Penile Prosthesis Implantation in Acute and Chronic Priapism

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ABSTRACT

Aim. To review the current literature regarding penile prosthesis implantation in acute and chronic priapism.
Methods. A nonstructured Pubmed base search using the terms ischemic priapism, penile prosthesis, and refractory erectile dysfunction has been carried out.
Main Outcome Measures. Surgical outcome and patient satisfaction following penile prosthesis implantation are reported.
Results. Implantation of a penile prosthesis in acute and chronic ischemic priapism is associated with increased complication rates, when compared with virgin implants. Implantation in acute priapism allows the painful priapic episode to settle and to preserve penile length, while implantation in chronic priapism is technically much more challenging and often requires the use of downsized shorter cylinders.
Conclusion. Implantation of a penile prosthesis in acute refractory ischemic priapism should be the solution of choice, as the dilatation is easier and allows the preservation of penile length, which is one of the main factors influencing postoperative patient's satisfaction in prosthetic surgery. **Garaffa G and Ralph D. Penile prosthesis implantation in acute and chronic priapism. Sex Med Rev 2013;1:76–82.**

Key Words. Ischemic Priapism; Penile Prosthesis; Erectile Dysfunction; Fibrosis

Introduction

Priapism, which is defined as a prolonged erection that lasts longer than 4 hours in the absence of sexual stimulation, can be subdivided into nonischemic (high flow) and ischemic (low flow) types [1–3].

Ischemic priapism (IP), whose underlying pathophysiology is still not completely understood, accounts for more than 95% of all priapic episodes and presents as a rigid and painful erection not relieved by orgasm and ejaculation.

The condition, which is idiopathic in up to two-thirds of cases, can be associated with vasoactive intracavernosal injections, psychotropic medications, recreational drugs, and alcohol abuse. Furthermore, all hematological abnormalities that lead to increased viscosity of the blood, such as sickle cell anemia, thalassemia, and hematological malignancies can potentially cause low-flow priapism secondary to the obliteration of the small emissary veins in the subtunical space [4].

At present, IP is considered a compartmental syndrome and as such represents a medical emergency as the progressive ischemia within the cavernosal tissue is associated with time-dependent changes in the corporal metabolic environment, which leads to smooth muscle necrosis. Even if untreated, the priapic episode tends to subside with time, and the necrotic corporal tissue is then progressively replaced by fibrotic tissue, resulting in erectile dysfunction refractory to medical treatment and in a shortened indurated penis [5].

The main goals of treatment of priapism are the immediate resolution of the painful erection and the preservation of the cavernosal smooth muscle in order to prevent penile shortening and the onset of erectile dysfunction in the future.

The initial management of IP involves ejaculation, vigorous physical exercise, cold baths, aspiration of the ischemic blood forming the corpora cavernosa, and repeated instillations of α-adrenergic agonists such as phenylephrine.

With regards to intracavernosal injections of α-adrenergic agonists in adult patients, phenylephrine should be diluted with normal saline to a concentration of 100–500 mcg/mL, and 1-mL injections were made every 3–5 minutes for approximately 1 hour in an attempt to increase the smooth muscle tone and promote detumescence [6]. Although instillation of α-adrenergic agonists should be performed in all patients, irrespective of the time of presentation, priapic episodes lasting more than 24–36 hours generally do not respond due to the presence of irreversible damages of the cavernosal smooth muscle.

The absolute time point at which irreversible damage to the smooth muscle occurs is difficult to establish and may vary according to the etiology of the priapism and the degree of pre-existing smooth muscle dysfunction. However, hypoxia, glucopenia, hypercapnia, and acidosis occur within 6 hours of the commencement of IP [6,7].

Both in vitro and in vivo studies have shown that anoxia and glucopenia may function as independent damaging factors to the cavernosal smooth muscle and that irreversible histopathological alterations are caused by the combination of the state of acidosis, glucopenia, and hypoxia that last for more than 4 hours [6–12].

It is widely accepted that if priapism is reversed within 24 hours, there is usually a recovery of erectile function in around 50% of patients, while a duration of more than 36 hours of the priapic episode is invariably associated with a degree of corporeal fibrosis and erectile dysfunction [13,14].

