医学新视角 2024年6月第1卷第3期:132-136
The New Perspectives Journal of Medicine. 2024; 1(3): 132-136.
综述/REVIEW
DOI: 10.5582/npjm.2024.01009

热消融术在结直肠癌肝转移瘤中的价值争论

段文斌，毛先海，杨建辉，段小辉，龚伟智，魏荣光，卿宇豪，任勇

湖南省人民医院（湖南师范大学附属第一医院）肝胆外科，湖南省长沙市410005

摘要: 肝切除术是可切除结直肠癌肝转移瘤（colorectal liver metastases, CRLM）的首选治疗方式，但近80%的CRLM患者在初诊时不可切除。笔者所在中心认为针对不可切除或肿瘤解剖位置深在但＜3cm的CRLM，若肝切除术联合热消融术能达到无疾病证据状态（no evidence of disease, NED），有利于患者的远期生存。但笔者2023年在日本访学期间，了解到日本外科学者对CRLM的热消融治疗持谨慎、质疑态度，主要基于热消融术后比较高的不完全消融率及局部复发率。但回顾既往文献，多数中心将“不可切除”的CRLM作为热消融术的主要指征，这可能导致不可避免的选择偏倚。国内外学者积极探索，认为当CRLM＜3cm、解剖位置深在、结节多发或分布于多个肝叶时，单独热消融或热消融联合肝切除术在能达到NED的前提下，具有积极意义。针对不可切除CRLM，热消融联合化疗的远期生存也要优于单纯化疗。

关键词: 热消融术，结直肠癌肝转移瘤

Debate on the value of thermal ablation in colorectal liver metastases

Wenbin Duan, Xianhai Mao, Jianhui Yang, Xiaohui Duan, Weizhi Gong, Rongguang Wei, Yuhao Qing, Raja Jahanzaib Sadiq

Department of Hepatobiliary Surgery, Hunan Provincial People's Hospital (First Affiliated Hospital of Hunan Normal University), Changsha, Hunan 410005

Abstract: Hepatectomy is the preferred treatment for resectable colorectal liver metastases (CRLM), but CRLM is unresectable in nearly 80% of patients at the time of initial diagnosis. The facility where the author works believes that if hepatectomy combined with thermal ablation can achieve a no evidence of disease (NED) status for CRLM that is unresectable or in a deep anatomical location but less than 3cm in size, then this approach would be beneficial to the patient's long-term survival. However, during a visit to Japan in 2023, the author learned that Japanese surgeons are cautious and skeptical about thermal ablation to treat CRLM, mainly based on the relatively high rate of incomplete ablation and the rate of local recurrence after thermal ablation. However, a review of the literature indicates that most centers regard "unresectable" CRLM as the main indication for thermal ablation, which may lead to inevitable selection bias. Domestic and foreign scholars are actively exploring the positive value of thermal ablation alone or in combination with liver resection, predicated on achieving an NED status when the CRLM is less than 3 cm in size, the metastasis is in a deep anatomical location, and nodules are multiple or distributed in multiple lobes of the liver. For unresectable CRLM, thermal ablation combined with chemotherapy results in a better long-term survival than that of chemotherapy alone.

Keywords: thermal ablation, colorectal liver metastases

1. 引言

肝脏是结直肠癌血行转移最主要的靶器官[1]。在结直肠癌患者的整个病程中，有将近一半的患者会发生肝转移[2]。肝切除术（hepatic resection, HR）是可切除CRLM患者的首选治疗方式[3,4]。CRLM患者接受根治性HR后5年无病生存率约为20%[5,6]，5年整体生存率（overall survival，OS）为21~58%[3]，有报道肝脏寡转移患者HR后5年OS高达71%[7-9]。然而，近80%的CRLM在初始诊断时不可切除[10,11]。不可切除CRLM包括外科学不可切除和肿瘤学不可切除两大类。导致外科学不可切除的因素主要包括病人全身情况不能承受手术创伤、肝功能不能耐受、剩余肝体积不足等。

