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OPEN PEER REVIEW

Shear Wave Elastography in Evaluating the Efficacy of Liver Microwave Ablation: An Experimental Study

Dandan Xu, Chao Tian, Shan Wei

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About this report

This open peer review (OPR) report shows the public comments made on this article during peer review, by the reviewers, the associate editor and the editor-in-chief, for every revision round, together with the authors' replies. Comments appear only with the consent of the people who wrote them. Reviewers who chose to sign their report are named; the others are shown as "Referee". Comments are edited for language only, and confidential remarks to the editors are not included.

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1 Original submission

4 comments · 6 Mar 2024 – 13 Mar 2024

Referee 1 Reviewer

MINOR REVISION 6 Mar 2024

Thank you for submitting your manuscript to the Iranian Journal of Radiology.
The main goal of this study was to assess the accuracy of shear wave elastography (SWE) in evaluating the ablation margin region in liver parenchymal tissue undergoing microwave ablation. This study was conducted on 15 healthy male 5-month-old mini-pigs. A total of 156 effective ablations and 740 effective SWE measurements were conducted, and 131 effective pathological results were obtained. After analysis, the authors concluded that the range of elastic modulus in the ablation margin region is relatively fixed. However, the position of the ablation margin region is not fixed. Generally, as the ablation time is prolonged, the ablation margin region will be further away from the ablation center. In the ablation center region, the elastic modulus decreased in a stepwise manner with the shortening of ablation time.

I would like to say that the main idea of the study is interesting and the manuscript is well written; however, there are some drawbacks in this manuscript as follows:

1. I would recommend rewriting the title as it does not state the main goal of this study properly.
2. Please write the full word “day” instead of d in lines 75 and 76.
3. Please write the generic name of the drug “Su-Mian-Xin” in line 81.
4. It seems that different zones surrounding microwave electrodes are mainly defined based on the pathological findings such as the percentage of cellular necrosis; however, it is not stated how the authors determine the consistency of these pathological zones with the SWE map. If there were any measurements, they should have been mentioned in the manuscript.
5. Please define “OCT” in line 119.
6. The meaning of Lines 168-172 on page 10 is not clear and could be interpreted in a wrong way. Please edit it.

Referee 2 Reviewer

MINOR REVISION 9 Mar 2024

I have carefully reviewed your manuscript and find the study to be promising. The results and discussion provide valuable insights into the feasibility and accuracy of using shear wave elastography (SWE) for the quantitative evaluation of microwave ablation margins in the liver. However, I believe that some minor revisions are necessary to improve the clarity and scientific rigor of the manuscript. I would like to draw your attention to the following points for your consideration:

Abstract
1. Lack of Background Information: The abstract background should briefly introduce the concept of microwave ablation, its application in the treatment of liver lesions, and the significance of evaluating the ablation margin.
2. Insufficient Methodology Description: The abstract's methodology section lacks important details that should be included. These details consist of information about the total sample size and group sizes, randomization process, blinding procedures, inclusion and exclusion criteria, laparotomic procedure, timing and intervals of measurements using shear wave elastography (SWE), statistical analysis, and explanations of symbols or syntax used.
3. Incomplete Results Summary: The abstract results should clarify the units of measurement (e.g., kPa for

elastic modulus). The abstract fails to mention the main findings related to the distribution of the elastic modulus within the ablation lesions and the observed differences for different ablation times.

Methods

4. Insufficient information on animal characteristics: The description of the experimental animals lacks important details such as their breed, genetic background, and housing conditions. These factors can have an impact on the study outcomes and should be properly documented.

5. Insufficient information on sample size determination: The methodology does not mention the rationale or calculation used to determine the sample size of 15 animals.

6. Lack of randomization and blinding: The methodology does not mention any randomization process or blinding procedures implemented during the study. Randomization helps to minimize bias, while blinding ensures objectivity in data collection and analysis.

7. Inadequate description of anesthesia and pain management: The methodology briefly mentions the use of anesthesia but does not provide sufficient details about the specific anesthetic agents, dosages, and methods of administration. Similarly, there is no mention of pain management protocols, which are crucial for the welfare of the animals involved.

8. Limited details on the surgical procedures: The methodology lacks specific information about the surgical procedures performed on the animals, such as the techniques used for castration and the details of the incision and closure methods.

