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Percutaneous Microwave Ablation of Hepatocellular Carcinoma: Proper Lesion Selection and Possible Complications

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Abstract

Background: Hepatocellular carcinoma (HCC) represents about 90% of the primary malignant hepatic neoplasms and now it is the third major cause of cancer-related deaths worldwide. The different management choices for HCC include surgical resection, liver transplantation, local tumoral ablation, and trans-arterial chemoembolization. The combination of these different techniques can create the best results for the patients if they were selected properly.

Aim of Study: To assess the role of percutaneous microwave ablation in the treatment of hepatocellular carcinoma and to study the effect of lesion selection on the incidence and types of complications.

Material and Methods: This study was carried out on 85 cases with 100 HCC focal lesions referred for loco-regional management for single and multiple hepatocellular carcinomas, 71 males and 14 females. The age of the patients ranged from 41 to 79 years and the mean age was 61.02 years. All patients were managed by microwave ablation (MWA).

Results: The present study included 85 patients with 100 lesions, all the patients were classified as BCLC, type A having single lesion or multiple (up to 3) HCC lesions. These lesions were not fit for liver transplantation or resection. The lesions were divided into two groups, the first group included non-complicated lesions (n=84) and the second group included complicated lesions (n=16). We had 14 minor complications and 2 major complications. There was significant significance (p=0.028) regarding the number of ablated HCCs between the two groups (as complications were more common when the number of lesions increased). Also, There was significant significance (p=0.04) between the two groups regarding tumors in segment III (p=0.006) and segment VI (as the location of the lesions in these sites increased the incidence of complications). No statistical significance was detected between the two groups regarding age and sex. No statistical significance was detected between the two groups regarding microwave ablation watt or ablation time. No statistical significance was detected between the two groups considering the tumor size.

Conclusion: MWA is an effective method for the treatment of HCC if the lesions are selected properly to achieve complete ablation and to reduce the incidence of major and minor procedural complications.

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Key Words: *Microwave ablation – Hepatic focal lesions hepatocellular carcinoma – Triphasic CT scan – Post-ablation complications.*

Introduction

THE common options for the treatment of hepatocellular carcinoma include surgical excision, hepatic transplantation, tumoral ablation, trans-arterial therapies (chemoembolization, and radiotherapy). Some of these therapies are potentially curative such as hepatectomy, hepatic transplantation, and percutaneous thermal ablation. The remaining options are almost palliative with a possible positive impact on survival rates **[1,2]**.

Few HCC patients (less than 20%) are good candidates for surgical resection and hepatic transplantation. While the ultimate choices for the majority of the patientsare interventional therapies (direct lesional ablation, trans-arterial chemoembolization). But many difficulties are encountered related to location, size, and the number of tumors, vascular or extra-hepatic involvement, and the residual functional hepatic reserve due to extensive cirrhosis affecting most of the patients. In patients with early or intermediate illness, interventional therapies could control disease progression until definitive treatment is possible. In advanced disease stages, the goal of therapy is to reduce the pain, control symptoms, prolong survival rates, and improve quality of life **[3]**.

The idea behind MWA is the usage of electromagnetic energy (up to 2cm surrounding the antenna); to produce a local electromagnetic field that induces rapid and homogeneous heating of targeted tissue. MWA equipment is formed of a generator connected to a mono-polar electrode which is introduced through a percutaneous incision into the tumor. The best heating effect is attained in tissues with high contents of water and the worst

effect is detected in fatty tissues. Another mechanism of MWA function is the ionic polarization to convert kineticenergy to heat energyand subsequently induces localized coagulation necrosis **[4]**.

The MWA machines use frequencies of more than 900 (915 MHz and 2.54 GHz). The MW of about 915 MHz allows deeper penetration than 2450 MHz microwaves. So, theoretically, the MW using a lower frequency can produce a larger area of ablation **[5]**. MWA can be used to treat tumors ranging in size between 5 and 8cm and it can be used also to ablate multiple lesions. Sometimes MW can be a part of combined therapy (ablation followed by resection) **[6]**.

Microwave ablation can cause major such as complications include bile duct stenosis, bleeding, haemothorax or intrahepatic hematoma, peritoneal hemorrhage, liver abscess, colon perforation, and tumor seeding. MWA was not proven to increase the risk of damage to vascular structures and/or bleeding. While minor complications included fever, pain, post-ablation syndrome, and asymptomatic pleural effusions, thickening of the gallbladder wall, and arterio-portal shunt; small stricture of the bile duct; and skin burns which are usually self-limiting or need minor treatment. With the peri-procedural mortality rate being reported to be as low as <0.01%, the safety of MWA was established **[7]**.

Imaging plays an important role during the different stages of diagnosis, treatment, and post-procedural follow-up of patients with HCC. The different imaging modalities involved are ultrasonography (US), computed tomography (CT) scanning, and magnetic resonance imaging (MRI). The most characteristic imaging findings of HCC on triphasic CT studies are significant arterial enhancement with rapid contrast washout on the portal and/or delayed phase. While post-procedural (post-MWA) appearance includes a hypodense non-enhancing area of coagulative necrosis with possible surrounding inflammatory changes **[8]**.

Patients and Methods

Patients:

This study was conducted in the Diagnostic and Interventional Radiology Department of the Gastroenterology Surgery Center at Mansoura University. All cases were referred to our department from the internal medicine hospital, tropical department, and GEC clinics from August 2017 to December 2018. It included eighty-five patients with 100 hepatic focal lesions diagnosed as hepatocellular carcinoma by multidetector post-contrast triphasic CT. All patients underwent thermal ablation microwave ablation of the tumor.

Inclusion and exclusion criteria:

A- *Inclusion criteria:*

- Patientsof any age having malignant hepatic tumors on triphasic CT imaging or triphasic MRI (if there are contraindications to triphasic CT) and not fit for surgical management.
- Both sexes.
- Size of the lesions up to 8cm.
- The number of lesions up to 3 lesions.
- Written consent to participate in the study was obtained from all patients.

