CASE

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A case of duodenal perforation and pancreatic bleeding after flexible ureteroscopy for right renal pelvis UTUC

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Abstract

Upper tract urothelial carcinoma (UTUC) can be managed by flexible ureteroscopy (f-URS) and tumor laser ablation if kidney-sparing surgery is possible. This procedure can be affected by minor to serious complications, including life-threatening sepsis, ureteral strictures, and ureteral and renal pelvis injuries. Here, we present the case of a 53-year-old man with history of high-grade right renal pelvis and bladder tumor who undergone multiple endoscopic treatments and has already refused radical surgery. F-URS and laser ablation with Thulium: YAG laser for UTUC recurrence of the right renal pelvis was performed, but the procedure was stopped due to significant bleeding which impaired vision. Postoperatively, the patient developed hematemesis and hemodynamic instability due to duodenal lesion and active bleeding documented on computed tomography scan. An emergency exploratory laparotomy was performed to drain the hemoperitoneum, repair the duodenal lesion, and concurrent radical right nephroureterectomy was carried out. A second surgery was necessary for repairing duodenal fistula. After one week, the patient presented again with recurrent hematemesis and hemorrhagic shock. He underwent angiography and selective embolization of the duodenal branch of the superior mesenteric artery and as well as branches of the gastroduodenal artery successfully and the patient recovered with no other complications. This is the first case of duodenal perforation and pancreatic bleeding due to flexible ureteroscopy and laser ablation of right renal pelvic urothelial carcinoma.
Keywords: UTUC, flexible ureteroscopy, laser ablation, bleeding, duodenum

Introduction

Upper tract urothelial carcinoma (UTUC) is an uncommon neoplasm and accounts for only 5–10% of all urothelial carcinomas [1]. Kidney-sparing endoscopic management of UTUC is a feasible option in patients with a solitary kidney and/or impaired renal function, as well as in cases of bilateral or low-risk tumors [2]. Flexible ureteroscopy (f-URS) can be used to perform diagnostic biopsies as well as ablate the tumor in the ureter or renal pelvis using laser technology. The potential risks of this procedure range from minor complications such as urinary tract infection (UTI) and hematuria to serious complications including life-threatening sepsis, ureteral strictures, and ureteral and renal pelvic injuries. [3, 4]. Here, we present the first described case of duodenal perforation and pancreatic bleeding due to flexible ureteroscopy and laser ablation of right renal pelvic urothelial carcinoma.

Case description

A 53-year-old man, with a significant medical history of peptic ulcer disease on treatment with proton-pump inhibitor (PPI) was referred to the urology department for high-risk UTUC involving the right renal pelvis and ureter. He was first treated in 2017 for right renal pelvis tumor and histology showed pTa G3 urothelial carcinoma. He refused right nephroureterectomy. During a follow-up period of 2 years, he underwent at least six endourological procedures (ureteroscopy and biopsies and endoluminal instillation of mitomicin C through MJ stent) to treat recurrent UTUC. He has also undergone multiple endoscopic bladder resections (TURB) for concurrent high grade bladder cancer

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followed by intravesical immunotherapy with BCG. Considering the extent of the disease, multiple recurrences and the limitations of the endoscopic treatment, he was repeatedly offered right radical nephroureterectomy (RNU), but the patient declined radical treatment.

In February 2019, he underwent right f-URS. A wireless and sheathless "no-touch" technique was performed using an 8.5 F flexible digital ureteroscope (Flex-XC, Karl Storz, Tuttlingen, Germany) [5]. Multiple papillary lesions were found in all the major calyces and the renal pelvis. Biopsy was performed with a tipless 1.9 F nitinol basket, followed by tumor ablation with a 200µm fiber for thulium: YAG (Tm:Yag) laser (Cyber-TM, Quanta System, Samarate, Italy). The laser was set to 10 watts for the procedure. After an initial bloodless ablation, endoscopic vision deteriorated due to the development of significant bleeding. The laser power was increased up to 30 watts in the effort of controlling the ongoing bleeding, but unsuccessfully. The decision was then made to terminate the procedure and a single J ureteral stent was placed under fluoroscopy without relevant findings on retrograde pyelography.

On postoperative day (POD) 1, the patient presented with acute hematemesis and hematuria. Computed tomography (CT) scan showed a large clot in the right renal pelvis clot. Duodenoscopy was also carried out in emergency and the patient was found to have a 1 cm perforation in the second part of the duodenum. This was treated endoscopically with injection of epinephrine to remove some clots adhering to the lesion and then 4 metallic clips were applied to close it (Figure 1).

