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Case Report

Second Order Horner Syndrome Concurrent with Brachial Plexus Injury Following Thyroid Radiofrequency Ablation: A Case Report

Thedi Darma Wijaya[1], Kevin Mulya Saputri[2], Denni Joko Purwanto[3]

[1]Department of Emergency EMC Hospital Alam Sutera, thedidarmawijaya@gmail.com
[2]Department of Neurology EMC Hospital Alam Sutera
[3]Department of Oncology Surgery EMC Hospital Alam Sutera

ABSTRACT

Introduction: Radiofrequency ablation (RFA) is a non-invasive, yet effective treatment of thyroid nodule. Complications following procedure is reported below 5%. Here, we report a case of Horner syndrome (HS) concurrent with brachial plexus injury (BPI) following RFA.
Case Report: A 20-year old female underwent the left thyroid US-guided RFA. She complained of dropped left eyelid, left arm weakness, numbness and tingling sensation on left index finger following surgery. On neurological examination; there were left-sided reduced pupil size on dim light (4 mm/2mm), eye ptosis (6 mm palpebral fissure height), face hypohydrosis, arm weakness (3444+), reduced physiological reflexes, and C5-6 hypesthesia. There was prominent edema extending from left thyroid to whole trunk of left brachial plexus as shown on cervical MRI. The patient was given a high dose methylprednisolone and mecobalamin injection for five days. There was notable improvement on the following month - increased left eye palpebral fissure to 8 mm, equal pupil on dim light, increased left arm strength (44+55) and physiological reflexes. Nonetheless, allodynia on the left shoulder and upper arm persisted.
Discussion: Although RFA theoretically produces less power and damage per unit time, it can cause neurological complications. Heat dissipated to surrounding neural tissue including brachial plexus and sympathetic trunk. This patient developed second order HS and BPI due to edema following injury to surrounding middle cervical sympathetic ganglion and brachial plexus. Apt treatment can prevent persistent neurological deficits.
Conclusion: HS and BPI are important neurological complications that should be acknowledged following thyroid RFA.

Keywords: Horner syndrome, Brachial plexus injury, Radiofrequency ablation

INTRODUCTION

Radiofrequency ablation (RFA) is a minimally invasive ablative modality for the treatment of thyroid nodules. Reports of RFA use have demonstrated an impressive safety profile and excellent volume reduction rates between 60–90%.[1] The safety profile of RFA is impressive and superior to other thyroid surgery. The overall risk of complication is reportedly 2–3%. The risk of permanent complication or severe injury is very unlikely, below 1%. Complications are infrequent, but may be nerve-related, endocrine-related, or

iatrogenic-related, and consequences of localized heat delivery.[2]

Horner syndrome manifests in patients who have sustained damage to sympathetic nerves and is a fearful yet rare complication of ultrasound-guided neck procedures. Patients present with a clinical diagnosis of a well-known triad: ptosis, facial anhidrosis, and miosis ipsilateral to the affected side.[3] One study of 746 patients undergoing ultrasound-guided RFA reported only a single case of Horner syndrome, an incidence of 0.13%.[4]

Injury to the brachial plexus is rare following RFA due to its anatomical location deep in the neck. Only one brachial plexus nerve injury following RFA of a thyroid nodule is discussed in the literature. Baek *et al*. present a brachial nerve injury (1/1,459; 0.07%), reporting a patient who displayed symptoms of numbness and decreased sensation in the fourth and fifth fingers of the left hand shortly after ablation therapy.[5] Here, we report a case of Horner syndrome (HS) concurrent with brachial plexus injury (BPI) following RFA.

CASE REPORT

A 20-year-old female presented with left thyroid nodule which was noticed by the patient for one week prior to hospital. There was no history of hypertension, diabetes, or other infectious diseases and allergies. Thyroid ultrasound suggested an enlargement of left thyroid (24×21 x 31 mm), and cystic lesion with minimal solid component and macrocalcifications within the left thyroid gland (TIRADS 3) (Fig.1). The MRI of thyroid with contrast showed a 17×20 x 29 mm solid cystic nodule, well defined with regular form, no extension to extrathyroid (Fig.2). Pre-RFA thyroid function tests showed a thyroid-stimulating hormone level of 0.663 uIU/mL, free T3 of 4.10 pmol/L, free T4 of 17.41 pmol/L, thyroglobulin of 1,460.00 ng/mL, Anti thyroglobulin of 2 IU/mL, and Anti thyroid peroxidase of <3 IU/mL. The results of the other examinations were all normal. The patient was given a principal diagnosis of nontoxic nodular goiter. She underwent the left thyroid ultrasound-guided RFA due to the small volume and benign character of the nodule.