热消融治疗（thermal ablation, TA）主要包括射频消融(radiofrequency ablation, RFA)与微波消融(microwave ablation, MWA)。单独TA或者TA联合HR在原发性肝癌外

收稿日期：2023-10-2; 修回日期：2024-3-25
基金项目：无
通讯作者/Corresponding author：毛先海/Xianhai Mao，E-mail: maoxianhai@hunnu.edu.cn; 杨建辉/Jianhui Yang，E-mail: yangjianhui403@126.com
本文编辑：武强

科治疗中的价值得到肯定[12,13]，但TA应用于CRLM的价值一直以来存在着争议。笔者所在中心针对部分外科学不可切除及肿瘤解剖位置深在但＜3cm的CRLM患者，采用单独TA或者TA联合HR方式，认为亦可达到NED状态，对患者预后有利。但笔者2023年在日本东京大学附属病院及国立国际医疗研究中心病院访学期间，发现日本外科医生对CRLM的TA治疗常持更谨慎甚至质疑态度，其主要顾虑在于TA术后不理想的完全消融率和比较高的局部复发率（local recurrence, LR）。本文综述国内外学者对于TA应用于CRLM的数据与观点，旨在探讨TA在CRLM中的价值。

2. TA应用于CRLM的不完全消融率与LR及其原因分析

文献报道TA用于CRLM的完全消融率为81~94%[14-17]，LR不一，从2% 到60%[12,16,18,19]。分析导致不完全消融和LR的原因主要有以下几方面：

2.1. CRLM无包膜

不同于肝细胞癌，CRLM无包膜，呈浸润性生长。CRLM的实际大小术前难以准确评估[20]；

2.2. 肿瘤＞3cm

肿瘤＞3cm被认为是LR的危险因素[15,21,22]。Hammil等人报道<3cm CRLM经过TA治疗后的LR为3%，3~5cm为4%[23],而>5cm CRLM的TA治疗后LR在27~45%之间[23,24]。分析原因可能跟TA的有效消融范围、＞3cm肿瘤的生物活性等因素相关。

2.3. 病灶特殊的解剖位置

（1）靠近主要血管或者肝蒂的CRLM 由于血液流动的热沉效应，消融血管旁肿瘤更加困难。Qin[25]、Wong[26]等认为病灶位于血管旁是术后LR的危险因素。Jiang[27]等研究报道当病灶位于≥3mm血管周围时，将导致消融不完全，是术后LR的独立危险因素。Wada[25,28,29]等报告肿瘤直接接触主要肝静脉时，TA后LR达到42.9%。

（2）Wada[28]等同时认为病灶位于肝后上段（第1、7、8段）且>15 mm是LR的独立危险因素，考虑与以下几个因素相关：7段病灶位置深、穿刺针道长导致穿刺难度大、术中超声评估穿刺针道及消融边缘困难；8段肿瘤尤其是靠近膈顶穹隆位置时，需要较小的穿刺角度和较长的穿刺距离，均有可能导致消融不完全；1段肿瘤位置深且被主要血管包绕，穿刺针道长且受限，同时为减少胆管热损伤风险，1段肿瘤的消融边缘也受到限制。

（3）病灶位于包膜下 可能是影响CRLM治疗效果的另一个因素。位于包膜下的CRLM在消融技术上存在困难，肝包膜附近CRLM在TA时不能获得足够的消融边缘，甚至可能对邻近结构造成热损伤，如横膈膜和胃肠道、出血或肝外肿瘤扩散[30-34]。但该技术困难理论上可通过腹腔镜或开腹手术解决。

