

Ablative radiofrequency therapy versus surgery in hepatocellular carcinoma

Andrea Carolina Ruiz Ladino ¹, Jesús Alfonso Orozco Pérez ², Daniela Olivera Barros ³, María José Espitia Reyes ³, Ana Carolina Posso Falquez ³, Zore Milene Montalvo Pérez ³, Julio César Fornaris Tamayo ² and Jesús David Montero Pérez ^{2,*}

¹ Universidad Libre de Barranquilla, Colombia.

² Universidad Cooperativa de Colombia, Colombia.

³ Corporacion Universitaria Rafael Nuñez, Colombia.

World Journal of Advanced Research and Reviews, 2025, 27(02), 125-131

Publication history: Received on 05 April 2025; revised on 13 July 2025; accepted on 15 July 2025

Article DOI: <https://doi.org/10.30574/wjarr.2025.27.2.1761>

Abstract

Background: Liver cancer is the result of abnormal growth of cells in the body; this type of cancer represents a health problem around the world. Among the most frequent primary carcinomas we have hepatocarcinoma.

Methodology: A narrative review was carried out through various databases from 2018 to 2022; the search and selection of articles was carried out in indexed journals in English and Spanish. The following keywords were used: therapy, radiofrequency, surgery, hepatocarcinoma.

Results: treatment options such as ablation therapies are very effective curative techniques largely due to the low morbidity they tend to present, on the other hand, surgical resection is one of the treatment options of first choice still when it comes to hepatocellular carcinoma.

Conclusion: there are different approaches for liver cancer, in the case of primary hepatocellular carcinoma, among these approaches we have radiofrequency ablation, which is a minimally invasive procedure, to more complex procedures such as liver resection.

Keywords: Therapy; Radiofrequency; Surgery; Hepatocarcinoma

1. Introduction

Liver cancer is the result of abnormal growth of cells in the body; this type of cancer represents a health problem around the world. Among the most frequent primary carcinomas we have hepatocarcinoma, which is one of the most frequent solid neoplasms. (1) This cancer can be difficult to diagnose because liver mass lesions are extensive, and patients may have genetic or molecular alterations that represent a genetic load. It is important to emphasize that liver tumors can be divided into primary and metastatic. (2)

The risk factors that are related to this cancer are those causal agents of hepatitis B virus (HBV) infection, the development of cirrhosis, hepatitis C virus (HCV) infection (3), including other etiological factors for its onset such as metabolic diseases such as Wilson's disease or hemochromatosis, The etiopathology is not yet fully clear, but a higher incidence is found with respect to the inflammatory response against the hepatocyte virus, than with the oncogenic response of the virus. (4)

* Corresponding author: Jesús David Montero Pérez

Normally, when cancer begins to develop, very little presents symptoms, when these usually occur it means that the disease is in an advanced stage, which makes it difficult to treat the cancer completely, however, hepatocellular carcinoma is characterized by having a broad clinical course which results in the opportunity for an early diagnosis. which increases the possibility of early arrest. (5)

The aim of this research is to reevaluate the differences in the treatments of ablative radiofrequency therapy and surgery, available in the literature, and to compare the oncological results obtained in the management of hepatocellular carcinoma.

2. Materials and methods

A literature review was carried out, in which the databases of PubMed, Scielo and ScienceDirect, among others, were searched. The collection and selection of articles was carried out in indexed journals in English and Spanish from 2018 to 2022. As keywords, the following terms were used in the databases according to the DeCS and MeSH methodology: therapy, radiofrequency, surgery, hepatocarcinoma. In this review, 70 original and review publications related to the topic studied were identified, of which 30 articles met the specified inclusion requirements, such as articles that were in a range of no less than 2018, that were full-text articles and that reported on the ablative radiofrequency therapy versus surgery in hepatocellular carcinoma. As exclusion criteria, it was taken into account that the articles did not have sufficient information and that they did not present the full text at the time of their review.

