

World Journal of *Gastrointestinal Surgery*

World J Gastrointest Surg 2023 December 27; 15(12): 2674-2961



Contents

Monthly Volume 15 Number 12 December 27, 2023

REVIEW

- 2674 Antimicrobial approach of abdominal post-surgical infections
Fiore M, Corrente A, Di Franco S, Alfieri A, Pace MC, Martora F, Petrou S, Mauriello C, Leone S

MINIREVIEWS

- 2693 Indocyanine green fluorescence in gastrointestinal surgery: Appraisal of current evidence
Kalayarasan R, Chandrasekar M, Sai Krishna P, Shanmugam D
- 2709 Post-cholecystectomy iatrogenic bile duct injuries: Emerging role for endoscopic management
Emara MH, Ahmed MH, Radwan MI, Emara EH, Basheer M, Ali A, Elfert AA

ORIGINAL ARTICLE

Case Control Study

- 2719 Multidisciplinary diagnosis and treatment nutritional support intervention for gastrointestinal tumor radiotherapy: Impact on nutrition and quality of life
Hui L, Zhang YY, Hu XD

Retrospective Cohort Study

- 2727 Association between the early high level of serum tacrolimus and recurrence of hepatocellular carcinoma in ABO-incompatible liver transplantation
Han JW, Choi JY, Jung ES, Kim JH, Cho HS, Yoo JS, Sung PS, Jang JW, Yoon SK, Choi HJ, You YK
- 2739 Determining the need for a thoracoscopic approach to treat a giant hiatal hernia when abdominal access is poor
Pérez Lara FJ, Zubizarreta Jimenez R, Prieto-Puga Arjona T, Gutierrez Delgado P, Hernández Carmona JM, Hernández Gonzalez JM, Pitarch Martinez M
- 2747 Predictive value of Hajibandeh index in determining peritoneal contamination in acute abdomen: A cohort study and meta-analysis
Hajibandeh S, Hajibandeh S, Evans L, Miller B, Waterman J, Ahmad SJ, Hale J, Higgi A, Johnson B, Pearce D, Helmy AH, Naguib N, Maw A

Retrospective Study

- 2757 Efficacy of pantoprazole plus perforation repair for peptic ulcer and its effect on the stress response
Leng ZY, Wang JH, Gao L, Shi K, Hua HB
- 2765 Application of electroacupuncture in the prevention of low anterior resection syndrome after rectal cancer surgery
Xu LL, Xiang NJ, Cheng TC, Li YX, Chen P, Jiang ZW, Liu XX

- 2774** Effects of remifentanyl combined with propofol on hemodynamics and oxidative stress in patients undergoing resection of rectal carcinoma
Huang J, Tian WJ
- 2783** Percutaneous microwave ablation and transcatheter arterial chemoembolization for serum tumor markers and prognostics of middle-late primary hepatic carcinoma
Lin ZP, Huang DB, Zou XG, Chen Y, Li XQ, Zhang J
- 2792** Novel invagination procedure for pancreaticojejunostomy using double purse string sutures: A technical note
Li J, Niu HY, Meng XK
- 2799** Laparoscopic resection and endoscopic submucosal dissection for treating gastric ectopic pancreas
Zheng HD, Huang QY, Hu YH, Ye K, Xu JH
- 2809** Prediction of the lymphatic, microvascular, and perineural invasion of pancreatic neuroendocrine tumors using preoperative magnetic resonance imaging
Liu YL, Zhu HB, Chen ML, Sun W, Li XT, Sun YS
- 2820** Impact of hepatectomy and postoperative adjuvant transarterial chemoembolization on serum tumor markers and prognosis in intermediate-stage hepatocellular carcinoma
Hu YD, Zhang H, Tan W, Li ZK

Observational Study

- 2831** Analysis of nutritional risk, skeletal muscle depletion, and lipid metabolism phenotype in acute radiation enteritis
Ma CY, Zhao J, Qian KY, Xu Z, Xu XT, Zhou JY

Randomized Controlled Trial

- 2844** Holistic conditions after colon cancer: A randomized controlled trial of systematic holistic care *vs* primary care
Wang J, Qiao JH

Basic Study

- 2855** Mutational separation and clinical outcomes of *TP53* and *CDH1* in gastric cancer
Liu HL, Peng H, Huang CH, Zhou HY, Ge J
- 2866** Hepatic vagotomy blunts liver regeneration after hepatectomy by downregulating the expression of interleukin-22
Zhou H, Xu JL, Huang SX, He Y, He XW, Lu S, Yao B