9. Statistical analysis

a. Lack of information on data distribution and assumptions: There is no mention of assessing the distribution of the data or checking the assumptions required for the chosen statistical tests, such as normality or homogeneity of variances.

b. Limited explanation of the analysis methods: The text mentions that analysis of variance (ANOVA) was used to compare the data among different time groups, followed by pairwise comparisons using the LSD-t test. However, no details are provided regarding the specific ANOVA model used (e.g., one-way, two-way) or any adjustments made for multiple comparisons.

c. Importance of utilizing tests for dependent data: In Table 2, to compare the differences within each group across three different time points, it is essential to employ either repeated measures analysis of variance (ANOVA) or the Friedman test, depending on the distributional characteristics of the data. Furthermore, for a better understanding of trends and differences, it is advisable to include graphs of repeated ANOVA as well.

d. Lack of power analysis: The text does not mention whether a power analysis was conducted to determine the appropriate sample size for detecting meaningful effects. A power analysis is important for ensuring adequate statistical power and minimizing the risk of type II errors.

e. Inadequate reporting of significance threshold: The text states that a p-value of less than 0.05 was considered statistically significant, but it does not specify whether this threshold was adjusted for multiple comparisons or provide any justification for the chosen threshold.

Results

10. Lack of clarity and organization: The text lacks clear headings or subheadings to separate different sections of the results. This makes it difficult to follow the flow of information and locate specific findings within the text.

11. Insufficient explanation of figures and images: The text references figures and images (e.g., Figure 2, Figure 3), but it does not provide captions or clear explanations of these figures.

12. Lack of data presentation: The text describes different regions and observations but does not present the actual numerical data or statistical analyses. Providing summary statistics, mean values, standard deviations, and p-values would improve the clarity and reliability of the results.

Discussion

13. Lack of integration with previous research: The discussion briefly mentions previous studies on elastography and microwave ablation but does not effectively integrate these findings into the current study. It would be beneficial to compare and contrast the current findings with previous research to provide a broader context and highlight the novelty or significance of the current study.

14. Lack of future directions: The discussion does not mention any future research directions or potential areas for further investigation. Including suggestions for future studies based on the current findings would add depth and completeness to the discussion section.

Please make the necessary revisions and provide a detailed response to each point raised in this review. I look forward to reviewing the revised version of your manuscript.

Associate Editor MINOR REVISION 13 Mar 2024

This manuscript was studied by two expert reviewers and by me. I agree with the reviewers' comments that it can be reconsidered following the suggested modifications and corrections.

Editor-in-Chief MINOR REVISION 13 Mar 2024

Dear authors,
Your article needs Minor Revision.
Regards

2

Revision 1

AUTHORS' RESPONSE TO REVIEWERS

Authors' reply to reviewers

The next pages contain the authors' point-by-point reply to the comments of this revision round, as submitted with the revised manuscript. It is published as the authors wrote it.

Dear Editor,

Thank you very much for the editorial staff and reviewer's hard work in processing our manuscript. We have carefully read the comments made by the editor and the reviewer. These comments were highly insightful and enabled us to greatly improve the quality of our manuscript. Also, we have revised our manuscript based on the reviewer's suggestions. In the following pages are our point-by-point responses to the comments.

We shall look forward to hearing from you at your earliest convenience.

Reviewer Comments:

Reviewer 1

Thank you for submission of your manuscript to the Iranian Journal of Radiology.

The main goal of this study was to assess the accuracy of shear wave elastography (SWE) in evaluating the ablation margin region in liver parenchymal tissue undergoing microwave ablation. This study was conducted on 15 healthy male 5-month-old mini-pigs. A total of 156 effective ablations and 740 effective SWE measurements were conducted, and 131 effective pathological results were obtained. After analysis, the authors concluded that the range of elastic modulus in the ablation margin region is relatively fixed. However, the position of the ablation margin region is not fixed. Generally, as the ablation time is prolonged, the ablation margin region will be further away from the ablation center. In the ablation center region, the elastic modulus decreased in a stepwise manner with the shortening of ablation time.

Reply: We would like to thank the reviewer for the recognition of our manuscript.

I would like to say that the main idea of the study is interesting and the manuscript is well written, however, there are some drawbacks in this manuscript as follows:

1. I would recommend rewriting the title as it does not state the main goal of this study properly.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have revised the title, which was described as follows:

Shear Wave Elastography in Evaluating the Efficacy of Liver Microwave Ablation:

An Experimental Study

2. Please write the full word “day” instead of d in lines 75 and 76.

Reply: We would like to thank the reviewer for the comments about English. We have polished our manuscript carefully and corrected the styling found in our manuscript.

3. Please write the generic name of the drug “Su-Mian-Xin” in line 81.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have modified "Su-Mian-Xin" to Xylazine Hydrochloride.

