Strategies for the management of ischaemic priapism

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Abstract

The pathophysiology of ischaemic priapism is still not completely understood although the initiating mechanisms are likely to be multifactorial involving central neuronal pathways, alterations in the corpus cavernosum microenvironment, modulation of the smooth muscle contractile machinery and aberrant neurotransmitter regulation in the corpus cavernosum leading to dysregulation of the smooth muscle. Ischemic priapism is a medical emergency and if left untreated the degree of tumescence tends to subside spontaneously with time and the necrotic cavernosal tissue undergoes fibrosis, resulting in erectile dysfunction. The goal of management of ischemic priapism involves successful detumescence and preservation of cavernosal smooth muscle function in order to prevent penile shortening and refractory erectile dysfunction in the long term. This can be achieved via a variety of surgical shunts which have been described in the literature; however, although shunt surgery may achieve detumescence, it can not always completely reverse the cavernosal smooth muscle damage and subsequent fibrosis. Due to the development of fibrosis and long term erectile dysfunction, penile prosthesis insertion is an option to maintain penile length and prevent penile curvature due to the inevitable fibrosis. This article provides a review of recent clinical developments in the medical and surgical management of ischaemic priapism.
Key words

Priapism, fibrosis, erectile dysfunction

Introduction

Priapism is defined as a prolonged penile erection that lasts longer than 4 hours in the absence of sexual stimulation and remains despite orgasm. It is commonly classified into non ischaemic (high flow), ischaemic (low flow) and stuttering (recurrent) subtypes. Ischemic priapism is the most common type of priapism accounting for more than 95% of all episodes. Obstruction of the penile venous outflow leads to stasis of blood within the corpus cavernosum forming a compartment syndrome which results in the development of hypoxia, acidosis and glucopenia.

Ischemic priapism is 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. The absolute time point at which irreversible damage to the corpus cavernosum smooth muscle occurs is unknown and may vary according to the aetiology of ischemic priapism and the degree of pre-existing smooth muscle dysfunction. There is evidence, however, that even after 6 hours of ischemia, irreversible changes have already started to occur. Broderick and Harkaway analysed the change in the cavernous blood gas alterations in the pO2, pH and pCO2 during the erection and found out that after 240 minutes the cavernous tissue is no longer perfused by highly oxygenated blood. Histologically the components of the corpus cavernosum undergo progressive changes as the duration of priapism increases. In cases where priapism is of a short duration (less than 12 hours) the tissue consisted of minor endothelial defects with occasional lymphocytic infiltration with no alteration in the smooth muscle cells. It is only after 12 to 14 hours of low-flow priapism that trabecular smooth muscle cells show the beginning of focal cytoplasmic transformation which manifests as an increase in size of the perinuclear cytoplasm, endoplasmic reticulum, ribosomes and Golgi apparatus. At between 24 to 48 hours duration widespread endothelial destruction and exposure of the basement membrane occurs with subsequent thrombocyte adherence. In addition to this the smooth muscle cells undergo a transformation as described above as well as necrosis. Persistent blood stasis for longer than two days is associated with infiltration of the trabecular tissue with inflammatory cells and smooth muscle cells undergoing necrosis or phenotypic change into fibroblast like cells.

Even if left untreated, unless secondary to direct malignant infiltration of the corpora, the degree of tumescence tends to subside spontaneously with time and the necrotic cavernosal tissue undergoes fibrosis, resulting in erectile dysfunction refractory to medical treatment and in a shortened indurated penis.
Diagnosis of ischaemic priapism

The diagnosis of ischaemic priapism is based on the clinical history and examination, radiological imaging and blood gas analysis, whilst urine toxicology, haematological screening and abdominal imaging are required to investigate the underlying cause.

