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Penile Erection During Transurethral Surgery

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ABSTRACT: Intraoperative penile erection during endoscopic surgery, although an infrequent occurrence, is a troublesome complication and a challenge to the urologist. It is difficult to perform the procedure during penile erection, because various complications may occur. The etiology is unclear, and a number of pharmacological remedies have been discussed in the literature. Herein, we describe the treatment and outcomes for 3 patients with intraoperative penile erection and provide a brief review of the associated literature. Intraoperative penile erection is a rare event during transurethral procedures, with a frequency of approximately 0.1% in our institution. To our knowledge, no generally accepted protocols for the prevention or treatment of this phenomenon have been reported in the literature. We recommend intracorporeal injection of 250 μg of phenylephrine: detumescence occurred rapidly in all patients after a single injection. The mode of administration is simple, and no complications have been reported.

Key words: Endoscopy, alpha-adrenergic agonists, phenylephrine, priapism.

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Some degree of penile engorgement following epidural anesthesia is not uncommon because of vasodilatation and pooling of blood in the venous sinuses of the penis. However, penile tumescence resulting in partial or total erection at the time of cystoscopy or transurethral surgery is a relatively infrequent phenomenon (Walther et al, 1987). It is very troublesome to perform the procedure during penile erection because attempts to do so will lead to complications, such as excessive bleeding and urethral trauma, and surgery has to be delayed or postponed as a result. At our institution, during the last 16 years (1988–2004), of 2867 patients who received epidural anesthesia while undergoing different transurethral procedures, such as transurethral resection of the prostate (TUR-P), transurethral resection of bladder tumors, transurethral incision of the prostate, or optical internal urethrotomy, intraoperative penile erection was only encountered in 3. The management of these cases, along with a review of the literature, is presented.

Materials and Methods

Over a 16-year period (1988–2004) at our institution, only 3 (approximately 0.1%) of 2867 patients had a penile erection while undergoing an endoscopic surgery procedure with epidural anesthesia. All 3 were successfully treated with an intracorporeal injection of 250 μg phenylephrine.

Patient 1

A 58-year-old man was admitted for transurethral resection of multiple superficial bladder carcinomas. He had a history of atrial fibrillation that was controlled with administration of digoxin. Results of routine laboratory analyses, including routine blood tests, prothrombin time, platelet count, fibrinogen time, and partial thromboplastin time, were within normal limits. He was given epidural anesthesia with 20 mL of 2% xylocaine in the L_3–L_4 intervertebral space before undergoing the intervention. The patient was placed in the lithotomy position, prepared with povidone-iodine solution, and draped. No tumescence was evident at this point. At the time of instrumentation with a 24F resectoscope sheath, and before the bladder was emptied, a severe rigid erection developed, with engorgement of the subcutaneous veins of the penile skin. The erection lasted for 45 minutes. Spontaneous detumescence was not forthcoming during a waiting period. The patient was given an intracorporeal injection of 250 μg of phenylephrine. Gentle pressure was applied to the injection site for 2 minutes, and rapid resolution of the erection was noted after only a single injection. No systemic change in blood pressure or heart rate occurred. The transurethral procedure was uneventful. The patient had a smooth postoperative recovery.

Patient 2

A 62-year-old man with a history of hypertension, chronic renal failure (serum creatinine level, 2.8 mg/L), and insulin-dependent diabetes mellitus was admitted to the urology

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department and received spinal anesthesia in preparation for TUR-P. Medications included furosemide (20 mg daily) and insulin (31 IU daily subcutaneously). In the operating room, epidural anesthesia with 10 mL of 2% xylocaine was given through the L_4–L_5 interspace before undergoing transurethral resection of the prostate. Subsequently, he was put in the lithotomy position, prepared for surgery, and draped. A 24F continuous flow resectoscope sheath was placed directly by using the classic 24F obturator. The bladder was emptied. The working element of the resectoscope was placed, and during inspection of the prostatic urethra and bladder neck before performance of the transurethral procedure, the patient was found to have a rigid penile erection. The resectoscope was removed. The penile erection lasted for 30 minutes. We administered an intracorporeal injection of 250 μg of phenylephrine with local application of cold saline to the penile shaft and waited 20 minutes. After partial detumescence occurred, transurethral resection of the prostate was completed, and 35 g of benign tissue was removed. Complete detumescence occurred 12 hours after the operation.