B- *Exclusion criteria:*

- Patients with respiratory and circulatory failure
- Patients with manifestations of hepatocellular failure.
- Metastatic hepatic or extra-hepatic deposits.
- Patients with severe allergies.
- Skin sepsis and necrosis at the site of a needle application.
- Severe systemic sepsis.
- Uncontrolled ascites.
- If the Prothrombin level is less than 40%.
- Platelets count that 40 x $10^3/\mu L$.
- INR more than 1.5.
- If the tumor size is more than 8cm.
- If the number of lesions more than 3.
- Pregnant females.

Pre-procedural assessment:

- *Full history taking:*
  - Personal history (including age, sex, and special habits).
  - History of the present illness.
  - History of systemic illness.
  - History of jaundice, blood transfusion, hematemesis, or melena.
  - History of hypertension or recent cardiac troubles.

- *Laboratory assessment:*
  - Liver function tests (including albumin, bilirubin, liver enzymeslevels, and INR value).
  - Serum creatinine level.
  - Alpha-fetoprotein value.
  - Complete blood count.

- *Radiological assessment:*

1- Abdominal ultrasound:

- o To assess the degree of cirrhosis.
- o Detect the presence of ascites.
- o Color Doppler study to assess the relationship between the hepatic focal lesion with the major vascular structures including the hepatic arteries, the hepatic veins, the portal vein, and the IVC.

2- Triphasic CT study of the liver:

- o For accurate characterization of the hepatic focal lesions regarding mainly the number and the site.

3- Triphasic MRI scan of the liver:

- o In this study, it was done for two patients who had an allergy to the contrastmedia (iodinated).

Ethical considerations:

- The study protocol was submitted for approval by The Medical Research Ethics Committee of the Faculty of Medicine, Mansoura University, Egypt.
- Informed written consent will be obtained from all participants in the study.
- Personal privacy was respected at all levels of this study. Collected data were not used for any other purpose.

Methods:

- *Patient preparation:*

A- All patients were advised to have a low residue diet on the day just before the procedure.

B- The patients were admitted to the hospital on the day of the procedure.

C- No food or drinks were allowed after midnight before the procedure.

D- Routine medications were allowed on the day of the procedure.

E- Blood pressure and sugar level measurement just before the procedure.

F- Chest and cardiac examination before the procedure.

G- ECG and Echo are necessary for cardiac patients.

H- Airway examination to ensure its patency.

I- Monitoring of blood pressure, heart rate, and pulse oximeter.

- *Procedure:*

1- The patient lies supine with complete exposure and sterilization of the abdomen.

2- Ultrasound localization of the hepatic focal lesion.

3- Adjust the watt and timethat will be used according to the MWA machine used.

4- Inject local anesthesia at the site of the needle entry followed by performing a small skin incision at this site.

5- Percutaneous guided ultrasound (by application of the convex probe 3.5 MHz). Then applyingthe MWA needle targeting the center of the focal lesion.

6- General anesthesia starts with the beginning of ablation.

7- When the ablation ends, we perform the US to ensure complete tumoral ablation followed by cooling of the needle before its removal.

- *Post-procedural care:*

º The patients were admitted into the hospital to be kept under observation for at least 4 hours. The patients were discharged if vital signs are stable and no complications occurred.

º Patients were advised to take oral antibiotics and antipyretics if there were sustained pain or fever for 5 days.

º If any complications occurred the patients were advised to come back to the hospital.

Follow-up:

1- Immediate post-procedural US was done to exclude the presence of free fluid, collections, or pleural effusion.

2- Post-contrast triphasic CT scan of the abdomen after two weeks of the procedure to evaluate the degree of tumor ablation as well as the presence of complications.

3- AFP blood level was also measured.

4- If the triphasic CT study showed no residue with normal AFP level, both tests were repeated after 3 months.

Statistical analysis:

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Quantitative data were described using mean, the standard deviation for parametric data after testing normality using the Kolmogorov-Smirnov test. The significance of the obtained results was judged at the 5% level. Student *t*-test; for parametric quantitative variables, to compare between two studied groups. Chi-Square test; for categorical variables and Monte Carlo test when appropriate. All tests were 2 tailed.

Results

This study included 85 patients with 100 HCC focal lesions 71 males (83.5%) and 14 females (16.5%). The age of the patients ranged from 41 to 77 years and mean age was 61.02 years. Patients were further classified into two main groups. The first group involving complicated cases and the second group involving the non-complicated cases.

I- *Demographic data (age and sex):*

In 85 patients with 100 hepatic focal lesions included in this study are illustrated in Table (1), Figs. (1,2). There was no significant difference between the two groups regarding age and sex.

Table (1): Demographic criteria of the studied cases.

	No complication n=84	Complication n=16	Test of significance
Age / years Mean ± SD	61.19±6.71	60.13±9.24	t=0.55 p=0.59
Sex, n (%): Male Female	71 (83.3) 14 (16.7)	13 (81.2) 3 (18.8)	χ^2=0.04 p=0.84

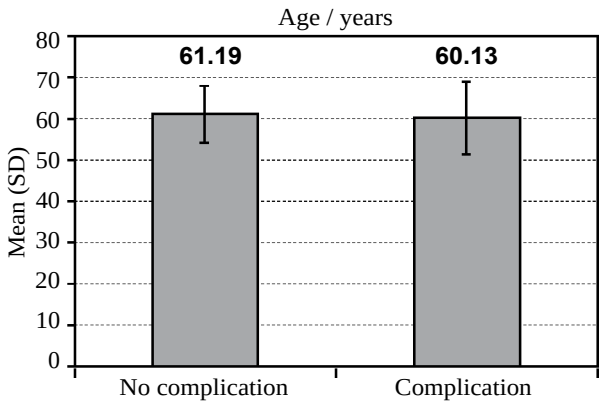

Fig. (1): Age distribution in the study group.