4. It seems that different zones surrounding microwave electrodes are mainly defined based on the pathological findings such as the percentage of cellular necrosis, however, it is not stated how the authors determine the consistency of these pathological zones with the SWE map. If there were any measurements, it should have been mentioned in the manuscript.

Reply: We would like to thank the reviewer for the comments. Unfortunately, we did not explore the relationship between pathological results of different areas around the microwave electrode and SWE diagram, which has been explained in the limitation section:

In addition, the different areas around the microwave electrode were mainly defined based on pathological findings (such as percentage of cell necrosis), however, the consistency of these pathological areas with the SWE map was not determined in this study and is expected to be further explored in future studies.

5. Please define “OCT” in the line 119.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. The full name of OCT is optimal cutting temperature compound, which we have added in the manuscript.

6. The meaning of Lines 168-172 on page 10 is not clear and could be interpreted in a wrong way. Please edit it.

Reply: We are sorry for causing you confusion about description. We have re-edited it and its description is as follows:

A comparison of the elastic modulus of the ablation margin region (22.44±7.17 vs 23.75±5.84 vs 22.94±4.91, P = 0.058) and the surrounding normal tissue region

(7.49±1.83 vs 7.85±2.16 vs 7.81 ± 2.04, P = 0.105) after ablation for 15, 30 and 60 s at an ablation power of 40 W revealed no statistically significant differences. However, in the ablation center region, the elastic modulus decreased gradually as the ablation time was shortened, with statistically significant differences (38.92 ± 3.14 vs 77.84 ± 9.58 vs 116.37±18.41, P < 0.01).

Reviewer 2:

I have carefully reviewed your manuscript and find the study to be promising. The results and discussion provide valuable insights into the feasibility and accuracy of using shear wave elastography (SWE) for the quantitative evaluation of microwave ablation margins in the liver. However, I believe that some minor revisions are necessary to improve the clarity and scientific rigor of the manuscript. I would like to draw your attention to the following points for your consideration:

Reply: We would like to thank the reviewer for the recognition of our manuscript and their constructive remarks.

Abstract

1. Lack of Background Information: The abstract background should briefly introduce the concept of microwave ablation, its application in the treatment of liver lesions, and the significance of evaluating the ablation margin.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have added the concept of microwave ablation, the application of microwave ablation in the treatment of liver lesions, and the significance of evaluating ablation margin in the abstract, which are described as follows:

Microwave ablation mainly generates high-frequency electromagnetic waves through the microwave antenna implanted in the tumor, which causes the charged ions and water molecules in the tissue to oscillate violently at high speed and generate high heat, thus leading to coagulation necrosis of proteins in tumor cells. The effect of microwave ablation on small hepatocellular carcinoma has no significant difference

from that of surgical resection, and microwave ablation can effectively inactivate hepatocellular carcinoma with tumor diameter ≤4cm. In view of the different thermal conductivity of each individual tumor and the influence of peripheral blood transport, the temperature field and damage area generated by ablation are difficult to be completely unified and standardized. Whether accurate and timely evaluation of ablation effect can be obtained is of great significance for ensuring the safety and effectiveness of hyperthermia and realizing individualized ablation therapy. Therefore, real-time monitoring and evaluation during surgery are very important.

2. Insufficient Methodology Description: The abstract's methodology section lacks important details that should be included. These details consist of information about the total sample size and group sizes, randomization process, blinding procedures, inclusion and exclusion criteria, laparotomic procedure, timing and intervals of measurements using shear wave elastography (SWE), statistical analysis, and explanations of symbols or syntax used.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have re-edited the methods section of the abstract, which is described as follows:

A total of 3 surgeons conducted the experiment, and each surgeon was randomly assigned 4 WZSPs to perform at least 12 ablation procedures each. A total of 2 radiologists performed 2D ultrasound and SWE on the ablation lesion and a pathologist made pathological sections of the ablation foci and observed them. In addition, they were blinded to the ablation process. The abdomen skin of WZSPs is shaved and disinfected. An "L" shaped incision was made in the middle of the abdomen to expose the liver, and laparoscopic microwave ablation of the liver was performed under direct vision with the ablation power of 40 W. Based on ablation time, they were divided into 15 s group, 30 s group and 60 s group. Immediately after ablation, SWE was performed 5 times for each ablation lesion, and at least 4 measurements of elastic modulus were conducted after each SWE. The measured data of SWE were expressed as $x \pm s$, and compared among different time groups by

analysis of variance. The LSD-t test was used for further pairwise comparisons. $P < 0.05$ was considered statistically significant.