3. Results

Hepatocellular carcinoma (HCC) is one of the most common malignant liver tumors. Liver resection is an option for treatment, among other treatment options such as ablative radiofrequency therapy, although the incidence of multiple lesions (6), and the development of chronic liver disease and alterations in liver functions generate limitations for certain techniques. (7)

For this reason, multiple palliative tools were implemented, such as the tumor ablation technique. This consists of the direct application of chemical therapies on focal lesions from the percutaneous access and is guided either by ultrasound, computed tomography or magnetic resonance imaging. (8)

The different treatment options for hepatocellular carcinoma depend largely on the tumor burden, the degree of liver dysfunction that the patient has. (9) Surgical resection is the first-line option for patients with early-stage hepatocellular carcinoma with solitary tumors, and provides a 5-year survival rate of 70%. With the Child-Pugh scorecard. (10) It is a staging system used to evaluate the prognosis of a chronic liver disease, widely applied in cases of cirrhosis, this is also used for the evaluation of the treatment of hepatocarcinoma according to the BCLC staging system. (11)

3.1 Ablative radiofrequency therapy

Ablation therapies are very effective curative techniques largely due to the low morbidity they tend to present, it should be noted that not all patients are candidates for this technique, so it can only be performed on a patient with a low tumor burden, likewise, to avoid short-term morbidity and the risk of tumor recurrences in the future. (12)

This therapy involves inducing coagulative necrosis of electromagnetic alternating current within an approximate frequency range of 375-500 kHz, to achieve a temperature of 90 to 120 °C. Monopolar devices with a single active needle-electrode are used. (13)

Radiofrequency therapy is a shorter technique, which provides you with a quick recovery and a shorter hospital time. (14) This technique is also used in combination with other therapies such as chemotherapy, but in these cases directed towards the liver called transarterial chemoembolization monotherapy, so as not to affect survival levels, this combination is widely used since it has better results than being used separately. (15) It has been shown in several studies that the combination of these two therapies provides better results than the recession surgical technique, since patients undergoing these therapies show a faster recovery and a shorter period within hospital facilities. (16)

However, like all procedures, there are certain risks or complications of ablative radiofrequency therapy mentioned in Table 1 below

Table 1 Complications after radiofrequency ablation

Complications after radiofrequency ablation	
minor complications	Pain
	Fever
	Asymptomatic pleural effusion.
Major complications	Biliary stenosis
	Bilioma
	Cholecystitis
	Bronchial fistulas
	Abscesses
	Peritonitis
	Vascular thrombosis
	Hepatic infarction
Causes of death	Intestinal perforation
	Portal thrombosis
	Liver failure
	Septic shock
	Massive hepatic hemorrhage

3.2 Surgery

Table 2 Complications of hepatectomy

Fever
Ascites
Pleural effusion
Tumor recurrence
Infection at the wound site
Intra-abdominal hemorrhage
General Complication Events
Atelectasis
Pneumothorax
Hepatic subcapsular hematoma
Postoperative liver failure

Surgical resection is still one of the first-choice treatment options when it comes to hepatocellular carcinoma, but tumor recurrence is a high possibility years after surgery. (17) It should be noted that periodic check-ups of patients undergoing surgery can detect the early onset of recurrent tumors, and thus provide patients with multiple treatment options. (18)

Not all patients with hepatocellular carcinoma are candidates for these procedures, only 20% become acts. (19) In another instance, with reference to the surgical technique, only 9.8% of the cases were approached by laparoscopic technique, another technique that is frequently used is atypical resection (47.5%) (20) and intraoperative radiofrequency, which was managed for unresectable hepatocellular carcinomas. An ultrasonic scalpel is most often used on patients. (21)

However, Table 2 will mention the possible complications that may occur in the different surgical resection techniques

4. Comparison of ablative therapies and surgical resections

Having a clear comparison between ablation and surgical reception is widely difficult, as treatment indications are different, patients with lesions, advanced age, or poor liver function often undergo ablative radiofrequency therapy, (22) while those with a large tumor often undergo surgical reception. (23)

The difference between the 2 treatments has been shown to be non-significant as overall survival from the disease is not statistically different between the 2 treatments. (24)

The adverse events that can occur are frequent and serious in the surgical reception due to the risks to which patients are usually exposed due to the slightly longer hospital stay and other postoperative risks. (25) Chemoembolization can be combined with ablative radiofrequency therapy, since it has been shown that in the first option it improves survival in general and lowers the chances of suffering concurrences. (26)

From the point of view of cost-effectiveness, ablative radiofrequency therapy may be superior to surgical reception, as it is a satisfactory alternative in the reception of primary hepatocellular carcinoma. Although several studies showed that recurrence-free survival was more frequent in partial surgical reception, however, overall survival does not mean a difference between the 2 treatments, possibly this is because in surgical reception a much larger volume of non-cancerous liver tissue is lost, being able to eliminate some latent metastases and reduce the probability of new metastases, resulting in a slightly lower rate of concurrences. despite the complications that this technique tends to generate, such as liver decompensation. If tumor concurrences occur, other therapeutic methods such as ablative radiofrequency therapy can be applied, since in most cases a surgical resection could not be repeated. (27)

