# Laparoscopic Ultrasound–Guided versus Percutaneous Radiofrequency Ablation in Treatment of Unresectable Hepatocellular Carcinoma

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**Abstract**

*Objective:* The purpose of this study was to compare laparoscopic ultrasound–guided radiofrequency ablation (LUSRFA) versus percutaneous radiofrequency ablation (PRFA) in treatment of localized hepatocellular carcinoma (HCC).

*Methods:* From January 2005 through April 2008, for 60 consecutive patients, who were diagnosed with localized primary liver cancer and underwent percutaneous RFA ($n$ = 30) or laparoscopic ultrasound guided radiofrequency ablation ($n$ = 30) at our institution. RFA was evaluated prospectively intra- and postoperatively (1, 6, 12, 18 and 24 months after surgery).

*Results:* Intra and postoperative complications were significantly lower in the LUSRFA group than in the PRFA group. The Hospital stay, intraoperative complications, early and late postoperative complications were significantly reduced with LUSRFA. However, there was insignificant decrease in tumour volume in both groups. Furthermore, Local recurrence and distant metastases in the LUSRFA group showed a significant decrease during follow-up periods.

*Conclusion:* LUSRFA could be a valuable alternative treatment for selected patients with localized unresectable hepatic malignancies.

**Keywords:** Radiofrequency; primary liver tumor; local ablation of liver malignancy; laparoscopic radiofrequency.

## INTRODUCTION

Hepatocellular carcinoma (HCC) is one of the most common solid tumours in the world with, at least, one million new cases per year.[1] The majority of patients with hepatic cancer have irresectable disease at the time of presentation.[2]

Locoregional therapy has become the focus of interest in recent years, hence if the disease is confined completely or largely to the liver, local tumour ablative therapies can be performed, with good local control of the disease.[3] Local ablative therapies include: ethanol injection; acetic acid injection; cryotherapy ablation; microwave coagulation; laser therapy; and radiofrequency thermal ablation.[4,5]

Radiofrequency ablation (RFA) has both a curative and palliative role in treatment of solid tumours.[6] It is a safe and effective treatment modality to achieve tumour destruction in patients with unresctable hepatic malignancies.[7,8] Although the RFA can be performed via either laparotomy or percutaneously, there is some data focusing on laparoscopic approach.[9]

The main aim of thermal tumour ablation therapy is to destroy the entire tumour by using heat to kill malignant cells without damaging adjacent vital structures, with 0.5-1 cm safety margin of apparently healthy tissue adjacent to the lesion.[10]

The aim of the study was to evaluate laparoscopic ultrasound guided RFA comparing with percutaneous RFA in treatment of localized HCC in patients not candidate for hepatic resection.

## PATIENTS AND METHODS

From January 2005 to April 2008, the medical records of 63 patients with localized HCC requiring RFA at Oncology Center Mansoura University (OCMU), in Egypt, were reviewed. All patients were self-referred and consisted of PRFA group (n = 30) and LUSRFA group (n = 33). Patient selection for LURIA was made preoperatively on the basis of history, physical, and radiological diagnostic evidence of localized HCC, three patients were referred to other facilities, as they were not candidate for RFA as it invade important pedicle as detected by IOUS and thus excluded from the study. Thus, each group was of 30 patients.

### Inclusion Criteria

All the cases of HCC included in the study were considered unresectable due to bilobar location of tumours (n = 2), or reduced functional hepatic reserve (n = 58), in a site suitable for the laparoscopic approach (n = 33), with patent portal vein, and away from a large main blood vessel or main biliary duct. With no evidence of extrahepatic disease, vascular or biliary invasion,

or marked bleeding tendency with prothrombin time more than 50% and a platelet count more than 100000/mm$^3$. With absence or minimal ascites.

## Surgical Technique

Ablation was done by the RF 3000 generator (Radiotherapeutics) with a power of up to 200 W and 7 electrode prongs. Maximum power output of the RF generator, amount of electrode array deployment from the trocar, and duration of the effective time of the ablation were established at the beginning of the procedure with the goal of destroying the visible tumour mass plus a 0.5 to 1 cm safety margin all around.

### *Laparoscopic Assessment*

After peritoneal insufflations, laparoscope was inserted through a 10-mm trocar to assess stage of the tumour and any abdominal spread. Exposure and isolation of the liver from surrounding tissue was done (Fig. 1).

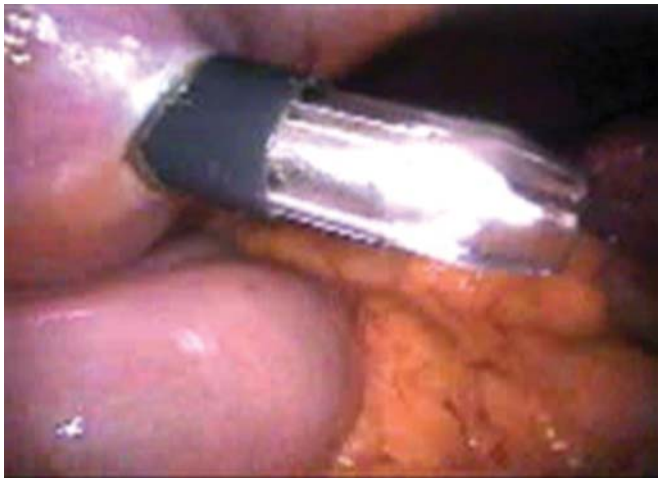

**Fig. 1:** A Laparoscope exploration

### *Laparoscopic Intraoperative Ultrasound (IOUS) Assessment*

An ultrasound probe was inserted through the second trocar to assess any radiographically occult or unablatable disease, detect any extrahepatic lesion (if present was biopsed), better declaration of the number and location of liver tumours, and decide the puncture point (Fig. 2).

### *Ultrasound-guided Laparoscopic RF Ablation*

The RF electrode was accurately placed into the tumour, without puncturing the nearby blood vessel (under the ultrasonic guidance). We indirectly puncture of the tumour by the RF electrode through non-tumourous liver parenchyma, to avoid needle track seedling, (Fig. 3). The tip of the needle (with retracted electrodes) was advanced under ultrasound guidance to the proximal edge of the lesion, and the electrodes were deployed to 2 cm (Fig. 4). The generator was turned on and runs by an automated program. The temperatures at the tips of the electrodes were controlled and the peak power is maintained until the temperature reaches the preselected target temperature (between 90° and 100°C). After the target temperature was achieved, the curved electrodes were advanced step-by-step to full deployment. When the electrodes were fully deployed, the program maintains the target temperature by regulating the wattage (Fig. 5). Then the ablation was performed with ablation margin of 0.5-1 cm to minimize the chance of local recurrence. We irrigate bile duct by ice-cold saline to avoid bile duct injury. After retracting the hooks, track ablation was performed at temperature above 75°C with the aim of preventing any tumour cell dissemination, as well as stop bleeding (Fig. 6).