Figure 1. EGDS and application of metallic clips for duodenal bleeding.

Unfortunately, the next day the patient developed hemodynamic instability and a drop of hemoglobin from 13 to 9 g/dL. An emergency exploratory laparotomy was performed with intraoperative findings of massive hemoperitoneum due to active bleeding from a 1 cm perforation of the anterior duodenal wall and from the pancreatic head (Figure 2).

After the abdomen was washed out, the pancreatic head bleeding was controlled with hemostatic sutures and the duodenal perforation was repaired. A right radical nephroureterectomy was also performed at the same setting. The patient received 4 pints of packed cell transfusion during surgery. Postoperatively, the patient was clinically stable but was admitted to the intensive care unit for monitoring. On POD 8, the drain output was suspicious for enteric content, hence a CT scan and gastrografin swallow were performed. The scans demonstrated a duodenal fistula. The patient was then brought back into the operating room for repair of the duodenal fistula (Figure 3).

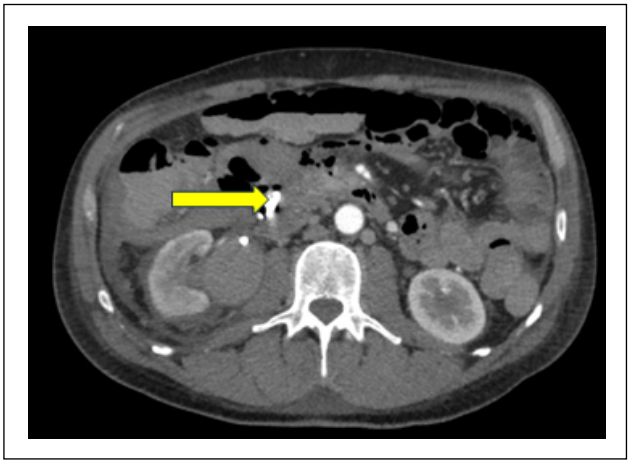

Figure 2. CT scan and hemodynamic instability: active bleeding and hemoperitoneum.

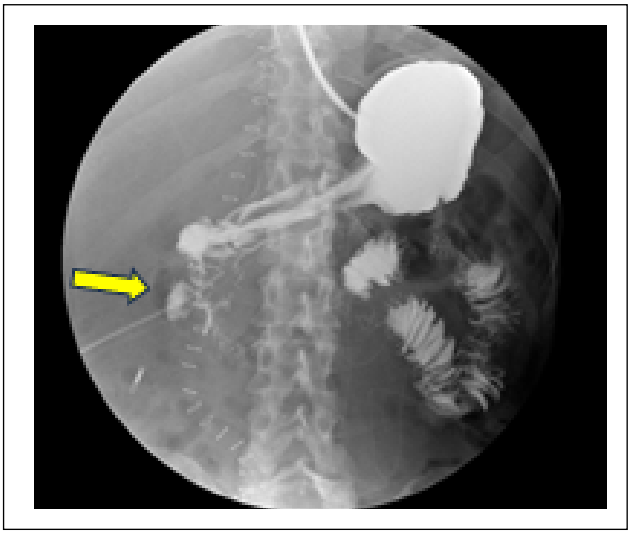

Figure 3. Abdomen X-Ray with gastrografin: duodenal fistula.

The patient recovered gradually following the second duodenal repair surgery. However, after one week, the patient presented with recurrent hematemesis and hemorrhagic shock. A CT angiogram documented recurrent active bleeding near the previous metallic clips used in the repair of the duodenal perforation. A celiac and mesenteric arteriography through femoral puncture was carried out and the patient underwent selective embolization of the duodenal branch of the superior mesenteric artery and as well as branches of the gastroduodenal artery successfully

by microcoil placement (Figure 4 & 5).
Subsequently, the patient recovered without further hematemesis and hemoglobin levels remained stable. He was discharged from the hospital on the 30th postoperative day since first surgery.
Final histologic examination of the right radical nephroureterectomy specimen was reported to be pTis urothelial carcinoma of the right renal pelvis. He is now still on periodic follow-up with flexible cystoscopy, with the last bladder recurrence in May 2022.