3. Incomplete Results Summary: The abstract results should clarify the units of measurement (e.g., kPa for elastic modulus). It fails to mention the main findings related to the distribution of the elastic modulus within the ablation lesions and the observed differences for different ablation times.

Reply: We would like to thank the reviewer for the comments. We have described in the results section of the abstract the units of measurement (e.g., the elastic modulus is kPa) and the main findings related to the distribution of the elastic modulus within the ablation lesion and the differences observed at different ablation times, please review again.

Methods

4. Insufficient information on animal characteristics: The description of the experimental animals lacks important details such as their breed, genetic background, and housing conditions. These factors can have an impact on the study outcomes and should be properly documented.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have added the description of the breed, genetic background and feeding conditions of the Experimental animals in section 1.1 Experimental animals and main materials, which are described as follows:

WZSP is a native breed of China. WZSPs are a natural miniature size breed having characteristics such as genetic stability, small size, tolerant to coarse fodder, and strong anti-reversion force. Under experimental conditions, WZSP were kept in metal fenced and concrete floors, each of which was 30 square meters in size and 1.6 meters in height. The temperature range of the pig house is 18~25℃, and the relative humidity is maintained between 40% and 60%. WZSP is fed 2 times a day, supplemented by a small amount of green vegetables, green and juicy feed or good quality grass. The daily feeding amount is calculated according to the weight of the pig, generally 2% to 3% of the body weight.

5. Insufficient information on sample size determination: The methodology does not mention the rationale or calculation used to determine the sample size of 15 animals.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have added the sample size determination in section 1.1 Experimental animals and main materials, which are described as follows:

According to the resource equation, the sample size required for this study is at least 11; 12 healthy male WZSPs were therefore included in this study.

6. Lack of randomization and blinding: The methodology does not mention any randomization process or blinding procedures implemented during the study. Randomization helps to minimize bias, while blinding ensures objectivity in data collection and analysis.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have added randomization and blinding in section 1.2 Experimental methods, which are described as follows:

A total of 3 surgeons conducted the experiment, and each surgeon was randomly assigned 4 WZSPs to perform at least 12 ablation procedures each.

A total of 2 radiologists performed 2D ultrasound and SWE on the ablation lesion, and the radiologists were blinded to the ablation process.

A pathologist made pathological sections of the ablation foci and observed them.

7. Inadequate description of anesthesia and pain management: The methodology briefly mentions the use of anesthesia but does not provide sufficient details about the specific anesthetic agents, dosages, and methods of administration. Similarly, there is no mention of pain management protocols, which are crucial for the welfare of the animals involved.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have described specific anesthetics, doses, and administration methods in detail in the 1.2.1 Preoperative preparation section, while adding information about animal management protocols, which are described as follows:

Subsequently, they were intraperitoneally injected with 3% pentobarbital sodium (Beijing Jiehui Biology) at a dose of 1 ml/kg. After anaesthesia, they were fixed to the operating table, with an indwelling needle inserted into the ear vein for an intravenous drip of 3% pentobarbital sodium (Beijing Jiehui Biology) at 0.2 ml/min for anaesthesia maintenance. Intraoperatively, the vital signs of the pigs were monitored, and when necessary, subcutaneous injection of 0.15 kg/ml xylazine hydrochloride (BALLYA) was administered to deepen anaesthesia.

Appropriate humane care was conducted according to guidelines of the Laboratory Animal Care and Use Committee and Ethics Committee, and every effort was made to minimize their pain, suffering, and death.

8. Limited details on the surgical procedures: The methodology lacks specific information about the surgical procedures performed on the animals, such as the techniques used for castration and the details of the incision and closure methods.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have added the description of the surgical procedures in the section 1.1 Experimental animals and main materials, which are described as follows: The experimental pigs were castrated after 14-day-old. WZSPs were hung their hind legs on a smooth fence, the surgical site was disinfected with alcohol or 2% iodine, lidocaine anesthetic was injected subcutaneously in the groin into each testicle (0.5ml per site) and each sperm cord (0.5ml per site), a 1cm incision was made in the scrotum of each testicle, and the testicle was pulled out of the scrotum. Apply an antibacterial ointment or spray to the surface of the wound after suture. The castrated pigs were placed in a birthing bed under a thermal lamp to gradually recover.

