Received: 19 July 2020 | Revised: 12 November 2020 | Accepted: 17 December 2020

DOI: 10.1002/ccr3.3745

CASE REPORT

Clinical Case Reports Open Access WILEY

Adrenal pheochromocytoma treated by combination of adrenal arterial embolization and radiofrequency ablation

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Abstract

Combined therapy with adrenal arterial embolization and RF ablation may represent a useful therapeutic option with curative properties in select patients with pheochromocytoma.

KEYWORDS

adrenal pheochromocytoma, arterial embolization, radiofrequency ablation, von Hippel-Lindau disease

1 | INTRODUCTION

A 40-year-old woman underwent percutaneous radiofrequency ablation (RFA) after adrenal arterial embolization to treat a growing adrenal pheochromocytoma measuring 2.8 cm. Although blood pressure rapidly surged during RFA, immediate administration of antihypertensive drugs subsided hypertension. The postoperative course was uneventful, and tumor enhancement disappeared along with normalization of blood pressure.

Pheochromocytoma is a rare tumor originating from the adrenal medulla or paraganglia, with an incidence of 1-2 cases per one million people.[1] This pathology causes various symptoms, including high blood pressure, headache, palpitations, excessive sweating, facial pallor, tremor, nausea, constipation, weight loss, and angina-like chest pain. The disease is progressive and is associated with malignancy in about 10% of cases. Although adrenalectomy is the gold standard of treatment, comorbid diseases sometimes limit the indications for surgery. Radiofrequency (RF) ablation is a useful therapeutic modality to treat both functional and malignant adrenal tumors.[2-4] However, few reports have described RF ablation to treat pheochromocytoma. We report herein a case of adrenal pheochromocytoma treated using a combination of adrenal arterial embolization and RF ablation.

2 | CASE REPORT

A 40-year-old woman with von Hippel-Lindau disease presented to our hospital for treatment of a right adrenal tumor which had enlarged over time. Contrast-enhanced CT showed a hypervascular tumor measuring 2.8 cm in maximum diameter in the right adrenal gland (Figure 1A,B). 3D image shows left superior adrenal artery and left middle adrenal artery are the feeding vessels clearly (Figure 1C). Subsequent

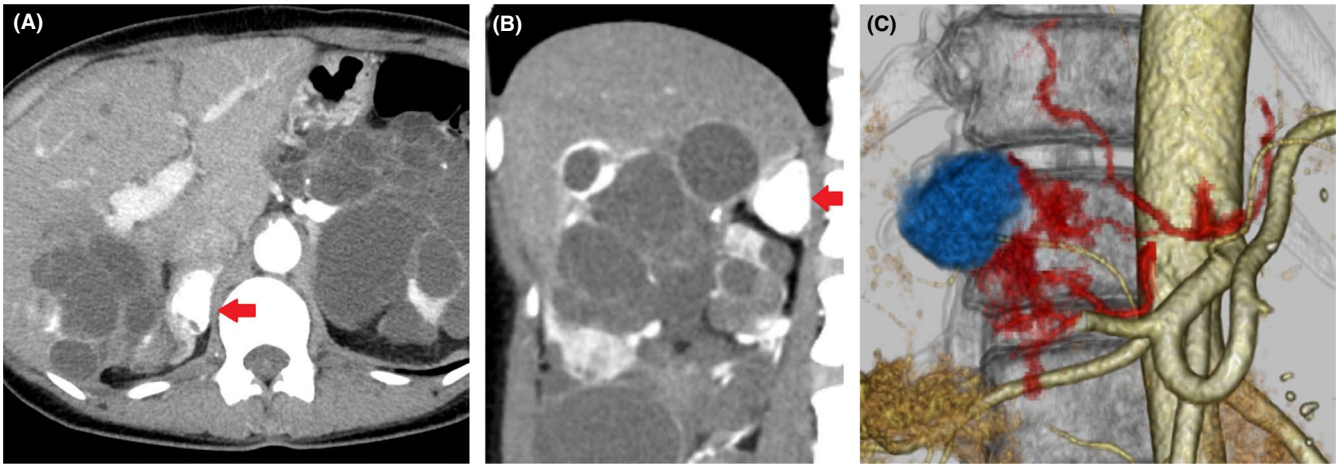

FIGURE 1 A, Contrast-enhanced CT early phase axial image. B, Contrast-enhanced CT early phase coronal image. C, Contrast-enhanced CT early phase 3D image. Axial contrast-enhanced CT demonstrates a well-enhanced mass (arrow) measuring 2.8 cm in maximum diameter in the right adrenal gland (A). No obvious invasion to the surroundings is observed even in the coronal image (B). 3D image shows left superior adrenal artery and left middle adrenal artery are the feeding vessels (C)