2.4. 术中难以即时准确评估消融边缘

与HR术中肿瘤切缘的宽度与OS的延长相关相似，TA的消融边缘与剩余肿瘤细胞的活性相关，足够的消融边缘是TA实现局部肿瘤控制的关键决定因素[35-38]。Kurilova、Wada等[28,39]认为＞1cm的消融边缘能提供良好的肿瘤控制，但是增加了部分患者胆道并发症的发生率。最小消融边缘≤5mm被认为是消融不完全的重要危险因素[30]。但不同于HR时切缘的直观测量，消融边缘仅能通过影像来评估。受病灶与周围组织信号强度、密度、回声相似导致的分辨率不足或干扰、术中多方位立体评估难度大等因素影响，术中术后准确评估消融边缘存在困难。

2.5. 不同的消融方式（RFA *vs*. MWA）

TA治疗CRLM相关文献中，多使用RFA[40-43]，MWA相较于RFA，理论上具有以下优势：受热沉效应的影响较小[38]，具有更快的消融时间、更大的消融区域、更高的瘤内温度和更完全的凝固性坏死[43-45]。Correa-Gallego等[46]学者统计分析认为，与RFA相比，MWA后LR更低。

3. 较高的不完全消融率及LR预示着比较差的生存预后，但TA的患者选择指征存在选择偏倚

一项meta分析[47]显示，HR治疗CRLM的3年OS和5年OS分别为55~82%、23~66%，而RFA治疗CRLM的3年OS和5年OS分别为32~84%、17.9~49%，提示HR的3年OS（RR：1.377,95%CI：1.246~1.522）、5年OS均显著优于RFA组（RR：1.474,95%CI：1.284~1.692）。

日本结肠癌和直肠癌学会2019年结肠直肠癌治疗指南[48]指出，关于TA有效性的报道较少，由于TA治疗CRLM伴随着LR高风险，应尽可能考虑切除。对于可切除CRLM，手术切除是标准治疗方法，因此不推荐TA作为首选的治疗方法；对于不可切除CRLM，全身治疗是标准治疗，因此也不推荐TA用于不可切除的病变。

然而，回顾既往文献报告[49-53]，发现多数中心将不可切除的CRLM作为TA的主要指征，这可能导致不可避免的选择偏倚。不可切除因素主要包括健康状况不佳、剩余肝脏功能储备不足、病灶数目多或散在分布于多个肝叶、病灶位于特殊部位如靠近大血管而对手术不耐受等。因此HR往往实施于条件比较好的患者，而TA往往应用于条件不佳患者。其次，HR可以更好地进行术中分期和术后病理评估，有助于优化术后化疗和生物治疗策略[47]。以上因素均有可能是导致TA治疗CRLM疗效劣于HR的原因。一项由国际消融术专家小组撰写的立场文件显示，荟萃分析15篇论文中接受RFA治疗的1613例CRLM患者，从首次TA日期开始，平均3年OS为50%（37~77%），平均5年OS为31%（17~51%）。几乎所有的研究都在不可切除的患者中使用RFA，但RFA应用于潜在可切除疾病的患者时，5年OS增加到50 %[54]。

4. TA应用于CRLM的积极价值

目前鲜有在同等基线条件下TA对比HR治疗CRLM的相关临床研究。但国内外学者积极尝试，认为针对CRLM的治疗，TA在以下几个方面具有积极价值：

4.1. 针对＜3cm CRLM

Gillams等[54]分析认为，TA应用于CRLM，局部肿瘤进展率随着肿瘤大小的减小而持续降低，目前最常用的分界点为3cm。Tez等[55]认为＜3cm CRLM开放RFA术后的局部复发率相当于HR。对于合并其他全身疾病不能耐受HR或不愿手术患者，TA是一个适宜的选择方案。