9. Statistical analysis

a. Lack of information on data distribution and assumptions: There is no mention of assessing the distribution of the data or checking the assumptions required for the chosen statistical tests, such as normality or homogeneity of variances.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have made changes to the statistics section, which is described as follows:

The measured data of SWE conforming to normal distribution were described by $\bar{x}$±s. For comparisons among three groups, one-way analysis of variance with a post hoc Fisher's least significant difference test. For comparisons between two groups, Student's independent t-test and paired t-test were used for independent and repeated measurements, respectively.

b. Limited explanation of the analysis methods: The text mentions that analysis of variance (ANOVA) was used to compare the data among different time groups, followed by pairwise comparisons using the LSD-t test. However, no details are provided regarding the specific ANOVA model used (e.g., one-way, two-way) or any adjustments made for multiple comparisons.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have made changes to the statistics section, which is described as follows:

For comparisons among three groups, one-way analysis of variance with a post hoc Fisher's least significant difference test. For comparisons between two groups, Student's independent t-test and paired t-test were used for independent and repeated measurements, respectively.

c. Importance of utilizing tests for dependent data: In Table 2, to compare the differences within each group across three different time points, it is essential to employ either repeated measures analysis of variance (ANOVA) or the Friedman test, depending on the distributional characteristics of the data. Furthermore, for a better understanding of trends and differences, it is advisable to include graphs of repeated ANOVA as well.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have supplemented the results of the repeated measures analysis of variance (ANOVA) and the graphs of repeated ANOVA, as shown in

Table 2 and Table 3.

d. Lack of power analysis: The text does not mention whether a power analysis was conducted to determine the appropriate sample size for detecting meaningful effects. A power analysis is important for ensuring adequate statistical power and minimizing the risk of type II errors.

Reply: We would like to thank the reviewer for the comments. We used the resource equation to determine the sample size of the study, not the power analysis.

e. Inadequate reporting of significance threshold: The text states that a p-value of less than 0.05 was considered statistically significant, but it does not specify whether this threshold was adjusted for multiple comparisons or provide any justification for the chosen threshold.

Reply: We would like to thank the reviewer for the comments. Readers may question the interpretation of findings in clinical trials when multiple outcome measures are used without adjustment of the p-value. This question arises because of the increased risk of Type I errors (findings of false "significance") when multiple simultaneous hypotheses are tested at set p-values. The rationalists have the following objections to that theory: 1) P-value adjustments are calculated based on how many tests are to be considered, and that number has been defined arbitrarily and variably; 2) P-value adjustments reduce the chance of making type I errors, but they increase the chance of making type II errors or needing to increase the sample size. We suggest that researchers faced with multiple outcome measures may wish to choose a primary outcome measure or use a global assessment measure instead of adjusting the p-values.

Results

10. Lack of clarity and organization: The text lacks clear headings or subheadings to separate different sections of the results. This makes it difficult to follow the flow of information and locate specific findings within the text.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have added subheadings to the results section to distinguish the different parts of the results, which are described as follows:

2.2.1 Naked-eye observation

2.2.2 Microscope observation

2.3.1 The post-ablation SWE images

2.3.2 The comparison of SWE measurement parameters of post-ablation

11. Insufficient explanation of figures and images: The text references figures and images (e.g., Figure 2, Figure 3), but it does not provide captions or clear explanations of these figures.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have deleted these pictures.

12. Lack of data presentation: The text describes different regions and observations but does not present the actual numerical data or statistical analyses. Providing summary statistics, mean values, standard deviations, and p-values would improve the clarity and reliability of the results.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have added summary statistics, mean values, standard deviations and P-values in the results section to improve the clarity and reliability of the results, which are described as follows:

A comparison of the elastic modulus of the ablation margin region (22.44±7.17 vs 23.75±5.84 vs 22.94±4.91, P = 0.058) and the surrounding normal tissue region (7.49±1.83 vs 7.85±2.16 vs 7.81 ± 2.04, P = 0.105) after ablation for 15, 30 and 60 s at an ablation power of 40 W revealed no statistically significant differences. However, in the ablation center region, the elastic modulus decreased gradually as the ablation time was shortened, with statistically significant differences (38.92 ± 3.14 vs 77.84 ± 9.58 vs 116.37±18.41, P < 0.01).

Discussion

13. Lack of integration with previous research: The discussion briefly mentions

previous studies on elastography and microwave ablation but does not effectively integrate these findings into the current study. It would be beneficial to compare and contrast the current findings with previous research to provide a broader context and highlight the novelty or significance of the current study.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have compared the results of the current study with previous studies in the discussion section, which are described as follows:

The SWE image immediately post-ablation displayed the near-field boundary and the vertical and anteroposterior boundaries of the ablated area via color differences, which supports the notion that elastography is less affected by gas.

