

Management of Disastrous Complications of Penile Implant Surgery



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ABSTRACT

Rationale: Penile Prosthesis Implantation (PPI) is the definitive treatment for Erectile Dysfunction not responsive to conservative management strategies. Furthermore, it is a staple of surgical treatment of severe Peyronie's Disease (PD) and phallic reconstruction. Expert implantologists occasionally face disastrous complications of penile implant surgery which can prove to be very challenging. In this article we present a selected number of case reports which exemplify this kind of situations and discuss management strategies while also commenting on plausible aetiologies.

Patients' concerns: The first case describes a PPI performed in end-stage fibrotic corpora after multiple instances of implantation/explant. The second and third cases show two diametrically opposed approaches to the management of glans necrosis after PPI in post-radical cystectomy patients. The fourth case describes the history of a diabetic patient suffering from glandular, corporal and urethral necrosis after a complicated PPI procedure. The fifth case reports the surgical treatment of a case of recurring PD due to severe scarring and shrinking of a vascular Dacron patch applied in a previous operation.

Diagnosis: Complication diagnosis in all patient was mainly clinical, intra- and postoperative, with Penile Color Doppler Ultrasonography performed when needed in order to demonstrate penile blood flow.

Interventions: The patients underwent complex surgical procedures that addressed each specific complication. Complex penile implants with fibrosis-related complications, penile prosthesis explant with and without surgical debridement of necrotic areas, penile prosthesis explant with necrotic penile shaft and urethral amputation with perineostomy, and complex corporoplasty with scar tissue excision and patch application with PPI were performed in the five patients.

Outcomes: Penile anatomy and erectile function with PPI was achieved in 4 out of 5 patients. 1 of 5 patient is scheduled to undergo a total phallic reconstruction procedure at the time of this writing.

Lessons: Management of disastrous complications of penile implant surgery can be very challenging even in expert hands. In-and-out knowledge of possible PPI and PD complications is required to achieve an acceptable outcome. **Bettocchi C, Osmonov D, van Renterghem K, et al. Management of Disastrous Complications of Penile Implant Surgery. J Sex Med 2021;18:1145–1157.**

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INTRODUCTION

Penile Prosthesis Implantation (PPI) is known to be the preferred treatment strategy for patients suffering from Erectile Dysfunction (ED) and unsuccessfully managed with conservative strategies.¹ Moreover, PPI is a staple of treatment for severe Peyronie's Disease (PD) and complex phallic reconstructive surgery,² allowing the surgeon to perform extensive modifications of existing anatomy while remaining certain of being able to restore a functional erection. In fact, satisfaction and utilization rates for penile prosthesis are fairly high.³

Recent advances in penile prosthesis manufacturing, materials and implantation techniques have definitely lowered the

impact of complications in most cases,⁴ but high-volume reference centres for PPI may happen to face peculiar clinical situations.

In this article we present a selected number of extreme complications in penile implant surgery which show that management of such cases can be challenging, even in expert hands. A case of end-stage implant surgery in severely fibrotic corpora after multiple PPI surgeries is presented, followed by two cases of glans necrosis in post-radical cystectomy patients with completely different management choices; then we describe a case of glandular, corporal and urethral necrosis in a diabetic patient after a complicated PPI procedure, and a case of recurring PD after severe scarring due to the shrinkage of a previously applied patch in a corporoplasty procedure. We also discuss the possible aetiology of these disastrous complications on a case-by-case basis and the rationale behind the treatment choices made.

Case report 1: *End stage implant surgery using a malleable penile prosthesis after multiple implant- and explant surgeries due to functional problems and prosthesis infections*

A 57-year-old man presented at the outpatient clinic with disabling complaints of fibrotic scar tissue at the distal penile shaft, twelve years after multiple failed penile implant surgeries resulting in a final explant and a renouncement of further penile implant surgery due to extensive scar tissue and inaccessible corpora cavernosa. At the moment of the consultation, the patient and his partner were unhappy with the long-lasting state of erectile dysfunction (ED) and genital fibrosis due to previous surgery. Therefore, once again requesting a solution for the ED and if possible, to review the renouncement for further penile implant surgery. Despite being only 57 years old, a lot can be said about this patient's medical history to arrive at this end stage of ED.

This patient underwent his first penile reconstructive surgery from a plastic surgeon at the young age of 30 years old. At the time, a Nesbit plication was performed for a non-invalidating curvature of the penis without repercussions on the sexual activity. The decision for surgery was made on an aesthetic basis without taking into account the already objectified ED. Consequently, the ED worsened following surgery. All possible conservative treatment options were tried without a satisfactory result (psychological support, Phosphodiesterase Type 5 inhibitors, injection therapy). Six years later, all hope for a definitive solution was set on an inflatable penile prosthesis (Ultrex). Mechanical problems due to suboptimal quality of prostheses on the market led to revision surgery. Two months after this revision an infection resulted in explant surgery. One year after the explant, a second inflatable penile prosthesis (Ambicor) was implanted through penoscrotal access. This procedure was complicated by a perforation at the right distal corporal capsule during the dilation process. A corporoplasty was needed to ensure a safe position of the newly implanted prosthesis. Because of outcome dissatisfaction by patient and surgeon, a corporoplasty

with application of porcine acellular dermal collagen matrix (Pelvicol) at the distal corpora cavernosa was performed, two months after implant surgery. Unfortunately, the Ambicor prosthesis was explanted due to erosion of the right cylinder through the subcoronal skin, six months after the first implantation of this prosthesis.

