Percutaneous Resection of Renal Urothelial Carcinoma Using Bipolar Electrocautery

Kevin G. Kwan, MD, Ben H. Chew, MD, MSc, Patrick P.W. Luke, MD, John D. Denstedt, MD, Stephen E. Pautler, MD

ABSTRACT

Percutaneous approaches to upper tract urothelial cancers have been performed in patients unsuitable for radical nephroureterectomy. We present the case of an 82-year-old man with significant comorbidities including dependency on a cardiac pacemaker. Without deactivating the pacemaker, we used bipolar cautery to percutaneously resect a large upper tract urothelial tumor in the renal pelvis. Bipolar cautery is a suitable method of percutaneous or transurethral resection in patients who are pacemaker dependent.

Key Words: Electrosurgery, Urothelial carcinoma, Artificial Pacemaker.

INTRODUCTION

It is well established that the presence of neoplasms in the upper tract urothelium necessitates the en bloc removal of the ipsilateral kidney, ureter, and bladder cuff as the standard of care based on the premise that urothelial cancers are caused by a field change or defect. However, due to the morbidity associated with open nephroureterectomies, conservative management may be appropriate for poor surgical candidates. Percutaneous and ureteroscopic techniques have been utilized in the management of urothelial tumors with percutaneous access required to treat larger of upper tract urothelial cancers being used in suitable candidates. Various techniques for this approach have been reported including monopolar electrocautery, laser, rollerball, and electrovaporization. The reported recurrence rates have been low, and disease-free survival is comparable to that in patients treated with nephroureterectomy. The use of monopolar electrosurgery however can interfere with cardiac pacemakers resulting in potentially fatal dysrhythmias.

We report the case of an upper tract urothelial carcinoma in the renal pelvis resected with bipolar cautery through percutaneous access without deactivation of the cardiac pacemaker. To our knowledge, the use of bipolar cautery has not been described in this setting.

METHODS

An 82-year-old man who was a lifelong nonsmoker presented with a history of intermittent gross hematuria. His medical comorbidities included non-insulin-dependent diabetes, hypertension, hypercholesterolemia, hypothyroidism, chronic renal insufficiency (creatinine 2.4 mg/dL), multiple transient ischemic attacks, stroke, sleep apnea, peripheral vascular disease resulting in a below-knee amputation, colon resection for diverticulitis, and a VDD pacemaker (Model # 640, Vitatron, Minneapolis, MN) for bradycardia. His medications included aspirin, ramipril, hydrochlorothiazide, L-thyroxine and rosuvastatin. His preoperative cardiac risk was Goldman Class II-III, and he was at high risk of developing a deep venous thrombosis. Postoperative respiratory depression was a concern due to his sleep apnea.
Initial cystoscopic examination revealed no bladder tumors. The retrograde pyelogram on the right side was normal, but the left retrograde pyelogram demonstrated moderate hydronephrosis in a bifid collecting system and a 2-cm filling defect in the renal pelvis with renal malrotation (Figure 1). Urine cytology was positive for urothelial carcinoma. A CT scan of the abdomen and pelvis revealed a tumor limited to the left renal collecting system with no evidence of metastases. Further, a metastatic workup was negative.

Based on a background of renal insufficiency, the options were discussed with the patient and a tumor ablation with the Holmium:YAG laser and flexible ureteroscopy was carried out. The ureteroscopic procedure was ineffective in completely ablating the tumor at its stalk because the ureteroscope could not fully access the tumor due to the capacious renal pelvis and renal malrotation. This patient was dependent on his VDD pacemaker, thus making monopolar cautery potentially hazardous. Therefore, a percutaneous resection using a bipolar resectoscope was planned under a second general anesthetic without deactivating the pacemaker.

RESULTS

With the patient under general anesthesia, percutaneous access to the kidney was obtained, the tract was dilated to 30 F, and an Amplatz sheath was inserted. A resectoscope using bipolar cauter (VISTA, ACMI Corporation, Southborough, MA) was used to resect the tumor (settings: cut, 6; coagulation, 6) through the Amplatz sheath. The operation lasted 30 minutes without any evidence of dysrhythmias or interference with the pacemaker. A 22 F nephrostomy tube was left indwelling until postoperative day 1 when it was removed, and the patient was discharged home without any complications. The patient used a continuous positive airway pressure (CPAP) machine postoperatively that helped prevent any postoperative respiratory complications. There were no cardiac or thromboembolic complications. The patient was seen in follow-up at 3 months with an intravenous pyelogram (IVP) that was free of any filling defects and negative cytology. Serum creatinine increased only slightly from 2.4 mg/dL (preoperatively) to 2.6 mg/dL, postoperatively. At 8 months, a retrograde pyelogram revealed a recurrence of his upper tract tumor that was too large for ureteroscopic management, and percutaneous bipolar resection was once again undertaken. The patient declined upper tract bacille Calmette-Guérin therapy and laparoscopic nephroureterectomy due to his declining health including a recent cerebral vascular accident. At 6 months, the patient remains free of recurrent or metastatic disease with stable renal function (2.5 mg/dL).

