

## Hyperbaric Oxygen Therapy to Promote Vaginal Wall Healing after Salvage Surgery for Mesh-related Complication

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### Abstract

Patients with multiple failed vaginal surgeries utilizing synthetic mesh present a therapeutic challenge. We present a case of a 75-year-old woman with severe stress urinary incontinence and mesh extrusion after two failed synthetic sling surgeries. Surgical reconstruction consisted of mesh excision, urethral reconstruction with vaginal tubularization, autologous rectus fascia sling placement. The patient developed a vaginal hematoma and wound dehiscence post-operatively, which was treated with surgical debridement and hyperbaric oxygen (HBO). The patient's wound healed well, and she regained full continence, which was sustained at 10 months postoperatively. HBO therapy promotes wound healing after complex transvaginal reconstructive surgery.

**Keywords:** Hyperbaric oxygenation; Suburethral sling; Urinary incontinence; Wound healing; Vagina; Surgical

### Abbreviations:

HBO: Hyperbaric Oxygenation; INR: International Normalized Ratio; SUI: Stress Urinary Incontinence; PCP: Primary Care Provider; POP: Pelvic Organ Prolapse

### Introduction

Vaginal mesh placement for stress urinary incontinence (SUI) or pelvic organ prolapse (POP) is a common procedure. However, serious complications including mesh erosion, mesh extrusion, dyspareunia, chronic pelvic pain, urinary retention, and recurrent infection have been reported. A surgical field with disrupted vascular supply and suboptimal tissue quality after prior operations presents a challenge to surgical reconstruction.

Wound healing is a complex phenomenon. While initial hypoxia, acidosis, and lactate encourage early wound healing, hypoxia in a chronic wound can impede fibroblast collagen deposition and macrophage bacterial killing, thereby delaying wound healing. The return of oxygenation to hypoxic tissues by restoration of blood flow or by hyperbaric oxygen (HBO) therapy can facilitate wound healing. Increased cellular oxygen levels lead to an increase in reactive oxygen and nitrogen species that signal transduction cascades, ultimately leading to neovascularization and improved post-ischemic tissue survival. While HBO has been used to treat chronic ulcers, non-healing skin wounds, its application to a compromised vaginal flap after transvaginal surgery for synthetic mesh complication has not been described.

### Case Presentation

A 75-year-old gravida 10, para 9, post-menopausal woman presented for treatment of persistent SUI after a previous abdominal hysterectomy and two failed synthetic sling procedures. Her symptoms

consisted of severe SUI, enuresis, and urinary urgency. The patient wore diapers for her incontinence and was not sexually active. Other relevant medical history included a prosthetic aortic valve requiring long-term anticoagulation.

Pelvic exam demonstrated a spatulated urethra extending towards the proximal urethra with mesh extrusion at the bladder neck and a positive cough stress test without POP. Cystourethroscopy showed a short urethra approximately 1cm in length, a sphincter with poor urethral coaptation, and no evidence of intra vesical mesh erosion. Urodynamics revealed a compliant bladder, no detrusor overactivity, and post-void residual of 0 mL, consistent with a diagnosis of pure SUI with low abdominal leak point pressures.

The patient underwent complete synthetic sling removal, creation of a neourethra with vaginal wall U-flap, and placement of an autologous rectus facial sling underneath the vaginal flap (Figure 1). A suprapubic catheter was also placed. Warfarin was held for five days preoperatively, and the patient was bridged on enoxaparin until her International Normalized Ratio (INR) returned to therapeutic range on warfarin postoperatively. After discharge, the patient was seen weekly in the outpatient urology clinic and was instructed to follow up with her primary care provider (PCP) for anticoagulation monitoring. The vaginal flap initially remained intact with some mild, sanguineous drainage. By post-operative day 25, however, the patient had developed worsening vaginal bleeding with a hematoma under the vaginal flap, necrotic wound edges, and a 3 cm dehiscence of the neourethra without signs of infection. Laboratory studies revealed an INR of 3.5, which was within recommended therapeutic range, and hemoglobin of 6.1 g/dL. The patient was readmitted to the hospital for transfusion and reoperation the same day. Placement of a urethral catheter, a suprapubic tube exchange, irrigation and debridement of a necrotic neourethral tissue, and evacuation of vaginal hematoma were performed. The autologous sling was viable and in good position.



