ISSN 2307-8960 (online)

World Journal of *Clinical Cases*

World J Clin Cases 2022 October 16; 10(29): 10391-10822

Published by Baishideng Publishing Group Inc

World Journal of Clinical Cases

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NAME OF JOURNAL
World Journal of Clinical Cases

ISSN
ISSN 2307-8960 (online)

LAUNCH DATE
April 16, 2013

FREQUENCY
Thrice Monthly

EDITORS-IN-CHIEF
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EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/2307-8960/editorialboard.htm

PUBLICATION DATE
October 16, 2022

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World J Clin Cases 2022 October 16; 10(29): 10755-10762

DOI: 10.12998/wjcc.v10.i29.10755

ISSN 2307-8960 (online)

CASE REPORT

Perithyroidal hemorrhage caused by hydrodissection during radiofrequency ablation for benign thyroid nodules: Two case reports

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Specialty type: Radiology, nuclear medicine and medical imaging

Provenance and peer review: Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B
Grade C (Good): C, C
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Chrcanovic BR, Sweden; Ghimire R, Nepal; Moshref RH, Saudi Arabia

Received: July 4, 2022
Peer-review started: July 4, 2022
First decision: August 1, 2022
Revised: August 15, 2022
Accepted: September 1, 2022
Article in press: September 1, 2022
Published online: October 16, 2022

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Abstract

BACKGROUND

Hydrodissection is a widely used technique during radiofrequency ablation (RFA) for benign thyroid nodules. Although it could effectively avoid thermal injury to the surrounding critical structures and achieve complete treatment, routine operation of the remaining needle could cause perithyroidal hemorrhage. In this report, we present 2 cases of perithyroidal hemorrhage during RFA caused by a hydrodissection needle, which have not been reported before.

CASE SUMMARY

A 21-year-old female and a 45-year-old male were admitted for RFA for benign thyroid nodules. Considering that their nodules were adjacent to the recurrent laryngeal nerve, the needle used for hydrodissection was placed and remained between the dorsal capsule of the lateral lobe and the recurrent laryngeal nerve. During the procedure, active bleeding near the needle appeared on ultrasonography (US). Although moderate pressure was quickly applied to the neck for several minutes, contrast-enhanced US (CEUS) still showed an active hemorrhage. A radiofrequency electrode was placed at the bleeding point under the guidance of CEUS to stop the bleeding, and the procedure was finally confirmed to be successful by CEUS, without other complications.

CONCLUSION

Hydrodissection during RFA of benign thyroid nodules was associated with a risk of perithyroidal hemorrhage. The timely recognition of this acute hemorrhage could help in the timely control of the bleeding, and CEUS-guided ablation of the bleeding point could be useful.

Key Words: Complication; Hemorrhage; Hydrodissection; Radiofrequency ablation; Benign thyroid nodules; Case report

Core Tip: Hydrodissection is a widely-used technique during radiofrequency ablation on benign thyroid nodules to avoid thermal injury to the surrounding critical structures. Though it is widely regarded as safe, its routine performing of the remaining needle could cause perithyroidal hemorrhage. We presented 2 cases of perithyroidal hemorrhage during radiofrequency ablation caused by the hydrodissection needle, and additional intervention was used to stop the bleeding, which has no yet been reported. We believe that clinicians should be aware of the possible risk, and the improvement of hydrodissection is needed.

Citation: Zheng BW, Wu T, Yao ZC, Ma YP, Ren J. Perithyroidal hemorrhage caused by hydrodissection during radiofrequency ablation for benign thyroid nodules: Two case reports. *World J Clin Cases* 2022; 10(29): 10755-10762
URL: https://www.wjgnet.com/2307-8960/full/v10/i29/10755.htm
DOI: https://dx.doi.org/10.12998/wjcc.v10.i29.10755

INTRODUCTION

Currently, radiofrequency ablation (RFA) has been widely used in the treatment of benign thyroid nodules (BTNs)[1-3]. It is safe and extremely well tolerated, and no life-threatening complications have been reported[4-6]. Although a hemorrhage or a hematoma is one of the most common complications, the reported incidence is still relatively low (0.9%-17.0%)[6]. It includes perithyroidal, subcapsular, and intranodular hemorrhage[4-6]. Although the mechanical injury due to the electrode because of the rich blood supply to the BTNs, or the sudden reduction in intranodular pressure due to fluid evacuation primarily contributes to hemorrhage susceptibility[4-7], hydrodissection is an additional causative factor that should not be ignored.