*For larger tumours, multiple ablations were done* to be overlapped to build a composite thermal lesion with sufficient size to kill the entire tumour and to provide 0.5-1 cm tumor-free margin, we applied RF prior to any needle or array repositioning,

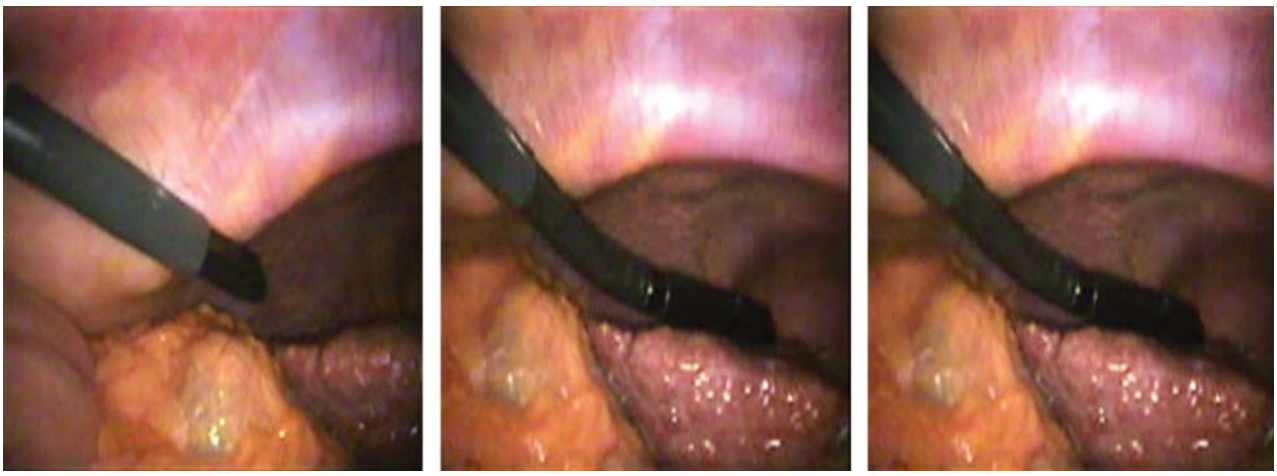

**Fig. 2:** Laparoscopic ultrasound assessment for radiographically occult or unablatable disease

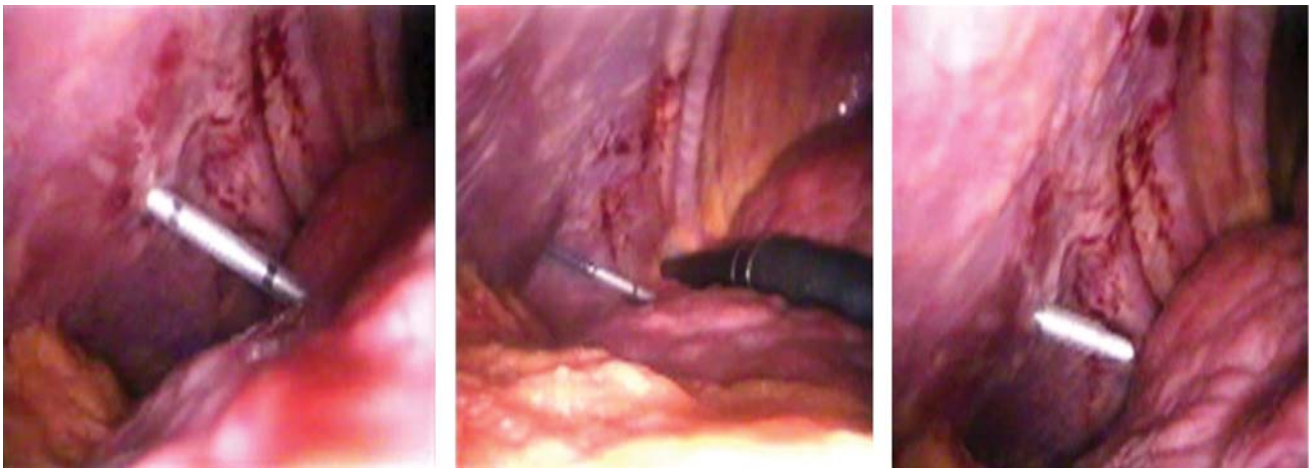

**Fig. 3:** RF electrode was accurately placed into the tumor, without puncturing the nearby blood vessel (under the ultrasonic guidance)