META-ANALYSIS

- 2879** Recent evidence for subcutaneous drains to prevent surgical site infections after abdominal surgery: A systematic review and meta-analysis
Ishinuki T, Shinkawa H, Kouzu K, Shinji S, Goda E, Ohyanagi T, Kobayashi M, Kobayashi M, Suzuki K, Kitagawa Y, Yamashita C, Mohri Y, Shimizu J, Uchino M, Haji S, Yoshida M, Ohge H, Mayumi T, Mizuguchi T

- 2890** Prognostic role of serum carcinoembryonic antigen in patients receiving liver resection for colorectal cancer liver metastasis: A meta-analysis

Tang F, Huang CW, Tang ZH, Lu SL, Bai T, Huang Q, Li XZ, Zhang B, Wu FX

- 2907** Significance of carcinoembryonic antigen detection in the early diagnosis of colorectal cancer: A systematic review and meta-analysis

Wang R, Wang Q, Li P

CASE REPORT

- 2919** Primary repair of esophageal atresia gross type C *via* thoracoscopic magnetic compression anastomosis: A case report

Zhang HK, Li XQ, Song HX, Liu SQ, Wang FH, Wen J, Xiao M, Yang AP, Duan XF, Gao ZZ, Hu KL, Zhang W, Lv Y, Zhou XH, Cao ZJ

- 2926** Portal vein embolization for closure of marked arteriportal shunt of hepatocellular carcinoma to enable radioembolization: A case report

Wang XD, Ge NJ, Yang YF

- 2932** Removal of a large rectal polyp with endoscopic submucosal dissection-trans-anal rectoscopic assisted minimally invasive surgery hybrid technique: A case report

Polese L

- 2938** Successful treatment of invasive liver abscess syndrome caused by *Klebsiella variicola* with intracranial infection and septic shock: A case report

Zhang PJ, Lu ZH, Cao LJ, Chen H, Sun Y

- 2945** Duodenojejunostomy treatment of groove pancreatitis-induced stenosis and obstruction of the horizontal duodenum: A case report

Zhang Y, Cheng HH, Fan WJ

- 2954** Awake robotic liver surgery: A case report

Delvecchio A, Pavone G, Conticchio M, Piacente C, Varvara M, Ferraro V, Stasi M, Casella A, Filippo R, Tedeschi M, Pullano C, Inchingolo R, Delmonte V, Memeo R

ABOUT COVER

Editorial Board Member of *World Journal of Gastrointestinal Surgery*, Lapo Bencini, PhD, General Surgery Unit, AOUC, Department of Oncology and Robotics, Careggi University Hospital, Florence 350134, Italy. lapbenc@tin.it

AIMS AND SCOPE

The primary aim of *World Journal of Gastrointestinal Surgery* (WJGS, *World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGS mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal surgery and covering a wide range of topics including biliary tract surgical procedures, biliopancreatic diversion, colectomy, esophagectomy, esophagostomy, pancreas transplantation, and pancreatectomy, etc.

INDEXING/ABSTRACTING

The WJGS is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Current Contents/Clinical Medicine, Journal Citation Reports/Science Edition, PubMed, PubMed Central, Reference Citation Analysis, China Science and Technology Journal Database, and Superstar Journals Database. The 2023 Edition of Journal Citation Reports® cites the 2022 impact factor (IF) for WJGS as 2.0; IF without journal self cites: 1.9; 5-year IF: 2.2; Journal Citation Indicator: 0.52; Ranking: 113 among 212 journals in surgery; Quartile category: Q3; Ranking: 81 among 93 journals in gastroenterology and hepatology; and Quartile category: Q4.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: Rui-Rui Wu, Production Department Director: Xu Guo, Editorial Office Director: Jia-Ru Fan.

NAME OF JOURNAL

World Journal of Gastrointestinal Surgery

ISSN

ISSN 1948-9366 (online)

LAUNCH DATE

November 30, 2009

FREQUENCY

Monthly

EDITORS-IN-CHIEF

Peter Schemmer

EDITORIAL BOARD MEMBERS

<https://www.wjgnet.com/1948-9366/editorialboard.htm>

PUBLICATION DATE

December 27, 2023

COPYRIGHT

© 2023 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS

<https://www.wjgnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjgnet.com/bpg/GerInfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjgnet.com/bpg/gerinfo/240>

PUBLICATION ETHICS

<https://www.wjgnet.com/bpg/GerInfo/288>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/GerInfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>



Retrospective Study

Percutaneous microwave ablation and transcatheter arterial chemoembolization for serum tumor markers and prognostics of middle-late primary hepatic carcinoma

Zhi-Peng Lin, Da-Bei Huang, Xu-Gong Zou, Yuan Chen, Xiao-Qun Li, Jian Zhang

Specialty type: Gastroenterology and hepatology

Provenance and peer review:

Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): 0
Grade C (Good): C, C
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Nozaki Y, Japan;
Takehara T, Japan

Received: October 26, 2023

Peer-review started: October 26, 2023

First decision: November 8, 2023

Revised: November 17, 2023

Accepted: December 4, 2023

Article in press: December 4, 2023

Published online: December 27, 2023



Zhi-Peng Lin, Da-Bei Huang, Xu-Gong Zou, Yuan Chen, Xiao-Qun Li, Jian Zhang, Department of Interventional Medicine, Zhongshan People's Hospital, Zhongshan 528400, Guangdong Province, China

Corresponding author: Jian Zhang, MD, Professor, Department of Interventional Medicine, Zhongshan People's Hospital, No. 2 Sun Wen East Road, Zhongshan 528400, Guangdong Province, China. wy18988583838@163.com

Abstract

BACKGROUND

Primary hepatic carcinoma (PHC) has an insidious onset and is usually diagnosed in the middle and late stages. Although transcatheter arterial chemoembolization (TACE) is the preferred option for treating middle- and advanced-stage PHC, it has limited efficacy in killing tumor cells and poor long-term efficacy. TACE plus percutaneous microwave coagulation therapy (PMCT) is more effective than interventional therapy alone and can improve survival time. However, there are few reports on the effects of TACE and PMCT on serum marker levels and the prognosis of patients with advanced PHC.

AIM

To investigate the effect of PMCT + TACE on serum tumor markers and the prognosis of middle-late PHC.

METHODS

This retrospective study included 150 patients with middle-late PHC admitted to Zhongshan People's Hospital between March 2018 and February 2021. Patients were divided into a single group (treated with TACE, $n = 75$) and a combined group (treated with TACE + PMCT, $n = 75$). Before and after treatment, the clinical efficacy and serum tumor marker levels [carbohydrate antigen 19-9 (CA19-9), alpha-fetoprotein (AFP), and carcinoembryonic antigen (CEA)] of both groups were observed. The 1-year survival rates and prognostic factors of the two groups were analyzed.

RESULTS

The combined group had 21 and 35 cases of complete remission (CR) and partial remission (PR), respectively. The single group had 13 and 25 cases of CR and PR,

respectively. After 4 wk of treatment, the serum CA19-9, CEA, and AFP levels in the single and combined groups decreased, with the decrease in the combined group being more significant ($P < 0.05$). The 1-year survival rate of the combined group (80.00%) was higher than that of the single group (60.00%) ($P < 0.05$). The average survival time within 1 year in the combined group was 299.38 ± 61.13 d, longer than that in the single group (214.41 ± 72.97 d, $P < 0.05$). COX analysis revealed that tumor diameter, tumor number, and the treatment method were prognostic factors for patients with middle-late PHC ($P < 0.05$).

CONCLUSION

TACE + PMCT is effective in treating patients with mid-late PHC. It reduces the levels of tumor markers, prolongs survival, and improves prognosis.

Key Words: Middle-late primary hepatic carcinoma; Percutaneous microwave coagulation therapy; Transcatheter arterial chemoembolization; Effect; Tumor markers; Prognosis; Survival

©The Author(s) 2023. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: Middle- and late-stage primary hepatic carcinoma (PHC) has reached a phase of comprehensive treatment. Compared to single interventional therapy, transcatheter arterial chemoembolization (TACE) plus percutaneous microwave coagulation therapy (PMCT) can effectively improve prognosis and prolong patient survival. This study reveals that TACE + PMCT in the management of patients with middle-late PHC enhances tumor marker levels and prolongs survival time. Furthermore, we identify tumor diameter, tumor number, and treatment method as pivotal factors influencing prognosis.

Citation: Lin ZP, Huang DB, Zou XG, Chen Y, Li XQ, Zhang J. Percutaneous microwave ablation and transcatheter arterial chemoembolization for serum tumor markers and prognostics of middle-late primary hepatic carcinoma. *World J Gastrointest Surg* 2023; 15(12): 2783-2791

