Thoracoscopic radiofrequency ablation for the treatment of hepatocellular carcinoma over the last decade

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Abstract

Aim: To assess the feasibility and usefulness of thoracoscopic radiofrequency ablation (TRFA) for hepatocellular carcinoma (HCC).

Background: HCC located below the diaphragmatic dome remains one of the poorly treatable tumors for percutaneous ablation therapy. TRFA has been proposed as a technique of choice for those tumors.

Patients and Methods: Between January 2000 and December 2010, 92 patients who suffered from HCC under the diaphragm were indicated for local ablation therapy. The thoracoscopic approach was required for accurate and safe ablation procedures.

Results: The surgical procedures consisted of thoracoscopic radiofrequency ablation with endoscopic ultra-sonography. All patients recovered and were eventually discharged. Postoperative mortality rate was 0%. The overall and disease-free 5-years survival rates of TRFA were 51.9% and 7.1%, respectively.

Conclusion: TRFA is recommended as an effective and feasible treatment for the HCC located under the diaphragm.

Key words: local ablation therapy, thoracoscopic surgery, radiofrequency ablation, hepatocellular carcinoma, feasibility

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Introduction

For these ten years, we commonly used radiofrequency ablation (RFA) device for local ablation therapy (LAT), which is able to coagulate the tumor and surrounding liver tissue. RFA for hepatocellular carcinoma (HCC) has been one of the most beneficial treatment methods for patients with a cirrhotic liver and the approach method of ablation is one of the most crucial points for LAT.

The treatment of tumors under diaphragmatic dome remains an important concern. These patients are not suitable candidate for percutaneous puncture because of the following reasons: The major reasons for difficulties for the treatment of the tumor under diaphragm based on the anatomical location, where percutaneous ablation tend to pose problems regarding the existence of thoracic cavity. Because of the close proximity to the lung, the examination with ultrasoundsonography is limited and the puncture method tends to be inaccurate, difficult, and sometimes dangerous.

In contrast, LAT with the thoracoscopic surgical method (TLAT) is one of the beneficial techniques of choice for the treatment of liver tumors under the diaphragm. The thoracoscopic technique is able to avoid the lung on the puncture line with one-lung ventilation under general anesthesia, so the ablation is safer than the percutaneous ablation method, and the direct observation can possibly reduce the risk of injury of other organs and bleeding. This report focuses on the technical feasibility and long-term outcomes for thoracoscopic radiofrequency ablation (TRFA).

Patients and Methods

Between January 2000 and December 2010, 823 RFA for liver tumors were performed in our institute. We retrospectively analyzed 92 consecutive HCC patients who were treated using TRFA.

After evaluating the laboratory data, liver function, computed tomography (CT), ultrasound examination, and magnetic resonance images (MRI), for the most appropriate treatment was selected. Liver function was evaluated based on the “Liver damage” criteria of the Liver Cancer Study Group of Japan. In spite of indications for LAT, the percutaneous procedure was difficult because of the tumor location. Therefore, 92 patients were considered to be candidates for TRFA. Before the operation, all patients were informed to obtain their consent. Our enrollment criteria for thoracoscopic LAT for HCC were (i) tumor located in surface or nearby surface under diaphragm, (ii) a tumor size less than 4 cm (3 cm and under recommended), (iii) no invasion of the vessels and biliary tract, (iv) less than three tumors in the whole liver, and (v) exception of bleeding tendency for severe liver dysfunction.

Surgical procedure

General anesthesia was required for all patients in semi- to full left lateral position. Left-side one-lung ventilation is required to maintain the space of right thoracic cavity. Two or Three ports were required, one for the thoracoscope and one for the ultrasound transducer. After the tumor was identified with endoscopic ultrasound under the diaphragm, the electrode of RFA was inserted to tumor under thoracoscopic inspection with ultrasound guidance.

RFA for HCC was performed using a cooled-tip (Radionics Inc., Burlington, Mass.) and an electrode with a 2-cm exposed tip was connected to a 500-kHz RF generator (Radionics, Burlington, MA) under the programmed cyclic impedance control condition. At the end of procedure, single thoracic drainage tube (20-22 Fr) was inserted in right thoracic cavity for information drainage and usually pulled out within 48 hrs.

The judgement of efficacy was made based on the dynamic CT findings within one week. Postoperative complications were diagnosed both clinically and radiologically. Whenever significant symptoms were observed, emergency CT and US was performed.

The statistical software package StatView (SAS Institute Inc., Cary, NC), version 5.0 for Windows, was used for the statistical analysis. A P value less than 0.05 was considered significant.