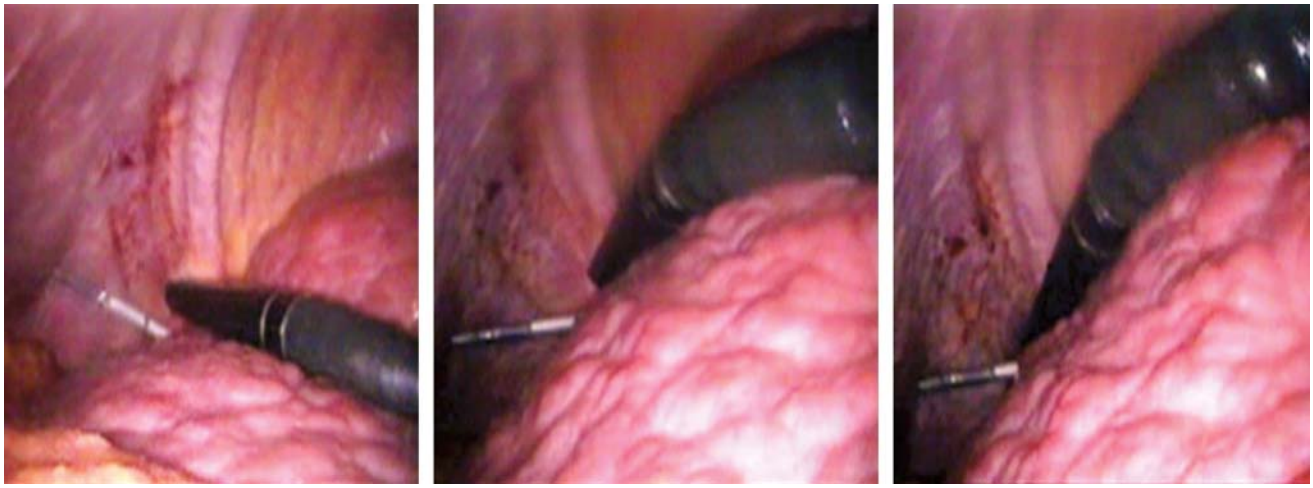

**Fig. 4:** The tip of the needle was advanced under ultrasound guidance to the proximal edge of the lesion

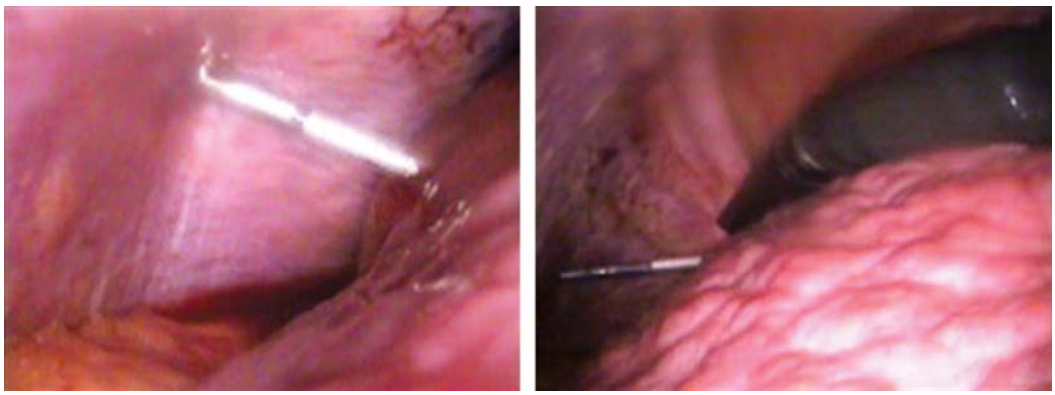

**Fig. 5:** The curved electrodes were advanced step-by-step to full deployment

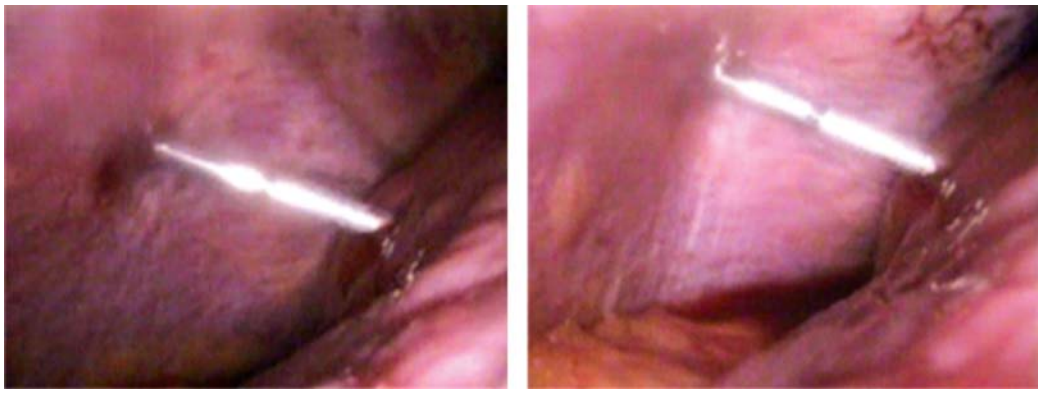

**Fig. 6:** Coagulation of the needle track

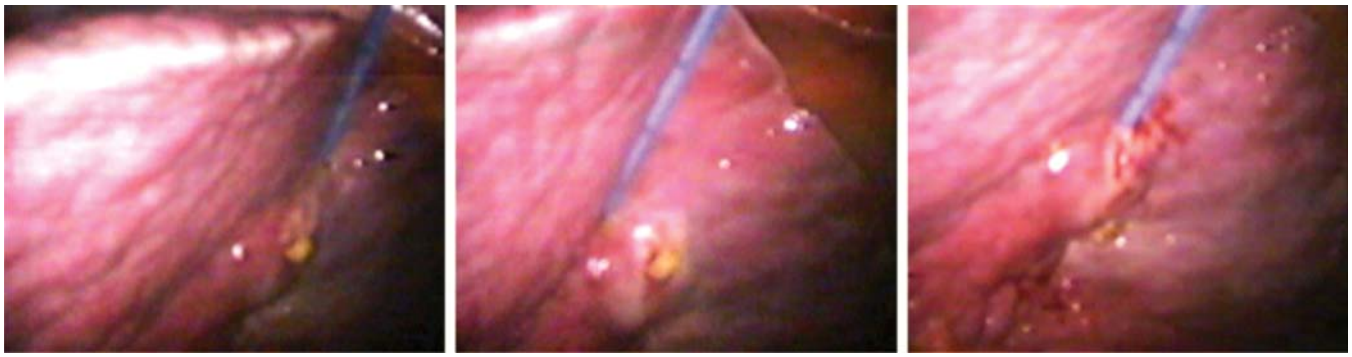

**Fig. 7:** For larger tumors, multiple ablations were needed to be overlapped to build a composite thermal lesion with sufficient size to kill the entire tumor and to provide 0.5-1 cm tumor-free margin

