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Case report

Iatrogenic ureteric stricture post image guided renal cryoablation in a patient with von hippel-lindau syndrome ☆,☆☆

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ABSTRACT

A 53-year-old lady is known to have Von Hippel-Lindau syndrome with a long history of previous renal cell carcinomas (RCCs) in both kidneys. She was treated by partial nephrectomy for a right peripheral RCC and subsequently image guided radiofrequency ablation (RFA) of a left central RCC. She developed another de novo RCC adjacent to the right pelvic-ureteric junction (PUJ) 4 years after the initial RFA. Due to the close proximity to the PUJ and visibility of an ice ball with cryoablation (CRYO), the consensus from the MDT was that CRYO would be safer than RFA and she subsequently underwent percutaneous image guided CRYO to treat the small de novo RCC. Unfortunately, during the 1-month imaging follow up, she developed moderate hydronephrosis and a ureteric stricture needing long-term ureteric stent management. This case highlights the risk of ureteric injury caused by the thermal effect of the ice ball during image guided renal CRYO. Therefore, it is vital that all interventional

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radiologists adopt various manoeuvres to protect the ureter from the ice ball during CRYO in order to avoid the development of latent ureteric stricture.

Case report

This case report has followed the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Introduction

Von Hippel-Lindau (VHL) disease is a rare hereditary autosomal dominant syndrome caused by germline mutation at the short arm of chromosome 3 in the tumour suppressor gene, VHL [1–3]. This syndrome is characterized by tumours in various organs such as phaeochromocytomas, neuroendocrine tumours in the pancreas, haemangioblastomas in the central nervous system and retina, and multifocal, recurrent de novo renal cell carcinomas (RCCs) [4–6]. VHL patients commonly succumbed owing to metastatic disease from RCC and renal failure from repeated RCCs treatment [7–9]. The management of RCCs in the VHL patients poses a clinical dilemma as the balance between oncological durability must be weighed against the need for long term renal function preservation, hence, conservative treatments should be offered whenever possible. Although partial nephrectomy (PN) is now the standard treatment for T1a RCC [10], repeated PN for multifocal and recurring de novo RCCs in VHL patients can risk higher major complication rates [11]. In the last decade, there has been reported literature of case series by various authors in using image guided ablation including radiofrequency ablation (RFA) [12, 13], cryoablation (CRYO) [12, 14] and irreversible electroporation (IRE) [15] for RCCs for VHL patients. Image guided ablation is becoming the preferred treatment option in VHL patients as the technique offers good local cancer control and renal function preservation.

Clinical details

A 53-year-old lady known to have Von Hippel-Lindau syndrome developed another de novo small renal tumour during her annual screening in 2008 and was referred to the Interventional Oncology program for consideration of image guided renal ablation. The de novo renal tumour sited in close proximity (distance=0 mm) to the right pelvic-ureteric junction (PUJ) (Fig. 1). As part of the hereditary VHL syndrome, she developed multiple cysts in pancreas and kidneys. Her past medical history also included laser treatment in her right eye for a haemangioblastoma in 1988, partial nephrectomy for right RCC and surgical resection of a right renal adenoma in 1989. In

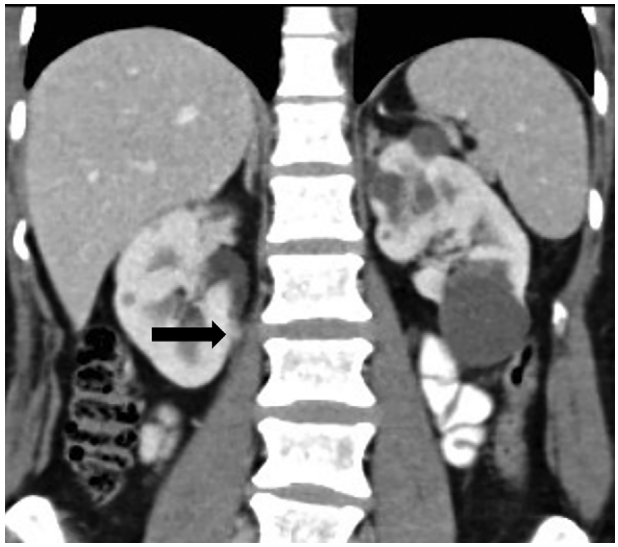

Fig. 1 – The baseline pre-CRYO Coronal CT showed a small 11mm RCC adjacent to the right PUJ and proximal ureter (black arrow).