Results

Since January 2000 to December 2010, 92 TRFA was performed. Clinical features and profiles of patients (age, sex,
viral infection, liver function, and history of HCC treatment) are shown in Table 1. The 92 patients treated with TRFA had mean age of 66.5 ± 8.7 years (median 66 y: range, 41-82 y). The mean ICG and liver damage showed their limited liver function. Also small number of platelets and lower PT were demonstrated in most of all patients.

Also, Table 1 represents a summary of surgical characteristics. The mean operative data and the stage of HCC (International Union Against Cancer [UICC]) are shown. The mean operative time was 211.0 ± 88.0 min for TRFA. The mean intraoperative blood loss was less than 20 mL. Two patients had a transfusion of platelet due to the thrombocytopenia from the splenomegaly. The mean tumor size was 22.2 ± 9.2 mm and the solitary number of nodules was 65 (71%). The effectiveness of the operation was confirmed within post operative 7 days, and the ablated tumors located in under diaphragm were free of enhancement on dynamic contrast-enhanced CT.

### Mortality and Morbidity

There was no mortality and severe morbidity after TRFA. Post operative complications developed in 9.8% the TRFA (9 of 92). Pleural effusions were the most frequent occurring adverse effect and were treated conservatively or by transient drainage and their symptoms resolved within 2 weeks. One patients with the severe adhesion of thoracic cavity, had pneumothorax, which was treated continuous drainage without surgical operation. The late onset herniation of diaphragm which developed in 78 years old patients after 12 month later since TRFA, was just followed as outpatient with no symptom.

There were no port-site related recurrence and no dissemination in thoracic cavity. The length of the hospital stay ranged from 8 to 26 days. The median postoperative length of the hospital stay was 10 days for TRFA.

### Survival and outcome

The complete necrosis after ablation was obtained, but local recurrence after TRFA was diagnosed in 5 patients (5.4%). Tumor recurrence on other site was observed in 45 patients (48.9%). The cumulative survival rates for the treatment groups are presented in Fig. 1, which demonstrated that Kaplan-Meier estimations of over all survival and disease free survival for TRFA at a mean follow-up 32.3 months. The overall and disease-free 5-years survival rates of TRFA were 51.9% (Fig. 1A) and 7.1% (Fig. 1B), respectively.

### Discussion

The location of liver around the diaphragmatic dome is difficult to approach and treat. Percutaneous ultrasound-guided RFA with artificially induced pleural effusion is one of the technique of choice, but the percutaneous puncture might be controversial. Especially, HCC which exists on the surface of the liver needs attention because of adverse events by puncture. The complication such as bleeding and a tumor cell spillage from superficial capsule might be happen by puncture procedure, even if percutaneous ablation can be done easily.
Kurokohchi et al. reported the use of thoracoscopic ethanol injection and RFA in 2006 \(^5\), and they described the value of thoracoscopic ablation for the treatment of hepatocellular carcinoma located under the diaphragm and the advantages of this approach. By thoracoscopic approach, the surface of liver under the top of diaphragm is relatively easy to inspect and examine under intraoperative ultrasonography. For the superficial or extrahepatic protrusive tumor, endoscopic ablation with the excision of diaphragm should be recommended in order to prevent neoplastic seeding or bleeding from tumor surface.

Although we experienced some characteristic problems (pleural effusion pneumothorax, and atelectasis) after TLAT, those patients could be successfully treated conservatively and was discharged when all symptoms resolved. A herniation of diaphragm was one of unexpected problem, but this adverse event occurred in the elder patient with severe liver dysfunction. It is suggested that a non-absorption thread for continuous suture ligations of diaphragm should be indicated for the old patients with poor liver function. No liver abscess and biloma has been occurred, RFA might be recommendable for avoidance of severe complication in our experiences. The TRFA was well tolerated in this study, with a morbidity rate of 9.8% and a mortality rate of 0% \(^12\) \(^13\). Furthermore, we had no port-site related recurrence and no dissemination in thoracic cavity \(^10\).

As for analysis of long term outcomes, relative poor prognosis of these patients with recurrent tumor should be expected because of lower ratio of first treatment for HCC (less than 25%). The result of current study revealed that the patients who received thermal ablation as the first treatment had longer 5-year OS rate than the patients with recurrent tumors (54% vs. 38%) \(^11\). Although patients in this study had relative lower 5-year disease-free survival rates, they had acceptable 5-year OS rate more than 50% \(^14\). Those patients with limited liver function are considered to provide those favorable results.

**Conclusions**

Our study demonstrates the feasibility and long term results of TRFA for HCC during past decade. For the patients with HCC located under the diaphragm, we consider TRFA to be a considerable technique of choice.
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References