5. Discussion

Both ablative radiofrequency therapy and surgical resection are techniques that have the same end in patients, which is the eradication of liver cancer as described in the article entitled "Transarterial chemoembolization + radiofrequency ablation versus surgical resection in hepatocellular carcinoma: a meta-analysis" written by Chuan Hao Gui et al, where 8 retrospective studies and one randomized controlled trial with 1892 patients were evaluated, these met the eligibility criteria and were included. The unadjusted pooled analysis demonstrated no significant difference in surgical resection between 1, 3, and 5 years or in DFS at 1 year between transarterial chemoembolization + radiofrequency ablation and surgical recession. The latter had a DFS greater than 3 years (OR 0.78, 95% CI 0.62–0.98, $P = .03$) and a DFS at 5 years (OR 0.74, 95% CI 0.58–0.95, $P = .02$) compared with TACE+RFA. When analyzing only propensity-matched data, the difference in 3-year SLE and 5-year SLE was not significant. TACE+RFA had a higher LTP rate (OR 2.48, 95% CI 1.05–5.86, $P = .04$). The combination of transarterial chemoembolization + radiofrequency ablation offers comparable oncological outcomes in patients with hepatocellular carcinoma compared to surgical recession and with the added benefit of lower morbidity. (28)

Another study published by Chao-Chuan Wu called "Radiofrequency ablation versus surgical resection for the treatment of solitary hepatocellular carcinoma of 2 cm or less: a cohort study in Taiwan" obtained the following results in terms of 1, 3, 5 and 7 years where they were comparable between the surgical resection group and the radiofrequency ablation group ($P = 0.193$), but in the surgical resection group, significantly higher results were obtained at 1 year, 3 years, 5 years, 7 years, and 10 years RFS than the Radiofrequency ablation (RFA) group ($P = 0.018$). Multivariate analysis revealed that patients with lower Child-Turcotte-Pugh score or albumin-bilirubin score before treatment had better surgical resection, and patients with HCV infection or receiving treatment with RFA had higher hepatocarcinoma recurrence rates, meaning that although surgical resection provides more favorable hepatocellular carcinoma recurrence outcomes than RFA, The profit decreases over time. (29)

6. Conclusion

The research of the literature presented here indicates that there are different approaches for liver cancer, in the case of primary hepatocellular carcinoma, among those approaches we have radiofrequency ablation which is a minimally invasive procedure to more complex procedures such as liver resection, the results of both techniques have been quite positive, However, it must be clarified that these procedures despite being applicable for many pathologies, They cannot always definitively correct the problem, as evidenced in the literature consulted here, where these techniques are usually applied to patients with the presence of primary hepatocellular carcinoma.

It should be noted that there are patients who cannot perform any of these procedures, since they are high-risk patients, since they may have tumor structures near the bile duct or intestine, or they are simply not able to withstand the procedure.