This result indicates that for a large or deep ablated area, SE measurements are likely to underestimate the vertical diameter.

Luo C et al. found that there were still some overestimates of SWE values immediately post-ablation, and most of the SWE values stabilized at 5 min. Therefore, SWE measurements should not be performed too early post-ablation.

Crocetti L et al found, SWE was not able to reliably capture changes in stiffness within, at the border, and outside the necrotic zone in ex vivo liver model.

14. Lack of future directions: The discussion does not mention any future research directions or potential areas for further investigation. Including suggestions for future studies based on the current findings would add depth and completeness to the discussion section.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have described in the Limitations and Prospects section suggestions for future research that will add depth and completeness to the discussion section, which are described as follows:

The effect of microwave ablation of living tissue is different from that of isolated tissue. Due to the influence of blood flow in living tissue, the ablation volume is smaller than that of isolated tissue under the same dose of microwave. Meanwhile, the volume of living liver masses is larger and the internal echo is uneven, which will

cause interference to SWE imaging. Therefore, this paper only discusses the general rule of strain elasticity in evaluating the value of ablation lesions through in vitro tissues. To further apply it to clinical practice, more complete live animal experiments and clinical case studies are needed. However, there are still many difficulties in applying it to the evaluation of human ablation lesions, such as ribs, abdominal wall thickness, breathing, heartbeat, etc. Therefore, how to use strain elastic imaging to determine the scope of ablation in vivo needs to be further studied. In addition, the different areas around the microwave electrode were mainly defined based on pathological findings (such as percentage of cell necrosis), however, the consistency of these pathological areas with the SWE map was not determined in this study and is expected to be further explored in future studies. Finally, the sample size is insufficient, and only a limited number of ablation foci were observed and measured, and the display and evaluation capabilities of two-dimensional ultrasound and SWE imaging under the condition of further enlargement of ablation foci were not further observed. This requires further research to increase the ablation power and time in the future.

Please make the necessary revisions and provide a detailed response to each point raised in this review. I look forward to reviewing the revised version of your manuscript.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have modified and provided a detailed response according to the reviewer's comments, and look forward to getting the reviewer's recognize.

Associate Editor's Comments:

Associate Editor 1:

This manuscript was studied by two expert reviewers and by me. I agree with the reviewers' comments that it can be reconsidered following the suggested modifications and corrections.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have modified the article according to the reviewer's opinion, so that the quality of the article has been significantly improved, and we also look forward to the approval of the editor.

2 Revision 1

4 comments · 11 Jun 2024 – 29 Jun 2024

Referee 2 Reviewer

MINOR REVISION 11 Jun 2024

Dear Authors,

I am pleased to inform you that your manuscript has thoroughly addressed all the comments raised during the first round of review.

However, two minor points need your attention before final acceptance. Firstly, ensure that the abstract structure complies with the journal guidelines for clarity and consistency. Secondly, please correct the erroneous term "times" on the horizontal axis of Figure 1.

Your dedication to refining your manuscript is commendable, and I am confident that these final adjustments will further enhance the overall quality of your study. I look forward to receiving the revised version of your manuscript.

Best Regards,

Referee 1 Reviewer

ACCEPT 25 Jun 2024

Dear Authors,

Thank you for submitting the revised version of your manuscript titled “Shear Wave Elastography in Evaluating the Efficacy of Liver Microwave Ablation: An Experimental Study” for consideration at the Iranian Journal of Radiology. I appreciate the time and effort you have put into addressing my comments and revising your paper accordingly.

Upon reviewing the changes, I am pleased to see that most of the concerns raised during the initial review have been thoughtfully addressed.

Associate Editor

MINOR REVISION 28 Jun 2024

The revised manuscript has been improved significantly. A few minor corrections have been requested by one of the reviewers and need to be addressed.

Editor-in-Chief

MINOR REVISION 29 Jun 2024

Dear authors,
Your article needs Minor Revision.
Regards

3

Revision 2

AUTHORS' RESPONSE TO REVIEWERS

Authors' reply to reviewers

The next pages contain the authors' point-by-point reply to the comments of this revision round, as submitted with the revised manuscript. It is published as the authors wrote it.

Dear Editor,

Thank you very much for the editorial staff and reviewer's hard work in processing our manuscript. We have carefully read the comments made by the editor and the reviewer. These comments were highly insightful and enabled us to greatly improve the quality of our manuscript. Also, we have revised our manuscript based on the reviewer's suggestions. In the following pages are our point-by-point responses to the comments.

We shall look forward to hearing from you at your earliest convenience.