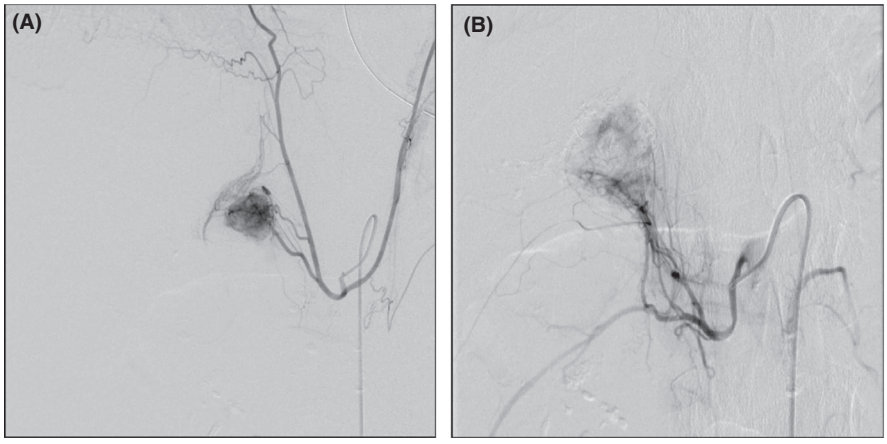

FIGURE 2 A, Lt. inferior phrenic artery angiography. B, Lt. middle adrenal artery angiography. Two adrenal arteries are embolized with iodized oil injection followed by gelatin sponge. The superior adrenal artery is seen arising from the right inferior phrenic artery (A), and the middle adrenal artery from the aorta (B); they are same as the 3D CT images

^{123}I-metaiodobenzylguanidine (MIBG) scintigraphy showed dense accumulation of MIBG in the tumor, suggesting pheochromocytoma.

The patient had developed hypertension 2 years earlier and had since been taking two kinds of antihypertensives, including an α-blocker. On admission, blood pressure was 132/74 mm Hg with a heart rate of 78 beats/min. She also complained of constant headache. Blood and laboratory tests were normal except for mild renal dysfunction (serum creatinine, 1.01 mg/dL; estimated glomerular filtration rate, 48 mL/min/1.73 m^2).

Surgical intervention was abandoned because multiple right renal cysts and pancreatic cysts made it difficult to approach to the right adrenal gland, and she had a history of adhesive ileus after surgery of right renal cell carcinoma (Figure 1A,B).

To strengthen antitumor effects and prevent hemorrhage, RF ablation was planned for immediately after adrenal arterial embolization.

After general anesthesia was induced with the patient in a supine position, adrenal arteriography was performed. The superior and middle adrenal arteries arose from the right inferior phrenic artery and aorta, and both arteries fed the adrenal tumor (Figure 2A,B). A coaxial 1.7-F microcatheter (Progreat λ; Terumo) was selectively inserted into each artery, and arterial embolization was performed by injecting iodized oil (Lipiodol®; Guerbet Japan KK) with a total dose of 3.0 mL followed by gelatin sponge (Gelpart; Nippon Kayaku). The patient tolerated embolization, and no adverse effects such as hypertension were observed.

After adrenal embolization, we changed the patient's position from supine to prone, just after we removed the catheter. However, 4Fr. vascular sheath was left in place in the right femoral artery. And CT images were acquired, demonstrating a dense accumulation of iodized oil in the adrenal tumor. Two 17-G internally cooled RF electrodes (Cool-tip RF Ablation System; Medtronic) with an exposed tip of 3 cm were simultaneously placed inside and outside the tumor

under real-time CT fluoroscopy (Figure 3). Both RF electrodes were connected to a generator and switching controller (Cool-tip Switching Controller; Medtronic), and RF energy was applied using an impedance-switching algorithm. The power of each RF electrode was automatically switched from one electrode to the next. RF energy application continued until impedance at each site had increased to 30 Ω above the baseline. RF ablation was performed from the caudal side of the tumor first, followed by cranial side. Consequently, RF electrodes were placed at 4 different points in the tumor. In order to avoid the heat-sink effect, we placed RF electrodes close to the IVC.