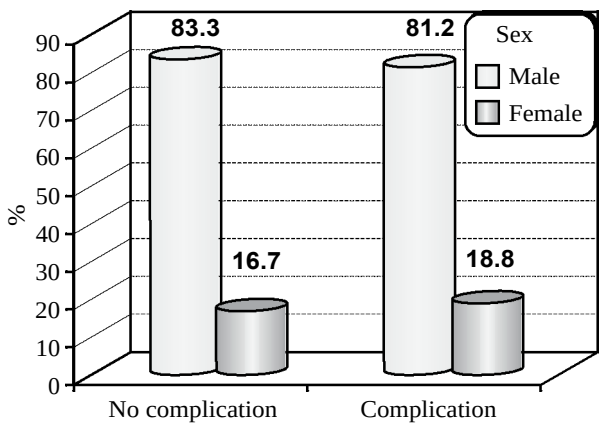

Fig. (2): Sex distribution in the study group.

II- *Values of the mean watt and time:*

The mean watt and timeused in MWA of 100 lesions (complicated cases & non-complicated cases) are illustrated in Table (2), Figs. (3,4). There was no significant difference between the two groups regarding the mean values of watt and time.

Table (2): Distribution of lesions according to time & wattused in MWA of 100 lesions.

	Non-complicated cases n=84	Complicated cases n=16	Test of significance
Time: Mean ± SD	8.61±4.1	9.38±4.4	t=0.68 p=0.5
Watt: Mean ± SD	69.99±20.54	70.31±17.46	t=0.06 p=0.95

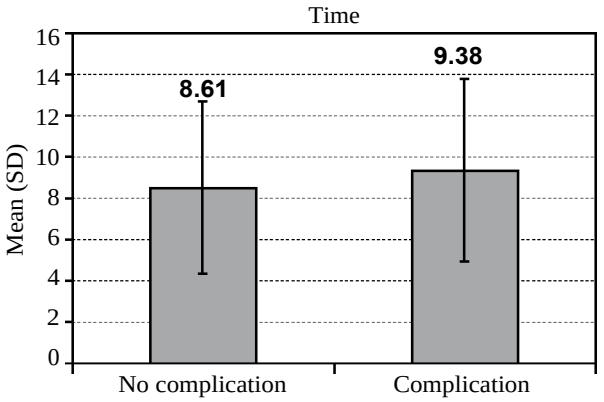

Fig. (3): Distribution of lesions according to time used in MWA in complicated and non-complicated cases.

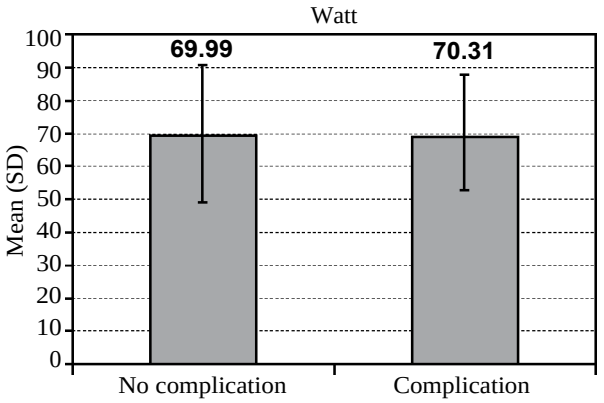

Fig. (4): Distribution of lesions according to watt in complicated and non-complicated cases.

III- *The relation between tumor size (<3cm and ≥3cm) and the incidence of complications:*

The sizes of the studied 100 lesions are illustrated in Table (3) and Fig. (5). Mean values of tumor size (<3cm and ≥3cm) in both complicated and non-complicated cases were found to be statistically insignificant.

Table (3): Distribution of lesions according to tumor size categories.

	Non-complicated cases n=84	Complicated cases n=16	Test of significance
Size in cm	39±1.13	3.42±1.18	t=0.07 p=0.94
Mean ± SD	n (%)	n (%)	
<3	30 (35.7)	7 (43.8)	χ^2=0.37
≥3	54 (64.3)	9 (56.2)	p=0.54

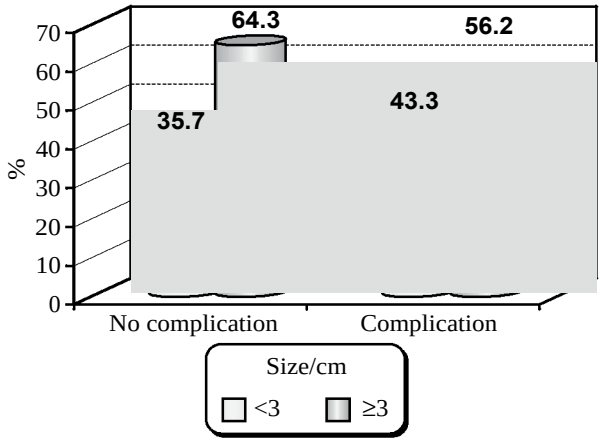

Fig. (5): Distribution of lesions according to size in complicated and non-complicated cases.

IV- *The relationship between tumor number and incidence of complications:*

The relationship between tumor number and incidence of complications in 85 cases with 100 lesions are illustrated in Table (4) and Fig. (6). This relation was found to be statistically significant (this means that the incidence of complications increased when the number of lesions increased).

Table (4): Distribution of lesions according to tumor numbers.

	Non-complicated cases n=84	Complicated cases n=16	Test of significance
Tumor number n (%):			MC
1	75 (89.3)	12 (75.0)	p=0.028*
2	7 (8.3)	1 (6.2)	
3	2 (2.4)	2 (12.5)	

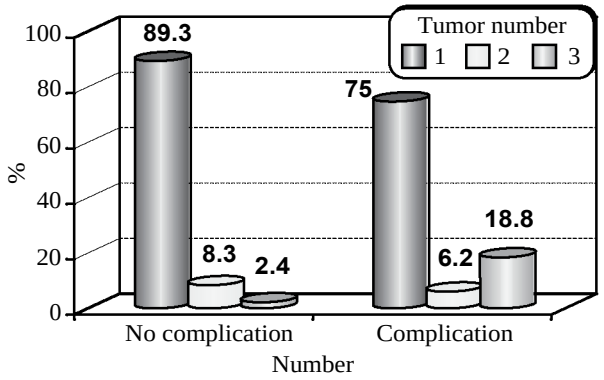

Fig. (6): Distribution of cases according to tumor numbers in complicated and non-complicated cases.

