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Percutaneous cryoablation for stage T1b renal cell carcinoma in a patient with horseshoe kidney

Kanichiro Shimizu MD[a,], Hisayo Furube MD[a], Kenkichi Michimoto MD[a], Takafumi Yanagisawa MD[b], Jun Miki MD[b], Koichi Kishimoto MD[b], Shunichi Sadaoka MD[a]*

[a] *Department of Radiology, The Jikei University School of Medicine, Kashiwa Hospital, 163-1 Kashiwa-shita Kashiwa-shi, Chiba 277-8567, Japan*

[b] *Department of Urology, The Jikei University School of Medicine, Kashiwa Hospital, Chiba, Japan*

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ABSTRACT

We report the first case of percutaneous cryoablation (PCA) for stage T1b renal cell carcinoma (RCC) in a horseshoe kidney (HK). A 76-year-old man with an HK underwent computed tomography-guided PCA for RCC measuring 42 mm (stage T1b) in diameter. Although transcatheter embolization before the PCA and hydrodissection were required to avoid complication and incomplete ablation, PCA was successfully performed without complication. The complete ablation was confirmed on computed tomography images 1 month after the procedure. There was no recurrence or metastasis during 2 years of follow-up. We believe this is the first report of PCA for stage T1b RCC in a patient with HK. This technique can be performed without regard to tumor size and location and may be considered as a treatment option to avoid complex surgery.

Introduction

Horseshoe kidney (HK), the most common anomaly of renal fusion, occurs in 1 in 400-1000 individuals [1]. Patients with HK bear the same risk of renal cell carcinoma (RCC) as the general population. One report attributed complications after surgical treatment for tumor in kidneys with fusion anomalies to renovascular anomalies [2]. We report a case of RCC in a patient with HK treated with percutaneous cryoablation (PCA).

Case report

A 76-year-old man with HK was referred to our institution for the treatment of the RCC measuring 42 mm (stage T1b) in diameter. Contrast-enhanced computed tomography (CT) revealed a strong enhancing tumor in the right side of the isthmus, adjacent to the inferior vena cava (IVC), the ascending colon, and the iliopsoas muscle (Fig. 1). The patient could not undergo general anesthesia because of chronic obstructive pulmonary

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* *Corresponding author.*
E-mail address: shimikan@jikei.ac.jp (K. Shimizu).

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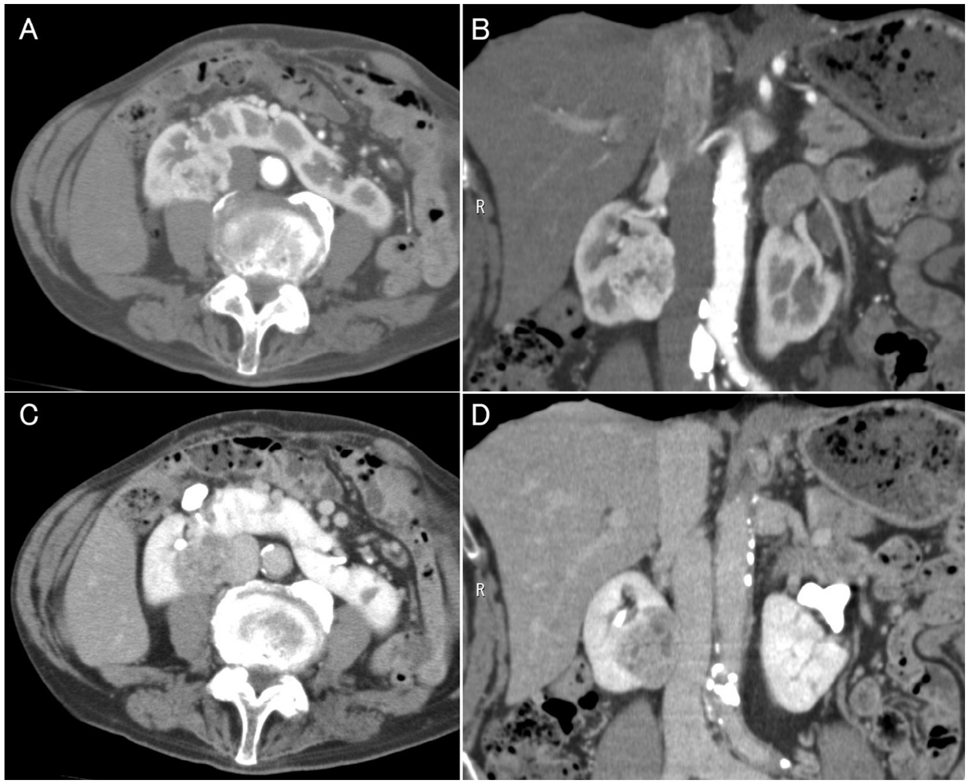

