CASE REPORT

Percutaneous ablation of functioning adenoma in a patient with a single adrenal gland

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SUMMARY

The conventional treatment of functioning adrenal adenomas is laparoscopic resection. Since the 1990s, radiofrequency ablation has been increasingly applied to the treatment of tumours of the liver, lungs and musculoskeletal system. However, the use of radiofrequency ablation to treat adrenal nodules is still an uncommon procedure, particularly in aldosterone-producing adenomas. We report the case of a 35-year-old male patient with resistant hypertension, hypokalaemia and aldosterone-producing adenoma in a single adrenal gland. The patient underwent CT-guided percutaneous radiofrequency ablation. Clinical, laboratory and MRI follow-up data indicated excellent response to treatment. This case report is the first in the literature to describe the use of CT-guided percutaneous radiofrequency ablation in the treatment of a functioning adrenal adenoma in a patient with a single adrenal gland.

BACKGROUND

This paper is the first in the literature to describe the use of CT-guided percutaneous radiofrequency ablation (RFA) in the treatment of a functioning adrenal adenoma in a patient with a single adrenal gland.

CASE PRESENTATION

In 2009 a 35-year-old male patient presented to our medical centre with a 10-month history of pain and weakness in the lower limbs. The patient was found to have severe hypokalaemia ($K=1.8$ mEq/L), and the fluid and electrolyte imbalance was corrected with improvement of complaints.

The patient had been diagnosed with systemic hypertension 2 years earlier, which was poorly controlled despite use of four antihypertensive agents. He had a family history of systemic hypertension.

Primary hyperaldosteronism was suspected, and specific laboratory tests (plasma renin activity (PRA) and serum aldosterone) indicated a state of mineralocorticoid excess. A CT scan of the abdomen revealed nodules in both adrenal glands, a myelolipoma of 3.0 cm in the left gland and an adenoma of 2.2 cm in the right gland. Treatment was initiated with spironolactone with improvement in blood pressure (BP).

The patient inadvertently underwent laparoscopic left adrenalectomy in a different hospital. Anatomopathological examination confirmed the diagnosis of myelolipoma (figure 1A). Follow-up examinations showed no clinical or laboratory

improvement. Thus, it was concluded that the functioning nodule was the adenoma located in the right adrenal gland (figure 1B).

In 2010 the patient again presented to the outpatient clinic of our institution with the same initial complaints and systemic hypertension (due to discontinuation of antihypertensive agents). At that time, the patient was using spironolactone (100 mg), amlodipine (5 mg), valsartan (160 mg), hydrochlorothiazide (12.5 mg) and potassium chloride. Physical examination revealed BP of 150/100 mm Hg, heart rate of 80 bpm without postural hypotension and body mass index (BMI) of 31. No other abnormalities were detected. The laboratory findings excluded overproduction of catecholamine, androgen or cortisol. The saline infusion test confirmed the diagnosis of primary hyperaldosteronism.

CT-guided percutaneous RFA was then suggested as a treatment option. Before the procedure, measurements of aldosterone (113 ng/dL), PRA (1.2 ng/mL/h) and aldosterone/renin activity ratio (ARR) (94.16) confirmed persistent aldosterone overproduction.

A previous CT scan was used for procedure planning, when we decided on the best strategy to be adopted, the shortest route to the lesion and the safest needle path, that is, avoiding important organs/structures in the abdominal cavity, in our case, the hepatic angle of the colon and the gallbladder. The procedure was performed with the patient under general anaesthesia and in the supine left posterior oblique (LPO) position (figure 2). The multitined expandable electrode with continuous temperature feedback was placed at a distance of approximately 2.0 cm from the centre of the lesion. A single RFA needle with a 2 cm active tip (StarBurst electrodes; RITA Medical Systems, Mountain View, California, USA) was introduced, and the tip was advanced gradually into the centre of the target lesion under real-time CT guidance. An electrical circuit was thus established between the needle tip, the two grounding pads attached to the skin and the radiofrequency generator (Model 1500X; RITA Medical Systems). One cycle of 10 min was performed. The mean effective temperature for RFA of adrenal adenoma is around 100°C. Immediately after ablation, contrast-enhanced CT scans were obtained, which confirmed treatment success and ruled out any immediate complications. Control MRI showed adequate necrosis of the nodule and preservation of the remaining glandular parenchyma (figure 3).

