HOW I DO IT

How I do it: Balloon tamponade of prostatic fossa following Aquablation

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ALJURI N, GILLING P, ROEHRBORN C. How I do it: Balloon tamponade of prostatic fossa following Aquablation. *Can J Urol* 2017;24(4):8937-8940.

Since its first report in the 1870s, control of bleeding after transurethral resection of the prostate (TURP) has remained a concern. Foley's initial report of a urinary catheter involved placement of the balloon into the prostatic fossa following TURP. Removal of prostate tissue with a high-velocity saline stream (Aquablation) is a recently reported alternative to TURP. As Aquablation is heat-free, alternatives to non-thermal hemostasis were sought to optimize the procedure. We report use of a balloon catheter in the prostatic fossa after Aquablation as a post-resection hemostatic method.

Key Words: benign prostatic hyperplasia, bladder outlet obstruction, Aquablation, minimally invasive robotic surgery, TURP, balloon catheter

Introduction

Lower urinary tract symptoms (LUTS) from benign prostatic hyperplasia (BPH) affect 30% of men over age 50.[1] By age 85, the prevalence is as high as 90%.[2] Treatment options for patients with mild- or moderate-grade symptoms include watchful waiting and medical management. Discontinuation of medical therapy for men with more severe symptoms is common and a number of office-based procedure and surgical alternatives for symptomatic relief are available.

Transurethral resection of the prostate (TURP) remains the gold standard for surgical BPH treatment as it provides reliable and marked symptom reduction and improvement in objective measures (urinary flow rates). Unfortunately, complications from TURP can be significant, including postoperative bleeding, urinary retention, urinary incontinence, erectile dysfunction, and retrograde ejaculation. Several alternatives to TURP have been proposed that fall short of demonstrating equivalence to TURP's effectiveness but have a more acceptable risk profile.

Previously we reported the initial experience with Aquablation, a novel minimally invasive waterjet ablation therapy combining real-time image guidance and surgical robotics for the targeted, controlled, heat-free and immediate removal of prostate tissue for the treatment of LUTS.[3,4] Technical success rates were high and marked improvements in symptom scores were seen, with preservation of sexual function. Aquablation is currently the subject of a prospective double-blind multicenter international randomized clinical trial against TURP (WATER study, NCT02505919).

In these previous reports we mostly used standard electrocautery techniques to arrest bleeding post-Aquablation by using a resectoscope with a bipolar or monopolar electrode in coagulation mode. The resectoscope protocol was to have a coagulation-specific bipolar or monopolar electrode installed and to utilize coagulation (COAG) mode on the RF generator only. Cutting/vaporization (CUT) mode was not to be used to ensure that all prostate resection was due to Aquablation and not attributable to variation in surgical skill or techniques.

It should be noted that use of cautery after Aquablation is substantially different. In TURP, cautery is used to both resect tissue and cauterize. In contrast, Aquablation removes tissue first and then the surgeon uses cautery to address post-Aquablation bleeding. Post-Aquablation prostatic substrate has a "fluffy" appearance, making it difficult to identify sources of bleeding and thereby limiting the ability to perform effective cautery. Therefore, we subsequently used an intraprostatic balloon catheter with a technique similar to that originally reported by Foley.[5]

Accepted for publication July 2017

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Method and technique

Device description

The AquaBeam System (PROCEPT BioRobotics Corporation, Redwood Shores, CA, USA) combines real-time prostate imaging and surgical robotics to deliver Aquablation, a waterjet ablation therapy that enables targeted, controlled, heat-free and immediate removal of prostate tissue for the treatment of symptomatic BPH. The system consists of three main components: the conformal planning unit (CPU), the console, and the robotic hand piece, Figure 1. Live transrectal ultrasound (TRUS) is imported and displayed on the CPU, Figure 2, allowing the surgeon to map the contour of the prostate adenoma and define the area of resection. Utilizing the planning parameters from the CPU, the console generates and adjusts the velocity of the saline stream to allow for a surgeon-controlled resection of the targeted prostate tissue employing transrectal ultrasound image guidance, built-in simultaneous cystoscopic visualization and robotic execution, Figure 3.