Fig. 1 – Multiphase contrast-enhanced computed tomography revealed a strongly enhancing tumor of 42 mm diameter in the right side of the isthmus of a horseshoe kidney. (A) Axial image of arterial phase. (B) Coronal image of arterial phase. (C) Axial image of delayed phase. (D) Coronal image of delayed phase.

disease that required home oxygen therapy, so CT-guided PCA was planned.

Three days before the PCA procedure, we performed transcatheter arterial embolization (TAE) of the RCC. Aortography obtained using a 5-French (Fr) pigtail catheter revealed right and left renal arteries and 2 accessory vessels to the isthmus branching from the aorta (Fig. 2A). Selective angiograms of each artery suggested that a single renal artery and accessory vessel supplied the RCC (Fig. 2B,C). A 2.5Fr microcatheter was inserted as distally as possible into these arteries, and the RCC was selectively embolized using a mixture of 5 parts of absolute ethanol (Fuso Pharmaceutical Industries, Ltd, Osaka, Japan) and 2 parts of iodized oil (Lipiodol, Laboratoires André Guerbet, Aulnay-sous-Bois, France).

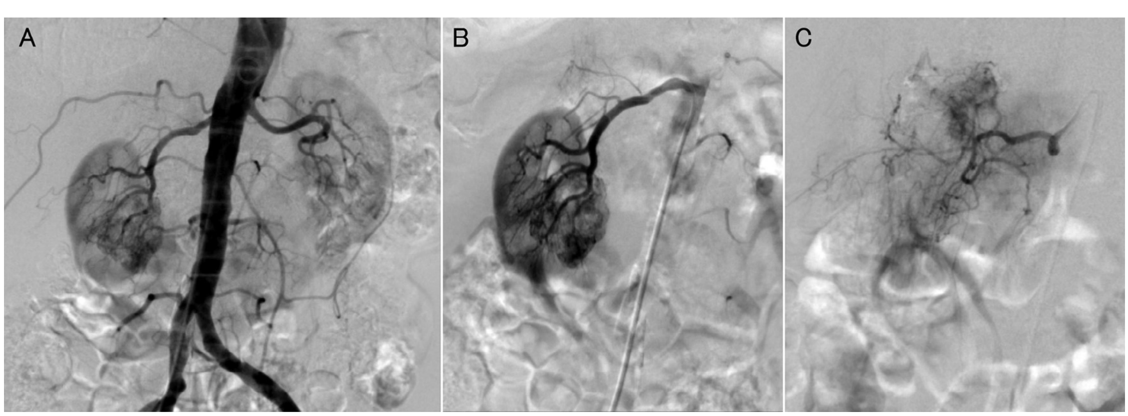

Fig. 2 – Transcatheter arterial embolization before percutaneous cryoablation. (A) Aortogram obtained using a 5Fr pigtail catheter showed right and left renal arteries and 2 accessory vessels to the isthmus branching from the aorta. (B) Selective angiography of the right renal artery revealed tumor stain in the lower pole. (C) Selective angiography of the accessory vessel to the isthmus also revealed tumor stain. This artery supplied blood to part of the tumor. A microcatheter was inserted as distally as possible into these arteries, and the tumor was selectively embolized.