V- *The relation of tumors (lesions) site (segmentation) to the incidence of complications:*

The relation of tumors site to the incidence of complications in the studied cases are illustrated in Table (5) and Fig. (7). We found that statistically significant relationship between the lesions located in segment III and segment VI with the incidence of complications.

Table (5): Distribution of lesions according to segmental lesion location.

	Non-complicated cases n=84	Complicated cases n=16	Test of significance
Tumor site n (%) :			
2	13 (17.9)	1 (6.25)	χ^2_2=1.35, p=0.24
3	4 (4.8)	5 (31.25)	χ^2_2=11.5, p=0.006*
4	12 (16.7)	2 (12.5)	χ^2_2=0.17, p=0.68
5	7 (9.5)	1 (6.25)	χ^2_2=0.18, p=0.67
6	16 (21.4)	0 (0.0)	χ^2_2=4.18, p=0.04*
7	16 (21.4)	5 (31.25)	χ^2_2=0.73, p=0.39
8	13 (17.9)	5 (31.25)	χ^2=1.51, p=0.22

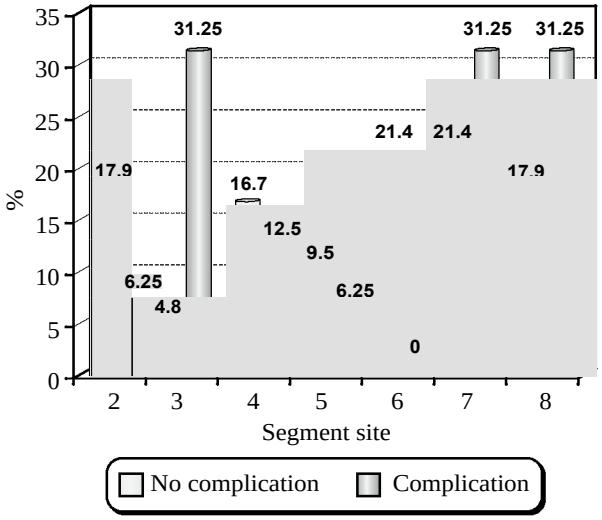

Fig. (7): Distribution of lesions according to segmental lesion location in complicated and non-complicated cases.

VI- *The incidence rate of complications and its degree:*

The incidence rate of complications and its degree 85 patients with 100 lesions are illustrated in Table (7).

Table (6): Distribution of complicated lesions according to the degree of complications.

Complication type n=16	N=16	%
Minor	14	87.5
Major	2	12.5

Fig. (8): Male patient aged 67 years old with hepatitis C cirrhosis. The patient was stage A according to the BCLC staging system. Microwave ablation of the right liver lobe HCC (segment VII) was done. (A&B): Triphasic CT of the abdomen (A) arterial and (B) portal phases showing a well-defined mass in the right lobe segment VII measuring 4.2 x 3cm, with faint arterial enhancement (yellow arrow) and rapid washout (red arrow) characteristic of HCC. (C): Post MWA non-contrast CT revealed right liver lobe large Abscess at the site of ablation (blue arrow) with right-sided pleural effusion (blue arrow).

Fig. (9): Male patient aged 74 years old with hepatitis C cirrhosis complicated by single right liver lobe HCC at segment VII. initially detected by ultrasound examination. Triphasic CT of theMicrowave ablation of the right liver lobe HCC was done. Two weeks follow-up triphasic CT of the abdomen revealed complete ablation of the focal lesion in the form of a hypo-dense non-enhancing focal lesion with a single minor complication in the form of the broken tip of a microwave needle.

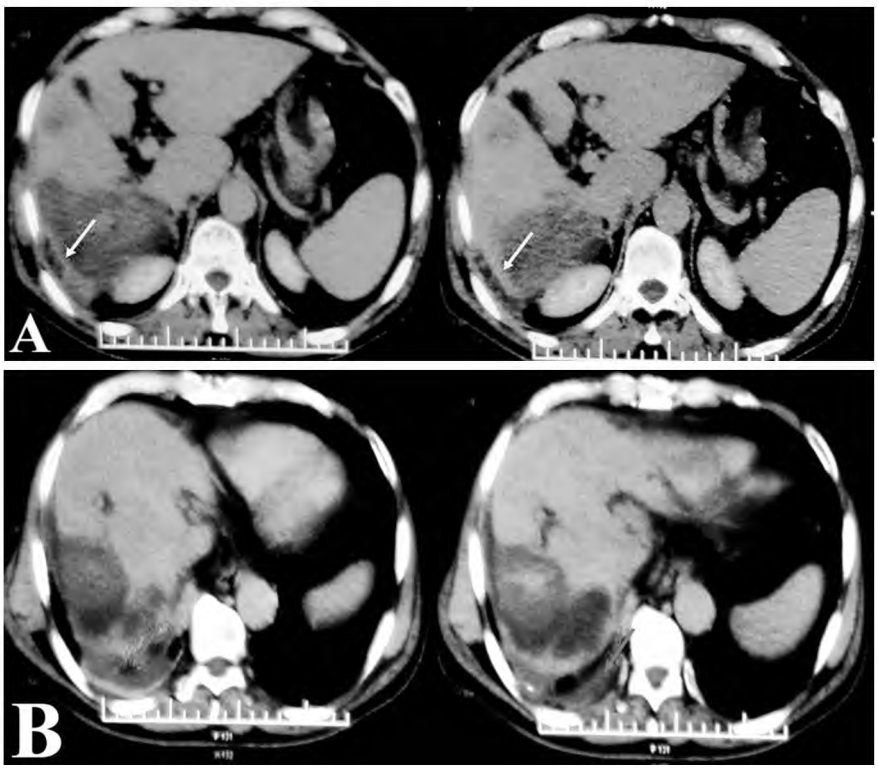

Fig. (10): Male patient aged 67 years old with hepatitis C cirrhosis. A triphasic CT abdomen was done and revealed a single HCC at segment VI/VII. (A&B): Triphasic CT abdomen showing a well-defined hypo-dense non-enhancing focal lesion in the right lobe segment VI/VII, coping with completely ablated HCC with peri-hepatic fluid collection (Yellow arrow) and right-sided pleural effusion (Red arrow).