Figure 1. AquaBeam System conformal planning unit, console and handpiece.

Figure 2. AquaBeam System display on CPU.

Procedure

Aquablation is performed under spinal or general anesthesia. A custom 24F rigid cystoscope is introduced into the bladder under direct visualization with the aid of a visual obturator. The obturator is removed, leaving the distal end of the sheath flush with the bladder neck. The Aquablation handpiece is advanced into the bladder. The articulating arm is locked into place to securely anchor the handpiece within the prostate.

A bi-plane TRUS probe (BK Medical, Peabody, MA, USA) is inserted into the rectum and secured using a stand-mounted stepper. Using live TRUS images, the surgeon identifies the target resection area in real time and maps the resection contour directly on the planning

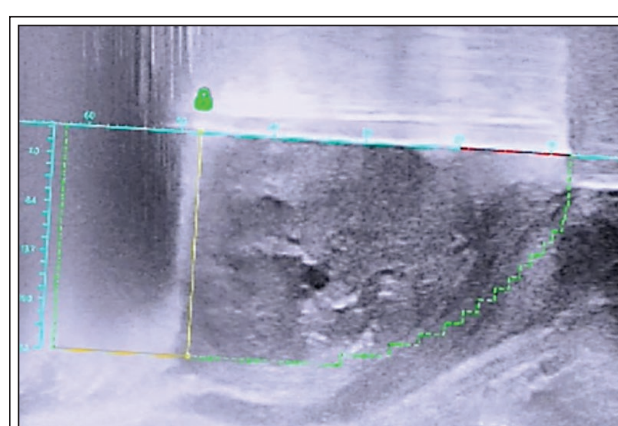

Figure 3. AquaBeam System resection of tissue under ultrasound guidance.

station. The surgeon initiates Aquablation with a foot pedal. The pump delivers a high-velocity sterile saline stream orthogonally (at a 90° angle) at various flow rates based on the depth of penetration required. The console also controls the rotational and longitudinal movement of the handpiece probe along the length of the prostate and follows the prescribed resection treatment plan. Active fluid aspiration removes fluid from the bladder to maintain intravesical volume equilibrium and to enable post-procedure histology. Once the resection is complete, the Aquablation handpiece is removed and a regular 24F cystoscope is introduced to remove some remaining free-floating prostate tissue as well as any clots that may have formed during the tissue resection.

Foley's original 1937 report described placement of a balloon catheter in the prostatic fossa after TURP to manage post-TURP bleeding, Figure 4.[5] This method has been mentioned in some textbooks.[6] In a similar fashion and under continuous TRUS guidance, we placed a 3-way Foley balloon catheter into the bladder following Aquablation and inflated with 5 cc-7 cc of saline. The balloon was then pulled distally into the prostatic fossa, inflated to a total volume equaling the approximate volume removed during the Aquablation and kept at this inflation volume for 2-5 hours, Figure 5.

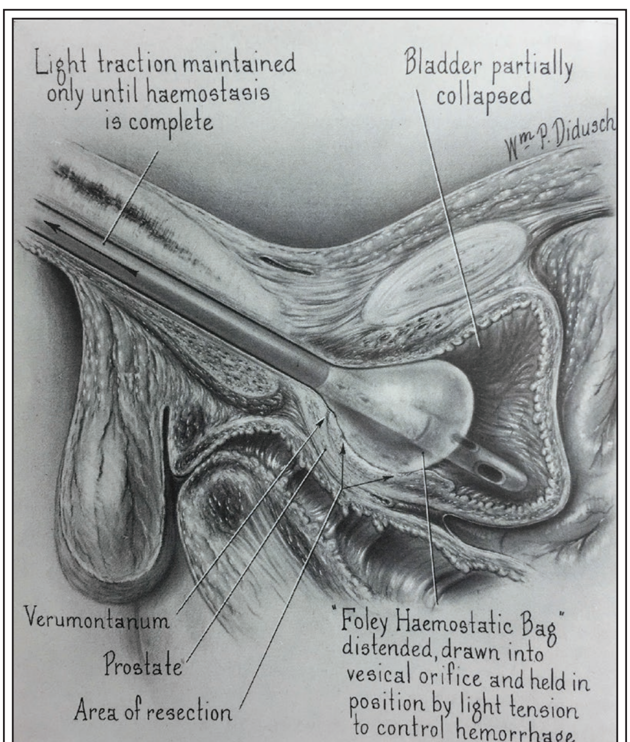

Figure 4. Use of balloon catheter as reported by Foley.[5] Reprinted with permission.