Patient 3

A 41-year-old patient was admitted to the urology department for treatment of multiple urethral strictures. Two years ago he had had a lumbar spine injury. There was no other significant medical history. Results of routine laboratory tests were within normal limits. The patient refused repair with open urethroplasty and was scheduled to undergo optical internal urethrotomy after receipt of epidural anesthesia without any preoperative medication. Immediately after the epidural injection (10 mL of 2% xylocaine mixed with 10 mL of 0.5% bupivacaine) given at the L_3–L_4 intervertebral space, the patient was positioned in a modified lithotomy position for performance of the internal optical urethrotomy. Five minutes after the introduction of the Sachse urethrotome under direct vision, he was found to have developed a penile erection with engorgement and severe penile rigidity. The Sachse urethrotome was removed, and the endourological procedure had to be delayed for approximately 30 minutes, because the penile erection was associated with penile tumescence and rigidity. Spontaneous detumescence was not forthcoming during a waiting period. The patient was given an intracorporeal injection of 250 μg of phenylephrine. No systemic change in blood pressure or heart rate was detected. Ten minutes after medication was administered and detumescence had occurred, a transurethral urethrotomy under direct vision was performed. The patient had a normal postoperative recovery.

Discussion

Priapism may be the proper term to describe the phenomenon of painless penile erection during endoscopic surgery and/or other endourological procedures, but the duration of tumescence is much shorter (<4 h). Usually, priapism is defined as a persistent penile erection unaccompanied by desire or sexual excitement and/or arousal. It is well-known that priapism sustained for more than 4 hours may result in edema, increased risk of abrasion, tissue drying, and necrosis of the penis, with the prognosis, in general, depending on the type of priapism and the amount of time elapsed before the therapeutic intervention. Relatively early reports found that most cases of priapism were idiopathic (Nelson and Winter, 1977). However, various etiologies of this pathologic condition are known, including sickle-cell anemia, polycythemia, blood disorders causing slugging (as may be observed with leukemia), pelvic thromboflebitis, retroperitoneal hemorrhage, obstruction of venous outflow by tumors, use of or exposure to drugs or chemicals (such as heparin, testosterone, hydralazine, phenothiazines, and carbon monoxide), neurologic diseases (such as spinal cord injury), tuberculosis, and penile trauma and pelvic regional surgery (Klotz et al, 2000; Rao et al, 2000; Gerber et al, 2001; Meuleman and Mulders 2003). Causes of intraoperative erection during anesthesia are not well understood but appear to be reflexogenic and psychogenic. Activation of sacral spinal cord parasympathetic pathways that do not seem to be inhibited by anesthesia is implicated. In addition, anesthetic agents may depress cortical centers in the brain that normally inhibit penile erection in the conscious individual, thereby enhancing the erectile response to tactile stimulation. The physiologic mechanisms of erection and the contributions of the sympathetic, parasympathetic, and somatic nervous systems to the development of reflex, as well as psychogenic erections, have been studied in animal models, patients with spinal cord injuries, and healthy persons.

The mechanism of penile erection involves the arterioles, venules, and arterovenous anastomotic channels of the corpora cavernosa (van Arsdalen et al, 1983). In the flaccid state, the arterioles are partially closed while the venules and arteriovenous channels remain open, providing an unimpeded drainage of the arterial inflow. Psychic or local sensor stimulation precipitates sacral (S2–S4) parasympathetic outflow, leading to relaxation of corporal arterioles and partial closure of the venules and arteriovenous shunts, with a subsequent engorgement of the corpora cavernosa. Normally, the erection subsides after sympathetically mediated arteriolar constriction, with the reduction of inflow and enhanced venous drainage. It has been shown that detumescence is mediated by adrenergic stimulation that causes a constriction of penile venous sinusoids, opening emissary veins and, thereby, increasing blood drainage (Bosch et al, 1991). Although spinal anesthesia interrupts the sympathetic and parasympathetic innervation of the penis, erection may occur. Psychogenic and reflex erections may occur during the early stages of spinal anesthesia when the pathways involved are still in-