4.2. 针对解剖位置深在的CRLM

对于解剖位置深在的CRLM，HR需要牺牲比较多的正常肝实质。若考虑TA可达到NED，则TA治疗可以保存尽可能多的残肝体积[56]。

4.3. TA联合化疗 *vs*. 单纯化疗

对于不可切除CRLM，TA联合化疗患者的远期生存要优于单纯化疗患者[40]。文献显示，TA联合化疗可以帮助延长不可切除CRLM患者的OS，3年OS可达37~77%，5年OS可达17~51%，而同期仅接受化疗的不可切除CRLM患者5年OS接近0%[54]。一项旨在研究初始不能手术CRLM患者系统化疗同时增加TA的随机对照试验（EORTC-CLOCC）[52]显示：RFA联合化疗组的30个月OS为61.7%（95%CI：48.2~73.9%），而单独化疗组为57.6%（95%CI：44.1~70.4%）。经过9.7年的中位随访，RFA联合化疗组OS要显著优于单纯化疗组（HR = 0.58；95%CI：0.38~0.88），其中RFA联合化疗组的8年OS为35.9%，而单纯化疗组为8.9%。联合化疗组的中位DFS显著延长，为16.8个月（95%CI：11.7~22.1），而单独化疗组的中位DFS为9.9个月（95%CI：9.3~13.7），HR为0.63（95%CI：0.42~0.95，p=0.025）。

4.4. 针对多个结节或分布于多个肝叶的CRLM，TA联合HR

ESMO[56]指南将≥5个结节患者定义为交界可切除，认为不能单纯用HR处理。wada等[28]将≥5个结节的CRLM患者分为可切除组（虚拟残肝体积≥30%）和不可切除组（虚拟残肝体积＜30%），通过回顾性分析认为：积极的外科治疗（TA和/或HR）处理交界可切除或不可切除的CRLM，能达到一个较好的远期生存，可切除组和不可切除组患者的3年生存率分别为51.4%和44.6%。5年生存率分别为33.3%、33.7%。虽然两组中大部分患者出现了复发，但是仍有近一半的患者可以再次接受外科处理[53]。相比之下，虽然CRLM患者的全身化疗方案得到改善，但增加的生存获益有限，在没有手术的情况下，3年OS为20~30%[57,58]。K. Imai等[59]通过对553例接受HR的CRLM患者资料进行倾向性匹配分析认为，RFA联合HR治疗CRLM后的短期和长期预后与单独HR术后相似。HR+RFA组患者的OS和DFS率与单独HR组患者的OS和DFS率均无差异。Saxena等[60]分析了701例接受HR和/或MWA的CRLM患者的结果，在151例≥5个病灶的CRLM的患者中，HR联合MWA不仅获得了与单独HR相当的生存获益，而且有效地扩大了可切除性的标准。Oba等[61]同时认为：MWA不仅能保留更多残肝体积，还能保存肝脏中的重要血管，为复发后的再次外科治疗提供机会。Mima等[62]学者认为，HR联合TA后肝内复发率高于单纯HR，可能与HR联合TA治疗患者中高度恶性因素占比高相关，这些高度恶性因素包括肿瘤多发、位于两个或多个肝叶、同时性肝转移等。Masuda等[63]分析指出，对于≥4个病灶的CRLM患者，接受HR+RFA或单纯HR的预后是相似的，认为肝脏中广泛转移性肿瘤数量可能中和RFA相关的负面预后影响。Viganò等[64]统计分析也认为，≥4个病灶是CRLM患者HR术后早期复发的独立危险因素。

5. 总结

综上所述，考虑到CRLM的浸润性生长方式，或靠近大血管、主要肝蒂的热沉效应等导致不理想的完全消融率和比较高的LR，以及伴随的胆道损伤风险，笔者亦认同日本学者的意见，HR是可切除CRLM的首选治疗方式。但笔者中心同时认为，针对部分外科学不可切除或解剖位置深在而＜3cm的CRLM患者，在能达到NED的前提下，单独TA或TA联合HR是一个可供选择方案，NCCN、ESMO、中国结直肠癌肝转移指南均有推荐。在实施TA时，安全的消融边缘（＞5mm）是达到完全消融的重要保障。在同等基线条件下，谨慎挑选的亚组如＜3cm可切除CRLM，开展TA对比HR的安全性和有效性的前瞻性随机对照研究的意义值得进一步探讨。

