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A Novel Approach for the Treatment of Radiation-Induced Hemorrhagic Cystitis with the GreenLight™ XPS Laser

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ABSTRACT

Introduction: The treatment of pelvic malignancies with radiotherapy can develop severe sequelae, especially radiation-induced hemorrhagic cystitis. It is a progressive disease that can lead to the need for blood transfusion, hospitalizations, and surgical interventions. This tends to affect the quality of life of these patients, and management can at times be difficult. We have evaluated the GreenLight Xcelerated Performance System (XPS) with TruCoag, although primarily used for management of benign prostatic hypertrophy (BPH), for the treatment of radiation-induced hemorrhagic cystitis.
Materials and Methods: After International Review Board (IRB) approval, a retrospective chart review was performed in addition to a literature search. A series of four male patients, mean age of 81 years, with radiation-induced hemorrhagic cystitis secondary to radiotherapy for pelvic malignancies (3 prostate cancer, 1 rectal cancer) were successfully treated with the GreenLight laser after unsuccessful treatment with current therapies described in the literature.
Results: All four patients treated with the GreenLight laser had resolution of their hematuria after one treatment and were discharge from the hospital with clear urine.
Conclusion: The GreenLight XPS laser shows promising results for the treatment of patients with radiation-induced hemorrhagic cystitis, and deserves further evaluation and validation, especially since there is limited data available in the literature regarding the use of this technology for the treatment of this devastating condition.

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INTRODUCTION

The treatment of radiation-induced hemorrhagic cystitis can be especially frustrating for the practicing urologist. This potentially severe condition can appear more than 10 years after pelvic radiotherapy (1). Among patients treated with external beam pelvic radiotherapy or brachytherapy, 2.1% to 8.2% will have symptomatic hematuria, which can result in repeat hospital admissions, require blood transfusions, and surgical interventions for necessary treatment (2). Historically, treatments have included bladder irrigation with evacuation of clots and fulguration with electro--cautery, oral and intravesical agents, hyperbaric oxygen, and ultimately cystectomy with urinary diversion (Table-1). These treatments have been successful to varying degrees in the past. One potential endoscopic treatment is the use of laser technology for coagulation of the bladder.

Over the last several years, there have been significant advances in laser technology. Since first introduced in 1992, the laser has been mainly utilized in prostatic ablation and stone surgery. The initial Neodymium: Yttrium-Aluminum-Garnet (Nd: YAG), with its wavelength of 1064nm, had an

Table 1 - Management options for the treatment of intractable hemorrhagic cystitis.

Large Bore Catheter Drainage
Bladder Irrigation with Saline/Water
- Intermittent
- Continuous
Cystoscopy/Clot Evacuation/Fulguration
-Monopolar Electro cautery
-Bipolar Electro cautery
Hyperbaric Oxygen
Bladder Instillation
-Alum
-1% Silver Nitrate
-Formalin
GreenLight™ Laser Ablation/Fulguration
Selective Bladder Angioembolization
Cystectomy and Urinary Diversion

excellent coagulation effect, but with significant absorption of energy into the tissue causing irritative post-procedural symptoms secondary to the sloughing of necrotic tissue (3). With the addition of the potassium-titanyl-phosphate (KTP) crystal the wavelength was reduced in half with more immediate and efficient vaporization of tissue, with Malek et al. introducing its use for photo selective vaporization of the prostate for benign prostatic hyperplasia (BPH) in 1998 (4). The application of the KTP laser has expanded beyond prostatic ablation surgery, including, but not limited to, urethral hemangiomas and even partial nephrectomies in human and animal models (5, 6). The GreenLight™ laser (American Medical Systems® (AMS); Minnetonka, MN) is capable of producing a coagulation effect by either defocusing the beam or reducing power. Most recently, the GreenLight™ Xcelerated Performance System (XPS) with TruCoag™ has been developed by AMS. The improved coagulation effect of this laser has expanded the potential uses of this technology.

It is a combination of this improved coagulation effect with minimal depth of penetration; the wavelength of 1064nm is ideal for lysing red blood cells, and the fact that the GreenLight laser has no contact, minimizing any additional trauma to the already friable tissue, that has led us to postulate that this technology would be of benefit in treating patients with refractory hemorrhagic cystitis. To our knowledge, after an extensive literature search, there have been no reports of its usage in the treatment of radiation-induced hemorrhagic cystitis.

We present our initial series of patients, after retrospective chart review, which underwent successful GreenLight laser therapy for radiation--induced hemorrhagic cystitis. We demonstrate that novel use of this technology may benefit patients with this difficult problem.

MATERIALS AND METHODS

Patients

After International Review Board (IRB) approval, a retrospective chart review was performed at the James A. Haley Veterans' Affairs Hospital in Tampa, FL. Patients treated for hemorrhagic cystitis, most commonly, but not limited to, radiation--induced between January 2010 and June 2012. These patients must first have been treated with current standard of care, and then treated with the GreenLight laser after unsuccessful treatment with current therapies as described in the literature.