Blood pressure was monitored in real time by arterial line via the radial artery. Rapid surges in blood pressure (>155 mm Hg) following rapid increases in heart rate were observed 3 times during RF ablation. On each occasion, the application of RF energy was suspended and a calcium blocker (nicardipine hydrochloride, Nicardipine; Sawai Pharmaceutical), α-blocker (phentolamine mesylate, Regitine; Novartis Japan), and short-acting β1 blocker (landiolol hydrochloride, Onoact; Ono Pharmaceutical, Osaka, Japan) were used to control blood pressure. After the spikes in blood pressure subsided, RF ablation was resumed.

Immediately after adrenal RF ablation, biopsy was performed under real-time CT fluoroscopy, leading to a histological diagnosis of pheochromocytoma.

The postablation course was uneventful, except for self-limited fever of 38.1°C the next day. Adrenal scintigraphy acquired 4 months after adrenal RF ablation showed no accumulation of MIBG in the right adrenal region. Contrast-enhanced magnetic resonance Imaging (MRI) showed disappearance of tumor enhancement after RF ablation and a reduction in size (Figure 4). Maximum tumor diameter had decreased from 2.8 cm to 2.3 cm by 6 months after RF ablation. Both headache and hypertension subsided without taking medicine.

We will follow up every 6 months because she has a few small renal cell carcinoma in both kidney.

3 | DISCUSSION

Radiofrequency ablation is well known to be useful in removing both benign and malignant tumors, and is used for the treatment of both functioning adrenal adenoma and adrenal metastasis.[2-8] Although some studies have used RF ablation to treat functioning adrenal adenoma such as primary aldosteronism and Cushing's syndrome, few reports have described the clinical utility of RF ablation in the treatment of pheochromocytoma. Mayo-Smith et al performed RF ablation for pheochromocytoma in a patient under local anesthesia and reported good therapeutic results with no episodes of hypertension. Self-limited dyspnea developed in the patient just after RF ablation.[3]

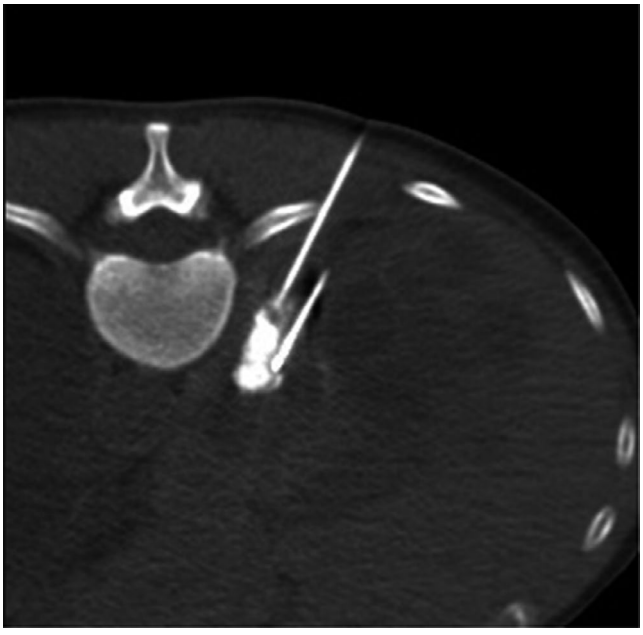

FIGURE 3 CT fluoroscopy axial image during RFA. Adrenal radiofrequency ablation was performed immediately after adrenal arterial embolization. Iodized oil is seen to have accumulated in the adrenal gland tumor. RF ablation is performed using two RF electrodes