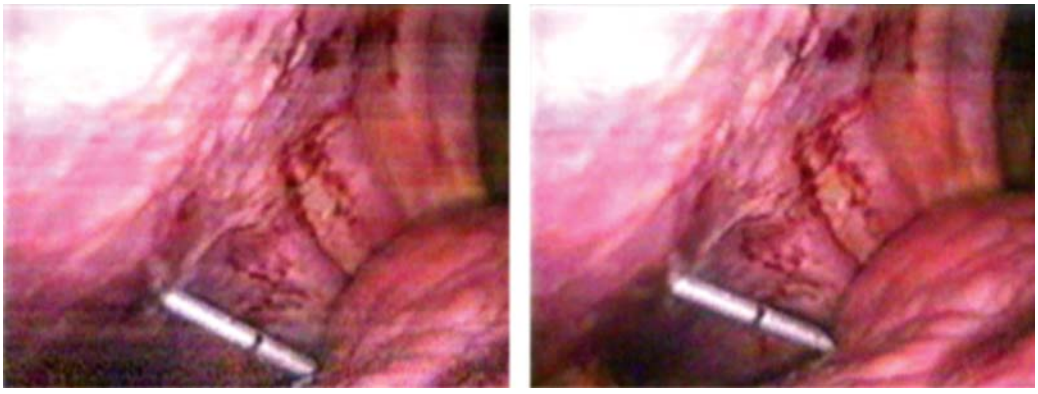

**Fig. 8:** The deepest ablations were performed before the superficial ones to minimize the possibility of microbubbles that might obscure visualization of the deepest portions of the tumor

especially if there has been any contact with the tumor, (Fig. 7). The deepest ablations were performed before the superficial ones to minimize the possibility of microbubbles that might obscure visualization of the deepest portions of the tumor and thus prevent completion of the ablation (Fig. 8). In case of tumours bulging on liver surface, the hilar portion of the tumor was ablated initially in order to destroy the inflow of blood supplying the tumor (Fig. 9).

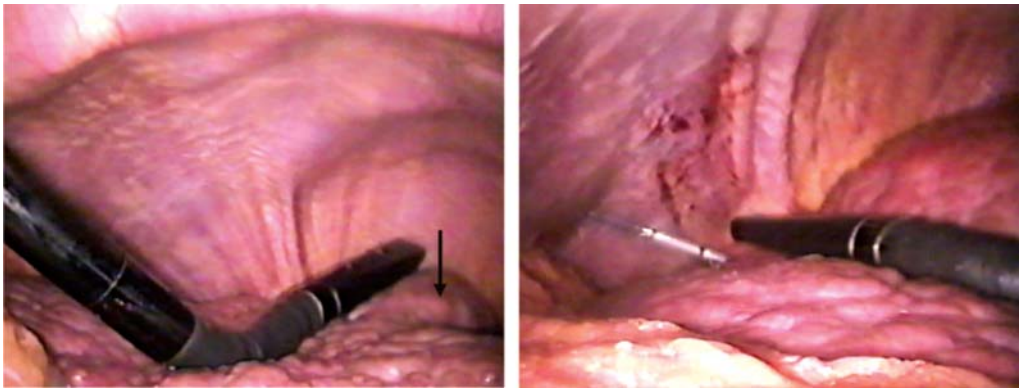

**Fig. 9:** In case of tumors bulging on liver surface, the hilar portion of the tumor was ablated initially in order to destroy the inflow of blood supplying the tumor

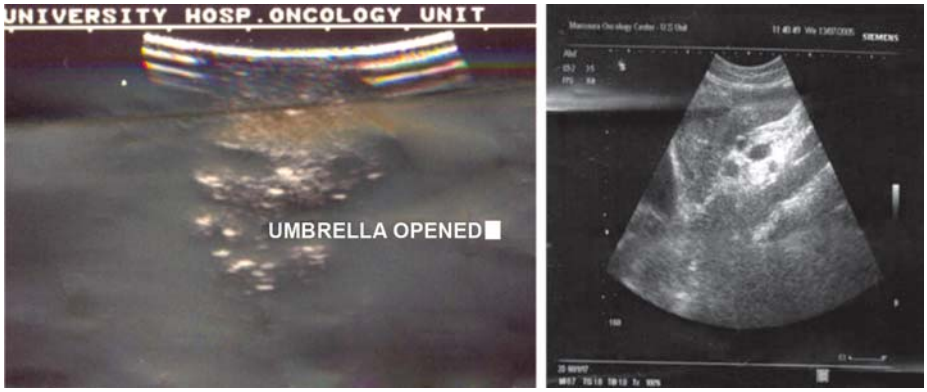


**Fig. 10:** Intraoperative US monitoring: Picture to the left showing RF Needle's umbrella opened inside the tumor. The one to the right shows the tissues after ablation

### *Intraoperative Ultrasound Monitoring*

The ultrasound probes used as a guide for any residual lesion, it allows measure the zone of increased echogenicity corresponding to the coagulation of the tissues (Fig. 10).

### *Ending RFA Treatment*

After complete ablation of the tumour was achieved, the arrays were completely retracted. The needle track was ablated as the needle electrode was withdrawn, and then the needle electrode was removed. The skin incisions were closed by sutures, sterilized and dressed. Patients were allowed to recover.

### *Postablation Care*

All patients were observed for 24 hours in the surgery department to detect any acute complications and to start IV fluid. IV antiemetic was given as all patients experienced post-ablation nausea. Strong IV analgesics were given to control pain as pethidine hydrochloride 50 mg (pethidine) or tramadol hydrochloride 50 mg (tramadol). Prophylactic IV antibiotic were started, amoxicillin-clavulanic acid (augmentin) or ceftazidine (fortum), and metronidazole, and continued for 24 hours. Before leaving the surgery department US examination was performed to the patients to detect any collection. The patient was allowed to eat within 24 hours.

### *Follow-up*

All patients were followed for 24 months for: Hospital stay; Procedure related complications; Early pos-tablation complications (first month); Tumour volume response; Tumour marker response; Late complications; Tumour recurrence and distant metastases; Two years–over all survival and disease free survival.

### Statistical Methods

Data was analyzed using SPSS (Statistical Package for Social Sciences) version 10. Qualitative data was presented as number and percent. Comparison between groups was done by Chi-square test or Fisher's exact test (FET). Kolmogrov – Smirnov test, tested quantitative data for normality. Normally distributed data was presented as mean + SD. Student t- test was used to compare between two groups. Non-parametric data was presented as min – max and median. Mann-Whitney test was used for comparison between groups. $P < 0.05$ was considered to be significant.

## RESULTS

This series involved 63 patients from ages 32 to 64 years, all of whom presented to OCMU for RFA. 46 males and 14 females (Table 1). Thirty patients were managed with percutaneous RFA (PRFA group), and 33 patients were planned to manage with laparoscopic ultrasound guided RFA (on clinical, laboratory and radiological bases), but IOUS reveal that the tumour in three patients were not candidate for RFA as it invade important pedicle and thus excluded from the study. Thus, each group was of 30 patients.