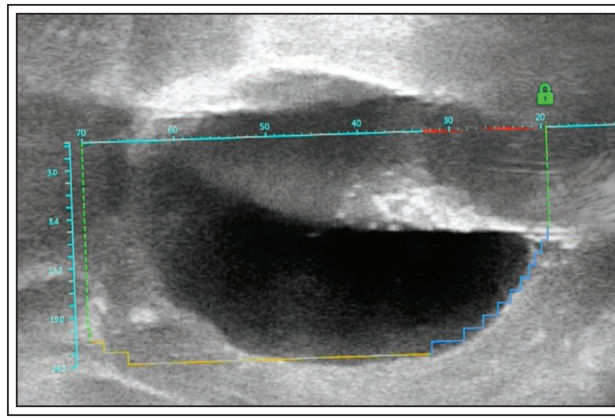

Figure 5. Transrectal ultrasound image of balloon catheter in prostatic fossa following Aquablation.

This volume is approximately 40%-50% of the baseline prostate size. The reason for limiting the inflation is to not put undue stress on the prostate capsule. A B&O Supprette suppository was given to manage any pain or discomfort the patient might feel from the surgery and this hemostatic technique.

Postoperatively, the catheter was manually flushed and aspirated with a large syringe for 2-5 minutes until the aspirate turned light pink or it was clear. The TRUS probe was removed and the catheter was connected to a saline bag for continuous bladder irrigation (CBI). The catheter also required some tension so that it did not slip into the bladder, which was achieved by a leg band or gauze strap tied to a 500 mL saline bag hung over the end of the patient bed acting as a counterweight. CBI was generally used overnight until the next morning when a voiding trial was performed. Patients were discharged the following day.

Discussion

Bleeding after TURP remains an important clinical problem, with bleeding requiring transfusion occurring in approximately 3% of TURPs.[7] Aquablation, a new procedure for the surgical removal of prostate tissue in men with LUTS due to BPH, does not use heat during tissue removal and thus requires a strategy for postoperative hemostasis. In our opinion, avoiding cautery may decrease the risk of ejaculatory dysfunction, which can be related to heat-induced damage to the seminal ducts.

Balloon tamponade is a well-known maneuver to control bleeding of non-surgical origin. Tamponade during gynecologic surgery has been reported[8] and there are multiple reports of intra-uterine balloons to control bleeding. In urologic procedures, balloon tamponade has been reported to control post-prostate biopsy rectal bleeding as well as bleeding after simple prostatectomy.[9] Balloon tamponade with a Foley catheter has been reported to treat dorsal venous complex bleeding during robotic assisted radical prostatectomy.[10] Though not widely reported, balloon tamponade of venous bleeding after TURP by compression of the balloon in the bladder against the prostatic fossa has also been described.[6,11]

Vesicourethral anastomotic stricture (VUAS) is reported commonly after radical prostatectomy and more rarely after photoselective vaporization of the prostate (PVP) or holmium laser enucleation of the prostate (HoLEP) for BPH. Risk factors for VUAS appear to be either related poor microvascular status[12] or operative complications.[13] Catheter use alone does not appear to be a risk factor, though one trial reported a lower incidence of VUAS with use of a suprapubic catheter versus transurethral catheter after radical prostatectomy.[14]

Initial experience with intraprostatic use of the Foley balloon catheter (i.e., the originally reported use of the device[5]) following Aquablation was promising, achieving acute bleeding control in most cases and no observed cases of VUAS to date. Some cases clearly demonstrated that modifications to the balloon catheter, along with methods to hold the catheter in place in the prostatic fossa, could potentially result in more effective tamponade.