Patients who do not respond to aspiration and instillation of α-adrenergic agonists are traditionally offered penile shunt surgery, which aims to achieve a surgically created vent for blood egress from the corpora cavernosa and concomitantly resolve the compartment syndrome and re-establish a blood circulation within the corpus cavernosum [6]. In particular, Burnett and Pierorazio have reported excellent preliminary results in terms of resolution of the priapic episode and recovery of the erectile function in patients managed with the corporal "snake" maneuver. This procedure involves the creation of a "surgical window" between the distal ends of the corpora cavernosa bilaterally and the glans penis to guarantee adequate blood drainage, followed by the retrograde insertion of a 7/8 Hegar dilator into the corporal bodies to release the congested viscous blood [15].

However, in patients with prolonged priapism, irreversible damage to the smooth muscle is likely to have already occurred, and therefore, attempts of re-oxygenation of the corpora with shunt surgery, although may promote a resolution of the painful priapic episode, will not change the long-term outcome for the need of a penile prosthesis [16–19].

Penile Prosthesis Implantation Acute Priapism

Penile prosthesis implantation, which has been the traditional treatment in patients who have developed refractory erectile dysfunction following a prolonged priapism, has now been advocated as an alternative initial management practice for IP by various authors [4,17,20–25]. However, at present, this treatment option is still not part of the American Association of Urology Guidelines for the management of refractory IP [6].

In particular, an IP nonresponsive to aspiration and intracorporeal instillation of α-adrenergic agonists or a significantly delayed presentation suggest an irreversible damage of the cavernosal smooth muscle, which will lead to fibrosis, penile shortening, and refractory erectile dysfunction. Therefore, immediate penile prosthesis implantation in these patients would solve the painful erection, guarantee the adequate long-term rigidity for sexual penetration, and prevent the otherwise inevitable penile shortening.

Initially described by Upadhyay et al. in 1998, acute implantation of penile prosthesis in patients with refractory IP is now advocated by various authors [4,17,20–25].

Overtreatment of patients with no necrosis of the cavernosal smooth muscle is one of the risks associated with this approach, and therefore, a correct timing of surgery is paramount. Various authors consider that after 24–48 hours of persistent erection irreversible smooth muscle necrosis has already occurred, and therefore, an immediate penile prosthesis implantation should be considered and discussed with the patient.

Imaging and cavernosal smooth muscle frozen sections can be extremely useful to aid clinicians in the decision whether to immediately implant a penile prosthesis or to adopt a conservative approach. Although penile ultrasonography is of limited utility to assess the viability of the corporeal tissue, a recent series of 23 patients, in which the radiological findings have been compared with the final histopathological report, has shown that gadolinium-enhanced high-definition magnetic resonance imaging (MRI) scan of the penis has a sensitivity of 100% when used to detect the

presence of necrosis of the cavernosal smooth muscle [26]. Therefore, this imaging modality may represent an extremely useful tool to support the clinical decision to proceed with acute penile prosthesis implantation (Figure 1).

Histological evidence of necrosis would also aid the clinician and patient in coming to the decision. If performing shunt surgery, taking a small cavernosal smooth muscle biopsy at the same site is quick and simple, and would aid subsequent management and give a long-term prognosis. Also, frozen sections can be harvested at the time of implant surgery to confirm the presence of necrosis of the cavernosal smooth muscle with penile prosthesis implantation being abandoned if viable tissue is demonstrated. Although potentially extremely useful, both gadolinium-enhanced high-definition MRI and frozen sections are not always available in all centers, especially out of hours, and therefore, the clinician frequently needs to make a decision based only on the duration of the priapic episode [17,26].

The main risk associated with acute penile prosthesis implantation is the infection of the erectile device, which can be as high as 6%, more than six times higher than reported for virgin implants [17,27]. This is because the previous introduction of aspiration needles and shunt surgery within the corpora cavernosa, in the attempt to induce detumescence, might increase the risk of infection, particularly if there is diffuse bruising and edema.