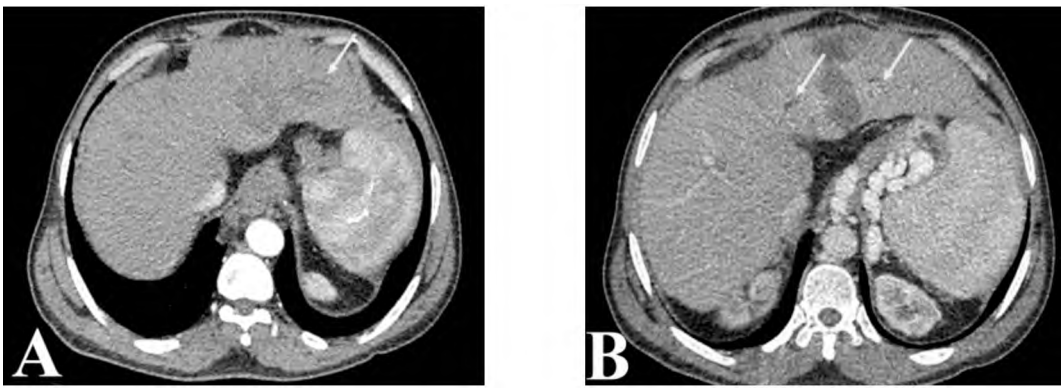

Fig. (11): Male patient aged 56 years old with hepatitis C cirrhosis. A triphasic CT abdomen was done and revealed 2 HCCs at the lateral segment of the left liver lobe. Microwave ablation of the 2 adjacent left liver lobe HCC was done. The patient was evaluated by triphasic CT of the abdomen two weeks after the procedure revealing complete ablation of left liver lobe HCC with peri-focal biliary dilatation. (A,B): Triphasic CT abdomen (A): Arterial (B): Portal phases showing a well-defined area of MWA in the left lobe segment II/III interface with no enhancement in all phases impressive of completely ablated HCC with peri-focal biliary dilatation (Yellow arrow).

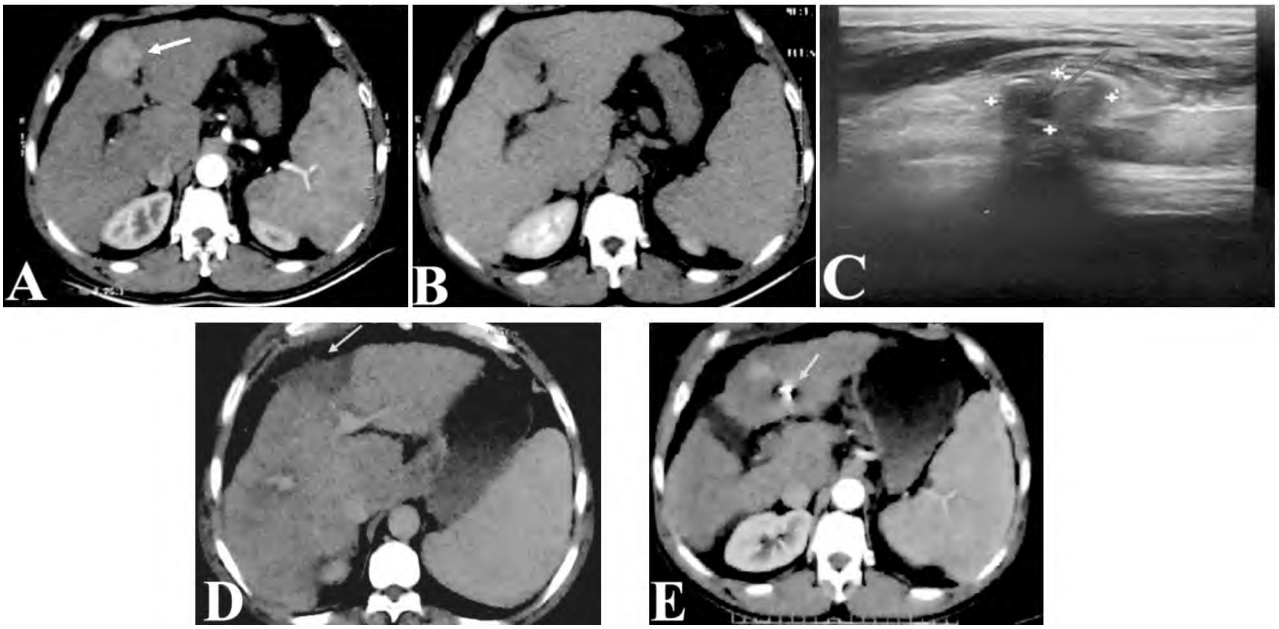

Fig. (12): A male patient aged 49 years old with hepatitis C cirrhosis complicated by left liver lobe HCC detected by triphasic CT examination. (A&B): Triphasic CT abdomen (A) arterial (yellow arrow). (B) Delayed (red arrow) showing a well defined focal lesion in the left liver lobe segment IV measuring 5 x 5cm, with arterial enhancement and rapid washout in portal phases characteristic of HCC. (C): Ultrasound shows peri-hepatic collection related to the site of previous MWA near segment IV (blue arrow). (D): Triphasic CT shows peri-hepatic collection near the site of the previous ablation at segment IV (orange arrow). (E): Triphasic CT shows evidence of MWA needle tip fracture (Green arrow).