A third and final implantation attempt was discontinued due to insurmountable tissue fibrosis as stated above. Further implantation requests were consequently renounced.

Ultimately, twelve years later at the age of 57 years old, the patient once again counselled for a penile prosthesis insertion considering poor sexual quality of life. Five months after extensive resection of disabling fibrotic tissue in the genital region, a final implant procedure was performed using a malleable prosthesis (Genesis). More than a decade after the first implant, expert knowledge and prosthesis durability led to a satisfied patient with realistic expectations, marked by its history.

During final surgery, some tools and tricks were used to successfully complete complete revision implant surgery.

The surgical procedure was performed by an expert surgeon using a longitudinal penoscrotal approach (Figure 1–2). Pre-operative management consisted of shaving of the surgical area, correct prophylactic antibiotic management and a 15-minute disinfection process of the surgical site. A CH16 latex foley urinary catheter is placed for better visualisation of the urethra during surgical dissection. An indwelling catheter, together with an atraumatic Babcock clamp are indispensable for dissection of the corpora cavernosa in redo penile implant surgery with loss of anatomical planes (Figure 3). After dissection and opening of the corporal bodies, the most challenging part of penile implant surgery after an explant is dilation of the corporal bodies. Literature sometimes uses the word 'excavation'. We started with small-size Hegar dilators, followed by backwards cutting scissors to incise the fibrotic envelope of the corpora from the inside (Figure 4). Rossello dilators are excellent for final removal of excess fibrotic tissue in corporal bodies (Figure 5). Maintaining bilateral symmetry in length is classically ensured using the Furlow, but crossover can be excluded by the 'goal post' test using Broux dilators (Figure 6). Rinsing of the excavated cavities with antibiotic enriched fluid can add protection to possible infectious contamination during surgery. After implantation of the malleable prosthesis, closure of the corporotomies is ensured using interrupted sutures. Wound closure is done in several layers (Figure 7).

Case report 2-3: *Glans necrosis. A severe complication following penile prosthesis implantation in two patients with Ileal neobladder*

A 53-year-old patient with therapy-resistant severe erectile dysfunction (ED) was referred to our medical center. The patient was a heavy smoker with pack years = 45. The patient had undergone open surgical radical cystectomy with orthotopic ileal



Figure 1. Pre-operative setting of extensive scarring of penoscrotal skin. Figure 1 is available in color online at www.jsm.jsexmed.org.



Figure 2. Longitudinal peno-scrotal incision, fibrotic tissue surrounding urethra and corpora cavernosa. Figure 2 is available in color online at www.jsm.jsexmed.org.

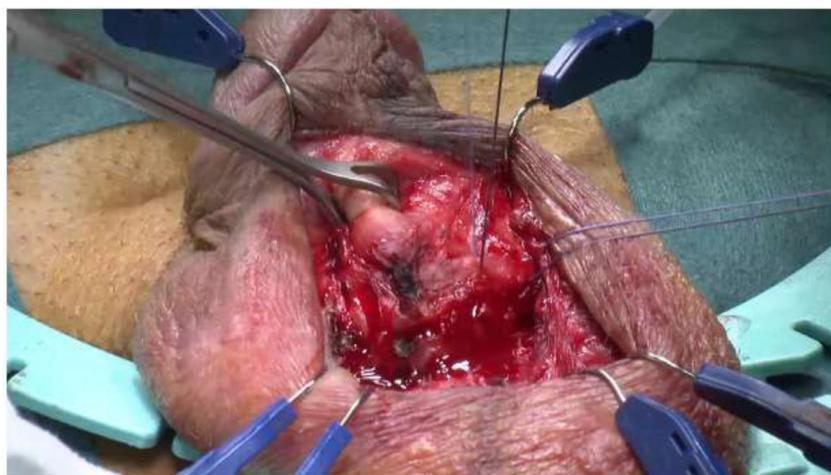


Figure 3. Atraumatic placement of Babcock clamp for urethral control and placement of stay sutures. Figure 3 is available in color online at www.jsm.jsexmed.org.