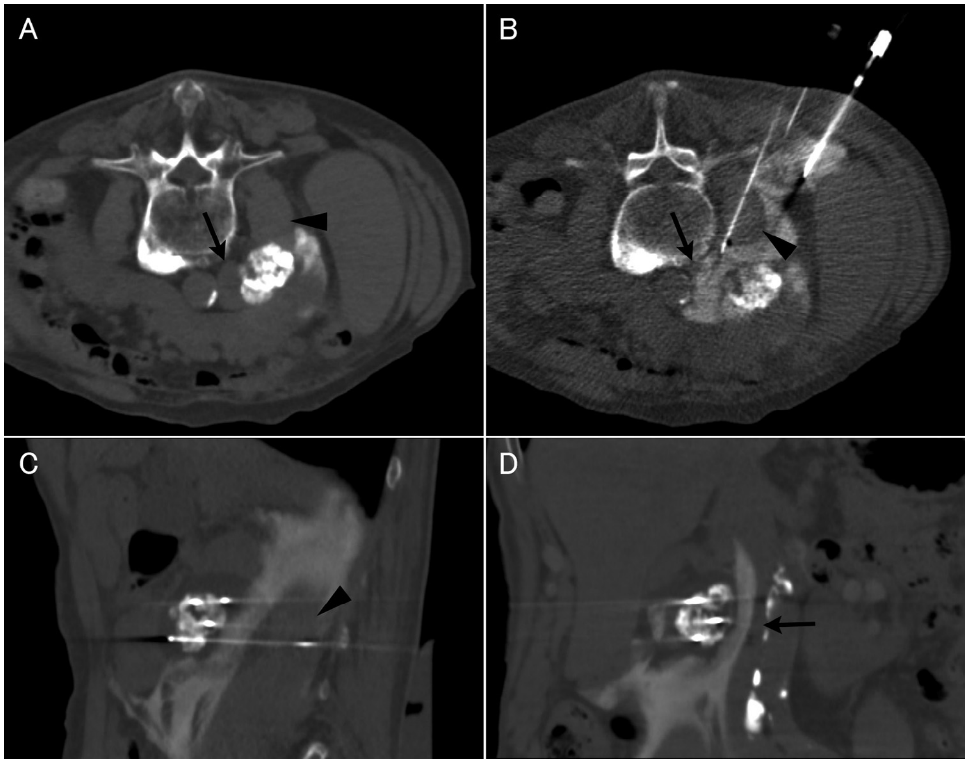

Fig. 3 – Percutaneous cryoablation under computed tomography (CT) guidance. (A) The patient was placed on the CT table in prone position. (B) Eighteen-gauge coaxial needles were punctured between the tumor and the inferior vena cava (IVC) (arrow) and between the tumor and the ascending colon. The IVC and iliopsoas muscle (arrowhead) were isolated from the tumor by hydrodissection. Cryoablation performed using 4 cryoneedles. (C) Sagittal image. (D) Coronal image. The ice ball, revealed as an area of low density, covered the entire tumor with several millimeters of safe margin.

For the cryoablation procedure, the patient was placed on the CT table in prone position. The accumulation of iodized oil on preprocedural unenhanced CT clearly depicted the distribution of the tumor (Fig. 3A), and these images were used to plan the puncture route. We first performed hydrodissection, injecting several milliliters of contrast medium diluted with 50 parts of saline solution through two 18-gauge coaxial needles [3]: one needle was placed percutaneously between the tumor and the IVC to avoid heat effect from the IVC and the second needle was placed between the tumor and the ascending colon to avoid injury to the adjacent iliopsoas muscle and ascending colon (Fig. 3B).