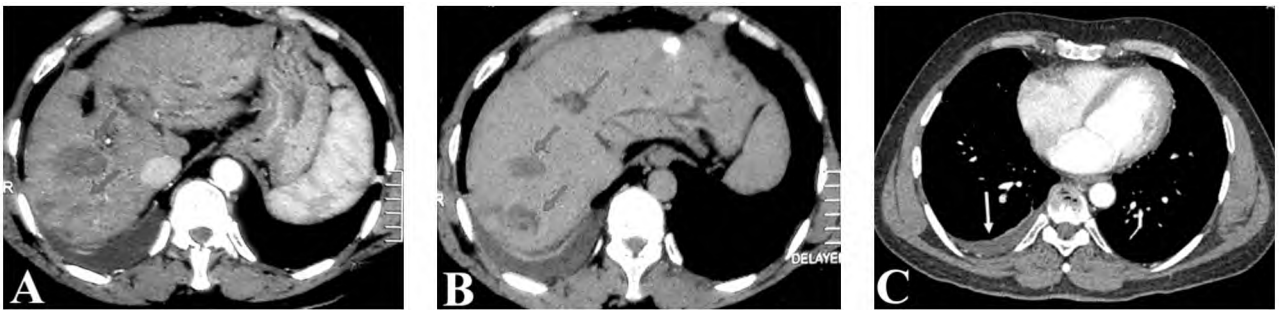

Fig. (13): Male patient aged 54 years old with hepatitis C cirrhosis complicated by right liver lobe HCC. Triphasic CT of the abdomen revealed 3 HCCs. (A&B): Triphasic CT abdomen (A): Arterial (B): Delayed phases showing multiple right lobe hypo-dense non-enhancing focal lesions in the right lobe segment VII & VIII denoting complete ablation of the hepatic focal lesions (Red Arrows). (C): Triphasic CT abdomen revealed complications in the form of mild right-sided pleural effusion. (Yellow arrows).

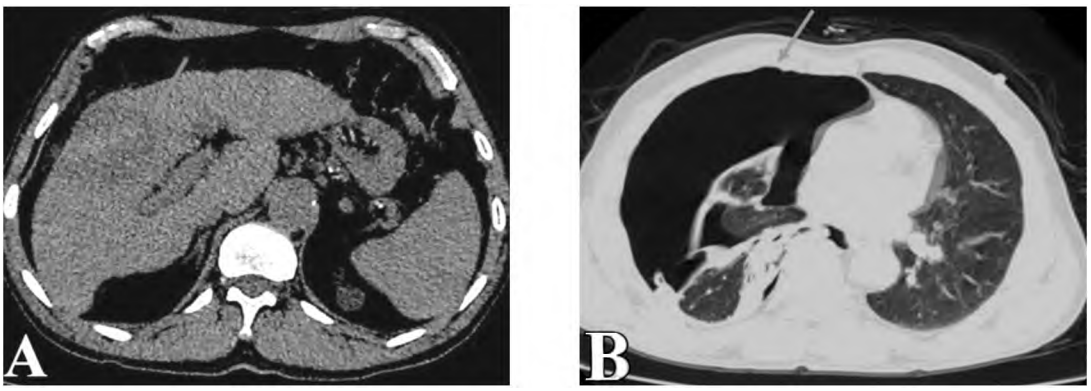

Fig. (14): Male patient aged 73 years old with hepatitis C cirrhosis. Triphasic CT of the abdomen revealed a single HCC. (A): Non-contrast CT of the abdomen showing a well defined focal lesion in the right lobe segment V denoting the previous ablation of the hepatic focal lesion (Red arrow). (B): Non-contrast CT chest revealed pneumothorax of the right lung 5 days post-MWA of the right liver lobe (Segment V) HCC (Yellow arrows).

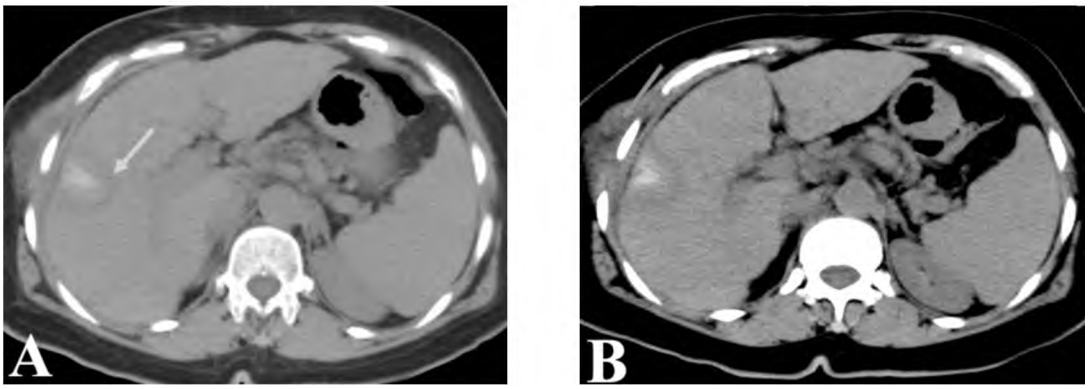

Fig. (15): A female patient aged 63 years old with hepatitis C cirrhosis presented by right liver lobe HCC. Two weeks follow-up triphasic CT of the abdomen revealed complete response to the ablation with no residual HCC lesions and subcutaneous and muscular burn related to the site of micro-wave needle insertion. (A&B): Non-contrast CT abdomen showing a well defined hypo-dense focal lesion in the right lobe segment VIII (Yellow arrow) measuring 3.5 x 3.2cm, with surrounding subcutaneous and muscular burn (Red arrow).