The patient had a good clinical response with normalisation of BP (mean BP, 12/8 mm Hg—home

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Figure 1 Non-contrast-enhanced CT scan showing (A) metal clips in the left renal area after adrenalectomy for myelolipoma and (B) adenoma in the right adrenal gland.

monitoring), absence of pain and weakness in the lower limbs, and return to normal activities within 2 weeks. There was a reduction in antihypertensive medication use from four to two classes. Laboratory findings were as follows: aldosterone 421 ng/dl; PRA 10 ng/ml/h and ARR 4.2.

INVESTIGATIONS

The prevalence of aldosterone-producing adenoma (APA) in patients with hypertension with incidentalomas is estimated at 1.6% to 5%.¹ The clinical suspicion of APA in young patients with hypertension involves the presence of resistant hypertension (use of more than three antihypertensive agents), hypokalaemia or family history of APA.

The process of diagnosis is performed in three stages, as follows: (1) screening—measurement of serum aldosterone and PRA, with ARR greater than 27; (2) confirmation—saline infusion test or sodium overload showing an autonomous adenoma; and (3) measures of aetiological distinction between hyperplasia and adenoma.² Imaging examination (CT or MRI) provides complementary information and may show the lesion responsible for hormone overproduction.

However, when imaging findings are negative or inconclusive in patients with unequivocal biochemical evidence of APA, selective venous catheterisation must be performed with collection of adrenal effluent blood samples for measurement of

aldosterone and cortisol levels.³ Although adrenal venous sampling may be technically difficult, especially in the catheterisation of the right adrenal gland, in skilled hands it is possible to detect lateralisation of aldosterone secretion, which should be at least 10 times greater than that of the suppressed contralateral adrenal gland.²

Laparoscopic resection is an established treatment for benign adrenal lesions, as drug therapy alone is ineffective in cases of functioning adenoma.⁴ Complication rates range from 3.2% to 20% and include haemorrhage, damage to adjacent organs and/or structures, surgical wound infection and cardiac complications (postoperative myocardial infarction and/or angina).^{4,5}

Less invasive treatment options, such as selective arterial embolisation and ethanol injection, have been described,^{6,7} but without proven efficacy. Percutaneous RFA and cryoablation have been evaluated as new treatment modalities for both benign and malignant adrenal nodules.^{8–10} These treatment options have been associated with only minor complications, with pneumothorax and retroperitoneal haematoma reported as the most common complications.¹¹ There is only one report in the literature of a case of major complication using cryoablation.⁹ It was a postoperative pleural effusion with delayed-onset pneumonia requiring hospitalisation. As for RFA, there are no reports of major complications.^{8,10}

To date, there have been no reports in the literature using CT-guided percutaneous RFA in the treatment of functioning adrenal nodules in patients with a single adrenal gland.

Figure 2 CT-guided radiofrequency ablation of right adrenal nodule—the patient in the supine left posterior oblique position, transhepatic access and radiofrequency needle properly positioned within the nodule.

TREATMENT

RFA is safe and extremely accurate. We were able to achieve a (circumscribed) ablation area ranging from 2 cm to 5 cm in diameter while preserving the treated gland or tissue. Studies about the radial heat flow^{12,13} have been conducted. In addition, in the previous studies on RFA of adrenal tumours, there were no reports of adrenal insufficiency after RFA, supporting the hypothesis of preservation of viable adrenal tissue.

Similarly to the use of RFA to treat patients with single adrenal metastasis, its benefits can be extrapolated to cases of bilateral adrenal metastasis because the recurrence rates of adenoma are similar to those achieved with surgical treatment. Long-term studies using this method have not been conducted so far.