Use of a low-pressure Foley catheter in the prostatic fossa should be distinguished from that proposed with transurethral balloon dilation procedures, which require much higher volumes and pressures and play little role in the current management of BPH.[15]

Most reviews of Foley catheter use focus on adverse consequences of prolonged use. In contrast, our use (i.e., the originally proposed use by Foley) involves only brief placement of the catheter. Although balloon use in the bladder with traction to control bleeding is often used, reports of balloon prostatic tamponade after prostatectomy is rarer.

Conclusions

In early cases, Aquablation of the prostate for BPH symptom relief was followed by brief cautery to manage postoperative bleeding. The balloon catheter achieves postoperative bleeding control without the need for treatments involving heat. Avoiding damage related to heat could be associated with a lower rate of adverse effects commonly seen after TURP, such as dysuria and retrograde ejaculation. Targets for improvement include modified balloon catheter designs as well as a reproducible method to hold tension/traction on the catheter to prevent intravesical migration.

Disclosures

Dr. Peter Gilling and Dr. Claus Roehrborn perform clinical research for PROCEPT BioRobotics. Dr. Nikolai Aljuri is a PROCEPT employee. PROCEPT BioRobotics manufacture the AquaBeam system used for Aquablation. ☐

References

1. Chute CG, Panser LA, Girman CJ et al. The prevalence of prostatism: a population-based survey of urinary symptoms. *J Urol* 1993;150(1):85-89.
2. AUA Practice Guidelines Committee. AUA guideline on management of benign prostatic hyperplasia (2003). Chapter 1: Diagnosis and treatment recommendations. *J Urol* 2003;170(2 Pt 1): 530-547.
3. Gilling P, Reuther R, Kahokehr A et al. Aquablation - image-guided robot-assisted waterjet ablation of the prostate: initial clinical experience. *BJU Int* 2016;117(6):923-929.
4. Gilling P, Anderson P, Tan A. Aquablation of the prostate for symptomatic benign prostatic hyperplasia: 1-year results. *J Urol* 2017;197(6):1565-1572.
5. Foley F. A hemostatic bag catheter. *J Urol* 1937;38:137-139.
6. Billingham R, Kobashi KC, Peters WA eds: Reoperative Pelvic Surgery. 2009 edition. Springer; 2009.
7. Ren J, Lai S, Jiang Z et al. A systematic review and meta-analysis of the effects on dutasteride treatment for reducing surgical blood loss during transurethral resection of the prostate. *Urol Int* 2017;98(4):456-465.
8. Timor-Tritsch IE, Cali G, Monteagudo A et al. Foley balloon catheter to prevent or manage bleeding during treatment for cervical and Cesarean scar pregnancy. *Ultrasound Obstet Gynecol* 2015;46(1):118-123.
9. Vaněk B. [A catheter for tamponade of the prostatic bed during prostatectomy performed transvesically]. *Rozhl Chir* 1983;62(10):707-709.
10. Anon. Recommendations in laparascopic and robotic surgery in urology. Dutch Urol. Soc. 2017. Available at: https://www.nvu.nl/Portals/_default/Skins/NVU/DocumentHandlerPublic.ashx?id=f7bbade9-ec12-e711-9438-005056b31e13&filename=20170203_Recommendations%20laparo-robot%20surgery_DEF2.pdf, accessed May 24, 2017.
11. Rassweiler J, Teber D, Kuntz R et al. Complications of transurethral resection of the prostate (TURP)--incidence, management, and prevention. *Eur Urol* 2006;50(5):969-979; discussion 980.
12. Borboroglu PG, Sands JP, Roberts JL et al. Risk factors for vesicourethral anastomotic stricture after radical prostatectomy. *Urology* 2000;56(1):96-100.
13. Rocco NR, Zuckerman JM. An update on best practice in the diagnosis and management of post-prostatectomy anastomotic strictures. *Ther Adv Urol* 2017;9(5):99-110.
14. Martinschek A, Pfalzgraf D, Rafail B et al. Transurethral versus suprapubic catheter at robot-assisted radical prostatectomy: a prospective randomized trial with 1-year follow-up. *World J Urol* 2016;34(3):407-411.
15. Vale JA, Miller PD, Kirby RS. Balloon dilatation of the prostate--should it have a place in the urologist's armamentarium? *J R Soc Med* 1993;86(2):83-86.