Color Doppler Ultrasonography of the penis is used to assess the flow in the cavernosal arteries and corpus cavernosum to differentiate ischaemic from non-ischaemic priapism. Penile Doppler will demonstrate reduced or absent flow within the cavernosal arteries and impaired perfusion of the distal corpus cavernosum (Figure 1). However, after corporal blood aspiration the interpretation of penile Doppler can be difficult due to aberrant high flow in segments of the corpus cavernosum\textsuperscript{13,14}. Therefore a more reliable investigation to distinguish between ischaemic and non-ischaemic priapism corporal blood gas analysis, which will typically show ischaemic, venous blood with pO2 <30mmHg and pCO2 >60 mmHg and pH <7.25 in cases of low flow priapism. A recent series of 23 patients, in which the radiological findings have been correlated with biopsies from the corpus cavernosum, Gadolinium enhanced high-definition Magnetic Resonance Imaging (MRI) of the penis has a sensitivity of 100% when used to detect the presence of necrosis of the cavernosal smooth muscle\textsuperscript{15}. Therefore, this imaging modality may represent an extremely useful imaging modality to assess the corporal tissue viability (Figure 2).
Management of ischaemic priapism

The goal of management of ischemic priapism involves successful detumescence and preservation of cavernosal smooth muscle function in order to prevent penile shortening and refractory erectile dysfunction in the long term.

The initial conservative management of ischemic priapism, if the duration of the erection is between 4 to 24 hours, involves ejaculation, vigorous physical exercise and cold baths with the aim to stimulate the noradrenergic system to release catecholamines, which would stimulate smooth muscle contraction via sympathomimetics and induce detumescence.

Aspiration and instillation of sympathomimetics

If conservative management fails, the next step involves aspiration of ischaemic blood from the corpora cavernosa using 19G ‘butterfly’ needle through the glans penis and into the corpora or insertion into the shaft at the 2 or 10 o clock position avoiding the neurovascular bundles which can be performed under local or general anaesthetic followed by repeated instillations of α-adrenergic agonists such as phenylephrine (usually 200μg repeated to a maximum of 1500μg) in an attempt to increase the smooth muscle tone and promote detumescence. Alternative α-adrenergic agonists include metaraminol and adrenaline. High dose phenylephrine has also been successfully utilised in small case series although in refractory cases it is unlikely to be successful due to irreversible smooth muscle dysfunction. Aspiration of ischaemic blood alone may resolve the ischemic priapism in up to one third of cases and therefore should always be attempted, before injecting the phenylephrine as the smooth muscle contraction is impaired in an ischaemic microenvironment. Treatment with phenylephrine should be performed with continuous monitoring of the blood pressure, especially in patients with hypertension or cardiovascular disease, as phenylephrine has a ionotrope and chronotrope effects and may potentially precipitate a vascular event.

Although corporal blood aspiration and instillation of α-adrenergic agonists should be performed in all patients, irrespective of the time of presentation, priapism episodes lasting more than 24–36 hours are unlikely to respond to this intervention per se due to the presence of irreversible damage to the cavernosal smooth muscle. However, aspiration of the corpora cavernosa and instillation of phenylephrine can lead to detumescence in up to 100% of cases, if performed within 12 hours from the onset of priapism.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>No of patients</th>
<th>Median duration of priapism (hrs)</th>
<th>Success rate (shunt + tunneling)</th>
<th>Post op ED</th>
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II) Shunt surgery

Patients who do not respond to aspiration and instillation of α-adrenergic agonists undergo penile shunt surgery as second line intervention. The basis of the shunt surgery consists of a fistula formation between the corpus cavernosum and the glans penis, corpus spongiosum or the saphenous vein. The aim of any of these surgical techniques is to decompress the corpora cavernosum of the veno occlusion and re-establishes the arterial inflow with a resultant complete flaccidity after the shunting procedure. The Winter and Ebbehoj shunts are the most widely used minimally invasive distal percutaneous shunts. The Winter shunt, characterized by the placement of a large-bore needle into the distal glans and corpus cavernosum is the less invasive technique but is associated with higher failure rate. The Ebbehoj technique consists of a simple stab incision with a No 10 scalpel into the corpora cavernosa through the distal aspect of the glans penis. In case of failure of percutaneous shunt surgery, an Al-Ghorab shunt, which is an open corporoglanular shunt involving the excision of a segment of tunica albuginea at the tip of the corpora.

Some authors have described a new shunt technique, which involves the creation of a wide connection between the distal corpora and glans penis. This technique, also known as the T-shunt, involves the insertion of a No 10 blade through the glans penis into the ipsilateral corpus cavernosum and then rotated of 90 degrees laterally, away from the urethra, and pulled out, to create a large fistula (Figure 3).

The procedure can be repeated on the contralateral side if detumescence is not achieved (TT shunt procedure). In case of TT shunt failure, a tunnelling manoeuvre should be attempted with the aim to allow the blood to be drained from the proximal aspect of the corpora cavernosa. This procedure, also known as the corporal snake manoeuvre, inserts an 8mm Hegar dilator through the previous T- or Al-Ghorab shunt (Figure 4).