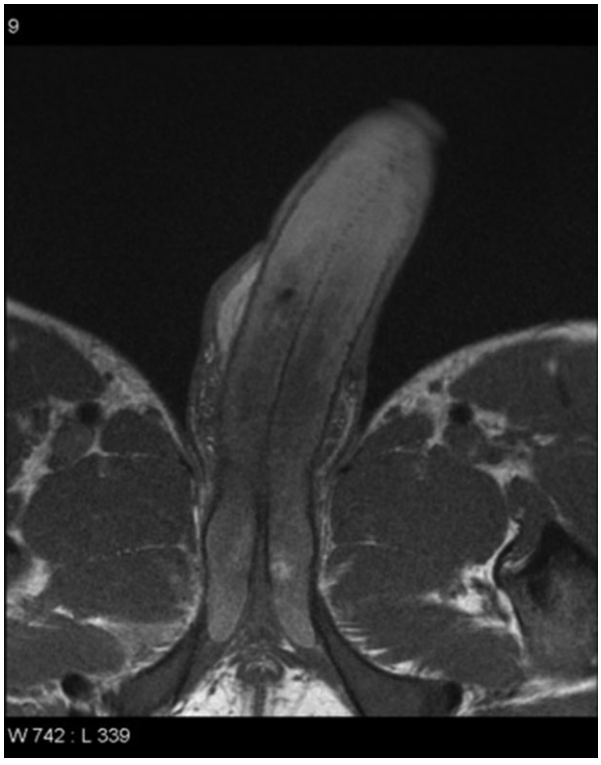

Figure 1 High-definition magnetic resonance imaging scan of a patient with longstanding priapism after gadolinium infusion. Areas of necrosis (arrow) are seen mid-shaft that does not take up the contrast.

Therefore, if the pain is well controlled with medical treatment, penile prosthesis implantation should be delayed for a few days to give enough time for the edema and bruising to subside and for the broad spectrum antibiotics to clear any possible bacterial contamination in the corporeal tissue [23]. Although the exact time beyond which the necrotic corporeal smooth muscle is substituted by fibrotic connective is not known, Sedigh et al. have described easy dilatation of the corpora after 1 week of priapism [23].

Although both malleable and inflatable penile prostheses have been successfully implanted in patients with acute IP [4,20–25], semirigid devices represent the first-choice implant in this group of patients [17]. This is because the necrotic corporeal tissue tends to heal with the formation of a fibrotic capsule around the cylinders, and therefore, inflatable rods must be kept inflated for at least 1 week postoperatively and cycled on a daily basis thereafter to prevent the development of contracture and penile deformity [4,17,23,25]. As patients presenting to the emergency room with IP tend to be poorly compliant and frequently present psychiatric conditions or a history of drug and alcohol abuse, regular cycling of the inflatable device may represent an issue, and therefore, malleable prosthesis represents an ideal solution. Highly motivated and compliant patients can be offered immediate implantation of an inflatable penile prosthesis, as they are likely to attend postoperative follow-up visits and cycle the device on a regular basis. Alternatively, an elective exchange to an inflatable device can be offered at a later date in patients dissatisfied with the cosmetic and functional outcome after implantation of a malleable penile prosthesis.

Intraoperatively, the tunica albuginea and dartos layer appear thickened and edematous, but once inside the corpora the dilatation is usually not particularly challenging as the cavernosal smooth muscle is necrotic and friable. In patients who have previously undergone shunt surgery, extra care must be taken when dilating the distal corpora, as the corporeal tips have been weakened and, therefore, there is an increased risk of distal perforation. This complication can occur in up to 6% of cases

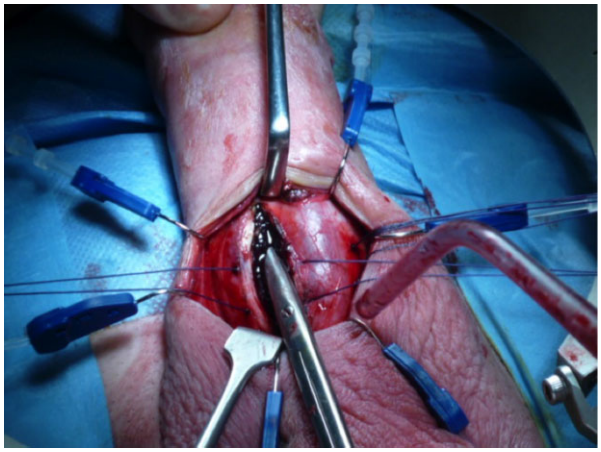

Figure 2 Necrotic tissue is seen at the site of the corporotomy; dilatation is easy, although care distally is needed to prevent perforation.

and is more common in patients who have undegone El-Ghorab, Ebbehoj, Grayhak, or Brant shunts, and when a malleable device is implanted (Figure 2: [23,24]). According to Salem and El Aasser, distal erosion can be minimized by applying a nonabsorbable sling suture through the malleable device and the edges of the opened tunica albuginea at the level of the corporotomy to fix the cylinder into the corpora in a similar fashion to the one described to manage perforation of the crura during proximal dilatation [24].

