this study, 87.1% reported an erection sufficient for penetration.

In 2006, Dhar et al. [34] reported on 455 patients who had an AMS 700 CX or CXM implanted, with a 91.5-month median follow-up. The 10-year Kaplan–Meier estimates of overall and mechanical survival were 74.9% and 81.3%, respectively. From a recent study on the mechanical reliability of the AMS 700 CX, Kim et al. [35] found that the overall survival rate of these implants at 10 years was 75.5%. Interestingly, overall device survival had no association with patient age, obesity or the presence of diabetes mellitus.

In a 10-year review of patients with PD who had a penile prosthesis placed, a mechanical malfunction occurred in eight of 20 (40%) who received the AMS 700 LGX, as opposed to one of 42 (2%) who received the AMS 700 CX [36].

As a means of maximising the straightening of the penis in patients with PD, penile modelling can be used in conjunction with a prosthesis. The Coloplast (previously Mentor) Alpha-1 (a former version of the Coloplast Titan) was shown to mechanically fail less often than the AMS 700 CX when modelling was used [9].

More recently, in a single-centre comparison of the AMS 700 CX and the Coloplast Titan implants in the treatment of PD with concurrent ED, there was no statistically significant difference in mechanical survival, yet the trend favoured the AMS 700 CX over the Coloplast Titan (91% vs. 87%, $P > 0.05$). Both devices nonetheless allowed similar penile straightening with no need for surgical revision [37].

Complications

Table 2 summarises selected complications of penile prosthesis surgery. The experience of the surgeon implanting the prosthesis has been shown to influence the outcome. Henry et al. [38] compared the results of penile prostheses that were implanted by 10 surgeons in a large urology practice, with prostheses that were implanted by one surgeon in a centre of excellence. The median cylinder length implanted by the multiple-surgeon group was 2 cm less than the cylinders implanted

Table 2 Complications and possible strategies.

Complication type	Prevention strategies/management
Mechanical failure	Complete device replacement
Infection	Use of coated devices and perioperative antibiotics, complete device removal, washout, replacement
Erosion	Distal corporoplasty, wind-sock repair
Corporal crossover	Lateral angulation of corporal dilators, position both Keith needles prior to final cylinder placement
Corporal perforation	Direct repair, windsock patch
Urethral perforation	Direct repair, healing over urethral catheter, suprapubic diversion in select cases; abort case and return at a later date after urethral healing (preferred approach); option: plug tubing and leave single cylinder on the non-perforated side
Glans bowing	Ensure proper device size and adequate corporal dilation. Repair of SST deformity if problem noted post-operatively
Reservoir herniation	Reposition the reservoir in the perivesical space; may leave reservoir in ectopic location in select cases

by the single surgeon. Also, the operative duration and the iatrogenic failure rate were both significantly higher in the multiple-surgeon group, thereby underscoring the significance of an experienced surgeon to ensure superior outcomes.

Imaging

There are various imaging methods, e.g. conventional plain films, ultrasonography, CT and MRI, for evaluating the complications of penile prosthesis surgery. The method that has been shown to be the most useful is MRI, in that it provides the best soft-tissue contrast, three orthogonal planes to evaluate the penile anatomy, and does not require ionising radiation [39,40].

Infection

Infection is one of the most difficult and distressing complications of penile implant surgery. It is most frequent within the first 3 months and almost certainly within the first year after surgery [41]. Inappropriate antibiotic prophylaxis, careless sterile technique, and protracted surgery time are some of the intraoperative details that increase the risk of infection. Techniques to help reduce infection include shaving the patient in the operating room, the use of an antimicrobial adhesive layer, reducing traffic in the operating room, double-gloving, and an antibacterial shower for the patient before surgery.

With the advent of the infection-retardant coated prosthesis, the infection rates have been diminished significantly [42]. In a study of primary implants in non-diabetic patients (223) and diabetics (83), no infections developed amongst the first group and only one in the second group during a follow-up of >1 year [43]. In the era of the uncoated prostheses, coagulase-negative *Staphylococcus* was the expected causative organism for local infection. However, there has been a change in this situation, as the infections of the coated devices are mostly caused by systemic infections with aggressive organisms such as *St. aureus*, *Serratia marcescens*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Bacteroides fragilis* [44]. Therefore, while antibiotic coating has decreased infection rates overall, the infections that now occur appear to be more severe with these increasingly aggressive organisms. As such, there must be a concerted effort to investigate and use strategies that prevent these more virulent and resistant infections.