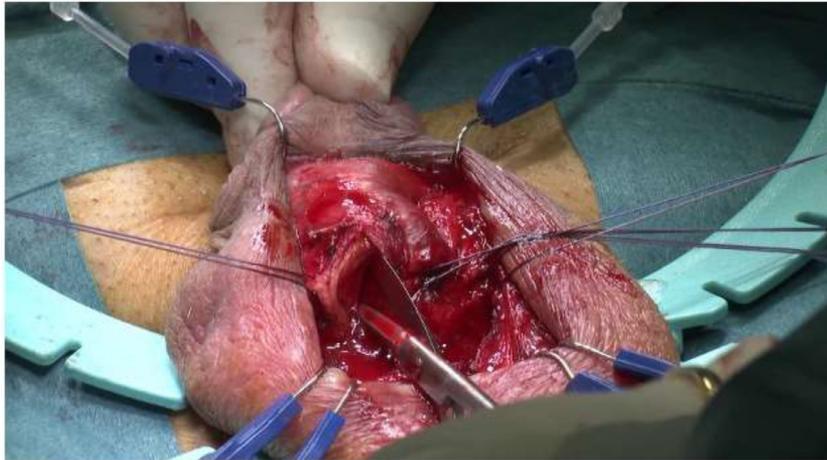


Figure 4. Dilation of fibrotic envelope with backward scissors. Figure 4 is available in color online at www.jsm.jsexmed.org.



Figure 5. Rossello curettage of proximal and distal part of the corpus cavernosum. Figure 5 is available in color online at www.jsm.jsexmed.org.



Figure 6. 'Goal post' test for proximal and distal symmetry. Figure 6 is available in color online at www.jsm.jsexmed.org.



Figure 7. Implantation of malleable prosthesis and final result. Figure 7 is available in color online at www.jsm.jsexmed.org.

neobladder 5 years before. He was under routine urological follow-up care without evidence of recurrent cancer.

The patient was examined and finally underwent penoscrotal IPP implantation with high submuscular ectopic reservoir placement. The IPP was semi-inflated, the vacuum-suction-drain was placed and a Henry's "mummy wrap" was attached/adjusted. The surgery procedure ran with any surgical or technical problems.

On day 1, roughly 2 hours after surgery, the patient complained of pain and prominent swelling in the glans penis. When the IPP was immediately deflated and the dressing resolved, patient reported slight amelioration (Figure 8). At 8 hours the patient reported less pain. However, examination revealed numbness of the glans (Figure 9). Doppler ultrasound examination of the glans showed a reduced blood supply of the glans, the urethral arteries could not be identified on doppler. Dorsal blood supply was found. Catheter was not removed. Aspirin and PDE 5i were additionally administered. At 20 hours post-operatively, necrotic areas were identified on the glans (Figure 10). The pain had subsided. Dr. Steve Wilson was consulted. His recommendation was to remove the device immediately. Thus, we explanted the device as recommended. Finally, the transurethral catheter was removed and a doppler ultrasound examination was performed again. The glans was partially vascularized. Patient was discharged under Aspirin and PDE5i medication.

At 2 weeks post-operatively, the patient did not complain of any problems, especially not of pain. The local examination

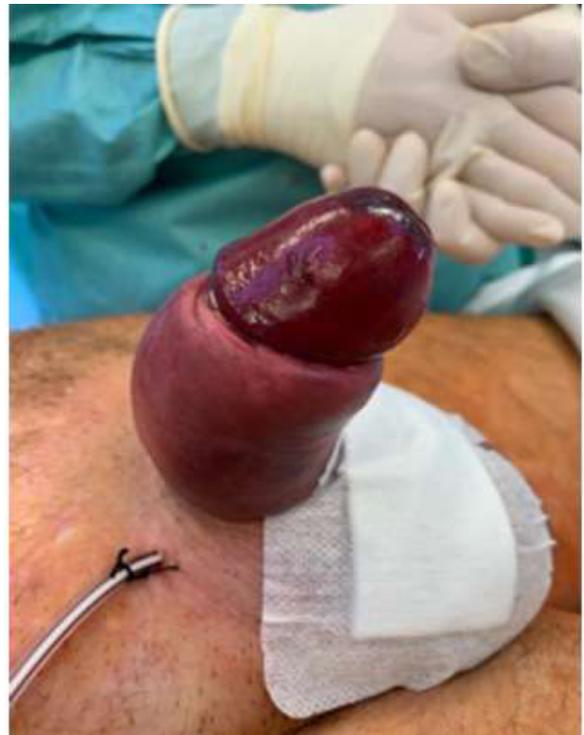


Figure 9. 8 h after surgery. Pain reduced, initial numbness. Figure 9 is available in color online at www.jsm.jsexmed.org.



Figure 8. 2 h after surgery. Complains of glans pain and swelling. Figure 8 is available in color online at www.jsm.jsexmed.org.



Figure 10. 20 h after surgery. Necrotic areas on glans. Figure 10 is available in color online at www.jsm.jsexmed.org.



Figure 11. 2 wk after surgery. Glans necrosis. Figure 11 is available in color online at www.jsm.jsexmed.org.

revealed evidence of glans necrosis (Figure 11). Doppler examination was without evidence of blood supply of the glans.

3 weeks after surgery, the patient underwent surgical debridement with removal of the necrotic masses (Figure 12). Seven days later, the transurethral catheter was removed and patient was able to urinate.

4 months later, a plastic reconstruction of the glans penis was performed.