The preoperative clinical, laboratory and radiological findings in the studied groups were summarized in Tables 2 and 3: The most common site was the right lobe (n = 44); both lobes were affected in two patients (3.33%). Tumours affect one segment (n = 48), or two segments (n = 12). Tumours sizes were less than 3 cm (n = 12) or 3 – 5 cm (n = 48). Child's – A (n = 16) or B (n = 44).

Intraoperative US do not change the operative plan except in three patients that were excluded from the study (Table 4).

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Hospitalization period, procedure related and early postoperative complications reported in the first month were significantly less in LUSRFA group, (Table 5). The average hospital stay was 1.2 days (vie 3 days with PRFA), skin burn (n = 4), internal haemorrhage (n = 4) and Acute liver failure (n = 4) were reported only with PRFA, all were treated conservatively. Liver abscess reported in four cases (2 with LURFA and 2 with PRFA). Early hospital mortality (n = 4) reported only with PRFA.

The late outcomes of this series are reported in Tables 6 to 10. There was insignificant decrease in tumour volume in all patients (Figs 11 to 13). While significant decrease in level of tumour marker alpha-fetoprotein was reported more with LUSRFA (80% vie 53.3% with PRFA group), p- value was highly significant 0.033. There were 28 deaths (16 with PRFA and 12 with LUSRFA). Less local recurrence, and distant metastases were reported with LUSRFA (13.33% and 6.67% vie 26.67% and 13.33% with PRFA). The overall survival was more with LUSRFA (60% vie 46.67%); also 2 years disease-free survival was more with LUSRFA (53.33% vie 40% with PRFA group) (Table 10).

Our study found that 75% of patients with Child-Pugh stage – A , and 83.33% of patients with tumour size less than 3 cm, survived for 2 years, from them 29/32 (90.63%) has single lesion (Table 11).

## DISCUSSION

The outcomes of this series of LUSRFA and PRFA performed by OCMU were equivalent to those in the surgical literature.[11-17]

The high rate of morbidity and mortality may be due to bad liver conditions and early learning course.

Procedure related complications represent 10% (6.67% with PRFA and 3.33% with LRFA), these included skin burn (n = 4), one patient developed a third-degree skin burn during the tract-ablation portion of a percutaneous procedure (this required debridement and wound care), and port site hernia (n = 2). De Baere, et al.[11] reported a total of 25 adverse events with radio-frequency ablations that performed percutaneously on 312 patients. Wood et al.[12] reported skin burn in (8%) of patients after RFA.

Early major complications occurred within 30 days of the RF ablation represent 20% (all with PRFA), these included internal haemorrhage (n = 4), acute liver failure (n = 4) and liver abscess (n = 4), that was successfully treated with percutaneous drainage ± endoscopically placed internal biliary stent. Livraghi

**TABLE 1: Patients characteristics**

| *Items* | *Group I (PRFA)* | *Group II (LUSRFA)* | *Total* | *P-value* |
|---|---|---|---|---|
| *Total Number* | *30* | *30* | *60* | |
| Sex: | | | | |
| = Male | 24(80%) | 22 (73.3%) | 46 (76.67%) | 0.66 |
| = Female | 6(20%) | 8 (26.7%) | 14 (23.33%) | |
| Age (Years): | | | | |
| = Mean ± SD | 52.3 ± 8.7 | 55.4 ± 6.6 | 53.9 ±7.6 | 0.284 |
| = Range | 32-64 | 42-64 | 32-64 | |

**TABLE 2: Preoperative clinical, laboratory and radiological finding in the studied groups**

| *Items* | | *Group I (PRFA)* | *Group II (LUSRFA)* | *Total* | *P-value* | |
|---|---|---|---|---|---|---|
| *Total number* | | *30* | *30* | *60* | | |
| Presentations: | | | | | | |
| = Right hypochondrial pain | | 14 (46.67%) | 24 ( 80%) | 38 (63.33%) | 0.05 | |
| = Bleeding per gums | | 6 (20%) | 6 (20%) | 12 (20%) | 1.0 | |
| = Epistaxis | | 6 (20%) | 4 (13.33%) | 10 (16.66%) | 0.7 | |
| = Varices | | 2 (6.67%) | 0 | 2 (3.33%) | 0.3 | |
| = Dyspepsia | | 2 (6.67%) | 0 | 2 (3.33%) | 0.3 | |
| Biochemical Finding: | | | | | | |
| = Albumin gm/dl (mean) | | 3.1 | 2.7 | 2.9 ± 0.4 | 0.000 | |
| = Bilirubin mg/dl (mean) | | 1.3 | 0.9 | 1.1 ± 0.22 | 0.000 | |
| = PPT seconds (mean) | | 32 | 33 | 32.5 ± 0.8 | 0.322 | |
| = Transaminases IU% (median) | | 90 | 62 | 76 | | |
| = α-fetoprotein IU% (median) | | 307 | 362 | 334.5 | | |
| Viral markers: | | | | | | |
| = HBs AG | | 4 (13.33%) | 2 (6.67%) | 6 (10%) | 0.543 | |
| = HCV | | 24 (80%) | 28 (93.33%) | 52 (86.67%) | 0.283 | |
| = HBs AG+HCV | | 4 (13.33%) | 2 (6.67%) | 6 (10%) | 0.543 | |
| Tumor | = One segment affected: | 22 | 26 | 48 | | |
| | o Left lobe: | 6 | 8 | 14 | | |
| | – Segment 2 | 2 (6.67%) | 0 | 2 (3.33%) | | |
| | – Segment 4 | 4 (13.33%) | 8 (26.67%) | 12 (20%) | | |
| | o Right lobe: | 16 | 18 | 34 | | |
| | – Segment 5 | 2 (6.67%) | 6 (20%) | 8 (13.33%) | 0.37 | |
| | – Segment 6 | 6 (20%) | 8 (26.67%) | 14 (23.33%) | 0.143 | |
| | – Segment 7 | 2 (6.67%) | 2 (6.67%) | 4 (6.67%) | 0.309 | |
| | – Segment 8 | 6 (20%) | 2 (6.67%) | 8 (13.33%) | 0.143 | |
| | = Two Segments | 8 | 4 | 12 | | |
| | o Left and right lobes: | 2 | 0 | 2 | | |
| | – Segment 4 and 7 | 2 (6.67%) | 0 | 2 (3.33) | | |
| | o Right lobe: | 6 | 4 | 10 | | |
| | – Segment 5 and 7 | 4 (13.33%) | 0 | 4 (6.67%) | | |
| | – Segment 5 and 8 | 2 (6.67%)0 | 0 | 2 (3.33%):·· | | |
| | = Tumor size: | | | | | |
| | • Less than 3 cm. | 8 (26.67%) | 4 (13.33%) | 12 (20%) | | 0.361 |
| | • 3 – 5 cm | 22 (73.33%) | 26 (86.67%) | 48 (80%) | 0.361 | |
| | = Tumour Numbers: | | | | | |
| | • Single. | 22 (73.33%) | 26 (86.67%) | 48 (80%) | 0.361 | |
| | • Two | 8 (26.67%) | 4 (13.33%) | 12 (20%) | 0.361 | |