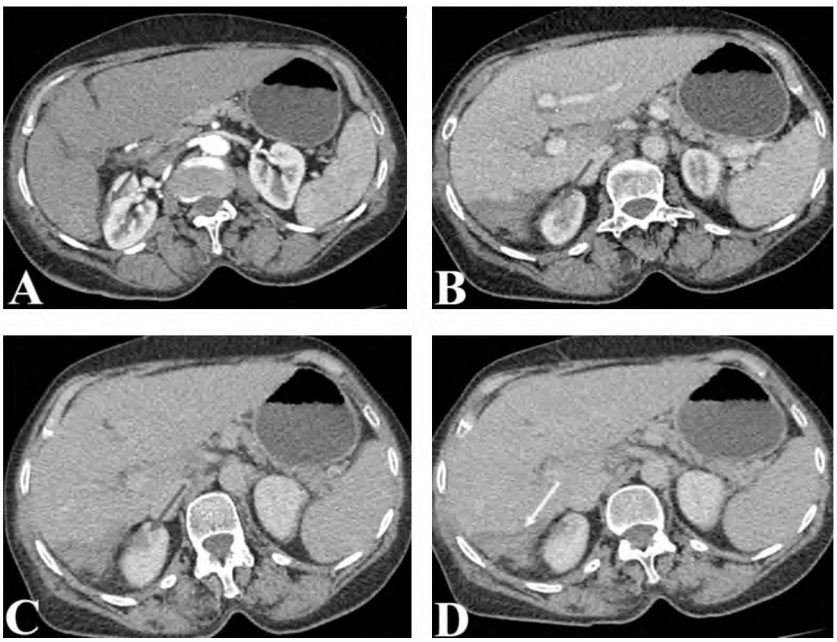

Fig. (16): A female patient aged 70 years old with hepatitis C cirrhosis presented by right liver lobe HCC. (A,B,C&D): Triphasic CT abdomen (A): (Arterial), (B): (Portal), (C): (Delayed), (D) (Hypodense area) showing well-defined hypo-dense non-enhancing area in segment VI of the right liver lobe in all phases (Yellow arrow) with a hypodense area in the capsule and cortex of the right kidney (Red arrow).

Discussion

Hepatocellular carcinomais considered the third ommon cause of death and the fifth most common type of malignancy worldwide. It occurs as a serious complication of hepatic cirrhosis and hepatitis (particularly viral hepatitis B and C). Unfortunately, Egypt has the highest incidence of HCV infection with an average of 13.8% among the Egyptian population **[5]**.

Obligatory screening programs for early detection of hepatitis and hepatocellular carcinoma are mandatory to reduce their high incidences among targeted populations. Early detection of cases allows complete cureusing; medical treatment, surgical procedures, orinterventional and ablative techniques **[9]**.

Microwave ablation is an important toolin the treatment of HCC, it can be used to induce total eradication of the whole tumor tissue resulting in liver free. It can be used also to allow down-staging of large-sized tumors to prepare the patient for surgical resection and liver transplantation **[10]**. Microwave ablation of hepatic tumors is considered a safe procedure with a low mortality rate and a relatively low incidence of serious complications. It is also considered an efficient procedure in the total ablation of malignant hepatic lesions as HCC **[11]**.

Eighty-five patients with 100 HCC focal lesions were included in our study with single or multiple focal lesions of HCC with BCLC stage A, all of our patients weren't fit for surgical treatment. They were 71 males and 14 females (male to female ratio nearly was to 5:1). This was in agreement with McGlynn et al., 2015 **[12]** who stated that hepatocellular carcinoma is more common in males than females and that the gender disparity in rates is not well understood. It may be possible due to the effects of steroid hormones and different genetic codes. Regarding the age of the patients, it ranged from 41 to 79 years, with a mean age ± SD equals 61.02±7.13 years. This was in agreement with Amer et al., 2015 **[13]**, and Chu et al., **[14]**, both studies stated that HCC was more common in the 6^{th} and 7^{th} decades decade of life. In our study, the age and sex differences between complicated and non-complicated cases were statically insignificant and this was in agreement with the study performed by Biondetti et al., **[15]**.

One of the advantages of the Barcelona Clinic Liver Cancer staging system (BCLC) is its ability to provide a guideline format to link each tumor stage with the appropriate therapeutic interventions **[11]**. In our study, all the patients were classified as BCLC type A.

Surgical options including liver transplantation or surgical resection and local tumoral ablation are the best lines of treatment for BCLC A stagepatients. When there are contrain dications for liver transplantation or surgical resection, ablative techniques by microwave ablation or radio-frequency are the best lines of treatment **[16]**. While transarterial chemoembolization (TACE) is the standard treatment choice for the BCLC B stage (2). The major contraindications of percutaneous ablation include un-cooperative patients, and certain tumor sites (liver dome, adjacent to the gallbladder, major vessels or right kidney, and exophytic large tumors) **[17]**.

Regarding BCLC guidelines for the usage of either MWA or RFA in the treatment of HCC, studies showed that MWA is an effective and safe interventional procedure with many advantages over RFA that include less sensitivity to the "heat-sink effect" (effect of blood vessels close to the ablation zone), faster ablation and larger areas of ablation. MWA is a good choice specially with inoperable liver tumors to decrease the morbidity and mortality rates **[18]**.

In the present study, our patients were classified into two main groups, the first group included non-complicated lesions (n=84) and the second group included complicated lesions (n=16). There was no statistical difference regarding the mean watt used or in the time consumes during the ablation between the two. In both complicated (mean watt: 70.31 watt, mean Time: 9.38min) and non-complicated cases (mean watt: 69.99 watts, mean Time: 8.61min), they were near to the same values regarding the watt & time. These results were in agreement with Smolock et al., **[19]**, and Kamal et al., **[20]**.