**Figure 1:** Urethral tubularization and reconstruction after primary surgery. A vaginal flap around the urethral opening using a U-shaped incision with the ends extending up towards the clitoris was isolated. Urethral tubularization was carried out tension-free over a 14 Fr Foley catheter. Perivesical tissue was dissected free laterally to allow advancement over the urethral reconstruction for a third layer of closure after an autologous rectus fascia sling was placed.

Postoperatively, the patient's hemoglobin remained stable and therapeutic anticoagulation was continued. She developed additional devitalized tissue at the anterior vaginal wall. After careful consideration of her surgical complexity and the need for chronic anticoagulation, the decision was made to start HBO. Rare risks of HBO were discussed with the patient, such as temporary myopia, barotraumas or oxygen toxicity, and deemed to outweigh the benefits. Treatments were administered via a Model 3200 Hyperbaric Chamber (Sechrist Industries, Inc., Anaheim, CA) delivered at 2.0 atmospheres pressure for 90 minutes twice daily for ten days. The vaginal flap remained healthy and well-vitalized after HBO therapy. The patient was discharged with close follow up with her urologist and PCP. Foley catheter and suprapubic tube were removed 2 and 4 weeks, respectively, after her initial debridement.

By four months after initial surgery the patient reported complete resolution of SUI. No objective SUI was demonstrated during physical exam. At her tenth month follow-up, the patient continued to have complete continence.

## Discussion

When considering complex post-surgical wounds, especially at locations that are not easily amenable to wound packing and daily debridement, optimizing tissue quality and blood flow is of utmost importance. For our patient, HBO therapy was well-tolerated and effective in the treatment of vaginal wall necrosis after complicated reconstructive surgery.

Treatment alternatives could have included further salvage surgery with debridement and placement of Martius labial flap to cover the defect, followed by delayed repeat autologous sling. However, the morbidity of additional surgeries must be considered. A 4.1% rate of symptomatic retropubic hematoma after suburethral sling has been previously reported [1], and this is presumed to be higher in patients requiring anticoagulation. Avoiding repeat surgery is desirable in the complex patient described in this case report; HBO therapy offers a viable and less morbid alternative.

Review of the literature shows that HBO has been successfully used for a variety of urologic conditions. HBO for radiation cystitis has been shown prospectively to be associated with 57% resolution and 32% significant improvement of symptoms [2]. A randomized, sham-controlled, double-blind trial in patients with interstitial cystitis showed that HBO was effective in 21.4% of the treatment arm and 0% of the sham arm [3].

HBO therapy has also been applied to two cases involving infected vaginal flaps after transobturator sling procedures. A case in 2009 documented a 45 year-old female who developed cellulitis involving the buttock and labia major after placement of a polypropylene sling and porcine acellular mesh. The mesh was salvaged with a combination of intravenous antibiotics and HBO therapy [4]. A more serious event of Fournier's gangrene after sling placement was described in 2008 [5]. This patient underwent surgical debridement, diverting colostomy, antibiotics, and 8 sessions of HBO, with subsequent improvement in infection control and wound healing. Both cases highlight the merits of HBO for mesh-related infection. Finding alternative treatment options for patients suffering from vaginal synthetic mesh complications is highly desirable, and additional prospective studies may help refine the indications for HBO.

## Conclusion

HBO therapy appears well tolerated and effective for complex wound healing to compromised vaginal tissue after urethral reconstructive surgery. This represents a helpful adjunct to promote vaginal wall wound healing along with appropriate nutrition and surgical debridement.

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