**TABLE 3: Preoperative clinical TNM staging and child-Pugh classification in the studied groups**

| *Items* | *Group I (PRFA)* | *Group II (LUSRFA )* | *Total* | *P-value* |
|---|---|---|---|---|
| *Total number* | *30* | *30* | *60* | |
| Clinical staging (TNM): | | | | |
| • I | 24 (80%) | 26 (86.67%) | 50 (83.33%) | 0.830 |
| • II | 4 (13.3%) | 2 (6.67%) | 6 (10%) | |
| • IIIa | 2 (6.67%) | 2 (6.67%) | 4 (6.67%) | |
| Child's-Pugh classification: | | | | |
| • A | 6 (20%) | 10 (33.33%) | 16 (26.67%) | 0.4 |
| • B | 24 (80%) | 20 (66.67%) | 44 (73.3%) | |

**TABLE 4: Correlation of laparoscopic finding and IOUS with preoperative imaging in LUSRFA group**

| *Items* | *Group I (PRFA)* | *Group II (LUSRFA)* | *Total* |
|---|---|---|---|
| *Total number* | *30* | *33* | *63* |
| Preoperative imaging: | | | |
| • Candidate for RFA | 30 | 33 | 63 |
| • Not candidate | 0 | 0 | 0 |
| Laparoscopic finding: | | | |
| • Candidate for RFA | – | 33 | 33 |
| • Not candidate | – | 0 | 0 |
| Laparoscopic and IOUS finding: | | | |
| • Candidate for RFA | – | 30 | 30 |
| • Not candidate | – | 3 | 3 |

**TABLE 5: Early postoperative course (first one month)**

| *Items* | *Group I (PRFA)* | *Group II (LUSRFA)* | *Total* | *P-value* |
|---|---|---|---|---|
| *Total number* | *30* | *30* | *60* | |
| Hospitalization period: | | | | |
| = Mean time (days) | 3 | 1.2 | 2.6 | 0.048 |
| = Range (days) | 2-5 | 1-2 | 1- 5 | |
| **Procedure related complications** | | | | |
| 1. Port site hernia | 0 | 2 (6.67%) | 2 (3.33%) | |
| 2. Skin burn | 4 | 0 | 4 | 0.048 |
| **Early postoperative complications** | | | | |
| 1. Internal haemorrhage | 4 | 0 | 4 | 0.021 |
| 2. Ascites | 10 (66.67%) | 4 (13.3%) | 14 (23.33%) | 0.035 |
| 3. Acute liver failure | 4 (13.33%) | 0 | 4 (6.67%) | 0.048 |
| 4. Liver abscess | 2 (6.67%) | 2 (6.67%) | 4 (6.67%) | |
| 5. Pleural effusion | 4 (13.33%) | 0 | 4 (6.67%) | 0.048 |
| Early hospital mortality | 4 (13.33%) | 0 | 4 (6.67%) | 0.048 |

**TABLE 6: Tumor volume response**

| *Response* | *Group I (PRFA)* | *Group II (LUSRFA)* | *P-value* |
|---|---|---|---|
| *Number* | *30* | *30* | |
| Partial response | 2 (6.6%) | 4 (13.3%) | |
| Minor response | 18 (60%) | 22 (73.3%) | |
| Stable disease | 4 (13.3%) | 4 (13.3%) | |
| Progressive disease | 6 (20.0%) | 0 | |
| Overall response | 20 (66.6%) | 26 (86.6%) | |
| Mean tumor volume: | | | |
| • Before treatment ($cm^3$) | 3.13 ± 0.8 | 3.90 ± 1.0 | 0.085 |
| • After treatment ($cm^3$) | 2.74 ± 0.7 | 2.73 ± 0.9 | |

**TABLE 7: Tumor marker response**

| *Response* | *Group I (PRFA)* | *Group II (LUSRFA)* | *P-value* |
|---|---|---|---|
| *Number* | *30* | *30* | |
| Complete response | 0 | 8 (26.6%) | |
| Partial response | 12 (40%) | 12 (40%) | |
| Minor response | 4 (13.3%) | 4 (13.3%) | |
| Stable disease | 6 (6.6%) | 6 (20%) | |
| Progressive disease | 8 (26.6%) | 0 | |
| Overall response | 16 (53.33%) | 24 (80%) | |
| Mean value (U/ml): | | | |
| • Before treatment | 307.47 | 362.8 | 0.033* |
| • After treatment | 223.8 | 87.96 | |
| P-value | 0.098 | 0.005 | |

** Is significant.*

**TABLE 8: Late postoperative complications**

| *Items* | *Group I (PRFA)* | | | | | *Group II (LUSRFA)* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Initial number* | *20* | | | | | *30* | | | | | |
| *Time* | *>1-6 ms* | *6-12 ms* | *12-18 ms* | *18-24 ms* | *Total* | *>1-6 ms* | *6-12 ms* | *12-18 ms* | *18-24 ms* | *Total* | *P- value* |
| *Clinical evaluation:* | | | | | | | | | | | |
| 1. Liver failure | 4 | 2 | 2 | 4 | 12 | 2 | 0 | 0 | 0 | 2 | 0.013 |
| 2. Ascites | 4 | 2 | 2 | 4 | 12 | 2 | 4 | 0 | 4 | 10 | 0.563 |
| 3. Pleural effusion | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0.043 |
| 4. Varicea | 2 | 6 | 4 | 0 | 12 | 0 | 4 | 0 | 0 | 4 | 0.0431 |
| 5. Tumour seedling | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| *Deaths* | 4 | 2 | 2 | 4 | 12 | 2 | 4 | 6 | 0 | 12 | |