DISCUSSION

Bipolar electrocautery was introduced over 20 years ago as an energy source for endourologic procedures. The potential benefits of bipolar energy include the use of isotonic normal saline irrigation and improved hemostasis. Importantly, it can also be used on patients with permanent cardiac pacemakers and has been described in a case involving transurethral resection of a bladder tumor in a similar pacemaker-dependent patient.

Electrocautery-induced cardiac pacemaker failure or malfunction has been well described. Since the invention of cardiac pacemakers nearly 50 years ago, electromagnetic interference has been a concern for patients who wear them. Over the years, despite improved technology, permanent cardiac pacemakers remain susceptible to this electromagnetic interference, including electrocautery, during surgical procedures. Traditionally, the use of monopolar electrosurgery is avoided in patients with cardiac pacemakers because the monopolar current passes from the instrument tip through the patient’s body towards the ground plate and may adversely affect the pacemaker, resulting in potentially fatal dysrhythmias. Bipolar electro-
surgery can reduce the level of interference between electrocautery units and pacemaker electrodes.5

Bipolar electrosurgery has also been shown to reduce the depth of thermal damage at the site of surgery. In an ex vivo porcine kidney model, Wendt-Nordahl et al7 compared the effects of the Vista bipolar system to monopolar cautery. The depth of thermal damage was significantly deeper at 300 μm measured with the monopolar resectoscope but only reached 160 μm with the bipolar device even at the highest output level (level 8). The lower tissue temperature may be beneficial during resection of upper tract renal tumors. Excessive heat may cause problems with the urothelium of the renal collecting system or penetrate deeply into parenchyma resulting in arteriovenous fistulae.

Radical nephroureterectomy is the gold standard in the treatment of upper tract urothelial malignancies. However, in patients with significant medical comorbidities who are not candidates for radical surgery, bipolar resection through a percutaneous access is an alternative. Given the patient’s cardiac status, a bipolar resectoscope was used not only to perform tumor resection but also to minimize the risk of electrical interference with the pacemaker. Both ureteroscopy and percutaneous laser ablation would have been tedious due to tumor size and location. Disease recurrence occurred due to multifocality and not due to failure of the initial bipolar procedure. It can be argued that the patient underwent 2 endoscopic procedures while under general anesthesia, whereas a laparoscopic nephroureterectomy would have offered treatment in a single procedure; however, the single procedure would have required more surgical time in one sitting and is much more invasive than 2 short endoscopic procedures. The mortality and morbidity risk would be higher with a nephroureterectomy than 2 shorter endoscopic procedures.

While the use of the bipolar electrocautery may be advantageous in the percutaneous resection of upper tract urothelial tumors, potential drawbacks of this technique include limited utility depending on tumor location and access, and dessication of the tissue creating more artifacts for pathological examination. It is advisable to perform a cold biopsy of the tumor for both pathology and margin status before using the bipolar electrocautery. More importantly, this approach is not a replacement for nephroureterectomy but may be an option for nonsurgical candidates or patients who may benefit from nephron-sparing procedures. It may be a palliative procedure in some cases and potentially therapeutic in others. As illustrated in this case, the use of bipolar electrocautery circumvents the potential risks of using electrocautery in patients with cardiac pacemakers.

CONCLUSION

Bipolar electrocautery is a safe and feasible resection modality in percutaneously approached upper tract urothelial neoplasms in patients with cardiac pacemakers.

References:

1. Jabbour ME, Desgrandchamps F, Cazin S, et al. Percutaneous management of grade II upper urinary tract transitional cell carcinoma: the long-term outcome. J Urol. 2000;163(4):1105–1107.
2. Nakada SY, Clayman RV. Percutaneous electrovaporization of upper tract transitional cell carcinoma in patients with functionally solitary kidneys. Urology. 1995;46(5):751–755.
3. Rothenberger K, Pensel J, Hofstetter A, et al. Controlled bipolar high-frequency coagulation for transurethral application: a new method for the destruction of urinary bladder tumors. Urol Int. 1983;38(5):257–262.
4. Lee D, Sharp VJ, Konety BR. Use of bipolar power source for transurethral resection of bladder tumor in patient with implanted pacemaker. Urology. 2005;66(1):194.
5. Kellow NH. Pacemaker failure during transurethral resection of the prostate. Anaesthesia. 1993;48(2):136–138.
6. Madigan JD, Choudhri AF, Chen J, et al. Surgical management of the patient with an implanted cardiac device: implications of electromagnetic interference. Ann Surg. 1999;230(5):639–647.
7. Wendt-Nordahl G, Hacker A, Reich O, et al. The Vista system: a new bipolar resection device for endourological procedures: comparison with conventional resectoscope. Eur Urol. 2004;46(5):586–590.