Hydrodissection is a widely used technique that can help improve the efficacy and minimize the complications of RFA for BTNs[2,8]. It mostly involves using a needle, which is inserted through the skin and placed between the nodule and the adjacent critical structures to inject fluids to separate the nodule and the adjacent structures[8]. This technique could effectively avoid thermal injury to the surrounding critical structures and achieve complete treatment. The injection needle should remain in place[8] so that the fluids can be injected continuously to achieve a sufficient safety margin during the procedure because the injected fluid may spread to other cervical spaces[9]. In that case, the remaining needle has a possibility of causing perithyroidal hemorrhage if the nodule has a rich blood supply. Here, we encountered 2 cases of perithyroidal hemorrhage during RFA caused by a hydrodissection needle, which has not been reported before. We presented the cases to make clinicians aware of the possible risk of hydrodissection.

CASE PRESENTATION

Chief complaints

Case 1: A 21-year-old female presented with a left neck mass that existed for 2 mo with cosmetic concerns and abnormal sensation.

Case 2: A 45-year-old male presented with a left neck mass that existed for 4 mo with cosmetic concerns and abnormal sensation.

History of present illness

Case 1: Her report showed no compressive symptoms of the neck mass, a symptom score of 5/10 on the visual analog scale, and a cosmetic score of 3/4.

Case 2: His report showed no compressive symptoms of the neck mass, a symptom score of 5/10 on the visual analog scale, and a cosmetic score of 3/4.

History of past illness

Case 1: She stated that she did not have a past medical history of thyroid diseases, allergies, or a family history of any thyroid diseases.

Case 2: He was infected with hepatitis B virus but did not have a coagulation disorder, allergies, thyroid diseases, or a family history of any thyroid diseases.

Physical examination

Case 1: She had a normal body mass index (20.32 kg/m^2; weight, 54 kg; height, 163 cm), blood pressure (106/72 mmHg), and electrocardiography (sinus rhythm with 70 bpm).

Case 2: He had a normal body mass index (24.6 kg/m^2; weight, 63 kg; height, 160 cm), blood pressure (106/72 mmHg), and electrocardiography (sinus rhythm with 73 bpm).

Laboratory examinations

Case 1: She had normal thyroid function (thyroid-stimulating hormone, 2.92 μIU/mL; normal, 0.55-4.78 μIU/mL), but both antithyroglobulin antibody and anti-thyroid peroxidase antibody were positive.

Case 2: He had normal thyroid-stimulating hormone (1.08 μIU/mL, normal, 0.55-4.78 μIU/mL) and negative antithyroglobulin antibody and anti-thyroid peroxidase antibody.

Imaging examinations

Case 1: Ultrasonography (US) of the thyroid showed a single nodule measuring 25 mm × 17 mm × 40 mm (volume, 8.9 mL) in the left lobe. The nodule was determined as level 4 based on the American College of Radiology's Thyroid Imaging, Reporting and Data System, with a completely solid composition, hypoechogenicity, a wider-than-tall shape, and smooth margins. The nodule also showed marked vascularity and the presence of peripheral blood supply on color Doppler US (CDUS) (Figure 1A).

Case 2: US showed a single nodule, measuring 20 mm × 21 mm × 31 mm (volume, 6.8 mL) in the left lobe. The nodule was determined to be level 2 based on the American College of Radiology's Thyroid Imaging, Reporting and Data System, with almost cystic composition, iso-echogenicity, a wider-than-tall shape, and smooth margins. The nodule also showed minimal vascularity and limited peripheral blood supply on CDUS (Figure 2A).