**TABLE 9: Local recurrence and distant metastases**

| *Items* | *Group I (PRFA)* | *Group II (LUSRFA)* | *Total* | *P-value* |
|---|---|---|---|---|
| *Number of patients* | *30* | *30* | *60* | |
| Local recurrence: | 8 (26.67%) | 4 (13.33%) | 12 (20%) | 0.032 |
| Distant Metastases: | 4 (13.33%) | 2 (6.67%) | 6 (10%) | 0.043 |
| • Pulmonary | 2 (6.67%) | 2 (6.67%) | 4 (6.67%) | |
| • Bony | 2 (6.67%) | 0 | 2 (3.33%) | |

**TABLE 10: Two years disease-free and overall survival**

| *Items* | *Group I (PRFA)* | *Group II (LUSRFA)* | *Total* | *P- value* |
|---|---|---|---|---|
| *Number of patients* | *30* | *30* | *60* | |
| No. of deaths in the first month | 4 (13.33%) | 0 | 4 (6.67%) | |
| Local recurrence | 8 (26.67%) | 4 (13.33%) | 12 (20%) | 0.032 |
| Number of late deaths: | 12 (40%) | 12 (40%) | 24 (40%) | |
| • Deaths due to local recurrence | 6 (20%) | 2 (6.67%) | 8 (13.337%) | |
| • Deaths due to other causes | 6 (20%) | 10 (33.33%) | 16 (26.67%) | |
| Overall deaths | 16 (53.33%) | 12 (40%) | 28 (46.67%) | 0.045 |
| Overall survival | 14 (46.67%) | 18 (60%) | 32 (53.33%) | 0.049 |
| Disease free survival | 12 (40%) | 16 (53.33%) | 28 (46.67%) | 0.042 |

**TABLE 11: Relation between the survival and Child-Pugh stage, size and number of primary tumor**

| *Items* | *Number* | *24 months Deaths* | *24 months Survival* |
|---|---|---|---|
| *Number of patients* | *60* | *28* | *32* |
| = Child – Pugh classification: | | | |
| • A | 16 | 4 (25%) | 12 (75%) |
| • B | 44 | 24 (54.55%) | 20 (45.45%) |
| = Tumor size: | | | |
| • Less than 3 cm | 12 | 2 (16.67%) | 10 (83.33%) |
| • 3 –5 cm | 48 | 26 (54.17%) | 22 (45.83%) |
| = Tumor number: | | | |
| • Single | 48 | 19 (39.58%) | 29 (60.42%) |
| • Two | 12 | 9 (75%) | 3 (25%) |

et al [13] reported that: major complications represent 2.2%. These included acute liver cell failure, intraperitoneal hemorrhage, and Hepatic abscesses. De Baere, et al[11] reported that with radio-frequency ablations performed on 312 patients: Hepatic abscesses occurred in 7 patients, despite the administration of an extended antibiotic prophylaxis regimen.

In our study hospital mortality occurred in 4 (6.67%) patients (all with PRFA). The fatalities were attributed to acute liver failure. In a major study by De Baere, et al,[11] the mortality rate for the RF ablations of a total of 350 cases, was 1.6%. The fatalities were attributed to portal vein thrombosis, liver failure, and colonic perforation. The high rate of hospital mortality may be due to bad liver conditions.