PCA was performed using a cryoablation system (CryoHit, Galil Medical, Yokneam, Israel) and 17-gauge cryoneedles IceRod (Galil Medical). Four cryoneedles were punctured—3 using a transhepatic approach and 1 percutaneously—to target the accumulation of iodized oil in the RCC. The ablation protocol consisted of a cycle of 15-minute freeze, 5-minute thaw, and 15-minute refreeze. CT imaging during the procedure confirmed that the ice ball covered the entire tumor with several millimeters of safe margin (Fig. 3C,D). We observed no ice ball involvement of adjacent organs, and there was no complication.

Contrast-enhanced CT images obtained 1 month after the procedure showed no enhancing effect, which confirmed the complete ablation of the RCC. No recurrence or distant metastasis was observed during the 2 years of follow-up.

Discussion

HK occurs in 1 of 400–1000 individuals and is apparent in approximately half of cases of renal fusion [1]. Although kidneys with fusion anomalies have a higher risk of transitional cell carcinoma and Wilms tumor because of urinary stasis or embryopathogenic mechanisms, the risk of RCC is the same in these cases as for the general population [1].

Although open hemi- or partial nephrectomy is the most common treatment for renal tumors, Mano et al. reported postsurgical complications related to renovascular anomalies in patients with renal fusion [2]. Several authors have described the excision of tumors relatively smaller than that of our patient by laparoscopic partial nephrectomy [4], and Husillos-Alonso et al. recently reported successful radiofrequency ablation of RCC in the isthmus of an HK [5]. Atwell et al. described 1 or 2 cases of HK among more than 90 patients undergoing PCA for renal tumors [6], and Chen et al. described PCAs for RCCs in more than 100 patients without detailing cases of HK [7].

Two-thirds of renal tumors arise from the isthmus of the HK [1]. The location of our patient's tumor near the isthmus limited the puncture root, increased the risk of injury to organs surrounding the tumor, and required the use of techniques to ensure safe puncture and avoid complications.

TAE can reduce hemorrhagic complication, and we successfully performed selective TAE before the PCA. Various renovascular anomalies have been reported in most cases with renal fusion anomalies [8]. Each side of our patient's fused kidney had both a right and left renal artery, and 2 accessory vessels led to the isthmus. Each artery was catheterized without difficulty. We concluded that 1 renal artery and 1 accessory vessel supplied blood to the RCC. Michimoto et al. reported that the use of TAE with ethanol and iodized oil permitted visualization of an endophytic tumor with a safe margin for ice ball formation on unenhanced CT [9]. Using a mixture of 5 parts of absolute ethanol and 2 parts of iodized oil, we could visualize and safely puncture our patient's large and hypervascular tumor. The selective accumulation of iodized oil showed a distinct focal metallic density surrounded by the soft tissue density of the normal renal parenchyma and adjacent organs. Cryoneedles were safely punctured to target the accumulated oil despite the tumor's endophytic location in the renal parenchyma and surrounded by critical organs. Ice ball formation was also clearly visualized during the procedure because of the high contrast ratio between the ice ball, showing an area of low density, and the accumulated iodized oil, demonstrating an area of metallic density.

Hydrodissection has been used to avoid injury to adjacent organs. Campbell et al. recommended a ratio of 1 part of contrast medium to 50 parts of saline solution as an optimal balance to increase contrast between the fluid and surrounding tissues with minimal beam-hardening artifacts [3]. The method allowed us to avoid heat effect from the IVC and injury to the ascending colon and iliopsoas muscle.

PCA for stage T1a or T1b RCC has demonstrated a high local control rate [10]. This technique allows clear visualization of the ablated area to avoid incomplete ablation and injury of adjacent organs [9]. Combined with TAE and hydrodissection to prevent complications, PCA was a safe and feasible treatment for stage T1b RCC in the HK of our patient. Although the procedure required a large number of cryoneedles, we achieved complete ablation without complication.

A rare condition of T1b RCC in HK was successfully treated with PCA. This technique can be performed without regard to tumor size and location and may be considered as a treatment option to avoid complex surgery.

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