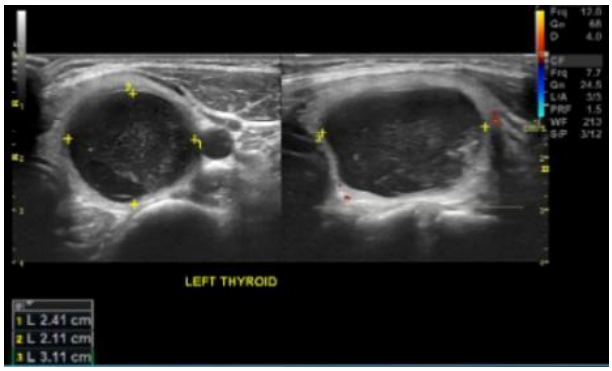

Figure 1. Thyroid ultrasound showed enlargement with cystic lesion of left thyroid.

Considering that local anesthesia would not adequately reduce pain, talking, or coughing during the RFA procedure, lidocaine was injected into the skin puncture site with the assistance of intravenous anesthesia. After confirming the effect of the anesthesia, ultrasound-guided core needle biopsy was performed and showed no malignancy. Next, ethanol was injected within the nodule and ultrasound-guided RFA was performed with the lowest power from the deep to the shallow part of left thyroid nodule. The procedure was completed successfully.

One day after RFA, she complained dropped left eyelid, left arm weakness, numbness and tingling sensation on left index finger. In neurological examination, there were unequal pupil size (4 mm/2mm on dim light), partial ptosis of left eye (palpebral fissure height (PFH) 6 mm) (Fig.3), decreased left upper limb muscle strength (3444+) and physiological reflexes (Biceps +1, Triceps +1), and slight hypohidrosis on left face. The MRI of cervical with contrast showed reduction of left thyroid nodule size (14 x 16 x 16 mm) (Fig.2); with prominent edema around the lesion that extends to left mid neck as high as C4-C5 until left upper clavicle; and left brachial plexus C5-C8 were covered by prominent edema (Fig.4).

The patient was given methylprednisolone 125 mg injection four times a day and mecobalamin 1000 mcg injection three times a day for five consecutive days. She was also consulted for physiotherapy. On day 4, there was improvement on partial ptosis of left eye (PFH 7 mm), but she complained pain and burning sensation on her left palm with hypoesthesia on left C5-C6 dermatomes. Pregabalin 75 mg once daily and amitriptyline 12.5 mg once daily were added to her treatment. On discharge, she was allowed to go home with pregabalin, amitriptyline, mecobalamin, and B-complex vitamins.

One month later, her symptoms were gradually resolved: left PFH become 8 mm, the pupil size was equal (4 mm/4 mm on dim light) (Fig.3), increased left upper limb muscle strength (44+55) and

physiological reflexes (Biceps +2, Triceps +2), increased sense of touch on left upper limb; but there was allodynia on left shoulder and upper arm. The pregabalin dose was increased to 150 mg once daily and her residual symptoms almost completely resolved in the next two months. Follow up of contrast cervical MRI showed no visible nodule on left thyroid (Fig.2); edema was reduced significantly, and hyperintense with thickening on C5 and C7 level of left brachial plexus (Fig.4).