Despite all these caveats and a revision rate for complications as high as 12% at 15.7 months, prosthesis implantation in acute priapism remains a reproducible procedure that allows preservation of penile length and the rigidity necessary for intercourse [17]. Implantation of a malleable penile prosthesis is also cheaper than any shunt procedure as it involves only an overnight stay, while shunt surgery frequently involves repeated procedures and therefore translates in longer hospital stay.

Penile Prosthesis Insertion in Chronic Priapism

As an alternative to acute penile prosthesis implantation, IP can be treated conservatively. Once the painful erection has subsided, a close rehabilitation with the use of daily phosphodiesterase type 5 inhibitors and the vacuum constriction device is commenced and continued for 3–6 months to promote a prompt recovery of the erectile function. Also, the administration of anti-inflammatory and antifibrotic agents may reduce the scarring formation and the consequent erectile dysfunction and penile shortening. However, if necrosis of the corporeal smooth muscle has already occurred, rehabilitation will be ineffective, and the patient will develop refractory erectile dysfunction and a contracted fibrotic penis that will ultimately require a penile prosthesis implantation. Typically, IP leads to the formation of dense fibrosis in the distal corpora, while the crura are relatively spared [28–30].

Penile prosthesis implantation in patients with severe corporeal fibrosis represents a real challenge for the surgeon as not only does the fibrotic corpora makes insertion of the cylinders difficult but that complications are frequent, particularly urethral injuries, tunical/crural perforation, and cylinder crossover.

A variety of techniques have been described to facilitate the implantation of a penile prosthesis in cases of severe fibrosis.

Traditionally, dense corporal fibrosis has been treated with extensive exposure of the tunica albuginea in order to allow the creation of the cavernosal channels under direct vision. Adequate exposure of the shaft penis and of the crura can be easily achieved by combining a penoscrotal and circumferential subcoronal incision with complete degloving of the shaft penis. Alternatively, in an attempt to minimize the dissection, the transverse penoscrotal incision can be extended distally along the raphe down to the coronal sulcus in "T" shape fashion to expose the corpora on their ventral aspect [31].

Various authors have described the technique of wide corporeal excision of the scar tissue that involves extensive incisions of the tunic albuginea, which can be prolonged proximally to the crura and distally down to the corona. The fibrotic corporal tissue is then carefully dissected off the tunica albuginea in order to create the space necessary to house the cylinders of the penile prosthesis (Figure 3). As the dissection can be technically extremely challenging and operative time is therefore prolonged, complication rates can be as high as 65%, with up to 30% of patients experiencing infection of the device and an overall prosthesis survival of only 50% at 1 year [28,32,33].

Alternatively, in an attempt to reduce morbidity and operative time, extensive tunical incision can be replaced by small corporal counter incisions, which are usually placed distally, in order to guide the tip of the Metzembaum scissors during the dilatation. This technique is extremely useful to minimize the chance of urethral injury, distal

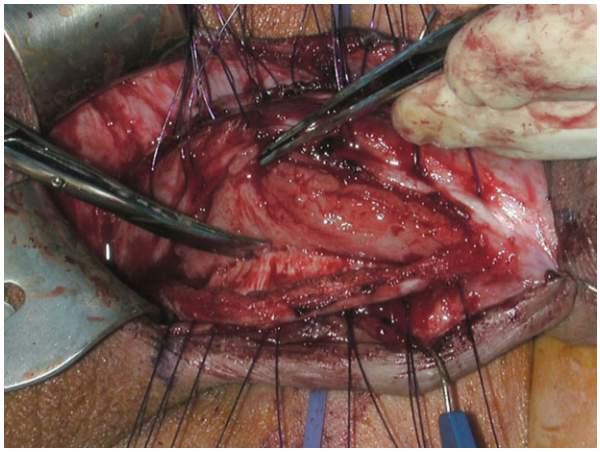

Figure 3 A plain is developed between the tunica and the fibrosis to remove the fibrotic core en-mass via an extended corporotomy (with permission from Professor L. Levine).

crossover, and malpositioning of the cylinders (Figure 4). Although the authors initially described this approach for the implantation of malleable prostheses, it can also be suitable for inflatable devices [34].

The use of synthetic, biological, and autologous grafts has been very popular after the excision of the fibrotic tissue when the tunica albuginea does not allow the primary closure of the corpora cavernosa. In fact, defects in the tunica albuginea larger than 1 cm, if left uncovered, are associated with increased risk of aneurysmal dilatation of the cylinders, erosion, migration, infection, and mechanical failure of the device [35,36].