Initial reports considered the combination of a distal shunt with the tunnelling manoeuvre a safe technique, which allowed the resolution of the priapism episode in almost all cases and excellent recovery of erectile function.
However, a recent series of 45 patients has shown that the success of T shunt and tunnelling manoeuvre is dependent on the duration of priapism. In particular, if carried out within 24 hours from the onset of priapism, this manoeuvre allows the resolution of the priapism episode in almost all cases, but long term refractory erectile dysfunction is still present in 50% of patients (Table 1). The outcome is even more dissatisfactory if the duration of priapism is greater than 48 hours as the manoeuvre always fails to resolve the priapism episode and all of the patients develop refractory erectile dysfunction.

III) Penile prosthesis implantation

Penile prosthesis implantation, which is the gold standard treatment in patients who have developed severe erectile dysfunction as a result of prolonged priapism, has in the last decade offered an alternative option to shunt surgery for the management of refractory ischaemic priapism. Acute implantation of a penile prosthesis in patients with refractory ischaemic priapism is now proposed by a number of institutions.

In particular, patients with ischaemic priapism >48-72hrs, unresponsive to the initial management with blood aspiration and intracorporal instillation of α- adrenergic agonists, are likely to develop 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 can resolve the painful erection, guarantee the adequate long term rigidity for sexual penetration and prevent the otherwise inevitable penile shortening.

In fact, immediate penile prosthesis implantation in patients with prolonged ischaemic priapism and cavernosal smooth muscle necrosis reduces the painful priapic episode, guarantees the adequate long term rigidity necessary for sexual intercourse and prevents the otherwise inevitable penile shortening secondary to the development of corporal fibrosis.

Potential overtreatment of patients with no evidence of necrosis in the cavernosal smooth muscle is one of the risks associated with this approach and therefore the correct timing of surgery is paramount. Preoperative penile MRI and cavernosal smooth muscle biopsies during the shunt procedure or frozen
sections during the implant surgery are essential to confirm the presence of necrosis and to assist the surgeon in the decision to proceed with the immediate implantation of a penile prosthesis (Figure 5). The main risk associated with acute penile prosthesis implantation is prosthesis infection which can be as high as 6%, more than 3 times higher than reported for virgin cases. This is because the previous introduction of aspiration needles and shunt surgery within the corpora cavernosa, in the attempt to induce detumescence, may increase the risk of infection, particularly if there is diffuse bruising and oedema of the dartos and tunica albuginea.

Therefore, it is suggested that the penile prosthesis implantation should be delayed for a few days in order to give enough time for the oedema and bruising to subside and for the broad spectrum antibiotics to clear any possible bacterial contamination in the corporeal tissue. Although the exact time beyond which the necrotic corporal 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. In this series dilatation was also simple after a 2 week interval.

Although both malleable an inflatable penile prostheses have been successfully implanted in patients with acute ischaemic priapism, semirigid devices are the first choice implant in this group of patients. This is because it preserves the penile length, without the need to cycle the device and it is easier to
explain if there is an infection. After 3 to 6 months it can be electively exchanged to an inflatable device in compliant patients.

During early penile prosthesis implantation, the corporal dilatation is generally easy, however distal perforation can occur in up to 6% of patients who have undergone previous shunt surgery, especially when a malleable device is placed. According to Salem et al, distal erosion can be minimized by applying a non absorbable sling suture to fix the rear tip of the malleable device to the tunica albuginea of the penis.

Delayed penile prosthesis implantation in patients with severe corporal fibrosis due to ischaemic priapism represents a real challenge for the surgeon and is associated with higher complication rates and lower patients’ satisfaction.

Due to the formation of dense fibrosis in the distal corpora, adequate exposure of the penile shaft and of the crura is often required. This can be achieved by combining a penoscrotal and total or semi circumferential subcoronal incision with partial or complete degloving of the penile shaft. Other authors have described a wide corporal excision of the scar tissue, which involves extensive incisions of the tunica albuginea. As the dissection can be technically challenging, the operative time is 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.