Wilson et al. [45] compared the AMS prostheses coated with InhibiZone and the Coloplast Titan dipped in five different types of antibiotic solutions, by measuring the zone of inhibition for these devices against five common pathogens. The Coloplast Titan dipped in each of the various antibiotic solutions, with the exception of bacitracin, showed a statistically significantly better zone of inhibition than the AMS device with InhibiZone. Of the several different antibiotic solutions tested, the infusion solution of trimethoprim/sulfamethoxazole was found to be the ideal choice for dipping in terms of its anti-infective spectrum, cost-effectiveness and ease of use.

Dhabuwala et al. [46] compared infection rates of the InhibiZone-coated AMS penile implants, vancomycin/gentamicin dipped Coloplast implants and rifampin/gentamicin dipped Coloplast Titan implants. The rate of infection was 1.3% for InhibiZone-coated prostheses, 4.4% for the vancomycin/gentamicin dipped prostheses, and 0% for the rifampin/gentamicin dipped prostheses. However, the only statistically significant difference in these groups was that the vancomycin/gentamicin dipped implants had a greater infection rate.

In another study by Dhabuwala et al. [47] it was shown that a mixture of rifampin 10 mg/mL and gentamicin 1 mg/mL was the best dipping solution for the Coloplast devices to combat *Escherichia coli* and *St. epidermidis*, with larger zones of inhibition than with the AMS InhibiZone devices.

In 2008, the AUA organised a best-practices policy panel of experts that reviewed published data and made recommendations for perioperative parenteral antibiotics used for penile prosthesis surgery. The policy statement advised using vancomycin or a first- or second-generation cephalosporin, together with an aminoglycoside, for broad-spectrum coverage 1 h before incision and for 24 h after surgery [48].

Eid et al. [49] propagated the 'no-touch' technique that protects the implant from contacting the patient's skin. This practice yielded an infection rate of only 0.46% from 1511 patients, which was especially noteworthy because the Coloplast devices were only soaked in saline with no antibiotic dip.

Hair removal with clipping or depilatory creams results in fewer surgical-site infections than does shaving with a razor. However, there was no difference in the infection rate in patients who had hair removed on the day before or the day of surgery, regardless of the method of hair removal [50].

Skin and nasal sterilisation has been evaluated as a means of reducing prosthesis infection by attempting to eradicate *Staphylococcus* contamination. Studies comparing Betadine, Hibiclens and Chloraprep skin preparations before urological implant surgery showed that Hibiclens and Chloraprep were better for infection control [51]. In a study by Silverstein et al. [52], all patients with nasal colonisation of *Staphylococcus* were treated before prosthesis implantation, which resulted in a lower infection rate.

Sadeghi-Nejad et al. [53] evaluated the use of closed-suction scrotal drainage for < 24 h after surgery in patients who received uncoated implants. It did not increase the infection rates compared to those reported previously, but it did significantly decrease scrotal haematoma and swelling. Therefore, this strategy can be used with no concern of increased infection.

Erosion

Prosthesis erosion typically portends an underlying device infection, but it can arise as an isolated occurrence. Of the different device types, semi-rigid prostheses have the greatest propensity for erosion. Patients who are poorly controlled diabetics or those who have had repeat implants are more prone to erosion because of poor tissue quality and an impaired vascular supply. Also, patients who require urethral catheterisation, either indwelling or intermittent, are at a significantly greater risk of erosion. In such patients, the use of inflatable prostheses instead of semi-rigid devices, and the creation of a suprapubic cystotomy or perineal urethrostomy, are approaches that greatly diminish the incidence of erosion [24].

Lateral extrusion of a prosthesis can be managed with a distal corporoplasty, as described by Mulcahy [54]. A new plane of dissection is developed behind the back wall of the fibrous capsule to accommodate the cylinders in a more medial and secure position. Carson et al. [55] compared distal corporoplasty with cylinder repositioning, to the use of a Gortex™ 'wind-sock' repair for distal extrusion, finding that the corporoplasty had lower morbidity, a better functional outcome, caused less pain and had fewer recurrences than the Gortex wind-sock repair.

Corporal crossover

Corporal crossover is a manageable complication that typically occurs during corporal dilatation, but can also occur when placing the cylinders. When crossover arises the contralateral cylinder can be perforated by the Keith needle while placing the ipsilateral cylinder. A method to prevent this is to place *both* Keith needles into their position through the glans before finally placing the cylinders. It is also important to properly angle the Metzenbaum scissors laterally during the initial tunnelling through the corpora, followed by gradual dilatation of the corpora with Brooks dilators, also directed laterally.

Perforation

Perforation is more likely to occur during dilatation if the corpora are fibrotic. This can occur distally or proximally, with the latter suspected in cases where there is a significant difference in length between the proximal dilators on each side. When proximal perforations occur during surgery they can be amenable to direct repair, using a Gore-Tex or Dacron windsock patch, absorbable polyglycolic acid patch, or attaching the cylinder tubing to the tunica [56–58].