The main disadvantage of synthetic grafts is their immunogenicity that translates in a significantly increased penile prosthesis infection rate, which has been reported as high as 30%, while donor size morbidity, limited availability, and increased operative time are the downsides of autologous materials [32,37].

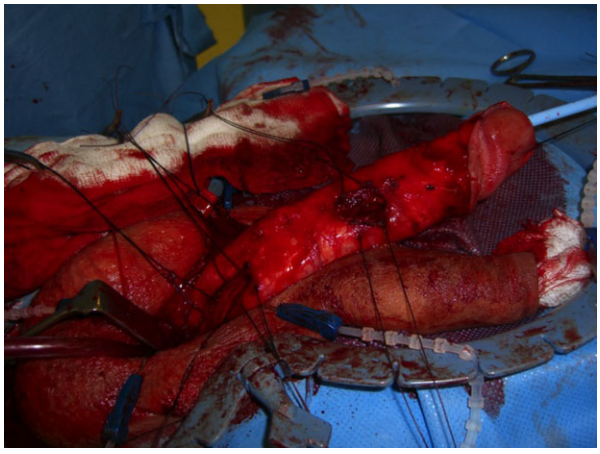

Figure 4 A second small corporotomy is made to allow scissors to push through the fibrosis with safety.

Extracellular matrix grafts instead are not associated with donor site morbidity and limited availability and, according to some authors, are not associated with increased infection rates of the prosthetic device. Therefore, extracellular matrix grafts represent the material of choice when grafting is required to close the corporotomy [38,39].

The main breakthrough in penile prosthesis implantation in severe fibrosis was introduced in 1995 when Wilson et al. described the concept of drilling into the fibrous cavernous tissue avoiding extensive albugineal incision and time-consuming excision of the fibrotic tissue [40].

This technique requires the use of Carrion-Rossello or Uramix cavernotomes that allow a channel to be created in the dense fibrotic tissue minimizing the risk of inadvertent urethral injury. Carrion-Rossello cavernotomes work like a wood rasp and are advanced with movements of pronosupination of the hand to allow the teeths to disrupt the fibrotic tissue, while Uramix devices present longitudinal blades, which allow to shave off the tissue if the instrument is moved in a drilling rotational fashion.

Alternatively, the Otis urethrotome represents an extremely useful tool to help the surgeon to create the channel inside the fibrotic corpora.

Using this technique, Wilson et al. were able to successfully implant an inflatable device without the use of grafting in 32 consecutive patients with severe corporal fibrosis. Infection rate in this series was 6.3%, with an overall 1-year survival of the implant of 87% [40].

Because of the severe scarring and contacture of the corpora, the authors advocated the use of downsized inflatable devices, which, if regularly cycled, would act as tissue expanders and eventually be replaced with standard cylinders. Although the newly replaced cylinders were 2–7 cm longer than the original ones, a significant penile length loss was still evident [41].

At present surgeons can use a combination of all the earlier techniques in order to achieve a satisfactory dilatation of the corpora.

Conclusions

In patients with IP nonresponsive to aspiration and intracorporeal instillation of α-adrenergic

agonists or a significantly delayed presentation, irreversible changes in the cavernosal smooth muscle are likely to have already occurred, and this will lead to refractory erectile dysfunction and fibrosis.

Immediate penile prosthesis implantation in these patients will therefore settle the priapic episode, maintain the long-term rigidity necessary to engage in penetrative sexual intercourse, and prevent penile shortening.

Patients needs to be warned that this procedure still is not part of the American Urological Association Guidelines and that it is associated with higher complication rates than in virgin cases.

Although complication rates after penile prosthesis implantation in acute priapism are high, they are still lower than after implantation in patients with severe corporal fibrosis because of chronic priapism. Furthermore, complication rates following acute implantation could be potentially further reduced if unnecessary shunt surgery is avoided or delaying surgery for a few days to allow the bruising and edema to settle and the broad spectrum antibiotics to clear bacterial contamination.

Regardless of the complication rates, implantation in acute priapism should be preferred as it allows the preservation of penile length, which is one of the main factors influencing postoperative patient's satisfaction following penile prosthesis implantation [42].

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Category 2

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(b) Revising It for Intellectual Content
David Ralph; Giulio Garaffa

Category 3

(a) Final Approval of the Completed Article
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