FINAL DIAGNOSIS

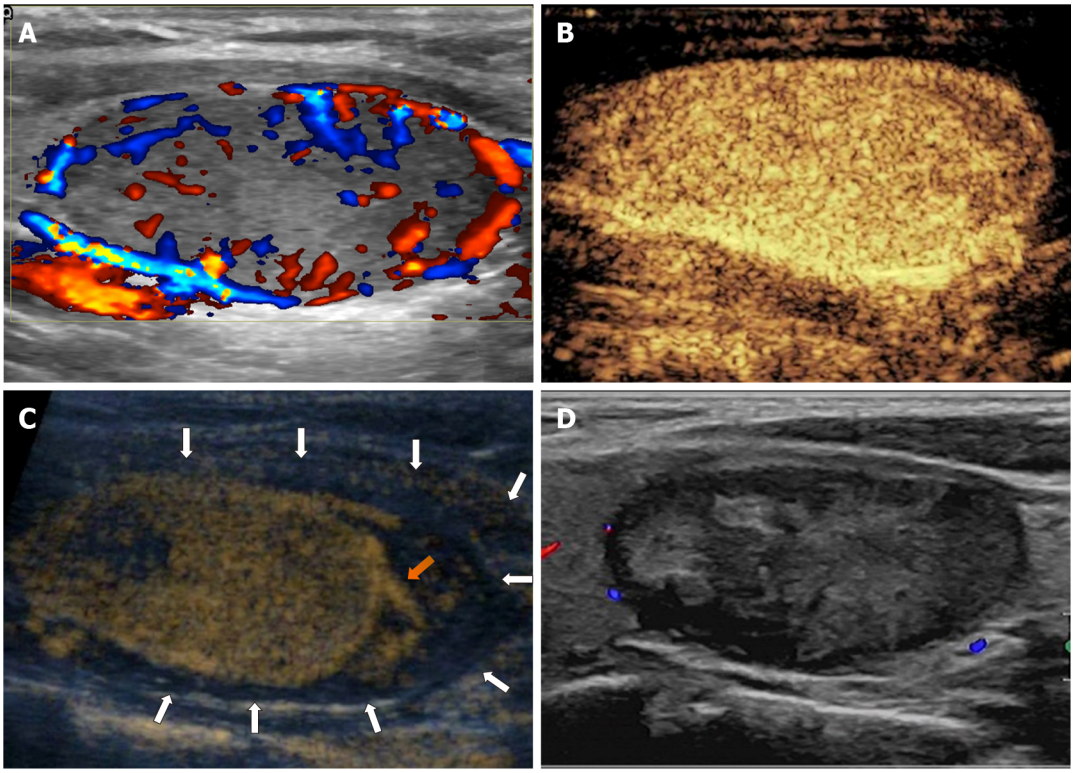
Case 1: The patient underwent US-guided fine needle aspiration, and the cytological diagnosis was benign (The Bethesda System for Reporting Thyroid Cytopathology II).

Case 2: The patient underwent US-guided fine needle aspiration, and the cytological diagnosis was benign (The Bethesda System for Reporting Thyroid Cytopathology II).

TREATMENT

Case 1: The patient was admitted to our institute for RFA treatment. A detailed preoperative assessment was performed, and an operative plan was created, which included local anesthesia, a hydrodissection approach (5% glucose), lateral approach, a moving-shot technique, and contrast-enhanced US (CEUS). Considering that the nodule was adjacent to the recurrent laryngeal nerve (RLN), the needle used for hydrodissection was planned to be placed between the dorsal capsule of the lateral lobe and the RLN and to stay in place for continuous injection.

During the procedure, preoperative CEUS was used to determine the range of RFA, and the nodule showed homogenous hyperenhancement and a peripheral blood supply (Figure 1B). Following local anesthesia, the needle was inserted and placed in the intended location based on the hydrodissection plan. After 40 mL of 5% glucose was injected, an irregular iso-echogenicity area around the needle, nodule, and lobe appeared on US. Perithyroidal hemorrhage was the first consideration, and CDUS showed active hemorrhage near the needle. The needle was quickly withdrawn, and moderate pressure was applied on the neck for several minutes. Another CEUS still showed active hemorrhage near the location where the needle was placed (Figure 1C). The radiofrequency electrode was inserted into the location under the guidance of CEUS, and RFA was used to stop the bleeding. A third CEUS confirmed its success and showed that the hematoma had surrounded the nodule. Since a perithyroidal hematoma (range, 14 mm × 21 mm × 40 mm; volume, 6.2 mL) separated the nodule and the RLN, further hydrodissection was not performed. The electrode was inserted into the nodule, and the moving-shot