利益冲突：所有作者均声明不存在利益冲突。

致谢：无。

作者贡献声明：无。

参考文献

1. 中国医师协会外科医师分会,中华医学会外科学分会胃肠外科学组,中华医学会外科学分会结直肠外科学组, 等.中国结直肠癌肝转移诊断和综合治疗指南(2023版). 中国实用外科杂志. 2023;43:9-22.
2. Nagai Y, Kiyomatsu T, Gohda Y, *et al*. The primary tumor location in colorectal cancer: A focused review on its impact on surgical management. Glob Health Med. 2021;3:386-393.
3. Dulundu E, Attaallah W, Tilki M, *et al*. Simultaneous resection for colorectal cancer with synchronous liver metastases is a safe procedure: Outcomes at a single center in Turkey. BioScience Trends. 2017;11:235-242.
4. Zhang W, Song TQ. The progress in adjuvant therapy after curative resection of liver metastasis from colorectal cancer. Drug Discoveries & Therapeutics. 2014;8:194-200.
5. Choti MA, Sitzmann JV, Tiburi MF, *et al*. Trends in long-term survival following liver resection for hepatic colorectal metastases. Ann Surg. 2002;235:759-766.
6. Pawlik TM, Scoggins CR, Zorzi D, *et al*. Effect of surgical margin status on survival and site of recurrence after hepatic resection for colorectal metastases. Ann Surg. 2005;241:715-722.
7. Aloia TA, Vauthey JN, Loyer EM, *et al*. Solitary colorectal liver metastasis: resection determines outcome. Arch Surg. 2006;141:460-466; discussion 466-467.
8. Hur H, Ko YT, Min BS, *et al*. Comparative study of resection and radiofrequency ablation in the treatment of solitary colorectal liver metastases. Am J Surg. 2009;197:728-736.