Table 1. *Main drugs used in intraoperative penile erection management*

Drug	Pharmacological Action	Route(s) of Administration	Success	Adverse Events	Dose
Phenylephrine	Pure α_1-adrenergic agonist	Intracorporeal injection	Yes	Lack of positive cardiac inotropism or chronotropism, decrease in cardiac output, increase in mean arterial pressure, bradycardia rarely	100–500 μg
Epinephrine	α_1-adrenergic agonist	Intracorporeal injection	Yes	Inotropism or chronotropism	10–20 μg
Ketamine	Dissociative anesthetic (unknown mode action)	Intravenously	No	Time for flaccidity to develop, hallucinations	0.5–1 mg/kg
Amylnitrate	Vascular smooth muscle relaxant	Inhalation	No	Serious complications in elderly patients	0.3 mL
Terbutaline	β_2-adrenergic agonist	Per os, subcutaneously, intravenously	Yes (with caution)	Tachycardia, pulmonary edema, hypokalemia	5 mg *per os*/ 0.25–0.5 mg subcutaneously or intravenously
Other α-adrenergic agonists (nor-adrenaline, metaraminol, etilnephrine)	α-adrenergic agonists	Intracorporeal injection, intravenously	Yes	Hypertensive crisis, pulmonary edema, rupture of aneurysms, additional β_1 activity	In case

completely blocked. The ability of patients with no integral spinal cord injuries to achieve a penile erection supports this mechanism (Bors and Coman, 1981). Another possible explanation is incomplete blockade of sacral segments of the spinal cord during spinal anesthesia. Because local anesthetic is diluted by the cerebrospinal fluid, its concentration is minimal in areas more distal to the site of injection (Greene, 1981). It is logical to suppose that the same mechanisms apply during epidurally administered anesthesia, as well.

During the past decade, an increased understanding of the physiology of detumescence has encouraged a scientific approach to the management of persistent erection. Many methods for treating intraoperative penile erection have been described. The traditional methods include use of deeper anesthesia with a simultaneous induction of hypotension by sodium nitroprusside, dorsal nerve block paralysis, corporeal aspiration with or without shunting procedures, and ketamine administration. Ketamine is a dissociative anesthetic that has been reported to be effective in some cases, but it takes time for flaccidity to develop, and it can cause hallucinations in patients who are concomitantly receiving spinal anesthesia (Anderson et al, 1991).

The methods and drugs mentioned in the previous paragraph are ineffective in many cases (Walther et al, 1987; Miller and Galizia, 1993; Seftel et al, 1994; Staerman et al, 1995). Studies in the past 2 decades have referred to the safe and successful use of intracorporeal injections of α-adrenergic agonists, such as epinephrine (Mels et al, 1991; Zappala et al, 1992) and phenylephrine (Walther et al, 1987; McNicolas et al, 1989), in cases of intraoperative penile erection. At present, intracavernous injection of α-adrenergic agonists is used in several research protocols to treat penile erection occurring during transurethral surgery. Some α-adrenergic agonists, such as noradrenaline, metaraminol, etilephrine, and epinephrine, that have been used with success in cases of intraoperative penile erection have furthermore an additional β-1 action that can result in systemic adverse events, such as severe hypertensive crisis, pulmonary edema, and even death due to rupture of aneurysms. Because of this β-1 activity, clinicians must be aware of the possibility of cardiac inotropism and chronotropism. In contrast, phenylephrine is a pure α-1 adrenergic agonist, which lacks such cardiac effects (Brindley, 1986) (Table 1). White et al (1982) also reported the use of phenylephrine, given by intracorporeal injection for the treatment of this intraoperative complication. Administration of epinephrine (10–20 μg) or phenylephrine (100–500 μg) every 5 minutes up to a maximum of 10 doses has been considered by some authors (Lee et al, 1995). Furthermore, of special interest is the issue of penile erection observed in patients with sickle-cell anemia, in whom α-adrenergic agonists are also effective in the treatment of priapism (Mantadakis et al, 2000). In general, the first line of treatment involves aspiration of the corpora and intracorporeal penile injection with an α-adrenergic agonist.