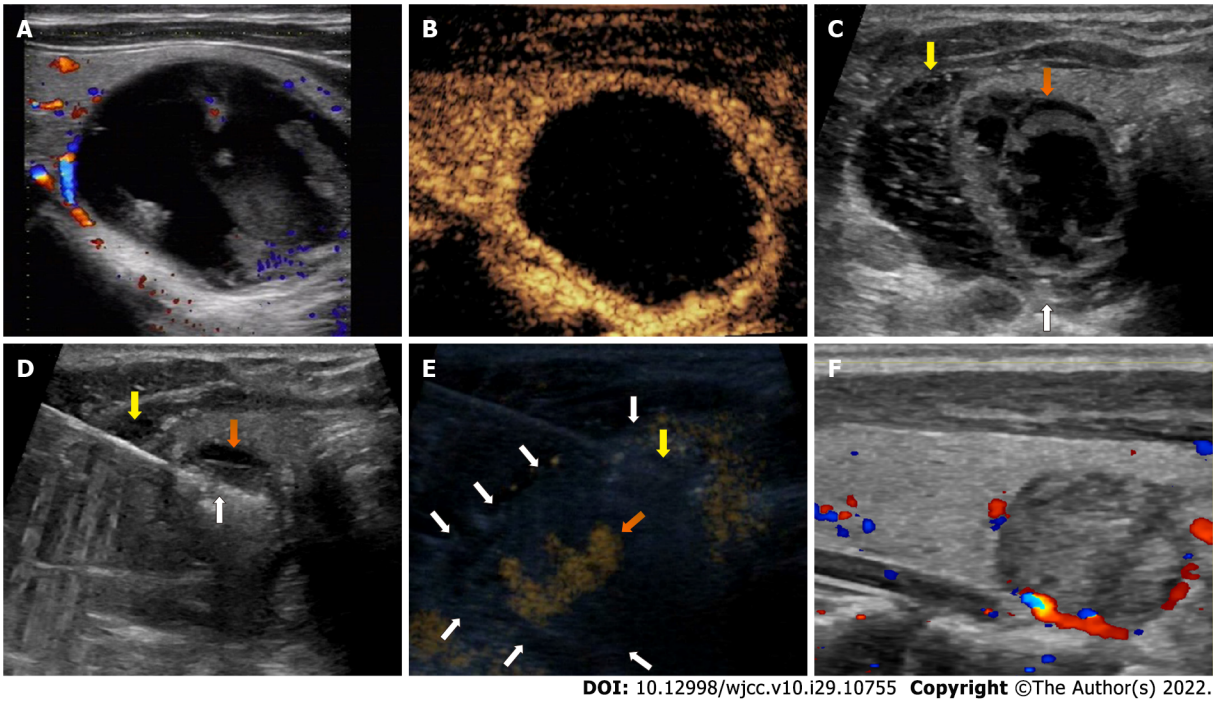
DOI: 10.12998/wjcc.v10.i29.10755

Figure 1 Case 1: Female, 21-year-old, with a solid benign thyroid nodule in the left lobe. A: Color Doppler ultrasonography showed the nodule with marked vascularity and peripheral blood supply; B: Preoperative contrast-enhanced ultrasonography showed the nodule with homogenous hyperenhancement and a peripheral blood supply; C: During the hydrodissection, contrast-enhanced ultrasonography showed a perithyroidal hematoma (white arrow) around the nodule and the active hemorrhage near the location where the needle was placed (orange arrow) after the needle was withdrawn. Compression was placed to achieve hemostasis. Then, radiofrequency ablation was performed to stop the bleeding; D: At the 1-mo follow-up, the perithyroidal hematoma had disappeared on ultrasonography, and the nodule showed shrinkage with a volume reduction ratio of 44.1%.

technique was used during the ablation, with a delivered energy of 29.3 kJ (3.3 kJ/mL). Complete ablation was confirmed by CEUS.

Case 2: The patient was admitted for RFA. A detailed preoperative assessment was performed, and the operative plan was created, which included local anesthesia, aspiration of the intranodular hemorrhage, hydrodissection (5% glucose), lateral approach, moving-shot technique, and CEUS. Considering that the nodule was adjacent to the RLN, the needle used for hydrodissection was planned to be placed between the dorsal capsule of the lateral lobe and the RLN and to be kept in place for continuous injection.