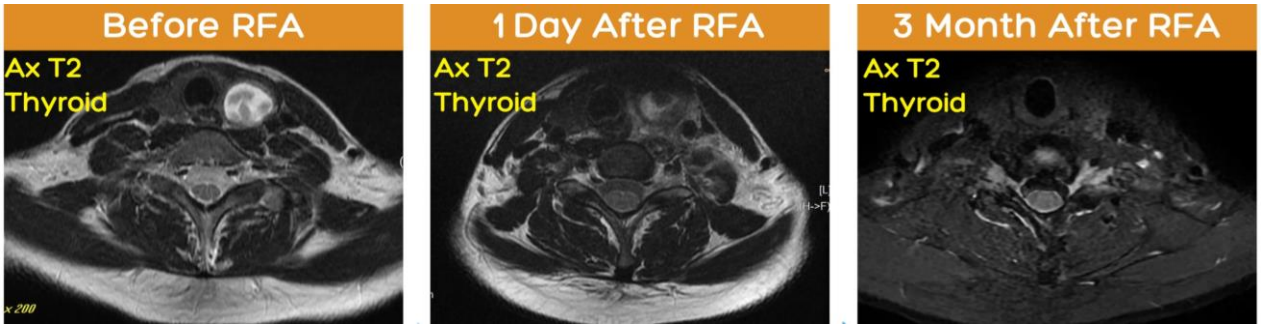

Figure 2. Left thyroid nodule size comparation on MRI. Left: before RFA, size: 17×20 x 29 mm. Middle: 1 day after RFA, size: 14 x 16 x 16 mm. Right: 3 months after RFA, no visible nodule on left thyroid (yellow arrow).

Figure 3. Pupil size on dim light and left partial ptosis comparation. Left: 1 day after RFA, unequal pupil size (4 mm/2mm), PFH 6 mm. Right: 1 month after treatment, equal pupil size (4 mm/4mm), PFH 8 mm.

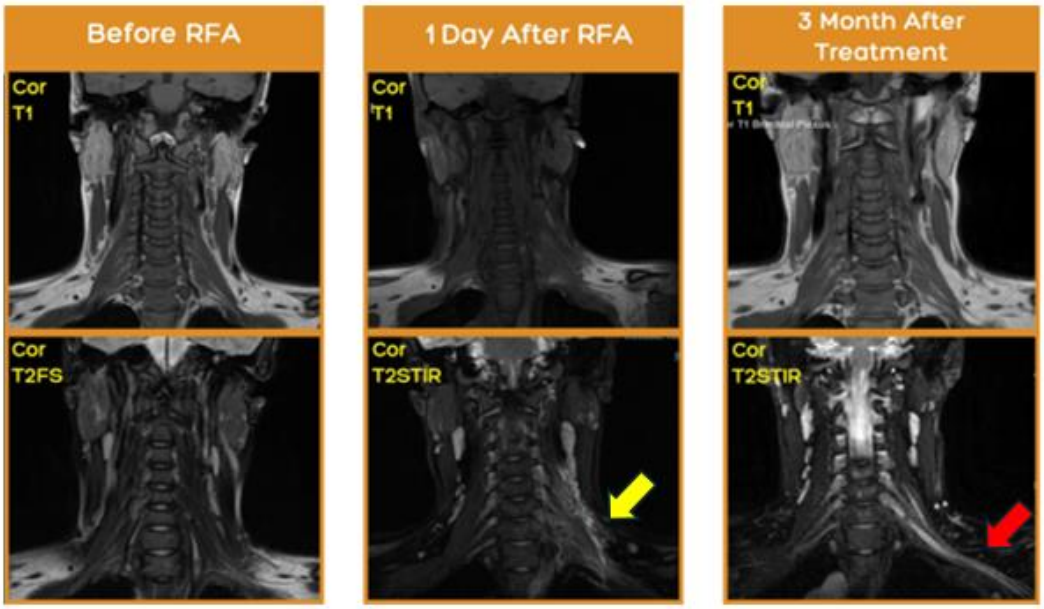

Figure 4. Cervical MRI comparation. Left: before RFA, no lesion or edema on left mid neck. Middle: 1 day after RFA, prominent edema around the lesion that extends to left mid neck and left brachial plexus (yellow arrow). Right: 3 months after treatment, edema was reduced but there was hyperintense on C5 and C7 level of brachial plexus (red arrow).

DISCUSSION

Ultrasound-guided RFA utilizes a percutaneous electrode to deliver a uniform centrifugal zone of thermal energy.[6] RFA uses an electrical current passing through a circuit with focal impedance (target tissue) to generate heat, ultimately to the point of cell death. Heat generates secondary to frictional forces at the ionic level and increases with tissue impedance, increased magnitude of the current, and increased current flow time.[7] RFA has less power and a smaller volume of damage per unit time, allowing the user to adjust the energy according to the patient's reaction at any time.[8] RFA of thyroid nodules is a safe, minimally invasive technique that is efficacious in the treatment of benign thyroid nodules.[7] However, every surgical procedure is associated with risks and even such a minor procedure such as RFA is not an exception, it still can cause complications especially in neurology.