For this reason, risk factors such as age, the experience of the treating physician, and the patient's possibility, which are associated with each of these techniques, including future complications that may occur before, during, or after the procedure, must be taken into account.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Gui, C. H., Baey, S., D'cruz, R. T., and Shelat, V. G. Trans-arterial chemoembolization+ radiofrequency ablation versus surgical resection in hepatocellular carcinoma—a meta-analysis. *European Journal of Surgical Oncology*, 2020; 46(5), 763-771.
- [2] Lee, S., Kang, T. W., Cha, D. I., Song, K. D., Lee, M. W., Rhim, H., and Kim, K. Radiofrequency ablation vs. surgery for perivascular hepatocellular carcinoma: propensity score analyses of long-term outcomes. *Journal of Hepatology*, 2018; 69(1), 70-78.
- [3] Maeda, M., Saeki, I., Sakaida, I., Aikata, H., Araki, Y., Ogawa, C., and Yamasaki, T. Complications after radiofrequency ablation for hepatocellular carcinoma: a multicenter study involving 9,411 Japanese patients. *Liver cancer*, 2020; 9(1), 50-62.
- [4] Uhlig, J., Sellers, C. M., Stein, S. M., and Kim, H. S. Radiofrequency ablation versus surgical resection of hepatocellular carcinoma: contemporary treatment trends and outcomes from the United States National Cancer Database. *European Radiology*, 2019; 29(5), 2679-2689.
- [5] Glassberg, M. B., Ghosh, S., Clymer, J. W., Qadeer, R. A., Ferko, N. C., Sadeghirad, B., and Amaral, J. F. Microwave ablation compared with radiofrequency ablation for treatment of hepatocellular carcinoma and liver metastases: a systematic review and meta-analysis. *OncoTargets and therapy*, 2019; 12, 6407.
- [6] Xia, Y., Li, J., Liu, G., Wang, K., Qian, G., Lu, Z., ... and Shen, F. Long-term effects of repeat hepatectomy vs percutaneous radiofrequency ablation among patients with recurrent hepatocellular carcinoma: a randomized clinical trial. *JAMA oncology*, 2020; 6(2), 255-263.
- [7] Lee, S., Kang, T. W., Song, K. D., Lee, M. W., Rhim, H., Lim, H. K., and Ha, S. Y. Effect of microvascular invasion risk on early recurrence of hepatocellular carcinoma after surgery and radiofrequency ablation. *Annals of surgery*, 2021; 273(3), 564-571.
- [8] Mohkam, K., Dumont, P. N., Manichon, A. F., Jouvet, J. C., Bousset, L., Merle, P., and Mabrut, J. Y. No-touch multibipolar radiofrequency ablation vs. surgical resection for solitary hepatocellular carcinoma ranging from 2 to 5 cm. *Journal of hepatology*, 2018; 68(6), 1172-1180.
- [9] Violi, N. V., Duran, R., Guiu, B., Cercueil, J. P., Aubé, C., Digkila, A., and Denys, A. Efficacy of microwave ablation versus radiofrequency ablation for the treatment of hepatocellular carcinoma in patients with chronic liver disease: a randomised controlled phase 2 trial. *The Lancet Gastroenterology and Hepatology*, 3(5), 317-325.