A 58-year-old patient with therapy resistant severe erectile dysfunction (ED) was referred to our medical centre. Like the one above the patient was a smoker (pack y = 30) and had undergone open surgical radical cystectomy with orthotopic ileal neobladder 11 years before. A malleable PP had been inserted removed due to prosthesis-related infection 7 years before. The patient was under routine urological follow-up care without evidence of recurrent cancer.

The patient was examined and finally underwent penoscrotal IPP implantation with ectopic high submuscular reservoir placement. Several problems were observed during the surgery: a. there was a huge scar formation in the area of the former corporotomies and sharp dissection revealed a non-resorbable suture residue from previous surgery, b. the urethra had been stitched with non-resorbable suture material (probably 4 × 0 Prolene) during the previous surgery.

Intraoperative flexible cystoscopy was performed, without evidence of the urethral stricture. IPP was inserted in a standard fashion. IPP was completely deflated, due to the experience with the first case, the vacuum-suction-drain was placed and a Henry's "mummy wrap" was attached.

About 2 hours after surgery, the patient complained of pain and prominent swelling in the glans penis (Figure 13). The dressing was immediately resolved, and catheter was removed. In addition, we diagnosed paraphimosis. Doppler ultrasound examination equally showed moderate glans penis perfusion and a low flow above the urethral arteries on the both sides.

The patient was taken back to the OR. A dorsal foreskin incision was performed and suprapubic catheter inserted. Dr. Steve



Figure 12. 3 wk after surgery. Removal of necrotic glans penis. Figure 12 is available in color online at www.jsm.jsexmed.org.



Figure 13. 2 h after surgery. Pain and swelling. Figure 13 is available in color online at www.jsm.jsexmed.org.

Wilson was consulted as in previous case. His recommendation was to monitor the situation every hour and in doubt to explant the device.

6 hours after surgery, the doppler ultrasound examination showed an adequate perfusion of the glans initially. However, after 12 hours the ischemic areas became visible (Figure 14). We decided to immediately remove the prosthesis. When the surgery was performed, the reservoir was left in place after sealing the tubing by means of “true lock” caps. The postoperative period ran smoothly without any complications.

When evaluating the patient after 12 weeks, we found the glans penis remained vital.

Case report 4: *Glans, corpora cavernosa and urethral necrosis after penile implantation and grafting for Peyronie’s Disease after intraoperative corpus spongiosum injury*

A 58 years old patient was referred to our clinic complaining of a 10 years history of erectile dysfunction (ED). The patient had been successfully treated with Viagra until the last 2 years, when the symptom had worsened and he became unresponsive to treatment. Roughly at the same time, he noticed a



Figure 14. 12 h after surgery. Ischemic areas of the glans. Figure 14 is available in color online at www.jsm.jsexmed.org.

progressively increasing dorsal penile curvature for which he had sought no treatment. He had a history of well-controlled diabetes mellitus type II on a metformin regimen, hypertension treated with amlodipine and dyslipidemia controlled with statin. He was also on primary prevention with aspirin and had no history of smoking.

Clinical examination revealed a circumcised penis with a Stretched Penile Length of 11 cm, and a large calcified plaque on the dorsal aspect of the shaft. Penile Color Doppler Ultrasonography was somewhat equivocal, as Peak Systolic Velocity was found to be around 30 cm/s while full erection was not achieved even with a 20 mcg alprostadil injection.

Surgical treatment options were discussed with the patient with Nesbit procedure being the first alternative proposed. The patient refused this option due to concerns regarding possible length loss and worsening of ED as sequelae. Therefore, he was scheduled to undergo a Penile Prosthesis Implant (PPI) and primary graft as the calcified plaque was deemed unlikely to be modelled.

During the degloving step of the surgical procedure, an accidental tear in the corpus spongiosum was made. Urethral mucosa was assessed for damage and found apparently uninjured, so it was decided to suture the small tear in the corpus spongiosum and resume the procedure as planned. The neurovascular bundle was mobilized from the paraurethral grooves. The plaque was incised and a pericardial graft measuring 8 × 4 cm was sutured into position. The penile prosthetic cylinders were then inserted in the usual fashion after careful dilation of the corpora cavernosa and the reservoir was placed in the Retzius space with the conventional blind maneuver without any further issue. A scrotal drain was placed, a tight mummy wrap was applied and the patient was put under an intravenous antibiotics regimen as per our standard protocol.

Complications manifested in the immediate post-operative period. In the first Post-Operative Day (POD) the patient failed two spontaneous micturition attempts and needed to be re-catheterized. Furthermore, a close examination revealed an incipient duskiness of the glans, so the implant was deflated and the mummy wrap removed. Drainage was minimal but was cautiously retained.

In the second POD duskiness was found much worsened over just 24 hours, so the patient returned in the operating theater to undergo removal of the penile prosthesis. The penis appeared to be generally swollen, but the glans showed clear signs of necrosis. A penile Color Doppler Ultrasonography revealed the presence of some flow in the corpora cavernosa, therefore in this regard we opted for a conservative management. The patient was dismissed after 1 week with a suprapubic urinary catheter in place.