Wilson et al. described the concept of drilling into the fibrous cavernous tissue avoiding an extensive albugineal incision and time consuming excision of the fibrotic tissue with the use of Carrion-Rossello or Uramix cavernotomes. This technique allows a channel to be created in the dense fibrotic tissue minimizing the risk of inadvertent urethral injury. 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. The infection rate in this series was 6.3% with an overall 1 year survival of the implant of 87%. Despite of all these caveats, the revision rate for complications is as high as 12% at 15.7 months, but prosthesis implantation in acute priapism remains a simple and reproducible procedure that allows the quick resolution of the priapism with preservation of penile length and guarantees the rigidity necessary for intercourse.

Conclusions

Cavernosal tissue damage in iscaemic priapism is time related. Conservative measures and aspiration with or without intracorporeal instillation of α- adrenergic agonists are usually successful in the early stages, before the metabolic changes in the corporal milieu have led to necrosis of the smooth muscle.

Shunt surgery in patients remains debatable, as the lack of response to aspiration and instillation of α-adrenergic agonists indicates that irreversible changes in the cavernosal smooth muscle are likely to have already occurred. Therefore shunt surgery may relieve the painful erection but will not prevent the formation of fibrosis and the consequent erectile dysfunction, which is not the actual aim of the treatment.

Immediate penile prosthesis implantation in patients with refractory iscaemic priapism settles the priapic episode, maintains the long term rigidity necessary to engage in penetrative sexual intercourse and
prevents the otherwise inevitable penile shortening (Figure 7). Although complication rates after penile prosthesis implantation in acute priapism are higher than in virgin cases, they are still lower than after implantation in patients with severe corporal fibrosis due to 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 oedema to settle and the broad spectrum antibiotics to clear bacterial contamination.

Regardless of the complication rates, penile prosthesis implantation in refractory ischaemic 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 surgery.

Περίληψη

Η παθοφυσιολογία του ισχαιμικού πριαπισμού δεν είναι ακόμα πλήρως κατανοητή, αν και οι μηχανισμοί που εμπλέκονται και οι καταστάσεις που εκκινούν το φαινόμενο είναι πιθανό να είναι πολυπαραγοντικοί. Μεταξύ άλλων, περιλαμβάνουν κεντρικές νευρωνικές οδούς, μεταβολές στο μικροπεριβάλλον των σηραγγώδων σωμάτων, διαφοροποίηση του μηχανισμού συστολής των λείων μυών και παρεκκλίνουσα διαβίβαση των νευροδιαβιβαστών στο σηραγγώδες σώμα που οδηγούν σε απορύθμιση του λείου μυός.

Ο ισχαιμικός πριαπισμός είναι μια επείγουσα ιατρική κατάσταση και αν αφεθεί χωρίς θεραπεία και η διόγκωση δεν υποχωρήσει, ο νεκρωμένος ιστός των σηραγγώδων σωμάτων υφίσταται ίνωση που έχει ως αποτέλεσμα την εμφάνιση στυτικής δυσλειτουργίας. Ο στόχος της αντιμετώπισης του ισχαιμικού πριαπισμού περιλαμβάνει την επιτυχή υποχώρηση της στύσης και τη διατήρηση της συμβατικής λειτουργίας των σηραγγώδων σωμάτων προκειμένου να αποφευχθεί η βράχυνση του πέους και η ανθεκτική στυτική δυσλειτουργία μακροπρόθεσμα. Αυτό μπορεί να επιτευχθεί με μια ποικιλία χειρουργικών τεχνικών που περιγράφονται στην διεθνή βιβλιογραφία. Ωστόσο, αν και η αναστομωτική επέμβαση μπορεί να επιτύχει την υποχώρηση της στύσης, δεν μπορεί πάντα να αναστρέψει και πλήρως την βλάβη των λείων μυικών ινών του σπογγώδους σώματος και εν συνεχεία την ίνωση. Λόγω της ανάπτυξης στυτικής δυσλειτουργίας η εισαγωγή πεικής πρόθεσης είναι μια επιλογή για τη διατήρηση του μήκους του πέους και την πρόληψη της κάμψης, λόγω της αναπόφευκτης ίνωσης. Αυτό το άρθρο παρέχει μια επισκόπηση των πρόσφατων εξελίξεων στην φαρμακευτική και χειρουργική διαχείριση του ισχαιμικού πριαπισμού.

Λέξεις ευρετηριασμού

πριαπισμός, ίνωση, στυτική δυσλειτουργία
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