Reviewer Comments:

Reviewer 1:

Dear Authors,

Thank you for submitting the revised version of your manuscript titled "Shear Wave Elastography in Evaluating the Efficacy of Liver Microwave Ablation: An Experimental Study" for consideration at the Iranian Journal of Radiology. I appreciate the time and effort you have put into addressing my comments and revising your paper accordingly.

Upon reviewing the changes, I am pleased to see that most of the concerns raised during the initial review have been thoughtfully addressed.

Reply: We would like to thank the reviewer for the recognition of our revised manuscript.

Reviewer 2:

Dear Authors,

I am pleased to inform you that your manuscript has thoroughly addressed all the comments raised during the first round of review.

Reply: We would like to thank the reviewer for the recognition of our revised manuscript.

However, two minor points need your attention before final acceptance. Firstly, ensure that the abstract structure complies with the journal guidelines for clarity and consistency.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have changed the abstract section to a structured abstract.

Secondly, please correct the erroneous term "times" on the horizontal axis of Figure 1.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have changed the "time" on the horizontal axis of Figure 1 to "times". The capital S is an abbreviation for the unit of time second.

Your dedication to refining your manuscript is commendable, and I am confident that these final adjustments will further enhance the overall quality of your study. I look forward to receiving the revised version of your manuscript.

Reply: We thank the reviewers for their careful reading of the manuscript and their constructive remarks. We have revised the manuscript according to your comments and look forward to your approval of the revised manuscript.

3 Revision 2

3 comments · 22 Jul 2024 – 30 Jul 2024

Referee 2 Reviewer

ACCEPT 22 Jul 2024

Thank you for submitting your manuscript titled "Shear Wave Elastography in Evaluating the Efficacy of Liver Microwave Ablation: An Experimental Study" to IJ Radiology. After review and consideration, I am pleased to inform you that the methodological rigor of your study is commendable. The clarity and detail provided in the methodology section facilitate reproducibility and validate the findings. This manuscript makes a valuable contribution to the field of radiology and liver ablation techniques and therefore is deserving of publication, particularly from a methodological standpoint.

Associate Editor

ACCEPT 23 Jul 2024

No further review is needed, and the manuscript can be accepted for publication in IJR.

Editor-in-Chief

MINOR REVISION 30 Jul 2024

Dear authors,
Your article needs Minor Revision.
Regards

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Revision 3

AUTHORS' RESPONSE TO REVIEWERS

Authors' reply to reviewers

The next pages contain the authors' point-by-point reply to the comments of this revision round, as submitted with the revised manuscript. It is published as the authors wrote it.

Dear Editor,

Thank you very much for the editorial staff and reviewer's hard work in processing our manuscript. We have carefully read the comments made by the editor and the reviewer. These comments were highly insightful and enabled us to greatly improve the quality of our manuscript. Also, we have revised our manuscript based on the reviewer's suggestions. In the following pages are our point-by-point responses to the comments.

We shall look forward to hearing from you at your earliest convenience.

Reviewers' Comments:

Reviewer: 1

Thank you for submitting your manuscript titled "Shear Wave Elastography in Evaluating the Efficacy of Liver Microwave Ablation: An Experimental Study" to IJ Radiology. After review and consideration, I am pleased to inform you that the methodological rigor of your study is commendable. The clarity and detail provided in the methodology section facilitate reproducibility and validate the findings. This manuscript makes a valuable contribution to the field of radiology and liver ablation techniques, and therefore, is deserving of publication, particularly from a methodological standpoint.

Reply: We would like to thank the reviewer for the recognition of our manuscript.

Reviewer 2:

This paper is suitable for publication in IJR.

Reply: We would like to thank the reviewer for the recognition of our manuscript.

Associate Editor's Comments:

Associate Editor 1:

No further review is needed and the manuscript can be accepted in IJR.

Reply: We would like to thank the reviewer for the recognition of our manuscript.

Associate Editor 2:

thanks to authors for sending their paper to IJR. please address following points:

1- please change method title of abstract to materials and methods

Reply: We would like thank the reviewer for the comments about abstract. We have changed method title of abstract to materials and methods.

2-this part is unclear: “and a comparison among inter-group and intra-group was performed” [may be: within group and between group comparisons were accomplished ….] please get a statistical consult.

Reply: We would like thank the reviewer for the comments. We have modified this sentence as "within group and between group comparisons were accomplished".

3-please change centre to center [please follow American writing style in paper]

Reply: We would like thank the reviewer for the comments about English. We have corrected the styling and typos found in our manuscript.