- [10] Yang, Y., Chen, Y., Ye, F., Cao, X., Xin, Y., Wang, Y., and Fan, Q. Late recurrence of hepatocellular carcinoma after radiofrequency ablation: a multicenter study of risk factors, patterns, and survival. *European Radiology*, 2021; 31(5), 3053-3064.
- [11] Wang, W., Hou, S., Zhong, Z., Ni, J., Jiang, X., Chen, D., and Xu, L. Radiofrequency ablation combined with transcatheter arterial chemoembolization therapy versus surgical resection for Barcelona-Clinic Liver Cancer (BCLC) A hepatocellular carcinoma: a meta-analysis. *Journal of Interventional Medicine*, 2018; 1(1), 49-57.
- [12] Du, S., Yang, J. Z., Chen, J., Zhou, W. G., and Sun, Y. Y. Comparisons of recurrence-free survival and overall survival between microwave versus radiofrequency ablation treatment for hepatocellular carcinoma: a multiple centers retrospective cohort study with propensity score matching. *PloS one*, 2020; 15(1), e0227242.
- [13] Chu, H. H., Kim, J. H., Yoon, H. K., Ko, H. K., Gwon, D. I., Kim, P. N., and Park, S. H. Chemoembolization combined with radiofrequency ablation for medium-sized hepatocellular carcinoma: a propensity-score analysis. *Journal of Vascular and Interventional Radiology*, 2019; 30(10), 1533-1543.
- [14] Laimer, G., Schullian, P., Jaschke, N., Putzer, D., Eberle, G., Alzaga, A., and Bale, R. Minimal ablative margin (MAM) assessment with image fusion: an independent predictor for local tumor progression in hepatocellular carcinoma after stereotactic radiofrequency ablation. *European radiology*, 2020; 30(5), 2463-2472.
- [15] Yi, P. S., Huang, M., Zhang, M., Xu, L., and Xu, M. Q. Comparison of transarterial chemoembolization combined with radiofrequency ablation therapy versus surgical resection for early hepatocellular carcinoma. *The American Surgeon*, 2020; 84(2), 282-288.
- [16] Conticchio, M., Inchingolo, R., Delvecchio, A., Laera, L., Ratti, F., Gelli, M., and Memeo, R. Radiofrequency ablation vs surgical resection in elderly patients with hepatocellular carcinoma in Milan criteria. *World journal of gastroenterology*, 2018; 27(18), 2205.
- [17] Chu, H. H., Kim, J. H., Kim, P. N., Kim, S. Y., Lim, Y. S., Park, S. H., ... and Lee, S. G. Surgical resection versus radiofrequency ablation very early-stage HCC (≤ 2 cm Single HCC): a propensity score analysis. *Liver International*, 2019; 39(12), 2397-2407.
- [18] Zheng, L., Zhang, C. H., Lin, J. Y., Song, C. L., Qi, X. L., and Luo, M. Comparative effectiveness of radiofrequency ablation vs. surgical resection for patients with solitary hepatocellular carcinoma smaller than 5 cm. *Frontiers in Oncology*, 10, 399.
- [19] Ahn, K. S., and Kang, K. J. (2019). Appropriate treatment modality for solitary small hepatocellular carcinoma: ¿Radiofrequency ablation vs. resection vs. transplantation? *Clinical and Molecular Hepatology*, 2020; 25(4), 354.
- [20] Peng, Z., Wei, M., Chen, S., Lin, M., Jiang, C., Mei, J., ... and Kuang, M. Combined transcatheter arterial chemoembolization and radiofrequency ablation versus hepatectomy for recurrent hepatocellular carcinoma after initial surgery: a propensity scores matching study. *European Radiology*, 2018; 28(8), 3522-3531.
- [21] Si, M. B., Yan, P. J., Hao, X. Y., Du, Z. Y., Tian, H. W., Yang, J., and Guo, T. K. Efficacy and safety of radiofrequency ablation versus minimally invasive liver surgery for small hepatocellular carcinoma: a systematic review and meta-analysis. *Surgical endoscopy*, 2019; 33(8), 2419-2429.
- [22] Hsiao, C. Y., Hu, R. H., Ho, C. M., Wu, Y. M., Lee, P. H., and Ho, M. C. Surgical resection versus radiofrequency ablation for Barcelona Clinic Liver Cancer very early-stage hepatocellular carcinoma: long-term results of a single-center study. *The American Journal of Surgery*, 2019; 220(4), 958-964.
- [23] Jin, H., Chalkidou, A., Hawkins, M., Summers, J., Eddy, S., Peacock, J. L., and Zou, L. (2021). Cost-effectiveness analysis of stereotactic ablative body radiation therapy compared with surgery and radiofrequency ablation in two patient cohorts: metastatic liver cancer and hepatocellular carcinoma. *Clinical Oncology*, 2020; 33(3), e143-e154.
- [24] Kim, T. H., Koh, Y. H., Kim, B. H., Kim, M. J., Lee, J. H., Park, B., and Park, J. W. Proton beam radiotherapy vs. radiofrequency ablation for recurrent hepatocellular carcinoma: a randomized phase III trial. *Journal of Hepatology*, 2021; 74(3), 603-612.
- [25] Kim, N., Cheng, J., Jung, I., Der Liang, J., Shih, Y. L., Huang, W. Y., ... and Seong, J. Stereotactic body radiation therapy vs. radiofrequency ablation in Asian patients with hepatocellular carcinoma. *Journal of hepatology*, 2020; 73(1), 121-129.
- [26] Chong, C. C., Lee, K. F., Cheung, S. Y., Chu, C. C., Fong, A. K., Wong, J., and Lai, P. B. (2020). Prospective double-blinded randomized controlled trial of Microwave versus RadioFrequency Ablation for hepatocellular carcinoma (McRFA trial). *HPB*, 2020; 22(8), 1121-1127.

- [27] Saavedra, A. A. R., Cedeño, C. B. G., Zamora, B. T. V., and Yépez, H. L. T. Ablation vs. radiofrequency. RECIAMUC, 2021; 5(4), 111-117.
- [28] García, A. G., González-Huix, F., Levy, M. J., de Paredes, A. G. G., and Vázquez-Sequeiros, E. Ablative treatment of pancreatic cystic lesions. Gastroenterology and Hepatology, 2019; 42(1), 43-50.
- [29] Wu, C. C., Tseng, C. W., Tseng, K. C., Chen, Y. C., Wu, T. W., Chang, S. Y., ... and Hsu, C. S. Radiofrequency ablation versus surgical resection for the treatment of solitary hepatocellular carcinoma 2 cm or smaller: A cohort study in Taiwan. Journal of the Formosan Medical Association, 2021; 120(5), 1249-1258.
- [30] Shi, F., Wu, M., Lian, S. S., Mo, Z. Q., Gou, Q., Xu, R. D., and Chen, X. M. Radiofrequency ablation following downstaging of hepatocellular carcinoma by using transarterial chemoembolization: long-term outcomes. Radiology, 2019; 293(3), 707-715.