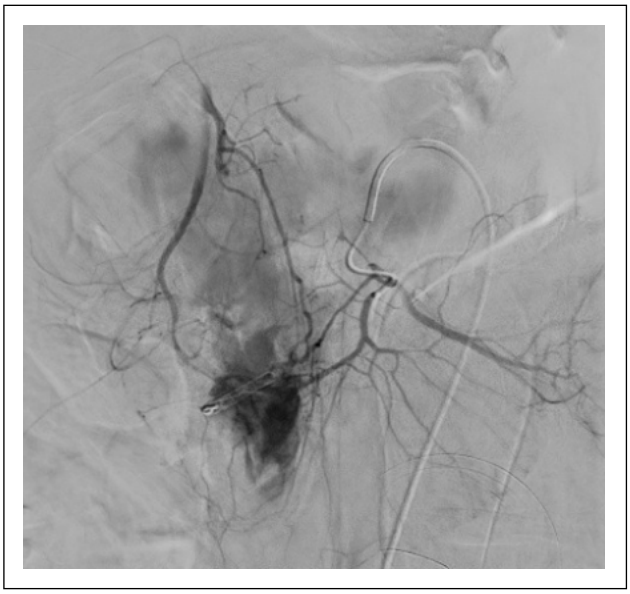

Figure 4. Active bleeding from mesenteric and gastroduodenal artery at angiography.

Figure 5. Hemostasis after selective angioembolization.

Discussion

According to the current European Association of Urology (EAU) guidelines, RNU remains the gold standard for high-risk UTUC [2]. Nevertheless, conservative treatment should be considered as an option in patients with imperative indications for kidney-sparing surgery, such as in solitary kidney, bilateral UTUC, or chronic renal failure, as well as for clinically low-risk UTUC [6]. In some cases where the patient chooses to avoid radical surgery, it is important to ensure that the patient is aware of the possible risks of disease progression and the necessity of close endoscopic follow-up. To date, f-URS is useful for both endoscopic tumor ablation and a close postoperative surveillance of the UTUC after kidney-sparing treatment [7]. Endoscopic procedures in the upper urinary tract are associated with the risk of trauma to the ureter and pyelocaliceal system [8]. These injuries are classified as a major complication of f-URS and are usually reported to be due to the use of a ureteral access sheath (UAS) [4]. This is the reason why we usually prefer to apply a "no touch" technique when performing f-URS for UTUC and avoid traumatism on the ureteral wall that can cause lesions or bleeding. In the described case, therefore, the pelvic wall perforation must have been due to tumor laser ablation with thulium: YAG laser in the setting of poor visibility due to significant bleeding. In endourology, adequate irrigation is fundamental. UAS are very useful to guarantee good irrigation and consequently a good intraoperative vision. According to this concept, more evidence is appearing in the literature to encourage this practice also during procedures for UTUC. Moreover, Douglawi *et al*. demonstrate a protective role for UAS in bladder recurrence in urothelial cancer [9].
In a review of URS complications by Linehan *et al*. [3], the authors found rates of bleeding ranging from 1.6% to 27.3%, but only a few were serious enough to require hospitalization and/or blood transfusion. Bleeding during URS treatment for UTUC was more frequently associated with patients who had previously received adjuvant instillations [3]. Renal pelvic wall perforation is an even rarer event, with rates varying from 1.3% to 7.4% of cases. There are also some disease-related factors to consider, such as tumor location and invasiveness. In this case, the patient presented with a large tumor involving the entire anterior wall of the renal pelvis and all the calyces, and the diseased urothelium is more prone to injury and perforation.
The choice of laser for the ablation of the tumor also contributes to the risk of injury to the collecting system, and hence the characteristics of the laser must be considered. Proietti *et al*. evaluated the effects of both Tm:YAG and Holmium:YAG (Ho:YAG) lasers on upper urinary tract urothelium, with a focus on incision depth and coagulation area [10]. This study showed a lower penetrative power for Tm:YAG (due to lower peak power, better water absorption and continuous mode) compared to Ho:YAG, with a higher coagulation effect without excessive carbonization of tissue. Despite these advantages in choosing the Tm:YAG laser, a major bleeding was encountered in the described case, resulting in poor vision that led to the inadvertent perforation of the renal pelvis with the involvement of the duodenum and the pancreas. In addition, the patient had a history of peptic ulcer disease, and this un-

derlying pathology may have contributed to the fragility of the duodenal wall. The second segment of duodenum "C" lies over the right renal hilum, hence its proximity resulted in the injury with the renal pelvis perforation (Figure 6).