At 3 weeks after surgery, the patient was reviewed and immediately readmitted to our clinic after clinical assessment revealed an increase in the extent of necrotic tissue (Figure 15). A debridement attempt was made in the operating theater, during which the whole corpora were found to be necrotic and were excised all the way down to the penoscrotal junction. The urethra was also



Figure 15. Patient reviewed 3 wk after surgery. Figure 15 is available in color online at www.jsm.jsexmed.org.

necrotic, so it was necessary to remove it to the same extent to find healthy tissue (Figure 16). The urethral stump was brought out as a salvage perineal urostomy and catheterized (Figure 17). The remaining skin of the penile shaft was closed to be available for eventual later use. The patient was dismissed after 1 week without any further complications arising.



Figure 16. Surgical field after removal of necrotic corpora and necrotic urethra. Forceps is holding the remaining healthy urethra. Figure 16 is available in color online at www.jsm.jsexmed.org.

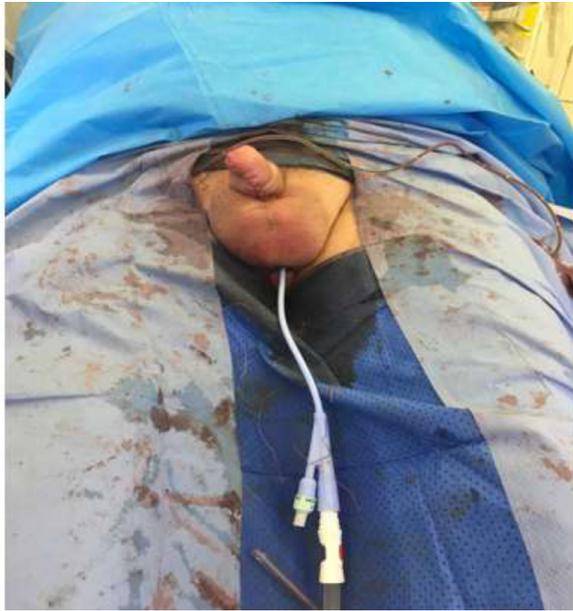


Figure 17. Final result with skin closed and perineal urostomy. Figure 17 is available in color online at www.jsm.jsexmed.org.

At the moment, this patient is due to undergo a total phallic reconstruction procedure with thigh flap phalloplasty.

Case report 5: Severe vascular Dacron graft retraction and scarring after surgery for Peyronie's Disease

A 40 years old man with an 8-year history of diabetes in oral treatment was diagnosed with Peyronie's disease, suffering from a 60 degrees right-leaning dorso-lateral curvature. The penis was of large diameter, having a circumference of about 18 cm.

Initial treatment consisted of oral Vitamin E and Verapamil for 6 months, without any improvement. He underwent surgery

in another hospital, where plaque incision and dorsal grafting with vascular Dacron was performed. In the post-operative period, he developed a pustulous infection which was treated by drainage and intravenous antibiotics. This conservative treatment allowed for a very slow healing of the wound with the secretion gradually resolving, but unfortunately there was a concomitant relapse of penile curvature on the same side which ended up being more severe than in the pre-operative situation.

About 1,5 years after the previous surgery, he presented to our clinic with a close to 90 degrees curvature, significant penile shortening and impossibility to achieve penetrative intercourse. Clinical examination revealed very hard and extensive scarring on the right and dorsal aspect of the penis which rendered penile stretching not feasible (Figure 18). Surgical procedures were discussed with the patient and it was decided to perform corrective surgery with re-grafting and simultaneous implantation of a penile prosthesis.

After standard pre-operative preparation and general anesthesia, the procedure was started with total penile degloving, which revealed the presence of very hard scar tissue on the dorsal aspect and in particular on the right side of the penis. Here, the retracted Dacron vascular graft from the previous surgical procedure was found to be severely conjoined with scar tissue and the surrounding neurovascular bundles, urethra and corpora cavernosa (Figure 19).

The graft was carefully excised while closely following its surface borders in order to preserve surrounding tissue as much as possible (Figure 20). After excision, the large defect in the right cavernosal body was covered with porcine dermis graft (Figure 21). A three-piece inflatable penile prosthesis was implanted to provide erection to the damaged corpora cavernosa. A suction drain was left in place for 2 days (Figure 22).



Figure 18. Severe penile curvature and shortening, scarring on the right side of the shaft prevents penile stretching. Figure 18 is available in color online at www.jsm.jsexmed.org.



Figure 19. Retracted vascular Dacron graft. Figure 19 is available in color online at www.jsm.jsexmed.org.

The immediate post-operative course was uneventful: the prosthesis was left partially inflated for the next 3 weeks, and after that, the patient was advised to practice daily inflation and deflation. The patient regained sexual intercourse about 8 weeks after surgery.