4- please change tumour to tumor

Reply: We would like thank the reviewer for the comments about English. We have changed tumour to tumor.

5-this part is unclear: “Microwave ablation is widely applied to the minimally invasive treatment of liver cancer” [may be: Microwave ablation is widely applied as a minimally invasive treatment of liver cancer]

Reply: We would like thank the reviewer for the comments. We have modified this sentence as "Microwave ablation is widely applied as a minimally invasive treatment of liver cancer".

6-please add objective part to paper [according to journal format]

Reply: We would like thank the reviewer for the comments. We have added objective part to paper.

7- aesthetic is wrong. It should be anesthetic.

Reply: We would like thank the reviewer for the comments about English. We have changed aesthetic to anesthetic.

8-sperm cord is better as spermatic cord

Reply: We would like thank the reviewer for the comments about English. We have changed sperm cord to spermatic cord.

9-Please add corporation name and country of all materials and devices used in the study.

Reply: We would like thank the reviewer for the comments. We have added corporation name and country of all materials and devices used in the study.

10-numbering of titles is as follows: 1.Background. 2.Objectives, 3.Materials and Methods. 3.1. Experimental animals and main materials, …….

Reply: We would like thank the reviewer for the comments about titles. We have changed numbering of titles.

11- please change anaesthesia to anesthesia

Reply: We would like thank the reviewer for the comments about English. We have changed anaesthesia to anesthesia.

12-there are some instances the authors used adjectives with “s” [that is british style] while these adjectives are in American style as “z”. for example, stabilised, oxidised, characterised, euthanised, analysed, summarised, utilise,….. please follow American style for all of these words.

Reply: We would like thank the reviewer for the comments about English. We have corrected the styling and typos found in our manuscript.

13-line 174, this part is unclear: “comparison among inter-group and intra-group was performed”

Reply: We would like thank the reviewer for the comments. We have modified this sentence as "within group and between group comparisons were accomplished".

14-does this sentence have verb?: “The needle tract region and needle tract periphery form the ablation centre region”

Reply: We would like thank the reviewer for the comments. We have modified this sentence as “The needle tract region and needle tract periphery constituted the ablation center region”.

15-it is better to change HE to H&E in all paper.

Reply: We would like thank the reviewer for the comments about English. We have changed HE to H&E.

16-please change analysing to analyzing. [analyse to analyze]. Please change carbonisation to carbonization.

Reply: We would like thank the reviewer for the comments about English. We have corrected the styling and typos found in our manuscript.

17- please delete 4. Conclusion title and begin paragraph with in conclusion, …..

Reply: We would like thank the reviewer for the comments about Conclusion. We have deleted 4. Conclusion title and begin paragraph with in conclusion.

18-please capitalize first characters of table legends

Reply: We would like thank the reviewer for the comments about table legends. We have capitalized first characters of table legends.

19-there are annotations of a to h in table 3 while they don't have any explanation in footnote. Please explain them in table 3 footnote.

Reply: We would like thank the reviewer for the comments about table 3. We have explained annotations of a to h in table 3 footnote, described as follows:

[a] compared with the 15-s ablation group, difference is statistically significant (t = 61.235, $P < 0.05$); [b] compared with the 15-s ablation group and the 30-s ablation group, difference is statistically significant (t = 62.467, 17.127, $P < 0.05$); [c] compared with the normal tissue region in the 15-s ablation group, difference is statistically significant (t = 15.110, $P < 0.05$); [d] compared with the normal tissue region and ablation margin region in the 15-s ablation group, difference is statistically significant (t = 31.411, 16.300, $P < 0.05$); [e] compared with the normal tissue region in the 30-s ablation group, difference is statistically significant (t = 15.984, $P < 0.05$); [f] compared with the normal tissue region and ablation margin region in the 30-s ablation group, difference is statistically significant (t = 69.983, 53.999, $P < 0.05$); [g] compared with the normal tissue region in the 60-s ablation group, difference is statistically significant (t = 15.138, $P < 0.05$); [h] compared with the normal tissue region and ablation margin region in the 60-s ablation group, difference is statistically significant (t = 89.361, 74.224, $P < 0.05$); SWE, shear wave elastography.

20-in figure 1, th ex axis is ablation times that seems wrong. It is better as ablation time.

Reply: We would like thank the reviewer for the comments about figure 1. We have changed ablation times to ablation time.

4 Revision 3

1 comment · 14 Aug 2024

Editor-in-Chief

ACCEPT 14 Aug 2024

Dear authors,
Your article is acceptable for publication in IJR.
Regards