Over the last two decades, dilators have been developed to assist with managing fibrotic corpora and preventing this complication. The Mooreville cavernotomes are a set of five dilators that gradually drill through fibrotic corpora with 1-mm cuts in a controlled way, to allow a dilated cavity to be developed [59]. Similarly, the Rossello cavernotomes are also advanced in an oscillating fashion and on withdrawal the back-cutting teeth create a channel through the scar tissue [60]. However, these cavernotomes should only be used by experienced surgeons because of the sharp edges, and need for proper technique to prevent urethral or proximal corporal injury.

Although proximal perforations are more amenable to repair, distal perforations in most cases should result in the termination of surgery and postponing the surgery to a future date. This is especially prudent if there is a distal perforation during dilatation of the first side. However, if one side has been effectively dilated with a subsequent perforation of the second side, the use of a single cylinder in the unaffected side might provide sufficient rigidity for coitus, and patient satisfaction that might preclude the need for a reoperation.

In the event of urethral perforation, many surgeons advocate abandoning the procedure because of the increased risk of an infected implant. However, if repeat surgery in a patient with corporal fibrosis might significantly increase the risk of infection, proceeding with the implantation, even with a urethral injury, can provide a better overall outcome [61]. This is a controversial subject and the present authors, as well as most surgeons

and guidelines, are in favour of abandoning the surgery. A highly visible and distal urethral injury can be repaired primarily in selected cases. If the perforation is minor it might heal over a urethral catheter or after urinary diversion with a suprapubic cystotomy. If one cylinder has been placed and the urethral injury occurs during the dilatation of the second corpus cavernosum, the implantation of the cylinder on the affected side can be aborted by cutting the cylinder and plugging the tubing; the ipsilateral cylinder can be placed later, after the urethral injury has healed.

In patients with corporal fibrosis where full dilatation is not possible, smaller cylinders such as the Coloplast Titan Narrow or the AMS CXR might be the best option for the patient. These devices can also be used to expand the tissue to allow for a larger prosthesis to be implanted in the future [22].

Glans bowing

This complication, also known as the 'supersonic transport' deformity (named after the Concorde aircraft), is a result of an undersized prosthesis or inadequate dilatation of the distal corpora. Ensuring sufficient distal dilatation and the use of rear-tip extenders can correct the deficiency during surgery. However, if this deformity is recognised after surgery, allowing adequate time for healing with scar formation can result in a suitable outcome that would preclude further intervention [62]. In patients who do not respond to conservative management, surgical treatment involves repositioning the glans more proximally on the corporal bodies, with a nonabsorbable suture, while preserving the integrity of the neurovascular bundle [63,64]. This deformity can also occur in cases of a missed proximal perforation, where the device gradually migrates away from the glans towards the perforation.

Reservoir complications

Although these complications are relatively uncommon, the outcome can vary from a mild nuisance to a devastating problem. The rare event of a reservoir herniation occurs in the setting of penoscrotal implantation and can result from forceful postoperative coughing, improper reservoir positioning, a subclinical hernia or a sizeable defect of the transversalis fascia [65]. The herniated reservoir can be repositioned in the perivesical space through the original scrotal incision or through a limited inguinal incision. In patients who are not bothered by the herniated reservoir, observation can be a safe and valid alternative.

In general, removing all malfunctioning hardware is sensible during repeat surgery and especially important in the setting of an infection. Rajpurkar et al. [66] evaluated 85 patients who had malfunctioning prosthetic cylinders and pumps replaced, but kept the reservoir of the original implant. With a mean follow-up of 50 months, all patients in the study had functioning implants with no occurrence of reservoir erosion. However, the authors of that study cautioned that previous pelvic surgery or infection should be considered before deciding to leave a pre-existing reservoir, because these conditions can increase the risk of erosion. The authors favoured complete removal of components whenever technically feasible.

For a reservoir to function properly there must be sufficient retropubic space to allow correct filling. In patients with adhesions or fibrosis secondary to pelvic surgery or radiation, expansion of the reservoir can result in compression of the iliofemoral vessels and possible deep vein thrombosis, which requires prompt evaluation and treatment to prevent devastating life-threatening sequelae. A concerted effort to place the reservoir more medially in these patients, or the use of a separate suprapubic incision, might be wise in such challenging cases [67,68].

Conclusion

Penile prosthesis surgery is an excellent treatment option when less invasive approaches fail to improve erectile function, particularly since the advances in the design of prosthetic devices. Although device infection and complications remain significant challenges, the use of meticulous surgical technique to minimise surgical time and to ensure optimal sterility makes this method a successful approach to treating ED.

Conflict of interest

None.

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