There was another problematic occurrence about 6 years later, when the patient noticed a malposition of the right cylinder tip. The patient was readmitted for surgical correction: the cylinder was repositioned and fixated under the glans with tunical reduction. Since then, the patient had no other issue to report.

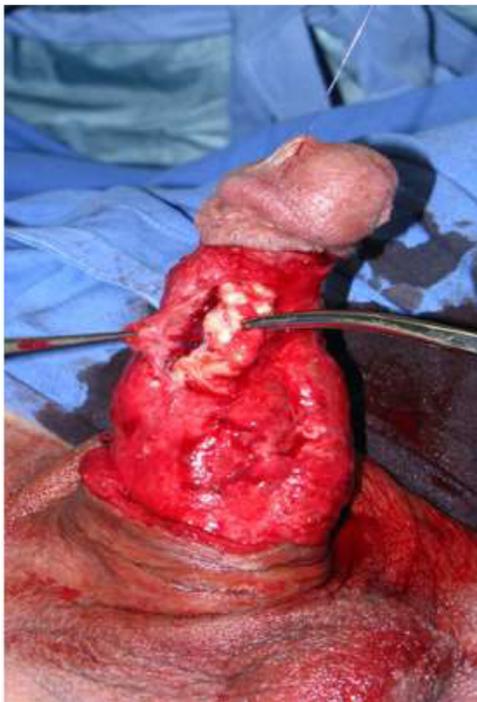


Figure 20. Excision of vascular Dacron graft. Figure 20 is available in color online at www.jsm.jsexmed.org.

DISCUSSION

Extreme complications of penile prosthetics surgery are not always manageable by following a standardized approach. Case-by-case examination of risk factors and highlighting of critical events can prove essential in order to make the correct choices for achieving the best possible outcome.

When taking a closer look at the first case report, we can see that most problems in this patient can be traced back to the first surgery he underwent at the age of 30 years old. Performing a Nesbit procedure for aesthetic reasons in a patient with initial erectile dysfunction can make the patients symptoms worse. Causing a deterioration of the ED led to a premature implantation of a penile implant device. At the time, durability of these prostheses was not yet ready to be implanted in a thirty-year-old patient. As mentioned above, complication rates increase during complex revision surgery⁵ and this is clearly illustrated in this case: the patient underwent multiple implantation/explant surgeries, with some of these resulting in complications, and this ultimately led to a difficultly manageable corporal fibrosis. Ideally, re-implantation within first months after a fibrosis-inducing event reduces postoperative complications,⁶ but this does not always happen.



Figure 21. Covering of the corporal defect with porcine dermis graft. Figure 21 is available in color online at www.jsm.jsexmed.org.

When approaching a patient with severe corporal fibrosis, there are several factors to consider and measures to resort to, that can help reduce potential damage. For instance, the clinical and surgical history of the patient has to be assessed before selecting the best approach to the corpus cavernosum for revision surgery (penoscrotal, infrapubic or subcoronal). Using the atraumatic Babcock clamp in combination with a catheterized urethra can prove helpful in dissecting the corpora without losing

track of the urethra. Dilation of fibrotic corporal bodies can lead to perforation of the corporal capsula as discussed in this case, so increasing the dilation gradually with Hegar dilators and the help of the backwards cutting scissors can be useful in such cases. These instruments are to be used with caution to avoid urethral damage. The same can be said about the Rossello dilators. Cross-over and proximal perforation of the corporal capsula can occur and can be diagnosed during surgery using the 'goal post' test to ensure symmetry between both sides. Intra-operatively rinsing of the corporal cavities with antibiotic enriched fluids can help reduce infection risk together with the shortest possible skin-to-skin time. Closure of the corporotomies is done using interrupted sutures to ensure maximal closure of the corpora cavernosa before wound closure in several layers.⁷

Cases 2 and 3 are important examples of different ways to manage an unusual but dreadful complication of PPI. Treating a case of glans necrosis post-PPI remains a dilemma. It is not easy to decide whether to conserve or to intervene; the decision depends mainly on the clinical picture and the surgeon's personal opinion. The main problem is to stay objective and not let one's own subjective thoughts to guide the decision. Many surgeons in this situation are afraid of losing authority among colleagues and of not being able to fulfill the patient's wishes. Such thoughts always seem to contradict a clinical indication for removal of the IPP device.

In case of opting in favor of leaving the implant in place, the surgeon must weigh the pros and cons of watchful waiting in hope of a spontaneous resolution vs immediate removal. If a suspected ischemic glans is observed, with implant left in place, the authors recommend instant debridement of any necrotic area to prevent bacterial invasion and gangrene development.⁸ However, if systemic or local signs of infection are evident from the start



Figure 22. End result. Figure 22 is available in color online at www.jsm.jsexmed.org.

(wet gangrene), an immediate removal of the implant would be the treatment of choice, accompanied by debriding of the necrotic areas - to the extent of partial amputation if necessary.⁹ A non-infected ischemic glans failing to resolve while observing the implant will eventually result in a protruding implant or a necrotic glans (dry gangrene) requiring prompt debridement and tissue loss.