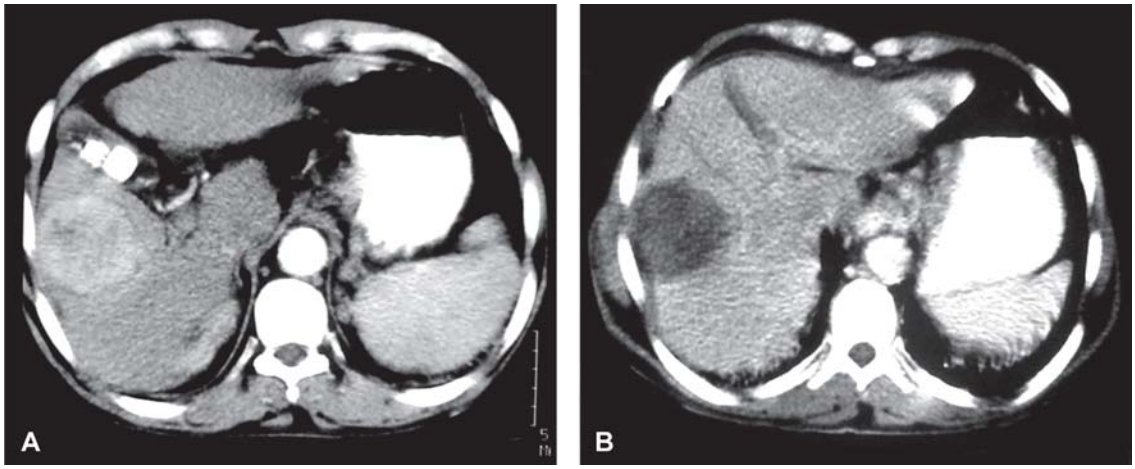


**Fig. 11:** CT-before and after RFA (minor response)

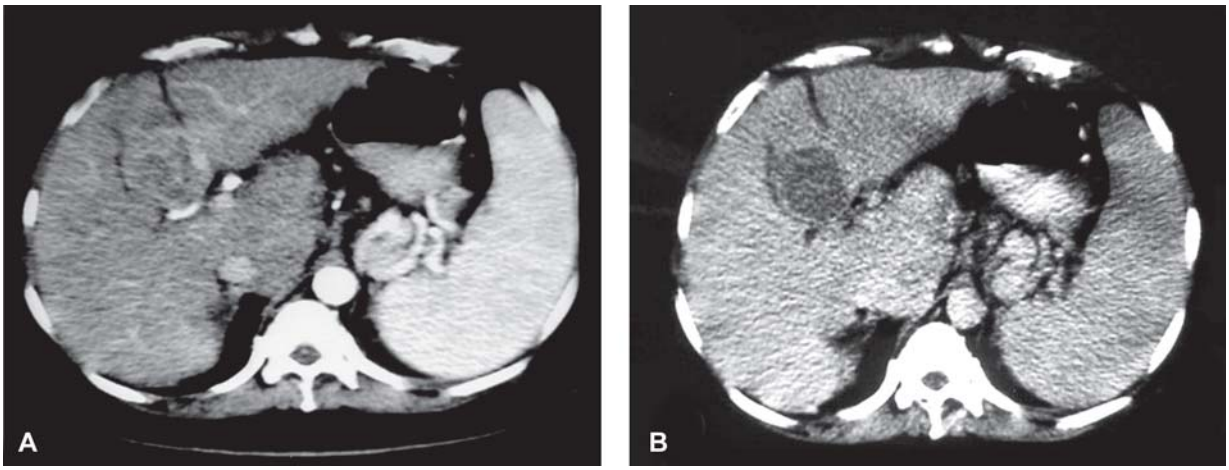


**Fig. 12:** CT-before and after RFA (minor response)

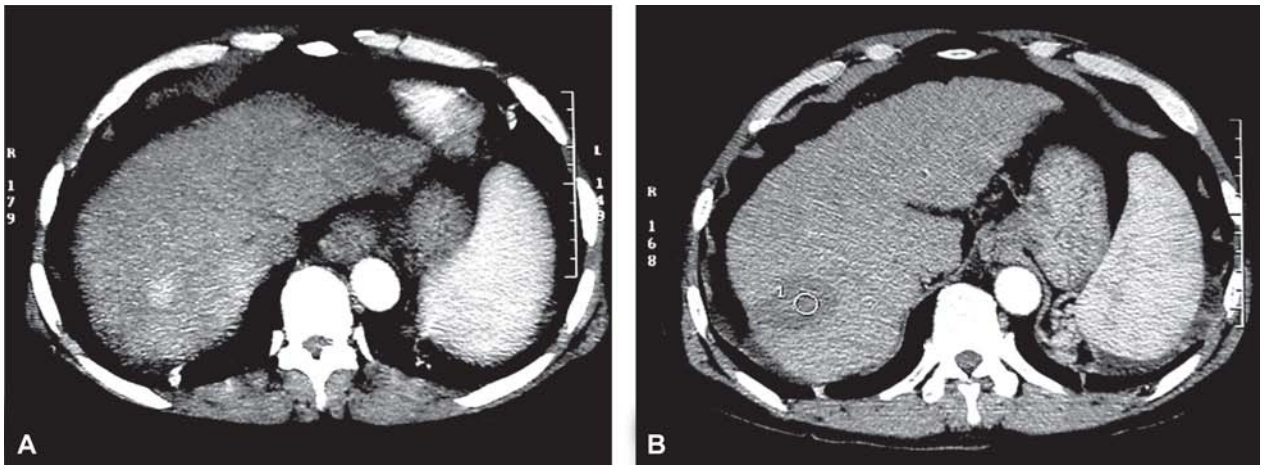


**Fig. 13:** CT-before and after RFA (minor response)

In our study no tumor seedling along the electrode track occurred. Livraghi, et al[14] reported 0.5% tumour seedling along the electrode track, the majority of these cases were noted in poorly differentiated HCC that had previously undergone large needle biopsy procedures. Appropriate maneuvers can be adopted to minimize them. These include indirect puncture of the tumour by the RF electrode through non-tumourous liver parenchyma.

In our patients local recurrence reported in 12 (20%) patients (8 with PRFA and 4 with LUSRFA) (treated with re-ablation with radiofrequency) and distant metastases reported in 10% (4 with PRFA and 2 with LUSRFA). Dominiqu et al [15] reported local recurrence rates of 5.7% for the 227 RFAs. Ashraf et al[16] reported overall recurrence of 65 % within 3 years period.

The 2 years overall and disease-free survival were 53.33% and 46.67% (60% and 53.33% with LUSRFA and 46.67% and 40% with PRFA). The cause of death was local recurrence in 28.57% and cardiopulmonary and cachexia in 71.43%. Vivarelli et al, [17] found that : The 1-year overall and disease-free survival rates were 78% and 60%. While the 3-year overall and disease-free survival rates were 33% and 20%. Ashraf, et al[16] reported Disease-free survival rates of 54.6% at 1 year and 27.3% at 2 years and 20% at 3 years, respectively.

Our study found that 75% of patients with Child-Pugh stage – A , and 83.33% of patients with tumour size less than 3 cm, survived for 2 years, from them 29/32 (90.62%) has single lesion. Vivarelli, et al[17] found that: The survival benefit was more evident for Child-Pugh class-A patients and for patients with a single tumour of less than 3 cm in diameter.

## CONCLUSION

- LUSRFA is a safe and effective treatment for unresctable hepatic malignancies with both curative and palliative role. It may replace hepatic resection in the management of resectable liver tumours in selected cases.
- Percutaneous RFA should be reserved for patients who cannot undergo general anesthesia and those with smaller lesions sufficiently isolated from adjacent organs.
- *LUSRFA has many advantages over PRFA* : (1) It allows patients assessment for radiographically occult, unresectable disease and thus avoiding unnecessary surgical intervention. (2) Some of RFA limitations can be overcome by its laparoscopic application as in cases of subdiaphragmatic lesions in which percutaneous application carry the risk of diaphragmatic thermal injury. (3) Laparoscopic ultrasonography provides better declaration of the number and location of liver tumours. (4) It allows direct visual control of the RFA procedure; exposure and isolation of the liver from surrounding tissue; allow handling of intraoperative bleeding; ablation of several lesions during one operation; fast recovery time; and short hospital stay. (5) Followed by less local recurrence, and distant metastases than percutaneous RFA.

## Practice Recommendations

- *Tissue-energy interactions for RFA can be improved by:* (A) Increasing energy deposition, by cooling tissues nearest the probe. (B) Improving tissue heat conduction by injection of saline, which spreads thermal energy further and faster. (C) Increasing tumour sensitivity to heat by cellular hypoxia or prior tumour damage by radiotherapy or chemotherapy. (D) Decrease heat loss. (E) Reducing blood flow during ablation therapy by embolotherapy before ablation.
- *Several complications can be minimized or even avoided by:* (1) Avoid RFA in cases with tumours that are in close proximity (1 cm) of other viscera. (2) Premedication with intravenous antibiotics to decrease the occurrence or even the severity of hepatic abscesses and peritonitits. (3) Applying RF around the electrode track to avoid tumor

seedling, as well as bleeding. (4) Applying RF prior to any needle or array repositioning, especially if there has been any contact with the tumor.

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