During the procedure, preoperative CEUS was used to determine the range of RFA, and the nodule showed only a peripheral blood supply and almost no enhancement inside (Figure 2B). Following local anesthesia, a needle was first inserted into the nodule, and 5 mL intranodular hemorrhage was withdrawn. The nodule showed little shrinkage but was still adjacent to the RLN. Then, another needle was inserted and placed in the intended location based on the hydrodissection plan, and the nodule was successfully separated from the surrounding structures (Figure 2C). The needle remained in place as planned, the radiofrequency electrode was inserted into the nodule, and the moving-shot technique was performed for ablation (Figure 2D). During the ablation, an irregular hyperechogenicity area around the nodule appeared on US. Perithyroidal hemorrhage was diagnosed, and CDUS showed active hemorrhage near the needle. The needle was quickly withdrawn, and moderate pressure was applied on the neck for several minutes. Another CEUS still showed active hemorrhage near the location where the needle was placed (Figure 2E). The radiofrequency electrode was placed into the same location under the guidance of CEUS, and RFA was performed to stop the bleeding. A third CEUS confirmed its success and showed that the hematoma had surrounded the nodule. Since a perithyroidal hematoma (range, 26 mm × 17 mm × 76 mm; volume, 17.6 mL) separated the nodule and the RLN, further hydrodissection was not performed. The procedure continued, with a delivered energy of 6.3 kJ/mL (0.9 kJ/mL), and 150 mL of 5% glucose was injected. Complete ablation was confirmed by CEUS.



DOI: 10.12998/wjcc.v10.i29.10755

Figure 2 Case 2: A 45-year-old male with a cystic benign thyroid nodule in the left lobe. A: Color Doppler ultrasonography showed the nodule with little vascularity and a minimal peripheral blood supply; B: Preoperative contrast-enhanced ultrasonography showed the nodule with only peripheral blood supply and almost no enhancement inside; C: After the first aspiration of the intranodular fluid, the nodule showed minimal shrinkage (orange arrow). Then, the needle for hydrodissection was placed in the location between the dorsal capsule of lateral lobe and the recurrent laryngeal nerve (white arrow), and the nodule was separated from the surrounding structures (yellow arrow); D: The needle for hydrodissection remained in place, and the radiofrequency electrode was inserted into the nodule (white arrow) for ablation; E: During the ablation, contrast-enhanced ultrasonography showed a perithyroidal hematoma (white arrow) around the nodule and an active hemorrhage near the location where the needle for hydrodissection was placed (orange arrow) after the needle was withdrawn. Compression was applied to achieve hemostasis. Then, radiofrequency ablation was performed to stop the bleeding; F: At the 1-mo follow-up, the perithyroidal hematoma had disappeared on ultrasonography, and the nodule showed shrinkage with a volume reduction ratio of 86.4%.

OUTCOME AND FOLLOW-UP

Case 1: The patient showed stable vital signs during the procedure and did not experience other complications, such as a voice change or an upper airway obstruction. At the 1-mo follow-up, the irregular iso-echogenicity area had disappeared on US, and the volume reduction ratio of the nodule was 44.1% (Figure 1D).

Case 2: The patient showed stable vital signs during the procedure and did not experience other complications, such as a voice change or an upper airway obstruction. At the 1-mo follow-up, the irregular hyperechogenic area had disappeared on US, and the volume reduction ratio of the nodule was 86.4% (Figure 2F).

DISCUSSION

This is the first report of 2 cases of active perithyroidal hemorrhage induced by hydrodissection during RFA of BTNs. Both cases were controlled by the ablation, and the RFA procedures were completed without other complications.