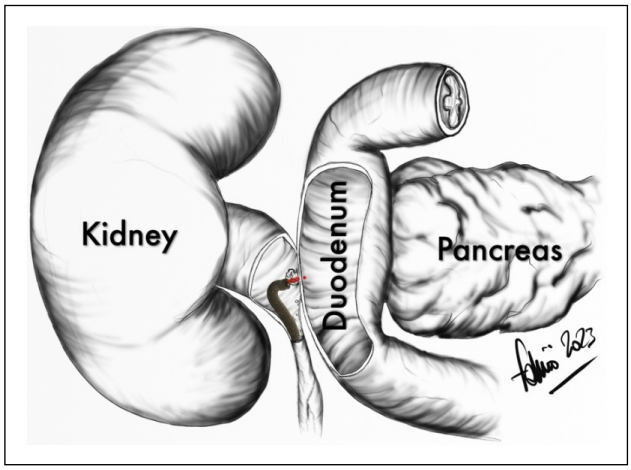

Figure 6. Anatomical relationship between the right renal pelvis, the II portion of duodenal C loop, and the pancreatic head.

Duodenal perforation is a rare condition, but is associated with high morbidity and mortality, ranging from 8% to 25% [11]. Isolated duodenal injuries after trauma are rare, and the pancreas is frequently injured concomitantly due to their close anatomical relationship. The second segment of the duodenum is the most commonly injured part (36%). When isolated minor CT findings are discovered, the clinical case can be managed conservatively with close monitoring, otherwise patients usually require surgical intervention. Endoscopic management with supportive medical therapies is the first-line therapy for gastrointestinal upper bleeding and is highly effective. The standard approach includes pre-injection of the bleeding area with epinephrine before removing clots with a cold guillotining snare technique. Numerous meta-analyses indicate that adding a second procedure, such as a second injectant agent (alcohol, thrombin, or fibrin glue), thermal contact, or clips, is superior to epinephrine injection alone [12]. This was the treatment of choice, and in this case, the endoscopic management appeared adequate enough to solve the bleeding and repair the defect without surgery (primary repair [13] vs. duodenectomy [14]). However, approximately 10% of all patients will either continue to bleed or experience rebleeding within 48 h of the endoscopic treatment. While surgical therapy has historically been considered the next line of treatment for upper GI refractory bleeding, angioembolization has now become the next line of therapy [15]. Given the dual supply to the duodenum from the celiac trunk (GDA), as well as the superior mesenteric artery (through the inferior pancreaticoduodenal arcades), embolization that is distal to the site, and proximal to the bleeding is needed for effective embolization [15]. In this case, the placement of the coils was able to stop the contrast medium spreading seen on the arteriography and was able to stop the bleeding.

The main complication after transarterial embolization is bowel ischemia. Although the upper gastrointestinal tract has a rich collateral blood supply, ischemic complications can still occur in 7 to 16% of cases [12], in which unfavourable evolution is very likely, but fortunately this was not the case. As a matter of fact, the following postoperative course was finally uneventful. In literature, a very limited number of cases of iatrogenic injury of the duodenum during endourologic surgery were found: one in a patient with an indwelling right ureteral DJ stent [16] and 4 cases of duodenal perforation during percutaneous nephrolithotomy [17].

Conclusion

Herein, we describe the first case of duodenal injury occurring during operative ureteroscopy for UTUC. The injury was due to laser ablation of the tumor in poor visibility condition on background of tissue fragility. Urologists should pay special attention when using lasers in endourology, especially during soft tissue treatment: the latest generation high-power lasers are very effective, but are also able to deliver an energy that may clearly exceed the amount needed, becoming dangerous and counterproductive, especially in case of severe bleeding. In this scenario, when controlling of the bleeding in the upper urinary tract is not achievable, always consider stopping the procedure in order to avoid life-threatening complication like this and involving interventional radiologists. Early recognition, diagnosis, and timely intervention are crucial in the management of these rare but serious complications.

Declarations

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Conflicts of interest statement : G.G.: consultant for Coloplast, Rocamed, Olympus, Boston Scientific, BD-Bard, Cook Medical, Quanta system. S.P.: consultant for Quanta System. The other authors have no conflicts of interest to declare.

Ethical Approval and Informed consent: The patient has provided an informed consent for publication of images and information in this study.

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