The algorithm of treatment, at this institution, involves first management with large bore catheters and intermittent/continuous bladder irrigations. If this fails, cystoscopy with clot evacuation and fulguration is then utilized. Once the patients have required more than one trip to the operating room (in a 3 month period of time) for management of their hemorrhagic cystitis, they are started on hyperbaric oxygen therapy, and are considered for bladder instillations. If unsuccessful, or if the patient prefers not to proceed with bladder instillations, prior to considering angioembolization/surgical intervention, they are given the option of proceeding with GreenLight laser ablation/fulguration of the bladder.

After reviewing 100 charts, we identified four male patients who presented to the emergency room with gross hematuria and were subsequently admitted to the hospital for management of their hematuria. The average patient age was 81 years and all had a history of external beam radiation therapy. Three patients underwent radio-

therapy for prostate cancer and one patient for rectal cancer. All had previously undergone a full clinical evaluation for their hematuria which was noted to be negative for upper or lower tract pathology. Each patient had been noted on cystoscopy to have evidence of hemorrhagic cystitis and had previously been treated with cystoscopy, clot evacuation, and at least one round of fulguration using electro-cautery with subsequent recurrence of their hematuria.

Surgical Technique

The procedure was performed under general anesthesia with the patient in the low dorsal lithotomy position. A rigid 22 French cystoscope was utilized to evacuate the bladder of all clots and a complete cystoscopy was performed to identify the source of bleeding and rule out any other unidentified pathology. The GreenLight laser was used to target any active source of bleeding, as well as any prominent telangiectatic vessels of the irradiated mucosa perceived as a potential source of future bleeding. These areas were coagulated with the laser at a setting of 40 watts with the laser fiber 3-4mm from the tissue. The vaporization setting was not used for this procedure. Throughout the procedure, saline irrigation was used and care was taken to ensure that the ureteral orifices were not injured. At the completion of the procedure, the bladder was drained under direct visualization to ensure adequate hemostasis. Very minimal bladder mucosal damage was appreciated. Then, a large three-way catheter was placed and continuous irrigation was maintained overnight and stopped the next morning.

RESULTS

All four patients successfully underwent coagulation with the GreenLight laser system. They were able to be discharged home with clear urine. One patient had urinary retention and mild recurrence of his hematuria on attempted catheter removal, which was solely managed by placement of a Foley catheter. The other three patients successfully underwent catheter removal without difficulty. None of the patients have required subsequent hospitalization or surgical procedures for management of their radiation cystitis in a mean follow-up of 12 months.

DISCUSSION

Traditionally, the treatment of patients with radiation-induced hemorrhagic cystitis has been a difficult and frustrating experience, especially because of the progressive ischemic nature of the radiation injury on the bladder mucosa. This can result in multiple hospital admissions with a significant financial expense. Multiple therapies have been utilized in the past with varying degrees of success, with hyperbaric oxygen showing the most promising results (7), but it requires several treatments with substantial cost and has limited availability.

The GreenLight laser has become one of the standards in prostatic ablative therapy. Multiple studies have been performed investigating the usage of this technology for the management of BPH (8-10). Its use in the treatment of radiation--induced hemorrhagic cystitis has not yet been described. The previously poor coagulation effect of the GreenLight™ laser limited its use in this regard. Thus, the advent of the GreenLight™ XPS system with TruCoag™ has opened up the realm of potential alternative uses, including the treatment of radiation-induced hemorrhagic cystitis. The non-contact nature of this laser, improved coagulation effect, and its wavelength of 1064nm (lysing red blood cells), all make this technology ideal for management of this very frustrating disease.

We acknowledge that this series is limited by the small sample size and its retrospective nature. However, the initial series of patients treated at our institution does demonstrate the potential use of this technology. While adjunct therapies such as hyperbaric oxygen may still be required in the long term, the short-term results and potential for decreased hospitalizations is promising. Further investigation of the GreenLight laser for radiation-induced hemorrhagic cystitis is necessary to determine the long-term viability of this treatment. At our institution, we have begun the prospective evaluation of this treatment.

CONCLUSION

Chronic hematuria secondary to radiation cystitis can be difficult to treat. Often times, a multidisciplinary approach is necessary. We have evaluated another indication for the GreenLight laser in the management of radiation-induced hemorrhagic cystitis refractory to current standard of care therapy. It is possible to perform this procedure, using minimally invasive technology, in a safe and efficient manner. It may be used in conjunction with other treatment modalities, and may also be incorporated as a bridge to more definitive therapy, including hyperbaric oxygen therapy. The KTP laser is a recent addition to the urologist's armamentarium in treating BPH, and now we have successfully treated refractory hematuria.

CONFLICT OF INTEREST

None declared.

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