2004, she developed a central RCC in the left kidney which was successfully treated by image guided RFA together with retrograde cold pyelo-perfusion technique [16]. Despite her successful treatment in the left kidney, RFA was found to cause ureteric stricture in the author institutional experience subsequently [17]. The de novo RCC measures 10mm and was located at the lower pole of the right kidney. The consensus from the renal cancer MDT was that percutaneous image guided ablation with ice-based energy should be offered instead of heat-based energy given the proximity of the tumour to the PUJ. The ability to visualize an ice ball in CRYO was deemed to be safer than heat-based energy where the fire ball cannot be visualized on imaging. The treatment risks and benefits were discussed in detail with the patient, and written consent was obtained to proceed with percutaneous image guided CRYO.

Technical Details of Image-guided CRYO

The patient was treated under general anaesthesia and had CT-guided renal CRYO. Under image guidance, a total of three IceSphere cryoprobes were inserted into the right RCC adjacent to the PUJ (Fig. 2A). Two complete freezing and thawing cycles were performed with a total treatment time of 30 minutes. However, after the second cycle of CRYO treatment and whilst reviewing the images, the ice ball was seen to encroach the PUJ and proximal ureter (Fig. 2B). Following discussions with the urologist, the decision was to insert a

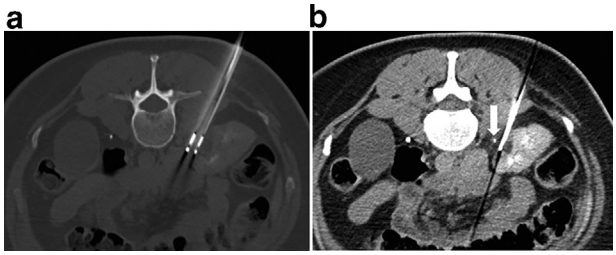

Fig. 2 – Intra-procedural axial CT during CT-guided CRYO showing (A) two parallel placement of the cryoprobes into the renal tumour close to the PUJ on bone window and (B) the third inferior cryoprobe which was sited close to the proximal ureter (white arrow). The ice ball engulfed the ureter inadvertently during CRYO treatment.

Fig. 3 – Coronal contrast-enhanced CT at 1-month showed no other complications and adequate treatment effect (black arrow).

retrograde ureteric stent to protect the ureter with the plan to check the ureter status at 3 months. There were no other immediate complications and the patient was monitored for as per standard care and she was transferred to a general ward after recovering from general anaesthesia. She was monitored as in-patient overnight and then discharged home the next day with stable renal function post CRYO eGFR of 50mL/min/1.73m^2 when compared to baseline eGFR of 57mL/min/1.73m^2.

Diagnosing ureteric stricture

The first imaging follow-up at one-month post right renal CRYO with ureteric stent in-situ showed no evidence of any early complications (Fig. 3). However, at 3-months follow-up, the patient had a retrograde study which confirmed proximal ureteric stricture (Fig. 4) and the decision from the MDT was to manage this with long-term retrograde ureteric stent insertion. To date, she has been managed with 6-monthly