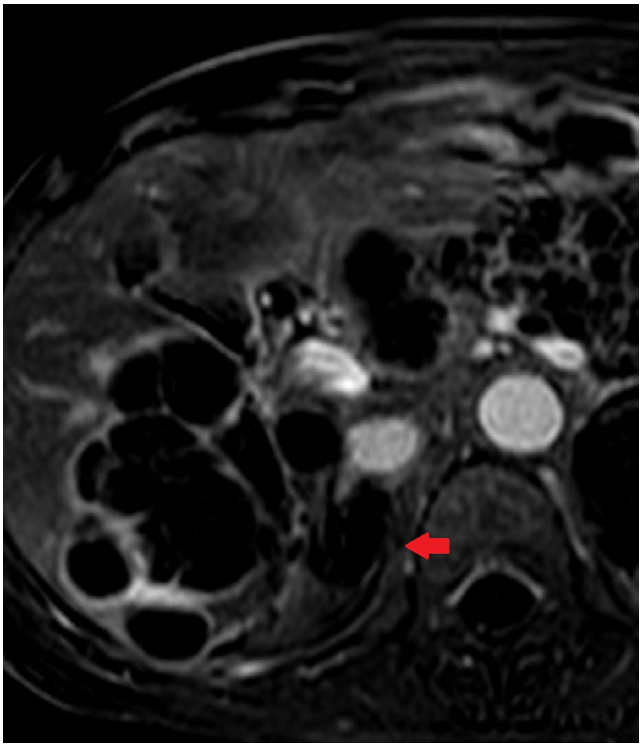

FIGURE 4 Contrast-enhanced MRI axial image. Axial contrast-enhanced MRI acquired 6 months after combination therapy shows an absence of enhancement in the region of the adrenal tumor (arrow). Tumor size has decreased to 2.3 cm in maximum diameter

We also showed the possibility that RF ablation can be a useful therapeutic option for treating pheochromocytoma in nonsurgical candidates. The shortage of reports featuring RF ablation of pheochromocytoma may be attributable to the possible risk of hypertensive crisis. Hypertensive crisis is one of the most serious adverse events when performing adrenal RF ablation.[3,9] This event occurs during adrenal RF ablation in two-thirds (67%) of patients with functioning adenoma other than pheochromocytoma and adrenal metastasis.[9] Catecholamine release from normal adrenal gland tissue is the cause of hypertensive crisis.[8-10] Use of α- and β1-blockers and calcium blockers helps to subside hypertension.[6,9] Pheochromocytoma itself releases catecholamines, and RF ablation may cause uncontrollable hypertensive crisis. To monitor real-time blood pressure and allow easier control of blood pressure, we performed adrenal RF ablation under general anesthesia. We immediately suspended RF energy application when blood pressure rose, and administered antihypertensive drugs. After hypertension subsided, we resumed adrenal RF ablation. We repeated these procedures and successfully achieved complete tumor ablation without major complications. We combined adrenal embolization immediately before RF ablation. Combined use of arterial embolization and RF ablation is useful in reinforcing antitumor effects and preventing hemorrhage.[6] Given that pheochromocytoma is a hypervascular tumor, combination use of embolization is considered reasonable. Combined use of adrenal arterial embolization before adrenal RF ablation may suppress catecholamine release from both tumor and normal adrenal gland.

Therapy using ^{131}I-MIGB therapy is another method of treating unresectable malignant pheochromocytoma.[11] Kotecka-Blicharz et al treated advanced malignant pheochromocytoma and paraganglioma tumors using ^{131}I-MIBG therapy, and reported a partial response rate of 6%, a stable disease rate of 72%, and a progressive disease rate of 11%. They concluded that ^{131}I-MIBG therapy has palliative properties.[12]

Although accumulation of more cases is required to confirm the safety and clinical utility of combined therapy with adrenal arterial embolization and RF ablation, this combined treatment may represent a useful therapeutic option with curative properties in select patients with pheochromocytoma.

ACKNOWLEDGMENTS

We would like to thank the following doctors for their cooperation. Hirokuni Akahori (Department of Internal Medicine, Cardiovascular Division and Division of Coronary Heart Disease), Manabu Kadoya (Department of Internal Medicine, Division of Diabetes, Endocrinology and Clinical Immunology), Akihiro Kanematsu (Department of Urology), Masaharu Ishihara (Department of Internal Medicine, Cardiovascular Division and Division of Coronary Heart Disease), Hidenori Koyama (Department of Internal Medicine, Division of Diabetes, Endocrinology and Clinical Immunology), Munetaka Hirose (Department of Anesthesiology and Pain Medicine).

CONFLICT OF INTEREST

The authors declare no conflicts of interest associated with this manuscript.

AUTHOR CONTRIBUTIONS

YK: involved in formal analysis, investigated the study, designed methodology, administered the project, visualized the data, and reviewed and edited the manuscript. RU: involved in data curation and supervised the study. SY: designed methodology, administered the project, and supervised the study. YA and OY: investigated the study. KY: conceptualized the study, acquired funding, designed methodology, supervised the study, administered the project, visualized the data, and reviewed and edited the manuscript.

INFORMED CONSENT

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

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How to cite this article: Kako Y, Ueki R, Yamamoto S, et al. Adrenal pheochromocytoma treated by combination of adrenal arterial embolization and radiofrequency ablation. *Clin Case Rep*. 2021;9:1261–1265. https://doi.org/10.1002/ccr3.3745