HS is caused by any compression or destruction of the oculosympathetic pathway (OSP), and it can lead to unilateral ptosis, an ipsilateral miotic but normally reactive pupil, and in some cases, ipsilateral facial anhidrosis. It can be classified into 3 types, central (first-order neuron), preganglionic (second-order neuron), and postganglionic (third-order

neuron), depending on the damaged region.[9] Second-order preganglionic neurons exit at the T1 level of the spinal cord to enter the cervical sympathetic chain, where the fibers ascend to synapse in the superior cervical ganglion at the C3-C4 level.[4] The cervical sympathetic trunk is located among the common carotid artery (CCA), the internal carotid artery, the vagus nerve, and the anterior fascia of the vertebra; with superior, middle, and inferior cervical sympathetic ganglion (CSG).[8] The superior CSG is the largest, and is located anterior to the longus capitis muscle at the C2-3 vertebra level; the middle CSG is the smallest, and is located anterior to the longus colli muscle at the C5-7 vertebra level; the inferior CSG is intermediate in size, and is commonly fused with the first thoracic ganglion to form a stellate ganglion at the C7-T1 vertebra level. Because the middle CSG is located at the lower level of the thyroid gland, it can be injured during procedures for thyroid lesions. [10] The middle CSG can be visualized in 41% of ultrasound images, it is usually located lateral to the CCA, but can also be located medial to the CCA.[11] Medial to the CCA, the middle CSG closely adjacent to the thyroid gland, and could be damaged during RF ablation near the lateral margin of benign thyroid nodules. [10, 11]

The brachial plexus is formed by the ventral rami of the lower 4 cervical and first thoracic nerves. They are subsequently located on the surface of the middle scalene and levator scapulae muscles in the posterior cervical triangle. BPI could occur during the RF ablation of benign thyroid nodules. Various symptoms could be developed according to the level of brachial plexus injury. The brachial plexus innervates the skin and muscles of the chest, shoulder, arm and hand, and BPI can cause severe functional problems due to weakness of the muscles. The symptoms and signs may include a paralyzed arm, lack of muscle control in the arm, hand, or wrist, and lack of feeling or sensation.[10]

This patient was diagnosed with second order HS based on the clinical findings: left-sided miosis, eye ptosis, face hypohydrosis; which had occurred following thyroid RFA and caused by middle CSG damage as an OSP structure adjacent to the thyroid. The patient also had left-sided arm weakness (3444+), reduced physiological reflexes, and C5-6 hypesthesia; which were resulted from BPI following thyroid RFA. There were likely

overlapping reasons for HS and BPI in our patient who underwent thyroid RFA. A common factor among conditions resulting from OSP damage (especially on middle CSG) and BPI is post-RFA hematoma and inflammation resulting the edema compression to the associated structures as we can see on the MRI of cervical with contrast after RFA. Perhaps the primary factor was the poor ability to see nerve structures (middle CSG and brachial plexus) during procedure under the guidance of ultrasound. However, the fundamental cause is the high heat generated by the active tip of the electrode in RFA, which is dissipated to surrounding neural tissue including brachial plexus and sympathetic trunk. The nerve is sensitive to heat exposure and the immediate effect of excess heat is the coagulation of intracellular proteins, resulting in cell dysfunction and ultimately cell death.

High dose steroid and mecobalamin injection for consecutive five days were chosen to reduce edema and induce neural recovery. Clinical improvement could be seen on the following three months after treatment. Apart from the emerging complications, significant thyroid nodule volume reduction was achieved at three-month post ablation.

CONCLUSION

HS and BPI are important neurological complications that should be acknowledged following thyroid RFA. Although HS and BPI are rare complications of thyroid RFA, surgeons should be aware of the anatomic relationship of the cervical sympathetic trunk, brachial plexus and thyroid gland with adjacent structures. Using local anesthesia and intraoperative nerve monitoring systems that utilize cutaneous surface electrodes can be considered to prevent RFA complication. We hope by reviewing and reporting these, surgeons are able to take precautionary measures to minimize the possibility of damage.

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TDW analyzed and interpreted the data; KMS, DJP contributed to manuscript editing. All authors read and approved the final manuscript.

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