Use of hyperbaric oxygen therapy to treat glans penis necrosis after prostatic artery embolization

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\textbf{ABSTRACT}

We report a case of non-target embolization after PAE, which was treated with topical and systemic therapies including hyperbaric oxygenation. In this case, a 77-year-old man developed distal penile pain, hours after undergoing PAE. Within days, he experienced tissue necrosis involving the glans penis. Treatment with tramadol, tadalafil, topical lidocaine, and hyperbaric oxygenation was initiated, and the necrosis resolved after fifteen days. There are no standard treatments for penile necrosis after PAE. Hyperbaric oxygenation may be effective in reducing ischemia-related tissue loss and may be considered as a treatment option for penile necrosis that occurs as a complication of PAE.

1. Introduction

Benign prostatic hyperplasia (BPH) is a common condition in older men that is often associated with lower urinary tract symptoms including nocturia, urinary frequency, and incomplete bladder emptying. Prostatic artery embolization (PAE) is a minimally invasive procedure that was initially investigated as a treatment for BPH in 2008.\textsuperscript{1} PAE is associated with successful outcomes but also carries risks including non-target embolization.\textsuperscript{2} This report describes a case of non-target embolization of the penis that occurred after PAE and was successfully managed using multiple treatments, including hyperbaric oxygen therapy. Written consent for publication was obtained from the patient described in the report.

2. Case presentation

A 77-year-old man with a past medical history significant for BPH and chronic urinary retention was referred for PAE. The procedure involved administration of local anesthesia, after which the left prostatic artery was embolized with 100–300 \( \mu \)m microspheres. The right prostatic artery was unable to be cannulated due to stenosis at its origin, and embolization was not performed.

The patient was discharged home post-procedure. Several hours after the procedure, he developed pain in the distal glans penis. The pain became progressively more severe and impaired his ability to ambulate. His urologist placed a Foley catheter for treatment of urinary retention, and within 3 days the patient developed dark discoloration of the glans penis (Fig. 1). Six days post-procedure, a penile ultrasound demonstrated abnormal echogenicity and echotexture within the right corpus cavernosum and absent arterial flow within the right cavernosal artery, consistent with nontarget embolization of the penis.

Tramadol, tadalafil, and topical lidocaine cream were prescribed, and the patient was referred for adjunctive hyperbaric medicine evaluation. He began hyperbaric oxygen treatments on post-procedure day 13 and completed a total of 15 treatments. Hyperbaric treatments were performed to a depth of 2.5 absolute atmospheres (ATA) for 90 minutes, on weekdays only. The patient experienced resolution of the penile pain within several days of starting hyperbaric treatments. By the tenth day of hyperbaric treatment, the area of dark discoloration of his glans penis was significantly smaller. On the fifteenth treatment day, the area of discoloration had nearly entirely resolved, and the patient remained pain free (Fig. 2).

3. Discussion

Traditional methods of relieving the signs and symptoms of BPH include medical therapy as well as surgical intervention including transurethral resection of the prostate (TURP). Recently, minimally invasive techniques, including PAE, have emerged as potential treatments for BPH. PAE utilizes an endovascular trans-arterial approach to occlude the...
arteries that supply the prostate; unlike other treatment methods for BPH, PAE avoids the resection of prostatic tissue. Compared with TURP, PAE is associated with a reduced incidence of ejaculatory disorders and may be preferred over TURP by some patients because of this. During PAE, embolic particles are injected slowly into the prostatic arteries to achieve embolization. The blood supply to the prostate can contain anastomoses or collateral vessels which increase the risk for non-target embolization that may involve the bladder, rectum, penis, and other structures.

Penile non-target embolization after PAE is infrequently reported in the medical literature. Couture et al. reported the case of a 75-year-old man who developed a painful and dark glans penis lesion one week after PAE. The lesion resolved within five weeks of the procedure, without specific topical or systemic treatments. Kisilevzky et al. described a 58-year-old man who developed ischemic changes of the glans penis 8 days after a PAE. Treatments including pentoxifylline and topical fusidic acid cream and potassium permanganate were utilized, and the wound healed completely by the 40th postoperative day. Chung reported a 65-year-old man who experienced perineal discomfort and urinary frequency immediately after a PAE procedure, followed by the development of a painful and necrotic glans penis 5 days postoperatively. The patient was referred for hyperbaric medicine evaluation and completed 10 treatments. At a follow-up visit 4 weeks after completion of hyperbaric oxygen therapy, the necrosis had nearly resolved.

Although spontaneous resolution of glans penis necrosis after non-target embolization has been reported, the optimal treatment regimen for this condition remains unclear. Multiple treatments have been utilized for ischemic necrosis of the glans penis, including pentoxifylline, iloprost, and phosphodiesterase 5 (PDE5) inhibitors. Pentoxifylline decreases blood viscosity and may enhance tissue oxygenation in patients with peripheral arterial disease. Iloprost also induces vasodilation but is only available for inhalational use in the United States. PDE5 inhibitors, including tadalafil, which are traditionally indicated for treatment of erectile dysfunction and BPH, induce vasodilation through increases in cyclic guanosine monophosphate (cGMP) and may enhance healing in cases of glans penis necrosis. The patient described within this case report represents the second reported case of PAE treated successfully with hyperbaric oxygen therapy. PAE is an example of acute peripheral arterial ischemia, a recognized indication for the administration of hyperbaric oxygen therapy. The mechanisms of action of hyperbaric oxygen therapy include neovascularization of hypoxic wounds as well as oxygen supersaturation of plasma which induces hyperoxygenation of ischemic tissues. In patients with acute arterial insufficiencies, including penile ischemia due to non-target embolization, these clinical effects can result in enhanced tissue recovery and survival. Hyperbaric oxygen therapy is available in numerous hospital facilities within the United States and is associated with limited side effects. Common adverse events associated with hyperbaric oxygen therapy include middle ear barotrauma, oxygen toxicity, and confinement anxiety. Fire safety is also a paramount safety concern in hyperbaric facilities, but this can be managed with careful attention to chamber maintenance and restriction of certain items within the hyperbaric environment. Within the United States, many major insurance carriers consider hyperbaric oxygen therapy to be a medically necessary treatment for conditions involving acute arterial insufficiencies.

4. Conclusion

Non-target embolization involving the penis is a rarely reported...
complication of PAE. While there is no standard treatment recommendation for this complication, the adjunctive use of hyperbaric oxygen therapy can contribute to the successful resolution of this condition within weeks of its occurrence and should be considered as a treatment for penile necrosis that occurs as a complication of PAE.

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