Wilson et al advise surgeons to avoid extensive PPI-related surgical approaches in patients with a high risk of GN. Moreover, dealing with signs of postoperative glans necrosis in these particular patients should be done in a more decisive manner to avoid inevitable glans tissue loss and disfigurement. Hence, once a glans appears suspicious or congested on POD 1, immediate implant removal to prevent subsequent glans necrosis is crucial.^{10,11}

In patients who underwent cystectomy with ileal neobladder, the urethral blood supply tends to be compromised by the destructive part of the cystectomy. This hypothesis, however, requires more evidence and further clinical observation. Wilson and coworkers have indicated that smoking is a risk factor for glans ischemia.¹⁰ Moreover, current ESSM recommendations indicate to evidence that cessation of smoking can significantly reduce IPP-related infections rates.¹² Both cases were heavy smokers with 30–45 pack years. This indicates that heavy smoking is a severe risk factor for IPP associated infection as well as for glans ischemia even prior to surgery.

In both cases the p.o. doppler ultrasound examination revealed a low flow above the urethral arteries. In case 3 the urethral perfusion was compromised mostly due to the previous PP implantation. We presume that previous cystectomy and/or cigarette smoking present two chief risk factors for glans ischemia.

With regards to urethral blood supply and glans necrosis, we can use case 4 as an example of cause-effect relationship. In this situation, glans necrosis can possibly be ascribed to the accidental intraoperative damage suffered by the corpus spongiosum and, hypothetically speaking, to the “mummy wrap” dressing applied at the end of the procedure. Both of those possible causes have previously been proven, in literature, to be among the risk factors for glans necrosis after PPI.¹³ It is known that vascularization of the glans penis partly depends on the terminal branches of the spongiosal arteries,¹⁴ therefore this kind of unfortunate outcome is not completely unsurprising. Moreover, this particular patient had a history of diabetes mellitus (although well-controlled), a condition which has been repeatedly found to present a risk of inducing penile necrosis even in the instance of modest compression of the corpus spongiosum, such as that produced by urethral catheterization.^{15,16} Intermittent catheterization of the bladder would have given the urethral a fighting chance at perfusion as opposed to a foley catheterization.

A lesson learned from this case is that risk-bearing comorbidities should never be ignored, and attention must be kept high to detect possible difficulties stemming from pre-operative, intra-operative and post-operative factors.¹⁷ When it comes to

high-risk patients, possible measures to undertake in order to reduce the incidence of glans necrosis may include avoiding sub-coronal incisions or circumcisions whenever possible.¹⁸ This is, of course, not always feasible if previous surgery or existing anatomy do require such an approach, but in this case the level of attention must be kept even higher, because initial signs of glans ischemia should prompt the immediate removal of the implant in order to avoid catastrophic outcomes.

Case 5 represents a situation which will probably be more and more frequent in the next years. Surgical treatment of Peyronie’s Disease includes plication techniques (such as Nesbit procedure) and plaque incision/excision and grafting (PIG/PEG) techniques (with or without PPI), depending on the severity and complexity of penile curvature and deformity.¹⁹ While it is possible to harvest autologous grafts in a PIG/PEG setting, this may require longer operative time and specific surgical tools and skills.²⁰ On the other hand, allografts, xenografts and synthetic grafts come pre-packaged, can be widely available and are readily usable at the moment of surgery. Despite the fact that an “ideal” graft has not yet been identified,²¹ technological advances in patch composition and increased commercial diffusion result in more PIG/PEG procedures being performed all over the world and, although smaller in number, more graft- and patch-specific complications coming to the attention of expert surgeons.

Recurrent curvature after penile patch/grafting is not an extremely uncommon occurrence,²² in fact the correct management of the post-operative period is of utmost importance to avoid retraction. Most authors rely on penile stretching and straightening protocols, consisting of manual exercises and application of penile traction devices, with or without an accompanying PDE5i regimen.²³ In the case we presented, such protocols had not been practiced after the first surgical procedure. This was probably due to the fact that the patient suffered from a pustulous infection of the surgical site in the immediate post-operative period, which was also treated conservatively. It is known that synthetic patches (such as Dacron which was used in the case in point) are more prone to causing inflammation and fibrosis in the graft site: the hypoxic environment resulting from the formation of a reactive capsule can be the cause of a heightened risk of infection.²⁴ Facing the consolidated results of such a complex pathological process almost one year and a half after its inception is not an easy task, even in expert hands: only an extensive but careful excision of compromised tissue with due caution for the surrounding anatomical structures has managed to achieve a satisfactory result. Notice that this time around, the patient was immediately advised to practice an inflation/deflation routine – which undoubtedly contributed to success.

CONCLUSIONS

In conclusion, we can say that management of extreme complications following PPI surgery does not always follow standardized

procedures. Deep knowledge and critical analysis of pre-operative, intra-operative and post-operative factors involved in the genesis of every single complication is required to make the best out of the worst situations. It is also very important to know when to make certain decisions, as even a few hours delay can make a difference. Complex PPI surgery remains, to this day, a field in which careful consideration of a large number of little details is the key to success in even the most challenging of procedures.