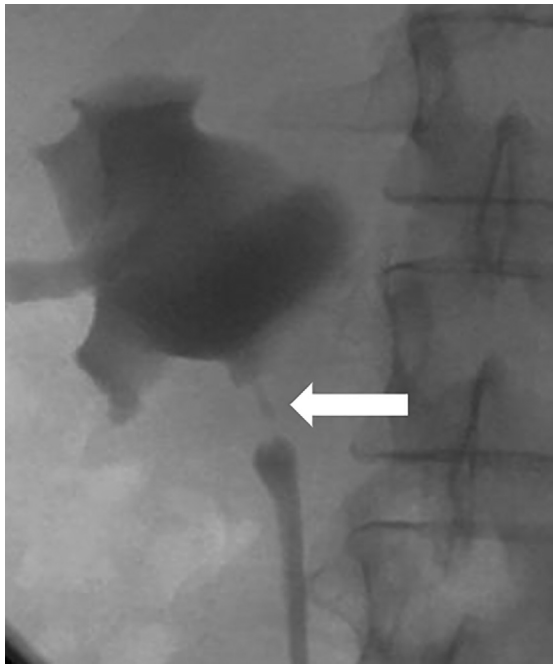

Fig. 4 – The right retrograde contrast study showed a tight proximal ureteric stricture (white arrow) caused by thermal injury during image guided renal cryoablation.

ureteric stent change and had underwent three further renal CRYO in the right kidney. Over a period of nine years, her renal function stabilized at eGFR of 38 mL/min/1.73m^2 despite the multiple treatments for de novo RCCs and managed to remain free of renal dialysis for a period of 17 years since the first image guided renal ablation.

Discussion

Management options for RCC in VHL patients include active surveillance and surgery, with ablative therapies as alternative options, particularly in patients who are not suitable for surgery [18]. Partial nephrectomy was not considered appropriate in treating this patient's tumour due to its size and location and the patient's previous complex surgical history to the kidney. RFA specifically has been long established to be a safe and effective treatment for small RCCs [17]. However, ureteric strictures have been reported in 1-2% of RFA procedures [19–21] and are also related to PN [22]. Our patient was considered for CRYO due to the location of her de novo tumour and that CRYO allowed ice ball visualization. CRYO has high treatment efficacy [23] and a case series have observed no ureteric strictures even when ice ball involved the ureter [24]. From our study, however, it is evident that care should still be taken to prevent ice ball involvement of the ureter if possible as the ureter can still be susceptible to thermal damage. Retrograde pyelo-perfusion is a technique commonly used during RFA to minimize the risk of ureteric injury [16] and has been shown to provide protection also in CYRO [25, 26].

Other safety techniques include changing body position, hydrodissection and electrode torqueing [27]. More recently a 'pushing-guidewire technique' [28] was also suggested to efficiently increase the distance of the ureter from the targeted tumour. In the recent years, non-thermal technology with irreversible electroporation (IRE) has been advocated to minimise the thermal injury to ureter [30], however, in authors' experience IRE can also lead to ureteric injury if attention has not been made to protect the ureter as described previously [29]. The best prevention, in the authors' beliefs, is avoidance. The ice ball in this case has completely encase the ureter, which should be entirely prevented. The authors believe the difficulty was that CT-guidance is not real time. Thus, by the time the image guidance showed the ice ball, it was beyond preventable. Despite needing long-term stenting to manage this complication from CRYO, the patient was able to be independent from dialysis while maintaining a stable eGFR. All interventional radiologists should take care in planning image guided renal CRYO to avoid this possible complication. In the future, artificial intelligence in navigation-assisted or robotic-assisted technologies with trajectory planning, coupled with augmented reality during needle insertion will have great potential in aiding interventional procedures to better precision and hopefully translating in less treatment complication.

Conclusion

This case highlights the risk of ureteric injury caused by the thermal effect of the ice ball during image guided renal CRYO. Therefore, it is vital that all interventional radiologists be vigilant during treatment planning and adopt various manoeuvres to protect the ureter from the ice ball during CRYO in order to avoid the development of latent ureteric stricture.

Author Contribution

The authors made the following contributions to this study: guarantor of integrity of entire study: T.M. Wah; literature search: H. Ng, V. Chan, T.M. Wah; case acquisition: T.M. Wah; manuscript preparation and editing: H. Ng, V. Chan, T.M. Wah; and manuscript review: all authors.

Ethical Approval

No ethical approval was required as the study was not classified as research under the United Kingdom National Health Service Health Research Authority.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Consent for publication

Consent for publication was obtained for every individual person's data included in the study.

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