9. Lee WS, Yun SH, Chun HK, *et al*. Clinical outcomes of hepatic resection and radiofrequency ablation in patients with solitary colorectal liver metastasis. J Clin Gastroenterol. 2008;42:945-949.
10. Cirocchi R, Trastulli S, Boselli C, *et al*. Radiofrequency ablation in the treatment of liver metastases from colorectal cancer. Cochrane Database Syst Rev. 2012;(6):CD006317.
11. Adam R, Delvart V, Pascal G, *et al*. Rescue surgery for unresectable colorectal liver metastases downstaged by chemotherapy: a model to predict long-term survival. Ann Surg. 2004;240:644-657.
12. 中华人民共和国国家卫生健康委员会医政医管局.原发性肝癌诊疗指南(2022年版).中国实用外科杂志. 2022;42:241-273.
13. Reig M, Forner A, Rimola J, *et al*. BCLC strategy for prognosis prediction and treatment recommendation: The 2022 update. J Hepatol. 2022;76:681-693.
14. Sofocleous CT, Petre EN, Gonen M, *et al*. CT-guided radiofrequency ablation as a salvage treatment of colorectal cancer hepatic metastases developing after hepatectomy. J Vasc Interv Radiol. 2011;22:755-761.
15. Liu M, Huang GL, Xu M, *et al*. Percutaneous Thermal Ablation for the Treatment of Colorectal Liver Metastases and Hepatocellular Carcinoma: A Comparison of Local Therapeutic Efficacy. Int J Hyperthermia. 2017;33:446-453.
16. Veltri A, Sacchetto P, Tosetti I, *et al*. Radiofrequency ablation of colorectal liver metastases: small size favorably predicts technique effectiveness and survival. Cardiovasc Intervent Radiol. 2008;31:948-956.
17. Gillams AR, Lees WR. Five-year survival in 309 patients with colorectal liver metastases treated with radiofrequency ablation. Eur Radiol. 2009;19:1206-1213.
18. Pathak S, Jones R, Tang JM, *et al*. Ablative therapies for colorectal liver metastases: a systematic review. Colorectal Dis. 2011;13:e252-265.
19. Bale R, Widmann G, Schullian P, *et al*. Percutaneous stereotactic radiofrequency ablation of colorectal liver metastases. Eur Radiol. 2012;22:930-937.
20. Sofocleous CT, Nascimento RG, Petrovic LM, *et al*. Histopathologic and immunohistochemical features of tissue adherent to multitined electrodes after RF ablation of liver malignancies can help predict local tumor progression: initial results. Radiology. 2008;249:364-374.
21. Fong Y, Fortner J, Sun RL *et al*. Clinical score for predicting recurrence after hepatic resection for metastatic colorectal cancer: analysis of 1001 consecutive cases. Ann Surg. 1999;230:309-318; discussion 318-321.
22. Hori T, Nagata K, Hasuike S, *et al*. Risk factors for the local recurrence of hepatocellular carcinoma after a single session of percutaneous radiofrequency ablation. J Gastroenterol. 2003;38:977-981.
23. Hammill CW, Billingsley KG, Cassera MA, *et al*. Outcome after laparoscopic radiofrequency ablation of technically resectable colorectal liver metastases. Ann Surg Oncol. 2011;18:1947-1954.
24. Nielsen K, van Tilborg AA, Meijerink MR, *et al*. Incidence and treatment of local site recurrences following RFA of colorectal liver metastases. World J Surg. 2013;37:1340-1347.
25. Qin S, Liu GJ, Huang M, *et al*. The local efficacy and influencing factors of ultrasound-guided percutaneous microwave ablation in colorectal liver metastases: A review of a 4-year experience at a single center. Int J Hyperthermia. 2019;36:36-43.
26. Wong SL, Mangu PB, Choti MA, *et al*. American Society of Clinical Oncology 2009 clinical evidence review on radiofrequency ablation of hepatic metastases from colorectal cancer. J Clin Oncol. 2010;28:493-508.
27. Jiang B, Luo H, Yan K, *et al*. Ten-year outcomes of percutaneous radiofrequency ablation for colorectal cancer liver metastases in perivascular vs. non-perivascular locations: a propensity-score matched study. Front Oncol. 2020;10:553556.