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STATEMENT OF AUTHORSHIP

C. Bettocchi: contributed in conceptualization, writing - original draft, writing - review & editing, and supervision; D. Osmonov: contributed in conceptualization, writing - original draft, writing - review & editing; K. van Renterghem: contributed in conceptualization, writing - original draft, writing - review & editing; R. Djovic: contributed in conceptualization, writing - original draft, writing - review & editing; DJ. Ralph: contributed in conceptualization, writing - original draft, writing - review & editing.

REFERENCES

1. EAU Guidelines. Edn. presented at the EAU Annual Congress Amsterdam; 2020.
2. Levine LA, Becher EF, Bella AJ, et al. Penile prosthesis surgery: current recommendations from the International Consultation on Sexual Medicine. *J Sex Med* 2016;13:489–518.
3. Jorissen C, De Bruyna H, Baten E, et al. Clinical outcome: patient and partner satisfaction after Penile Implant Surgery. *Curr Urol* 2019;13:94–100.
4. Chung E. Penile prosthesis implant: scientific advances and technological innovations over the last four decades. *Transl Androl Urol* 2017;6:37–45.
5. Sansalone S, Garaffa G, Djovic R, et al. Simultaneous total corporal reconstruction and implantation of a penile prosthesis in patients with erectile dysfunction and severe fibrosis of the corpora cavernosa. *J Sex Med* 2012;9:1937–1944.
6. Hebert KL, Yafi FA, Wilson S. Inflatable penile prosthesis implantation into scarred corporal bodies: timing may decrease postoperative problems. *BJU Int* 2020;125:168–172.
7. Martinez-Salamanca JI, Mueller A, Moncada I, et al. Penile prosthesis surgery in patients with corporal fibrosis: a state of the art review. *J Sex Med* 2011;8:1880–1889.
8. Yildirim A, Basok EK, Basaran A, et al. Gangrene of the distal penis after implantation of malleable penile prosthesis in a diabetic patient. *Adv Ther* 2008;25:143–147.
9. Mulcahy JJ. Long-term experience with salvage of infected penile implants. *J Urol* 2000;163:481–482.
10. Wilson SK, Mora-Estaves C, Egydio P, et al. Glans necrosis following penile prosthesis implantation: prevention and treatment suggestions. *Urology* 2017;107:144–148.
11. Garcia Gomez B, Romero Otero J, Diez Sicilia L, et al. Ischemic gangrene of the glans following penile prosthesis implantation. *Case Rep Urol* 2013;2013:323574.
12. Osmonov D, Christopher AN, Blecher GA, et al. Clinical recommendations from the European Society for Sexual Medicine exploring partner expectations, satisfaction in male and phalloplasty cohorts, the impact of penile length, girth and implant type, reservoir placement, and the influence of comorbidities and social circumstances. *J Sex Med* 2020;17:210–237.
13. Diallo D, Zaitouna M, Alsaïd B, et al. What is the origin of the arterial vascularization of the corpora cavernosa? A computer-assisted anatomic dissection study. *J Anat* 2013;223:489–494.
14. Cormio L, Taskinen S, Perttinen I, et al. Penile necrosis in a diabetic with renal disease and clean intermittent catheterization for recurrent urethral stricture. Case report. *Scand J Urol Nephrol* 1994;28:219–221.
15. Nacey JN, Delahunt B, Neale TJ, et al. Ischaemic necrosis of the glans penis: a complication of urethral catheterization in a diabetic man. *Aust N Z J Surg* 1990;60:819–821.
16. Krzastek SC, Smith R. An update on the best approaches to prevent complications in penile prosthesis recipients. *Ther Adv Urol* 2019;11:1756287218818076.
17. Scherzer ND, Dick B, Gabrielson AT, et al. Penile prosthesis complications: planning, prevention, and decision making. *Sex Med Rev* 2019;7:349–359.
18. Raheem OA, Hsieh TC. Penile prosthetic surgery for the management of Peyronie's disease. *Transl Androl Urol* 2017;6: S815–S821.
19. Carson CC, Chun JL. Peyronie's disease: surgical management: autologous materials. *Int J Impot Res* 2002;14:329–335.
20. Levine LA, Burnett AL. Standard operating procedures for Peyronie's disease. *J Sex Med* 2013;10:230–244.
21. Levine LA, Larsen SM. Surgery for Peyronie's disease. *Asian J Androl* 2013;15:27–34.
22. Moncada-Iribarren I, Jara J, Martinez-Salamanca JI, et al. Managing penile shortening after Peyronie's disease surgery. Annual Meeting of the American Urological Association, Anaheim, CA, USA; AUA. Linthicum, MD, USA; 2007. 19–24 May 2007.
23. Garcia-Gomez B, Ralph D, Levine L, et al. Grafts for Peyronie's disease: a comprehensive review. *Andrology* 2018;6:117–126.