Hydrodissection is an important technique that is performed to ensure the success and safety of percutaneous US-guided RFA for a wide range of tumors throughout the body[8,10-12]. It is widely regarded as safe, and few studies have shown reports of its related complications or side effects. Regarding RFA for BTNs, only one study showed that large-volume hydrodissection might cause more patients to suffer pain and chest tightness[9], but whether hydrodissection causes perithyroidal hemorrhage has not been reported. We supposed that the possible causes of perithyroidal hemorrhage secondary to hydrodissection during RFA were as follows: (1) Most BTNs that need treatment are large and hypervascular. They are usually closely adjacent to the capsule of the thyroid and usually have a peripheral blood supply. Therefore, most of them have large blood vessels that run over the dorsal capsule; (2) The needle used for hydrodissection is usually placed between the RLN and the dorsal capsule of the thyroid to separate the RLN and the BTNs since the RLN is one of the most important adjacent critical structures. The unintentional movement of the needle tip during the entire procedure

could easily cause unexpected displacement or injury to the blood vessels on the dorsal capsule; and (3) Hydrodissection sometimes tears the surrounding blood vessels, causing hemorrhage, which has been reported in some patients undergoing thermal ablation for liver tumors[13]. Therefore, for BTNs, hydrodissection is associated with a risk of causing unwanted bleeding, and clinicians should increase their awareness and should be concerned about needle placement during the entire procedure.

The management of hemorrhage during the RFA procedure is not difficult. It can usually be controlled by moderate pressure on the neck or the ablation of the bleeding point[5,6]. For hemorrhage induced by hydrodissection, clinicians should also focus on the following points: (1) The timely recognition of hemorrhage during hydrodissection or caused by hydrodissection during the RFA procedure should be important since it could help with timely management. Previous studies showed that perithyroidal hemorrhage could be found immediately on US as a hypoechoic thin layer surrounding the thyroid[4,6], but it should be noted that an acute hemorrhage could be iso- or hyperechoic, which is similar to the thyroid or the nodule, and may be difficult to distinguish. In this situation, clinicians should stay alert to the abnormally increased range of hydrodissection. In addition, CEUS could also play a role in the recognition of active bleeding[14] and the bleeding point[15]; (2) If the needle remains inserted within the same place, compression on the neck may have the risk of causing a secondary injury of the blood vessels because of the movement of the needle tip. Withdrawing the needle before moderate pressure is applied would be safer; and (3) Since the bleeding point is usually deeply located in the dorsal capsule, achieving hemostasis by compression may be less effective. If active bleeding persists, timely CEUS-guided RFA on the bleeding point could be performed. Surgical treatment should always be available; however, there have not been any cases of hemorrhage that need further hospital or surgical treatment in any of the studies.

Some precautions could help. First, clinicians should preoperatively assess whether patients with coagulation disorders or who are taking drugs that have a risk of hemorrhage should take necessary measures, *i.e.* stop the related drugs for a period before RFA[16]. In addition, a replacement could be considered for needles, as the needle tip can easily injure the blood vessels. Catheters would be a possible solution. Some studies have performed the Seldinger technique to insert catheters[17-21] or have directly inserted catheters[22] for hydrodissection during RFA of liver tumors. However, this approach had a reported technical failure rate of 11.1%-12.0%[17,22], especially in patients with postoperative adhesion formation because of previous surgery in the corresponding region[18]. This is likely due to increased difficulty in using catheters to open or establish spaces in different layers of tissue to reach the predetermined site. Improving the approaches for successful and safe hydrodissection would be helpful for safer and more effective RFA of BTNs, and further studies are needed.

CONCLUSION

In conclusion, hydrodissection during RFA of BTNs has the risk of perithyroidal hemorrhage. The timely recognition of this acute hemorrhage helps to achieve timely control of the bleeding, and CEUS-guided ablation of the bleeding point is useful. Further studies that focus on the improvement of hydrodissection are needed for safer and more effective RFA for BTNs.

FOOTNOTES

Author contributions: Zheng BW reviewed all the literature available about hydrodissection during radiofrequency ablation until June 2022 and was a major contributor to the manuscript; Wu T performed the literature review and made critical revisions of the manuscript; Yao ZC performed the literature review and made critical revisions of the manuscript; Ma YP performed the data acquisition; Ren J guided throughout the writing process as well as performed the radiofrequency ablation procedure; all authors read and approved the final manuscript.

Informed consent statement: Written informed consent was obtained from all patients.

Conflict-of-interest statement: The authors declare that they have no conflicts of interest.

CARE Checklist (2016) statement: The authors have read the CARE Checklist (2016), and the manuscript was prepared and revised according to the CARE Checklist (2016).

Country/Territory of origin: China

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S-Editor: Wang DM
L-Editor: Filipodia
P-Editor: Wang DM

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