28. Wada Y, Takami Y, Ryu T, *et al*. Predictive Factors for Local Recurrence after Intraoperative Microwave Ablation for Colorectal Liver Metastases. Cancers (Basel). 2022,15:122.
29. Takahashi H, Kahramangil B, Berber E. Local recurrence after microwave thermosphere ablation of malignant liver tumors: Results of a surgical series. Surgery. 2018;163:709-713.
30. Fan H, Wang X, Qu J, *et al*. Periprocedural risk factors for incomplete radiofrequency ablation of liver metastases from colorectal cancer: A single-center retrospective analysis. Int J Hyperthermia. 2021;38:985-994.
31. Han K, Kim JH, Yang SG, *et al*. A single-center retrospective analysis of periprocedural variables affecting local tumor progression after radiofrequency ablation of colorectal cancer liver metastases. Radiology. 2021;298:212-218.
32. Kim JS, Ko Y, Kwon H, *et al*. Impact of energy and access methods on extrahepatic tumor spreading and the ablation zone: an ex vivo experiment using a subcapsular tumor model. Korean J Radiol. 2019;20:580-588.
33. Shirai K, Tamai H, Shingaki N, *et al*. Clinical features and risk factors of extrahepatic seeding after percutaneous radiofrequency ablation for hepatocellular carcinoma. Hepatol Res. 2011;41:738-745.
34. Jaskolka JD, Asch MR, Kachura JR, *et al*. Needle tract seeding after radiofrequency ablation of hepatic tumors. J Vasc Interv Radiol. 2005;16:485-491.
35. Sotirchos VS, Petrovic LM, Gönen M, *et al*. Colorectal cancer liver metastases: biopsy of the ablation zone and margins can be used to predict oncologic outcome. Radiology. 2016;280:949-959.
36. Wang X, Sofocleous CT, Erinjeri JP, *et al*. Margin size is an independent predictor of local tumor progression after ablation of colon cancer liver metastases. Cardiovasc Intervent Radiol. 2013;36:166-175.
37. Sadot E, Groot Koerkamp B, Leal JN, *et al*. Resection margin and survival in 2368 patients undergoing hepatic resection for metastatic colorectal cancer: surgical technique or biologic surrogate?. Ann Surg. 2015;262:476-485.
38. Shady W, Petre EN, Do KG, *et al*. Percutaneous Microwave versus Radiofrequency Ablation of Colorectal Liver Metastases: Ablation with Clear Margins (A0) Provides the Best Local Tumor Control. J Vasc Interv Radiol. 2018;29:268-275.e1.
39. Kurilova I, Bendet A, Petre EN, *et al*. Factors Associated With Local Tumor Control and Complications After Thermal Ablation of Colorectal Cancer Liver Metastases: A 15-year Retrospective Cohort Study. Clin Colorectal Cancer. 2021;20:e82-e95.
40. Abdalla EK, Vauthey JN, Ellis LM, *et al*. Recurrence and outcomes following hepatic resection, radiofrequency ablation, and combined resection/ablation for colorectal liver metastases. Ann Surg. 2004;239:818-825; discussion 825-827.
41. Karanicolas PJ, Jarnagin WR, Gonen M, *et al*. Long-term outcomes following tumor ablation for treatment of bilateral colorectal liver metastases. JAMA Surg. 2013;148:597-601.
42. Martin RC, Scoggins CR, McMasters KM. Safety and efficacy of microwave ablation of hepatic tumors: a prospective review of a 5-year experience. Ann Surg Oncol. 2010;17:171-178.
43. Groeschl RT, Pilgrim CH, Hanna EM, *et al*. Microwave ablation for hepatic malignancies: a multiinstitutional analysis. Ann Surg. 2014;259:1195-1200.
44. Wright AS, Sampson LA, Warner TF, *et al*. Radiofrequency versus microwave ablation in a hepatic porcine model. Radiology. 2005;236:132-139.
45. Dupuy DE. Microwave ablation compared with radiofrequency