Many studies evaluated the factors resulting in the development of post-ablation complications, and there is an ongoing debate regarding this issue. In our study, the tumor size factor (<3cm or >3cm) in complicated (mean=3.42cm) and non–complicated cases (mean=3.39cm) was not found to be statically significant and this was in agreement with the studies performed by Smolock et al., **[21]**, Lee et al., **[22]** and An et al., (2018) **[23]**. On the contrary, there was disagreement with the studies performed by Liang et al., **[24]**, Ong et al., **[25]** & Wang et al., **[26]** found the tumor size to be statically significant. In the study carried out by Wang et al., **[26]**, it included 100 cases over one year reported

that the Microwave ablation success rate was significant in the tumor size less than 3cm as compared to the tumor greater than 3cm and they had a higher success rate in the small tumors less than 3cm.

In our study, the tumor multiplicity between both groups was found to be a statically significant factor, as most of these hepatic lesions were having already a large size and this increased the possibility of resultant hepatic coagulative necrosis and subsequently increased the incidence of complications. These results are in agreement with Liang et al., 2005 **[24]** & Ong et al., **[25]** but these results were not in agreement with Liang et al., **[6]**, and Groeschl et al., **[26]** and they explained their results, by the fact that MWA causes small areas of hepatic damage during the ablation process.

Regarding the specific tumor sites, in our study, we had 14 lesions in segment II, 9 lesions in segment III, 14 lesions in segment IV, 8 lesions in segment V, 16 lesions in segment VI, 21 lesions in segment VII, and 18 lesions in segment VIII. We found that there is a statically significant difference between both groups regarding the hepatic focal lesion in segment III and segment VI in comparison to hepatic tumors in other liver segments which were statically insignificant. These results are in agreement with Soliman et al., **[11]** and Dou et al., **[27]** as they agreed with our results that certain sites of the hepatic focal lesions seem to affect the efficacy of the procedure or the incidence of subsequent complications.

In our study; the Incidence of complications is relativelylow as we had 16 complicated cases in the whole study, 14 minor complications (14%), and 2 major complications (2%) with no incidence of death among the study cases.

The incidence of major complications in our study was lower than the incidence reported by-Ding, et al., **[28]** and Bertot, et al., **[29]**. While, the incidence of minor complications reported in our study was higher than the incidence reported by Livraghi, et al., **[7]**.

Follow-up of non-complicated cases was done 2 weeks after the ablation by triphasic CT abdomen and by AFP to ensure complete ablation of the hepatic tumors with no residual enhancing tumor tissue or presence of complications. The minor complications resolvedafter 2 weeks up to 3 months, during the post-procedural follow-up of thepatients with no need for any type of intervention to treat them. On contrary, the major complications needed interventional management inthe form of tube drain insertion, hospital admission, and mandatory follow-up every 3 days then every week till complete recovery.

If there was complete ablation with no residual tumor tissue and absence of complications (either minor or major), The triphasic CT abdomen and AFP were repeated after 3 months. During the 3 months follow-up after MWA, five patients with marked cirrhosis showed newly developed foci of HCC, so they were referred to perform TACE.

Artificial ascites was done for 2 cases with subcapsular lesions near to vital organs (one of them was close to the diaphragm and the other close to the duodenum) through injection of 150ml saline to widen the space between these lesions and adjacent vital organs, then the MWA was done successfully and completely without injury of these structures.

This study had few limitations; first, we could not assess the rate of tumor recurrence after MWA as this needed long term to follow. Second, thenumber of patients is relatively small. Third, Further studies are required to compare the efficacy of MWA with other interventional techniques.

Conclusion:

- The microwave ablation is an effective and safe method for the treatment of HCC with a good ablative response and reduced incidence of complications.
- The successful ablation depends on the accurate selection of candidates for MWA according to Barcelona Clinic Liver Cancer (BCLC) Staging.

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دراسة دور الكى الحرارى فى علاج أورام الكبد ودراسة تأثير إختيار البؤر المناسبة للكى على إحتمالية حدوث المضاعفات

هذه الدراسة تم إجرائها على ٨٥ حالة لديهم ١٠٠ ورم خبيث بالكبد وتم تحويلهم لإتخاذ الإجراء المناسب لعلاج مثل هذا الورم. تم إجراء الدراسة على ٧١ ذكر و١٤ أنثى تتراوح أعمارهم ما بين ٤١ إلى ٧٩ سنة بمتوسط عمر ٦١ سنة. تم علاجهم بإستخدام الكى الحرارى للورم.

يعتمد إجراء الكى الحرارى لأورام الكبد على وظائف وحالة الكبد. تم تحقيق الإستجابة الكاملة تقريباً فى كل الحالات مع وجود بعض المضاعفات بدرجات مختلفة مع ١٦ بؤرة كبدية سرطانية. ١٤ حالة كان لديهم مضاعفات بسيطة وحالتين كان لديهما مضاعفات كبيرة

أوضحت هذه الدراسة عدم وجود فرق ذو دلالة إحصائية بين الحالات ذات المضاعفات والأخرى الخالية من المضاعفات تبعاً لسن المريض ونوعه وقوة ووقت الكى الحرارى وحجم الورم. بينما كان هناك فرق ذو دلالة إحصائية تبعاً لعدد البؤر السرطانية ومكانها فى الكبد.

لم يتم التمكن من إحصاء معدل انتكاس الحالات بعد إجراء الكى الحرارى لأنها تحتاج لمتابعة على المدى الطويل (عدة سنوات) وكذلك إجرائها على عدد كبير من الحالات.

اشتملت هذه الدراسة على مرضى لديهم بؤرة كبدية سرطانية أو أكثر (لا تزيد عن ثلاث بؤر) ولا يمكن إجراء استئصالها أو إجراء عملية زراعة كبد لها ولذلك وجد أن الكى الحرارى فى هذه الحالات يعد وسيلة آمنة و فعالة وذلك نظراً لقلة المضاعفات المصاحبة لإجراء الكى الحرارى ونتائجه الجيدة.

تم إثبات أن الأشعة المقطعية تعد وسيلة هامة وفعالة فى إكتشاف ومتابعة المضاعفات التى قد تنتج عن عملية الكى الحرارى.