RFA can be an alternative choice of treatment when there is any contraindication (such as cardiovascular comorbidities, diabetes mellitus, elderly patients or lung disease) that would prevent the patient from undergoing a surgical treatment. Considering that most patients have functioning adrenal adenoma caused by overproduction of aldosterone, they already have an inherent risk for the underlying pathology to be treated; therefore, the indication of RFA should be extended to all cases of Conn's adenomas.²

Figure 3 Postcontrast axial MR images showing (A) a vascular adenoma (arrow) before radiofrequency ablation (RFA) and (B) complete necrosis of the RFA-treated adenoma.

OUTCOME AND FOLLOW-UP

The patient has been followed-up clinically at six-month intervals. At the time of the last clinical follow-up, the patient was asymptomatic, blood pressure was stable and all laboratory values were within the normal range.

DISCUSSION

RFA is a minimally invasive procedure that has already been applied to the treatment of tumours of the liver, kidney and lungs. There are reports of a few case series using ablation in the treatment of metastatic tumours^{14–17} and benign nodules, such as functioning adenomas (hyperaldosteronism and Cushing's syndrome) and pheochromocytomas.^{11 14 18}

According to previous reports, possible complications associated with RFA of tumours of the adrenal gland include immediate hypertension caused by sudden release of metabolically active hormones, retroperitoneal haematoma, abscess and adrenal insufficiency.^{8 18 19} In the present case, no anaesthesia-related complications or procedure-related complications were observed. This successful outcome suggests that RFA may be a less invasive alternative to surgical intervention in the treatment of functioning adrenal tumours.

Based on improved levels of aldosterone and PRA, associated with symptom remission and partial reduction in hypertension, RFA may be considered an effective method for treating functioning adenomas.

Pandharipande *et al*²⁰ conducted a study evaluating the cost-effectiveness of the treatment of small renal tumours (renal cell carcinoma) using percutaneous RFA versus laparoscopic partial nephrectomy. Based on the complex analytical model, the results clearly showed a significant increase in the costs of surgical treatment compared with ablative treatment.¹¹

No radiofrequency indication has been established in the literature. In a Chinese study,¹¹ the authors found equivalent efficacy among the methods used in the treatment of primary hyperaldosteronism in a comparison between videolaparoscopy versus radiofrequency for the treatment of functioning adenoma.

Based on the studies that have been carried out so far, it is not possible to establish the effect of RFA on the adrenal surface. However, the presence of fatty tissue around the adrenal gland has been evidenced. Such tissue serves as a thermal insulator and protects other structures, thus making the treatment effective. Skin surface is not harmed because the heat is delivered only through the distal end of the needle.

We decided to use RFA in the present study because, in addition to the fact that this treatment is available in our hospital, less invasive treatments, such as selective arterial embolisation and percutaneous ethanol injection, have been described,^{21 22 6} but their efficacy has not been confirmed. Cryoablation is an excellent alternative; however, there was one case of major complication because the patient remained in hospital for 7 days due to severe pneumonia after the procedure.⁹ In addition, when

using cryoablation, it is not possible to control the ablated area in comparison with RFA, and because the adrenal gland is a relatively small gland, this could cause higher rates of complications and damage of organs/adjacent structures.

In the department of Interventional Radiology of the Hospital São Paulo, Universidade Federal de São Paulo (Brazil), studies with radiofrequency of liver and adrenal tumours are being conducted.²³

Learning points

- ▶ Aldosterone-producing adenomas (APAs) have been previously treated with radiofrequency ablation (RFA); however, this is the first report of a patient with a single adrenal gland undergoing this procedure.
- ▶ RFA should be considered as a new treatment option for APA.
- ▶ The treatment of choice is undoubtedly the complete resection of the tumour; however, in patients with a single adrenal gland, RFA should be considered an option as only minor complications have been associated with this procedure.
- ▶ The present case report supports RFA as a safe method for treating functioning adenomas.

Contributors SMG conceived the study and reviewed the radiographic images. DS is the interventional radiologist who performed the ablation procedure. TFN is a abdominal radiologist who contributed to the radiological diagnosis and participated in the interventional procedure. ACWX participated in the laboratory and clinical assessment of the patient.

Competing interests None.

Patient consent Obtained.

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