ablation in lung tissue-is microwave not just for popcorn anymore?. Radiology. 2009;251:617-618.
46. Correa-Gallego C, Fong Y, Gonen M, *et al*. A retrospective comparison of microwave ablation vs radiofrequency ablation for colorectal cancer hepatic metastases. Ann Surg Oncol. 2014;21:4278-4283.
47. Weng M, Zhang Y, Zhou D, *et al*. Radiofrequency ablation versus resection for colorectal cancer liver metastases: a meta-analysis. PLoS One. 2012;7:e45493.
48. Hashiguchi Y, Muro K, Saito Y, *et al*. Japanese Society for Cancer of the Colon and Rectum (JSCCR) guidelines 2019 for the treatment of colorectal cancer. Int J Clin Oncol. 2020;25:1-42.
49. Machi J, Oishi AJ, Sumida K, *et al*. Long-term outcome of radiofrequency ablation for unresectable liver metastases from colorectal cancer: evaluation of prognostic factors and effectiveness in first- and second-line management. Cancer J. 2006;12:318-326.
50. Topal B, Aerts R, Penninckx F. Laparoscopic radiofrequency ablation of unresectable liver malignancies: feasibility and clinical outcome. Surg Laparosc Endosc Percutan Tech. 2003;13:11-15.
51. Minami Y, Kudo M. Radiofrequency ablation of liver metastases from colorectal cancer: a literature review. Gut Liver. 2013;7:1-6.
52. Ruers T, Van Coevorden F, Punt CJ, *et al*. Local treatment of unresectable colorectal liver metastases: results of a randomized phase II trial. J Natl Cancer Inst. 2017;109:djx015.
53. Wada Y, Takami Y, Tateishi M, *et al*. Efficacy of surgical treatment using microwave coagulo-necrotic therapy for unresectable multiple colorectal liver metastases. Onco Targets Ther. 2016;9:937-943.
54. Gillams A, Goldberg N, Ahmed M, *et al*. Thermal ablation of colorectal liver metastases: a position paper by an international panel of ablation experts, the Interventional Oncology Sans frontières meeting 2013. Eur Radiol. 2015;25:3438-3454.
55. Tez M, Tez S. Radiofrequency Ablation versus Resection for Resectable Colorectal Liver Metastases: Time for a Randomized Trial?. Ann Surg Oncol. 2008;15:1804.
56. Van Cutsem E, Cervantes A, Adam R, *et al*. ESMO consensus guidelines for the management of patients with metastatic colorectal cancer. Ann Oncol. 2016;27:1386-1422.
57. Nordlinger B, Van Cutsem E, Gruenberger T, *et al*. Combination of surgery and chemotherapy and the role of targeted agents in the treatment of patients with colorectal liver metastases: recommendations from an expert panel. Ann Oncol. 2009;20:985-992.
58. Falcone A, Ricci S, Brunetti I, *et al*. Phase III trial of infusional fluorouracil, leucovorin, oxaliplatin, and irinotecan (FOLFOXIRI) compared with infusional fluorouracil, leucovorin, and irinotecan (FOLFIRI) as first-line treatment for metastatic colorectal cancer: the Gruppo Oncologico Nord Ovest. J Clin Oncol. 2007;25:1670-1676.
59. Imai K, Allard MA, Castro Benitez C, *et al*. Long-term outcomes of radiofrequency ablation combined with hepatectomy compared with hepatectomy alone for colorectal liver metastases. Br J Surg. 2017;104:570-579.
60. Saxena A, Chua TC, Chu FC, *et al*. Impact of treatment modality and number of lesions on recurrence and survival outcomes after treatment of colorectal cancer liver metastases. J Gastrointest Oncol. 2014;5:46-56.
61. Oba M, Hasegawa K, Matsuyama Y, *et al*. Discrepancy between recurrence-free survival and overall survival in patients with resectable colorectal liver metastases: a potential surrogate endpoint for time to surgical failure. Ann Surg Oncol. 2014;21:1817-1824.
62. Mima K, Beppu T, Chikamoto A, *et al*. Hepatic resection combined with radiofrequency ablation for initially unresectable colorectal liver metastases after effective chemotherapy is a safe procedure with a low incidence of local recurrence. Int J Clin Oncol. 2013;18:847-855.
63. Masuda T, Margonis GA, Andreatos N, *et al*. Combined Hepatic Resection and Radio-frequency Ablation for Patients with Colorectal Cancer Liver Metastasis: A Viable Option for Patients with a Large Number of Tumors. Anticancer Res. 2018;38:6353-6360.
64. Viganò L, Capussotti L, Lapointe R, *et al*. Early recurrence after liver resection for colorectal metastases: risk factors, prognosis, and treatment. A LiverMetSurvey-based study of 6,025 patients. Ann Surg Oncol. 2014;21: 1276-1286.

引用本文 / Article Citation:

段文斌，毛先海，杨建辉，段小辉，龚伟智，魏荣光，卿宇豪，任勇. 热消融术在结直肠癌肝转移瘤中的价值争论. 医学新视角. 2024;1(3):132-136. doi:10.5582/npjm.2024.01009

Wenbin Duan, Xianhai Mao, Jianhui Yang, Xiaohui Duan, Weizhi Gong, Rongguang Wei, Yuhao Qing, Raja Jahanzaib Sadiq. Debate on the value of thermal ablation in colorectal liver metastases. The New Perspectives Journal of Medicine. 2024;1(3):132-136. doi:10.5582/npjm.2024.01009