We recommend injection of 250 μg of phenylephrine. Detumescence occurred rapidly in all patients with

a single injection. This approach is prompt, safe, reliable, reproducible, and provides sustained, instantaneous (in 1–2 min) resolution of erection due to spinal and general anesthesia without any systemic adverse events. It is most useful when urogenital operation would be delayed by penile tumescence. We also observed prompt response without any complications in all 3 of our patients.

Apart from phenylephrine, a number of other vasoactive drugs have been used in the treatment of intraoperative erection (Table 1). Intracorporeal injection of vasoactive agents, such as ethylephrine, metaraminol, norepinephrine, and epinephrine, has been used (Tsai and Hong, 1990; Serrate et al, 1992). These agents are believed to produce detumescence by decreasing blood supply to or increasing blood drainage from the corpora cavernosa through activation of adrenergic receptors. Ketamine has a dissociative effect on the limbic system, and its penile-relaxing property is probably secondary to this (Ravindram et al, 1982). Ravindram et al (1982) reported 2 cases of priarism that responded to ketamine (0.5 mg per kg body weight) and physostigmine (1.5 mg). Gale (1972) also treated intraoperative penile erection during general anesthesia with ketamine (1 mg per kg body weight intravenously), and complete flaccidity occurred 25 minutes after ketamine administration. However, 2 patients treated by Benzon et al (1983) with spinal anesthesia for transurethral resection of the prostate did not respond satisfactorily to ketamine. In the cases reported by Ravindram et al (1982), complete penile flaccidity occurred in 90–110 minutes after ketamine administration. Benzon et al (1983) reported an increase in blood pressure, with the delayed onset of ketamine activity representing a limiting factor. Amylnitrate has been successfully used to overcome this problem, because of its smooth-muscle relaxant property, which produces arterial and venous relaxation (Goodman and Gilman, 1975). The recommended route of amylnitrate administration is inhalation of a 0.3-mL dose through the breathing system. Complete flaccidity occurs after 4 minutes according to one report, but the investigator could not determine the effect of amylnitrate on detumescence during spinal anesthesia (Benzon et al, 1983). As with any potent vasodilator, caution in administration and close monitoring are always mandatory (Poon et al, 1990).

Moloney et al (1975) found that epidural anesthesia combined with chlorpromazine-induced hypotension results in transient penile flaccidity only at a systolic blood pressure equal to or less than 70 mm Hg; this technique is not indicated for the increased venous drainage. de Meyer and de Sy (1986) recommended intracavernous injection of noradrenaline to interrupt erections during transurethral procedures. Shantha (1989) has recommended the use of terbutaline (5 mg orally or 0.25–0.5 mg subcutaneously or intravenously) for the treatment of intraoperative penile erection. He recommended this therapeutic approach as the treatment of choice for patients who are concomitantly receiving general or regional anesthesia. Valley and Sang (1994) reported the use of glycopyrolate to treat intraoperative penile erection in patients receiving continuous spinal anesthesia. This is a safe approach for patients with coronary artery disease or those for whom cardiovascular stability is desired. Pertek et al (1994) and Seftel et al (1996) recommended dorsal penile nerve block for intraopeative management of penile erection. The procedure is performed using 8 mL of 0.25% bupivacaine injected into the subpubic space.

Repeated intracavernous injection of vasoactive drugs may be dangerous, whereas a penile nerve block has a lower risk of cardiovascular complications and can serve as a more effective postoperative analgesia. It must be emphasized that the relationship of treatment to the duration of the erection is the critical factor in the successful detumescence of the penis. With the onset of erection during an operative procedure, therapy must be quickly initiated to enhance venous drainage of the engorged corpora cavernosa, before prolonged venous stasis leads to increased viscosity associated with slugging and less readily reversible impairment of the routes of venous egress.

Conclusion

The pathophysiology and management of intraoperative penile erection are currently well understood. In our experience, the frequency of intraoperative penile erection during epidural anesthesia is very low (approximately 0.1%). With the onset of erection during an operative procedure, appropriate therapy of this pathologic condition must be quickly initiated, because the duration of erection is the critical factor in the detumescence of the penis. We recommend intracorporeal injection of 250 μg of phenylephrine. The mode of administration is simple, complications have not appeared, and this approach is prompt and safe, providing resolution of erection without systemic adverse effects.

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