URL: <https://www.wjgnet.com/1948-9366/full/v15/i12/2783.htm>

DOI: <https://dx.doi.org/10.4240/wjgs.v15.i12.2783>

INTRODUCTION

Primary hepatic carcinoma (PHC) is a common histological form of liver cancer, accounting for 70.0%–85.0% of total liver cancer cases, with a markedly poor prognosis[1]. Currently, the primary treatment methods for PHC include radical surgical resection, targeted therapy (such as sorafenib, lenvatinib, cabozantinib, *etc.*), interventional and immunotherapy [2]. Surgical resection can achieve significant efficacy in early PHC cases; however, due to the hidden onset of the disease, that is, the absence of obvious symptoms and signs in the early stages, only 20%–30% of patients undergo surgical resection in the middle to late stages[3]. Interventional therapy is the primary option for middle-aged patients who miss the optimal surgery window[4]. Transcatheter arterial chemoembolization (TACE) is a common type of interventional therapy for patients with middle-to-late stage PHC[5]. Normally, the liver receives blood supply through two routes: the portal vein supplies 70%–75%, and the hepatic artery supplies 20%–25%. However, the liver cancer tissue supplies 90%–95% of the latter[6]. TACE takes advantage of these features. On the one hand, embolization is performed on the target artery supplying blood to the tumor, resulting in tumor shrinkage and ischemic necrosis. On the other hand, it selectively injects chemotherapy drugs into the target lesion, thus achieving the goal of treating PHC with minimal damage to normal liver tissue[7,8]. However, TACE cannot completely eliminate the target lesion and is prone to tumor recurrence. The above drawbacks are major factors for patients undergoing multiple treatments and adjusting their treatment plans[9]. With the continuous development of new hyperthermia technologies, studies have shown that TACE plus percutaneous microwave coagulation therapy (PMCT) can improve the clinical curative effect in patients with liver cancer and prolong survival time[10,11]. In addition, PMCT can effectively improve anti-tumor immune responses in the body[12]. However, there are few reports on the effects of TACE and PMCT on serum marker levels and the prognosis of patients with advanced PHC. This study retrospectively analyzed the effects of PMCT combined with TACE on serum tumor marker levels and prognosis in patients with mid-late PHC to provide a reference for clinical management.

MATERIALS AND METHODS

Object

This study involved 150 patients with mid-late PHC admitted to Zhongshan People's Hospital between March 2018 and February 2021. The inclusion criteria were as follows: (1) PHC diagnosis confirmed by medical imaging, serum tumor marker detection, and pathological test; (2) Tumor TNM stage II–IV, with no indication for surgery or surgery cannot be performed; and (3) Complete clinical data and follow-up information. The exclusion criteria were as follows: (1)

Significant organ dysfunction (such as kidney, heart, lung, *etc.*) or severe illnesses; (2) combined with coagulation dysfunction; (3) Contraindications to TACE and PMCT; (4) Presence of other malignant tumors; (5) History of past PMCT or TACE treatment; (6) Recurrence of lung cancer; and (7) Patients with mental illness and inability to cooperate.

Based on the different treatments, the patients were separated into a single group ($n = 75$) and a combined group ($n = 75$). No statistically significant differences were observed in the basic data between the single and combined groups ($P > 0.05$), as shown in [Table 1](#).

Methods

The single group was treated under local anesthesia with TACE alone, guided by digital subtraction angiography, and percutaneous puncture of the femoral artery to the mesentery and the common hepatic artery. The catheter was placed into the main supplying artery of the lesion, and oxaliplatin (100 mg) and liquefied iodide (10 mL) were injected through the catheter. The main feeding artery was embolized with a gelatin sponge particle, and the effect of the embolization was again observed on angiography. Depending on the patient's condition before and after the first TACE treatment, the treatment was repeated 1 to 3 times, and the interval between the two TACE treatments was not less than 4 wk.

The combined group underwent a treatment regimen involving TACE + PMCT. Specifically, this group received 1–2 rounds of TACE treatment followed by 2–4 wk of combined PMCT treatment. In contrast, the single group received only TACE treatment. Before initiating microwave ablation (MWA) treatment, imaging studies were conducted on all patients to select the needle entry path. Special care was taken to minimize the risk of puncturing important organs such as the gallbladder, large blood vessels, and gastrointestinal tract.

First, preoperative preparation for conventional MWA was performed. Guided by a spiral CT scan, 1–2 MWA needles were inserted percutaneously into the tumor tissue, and a combined multisite ablation was performed by adjusting the depth and angle of the microwave antenna. The ablation power and time were selected according to the patient's lesion size and tolerance, as well as surrounding organs at risk. Postoperatively, the two groups of patients were treated with liver-protective, antiemetic, and antipyretic agents. Imaging studies were performed in both groups 2–4 wk after surgery, and the therapeutic effect was evaluated.

Survey tools

Clinical efficacy: Four weeks after the last treatment, the clinical efficacy in the enrolled patients was evaluated according to the mRECIST (modified response evaluation criteria in solid tumors) evaluation criteria[13]. Complete remission (CR) was defined as complete tumor disappearance sustained for at least 4 wk. Partial remission (PR) was defined as tumor shrinkage $\geq 30\%$, sustained for at least 4 wk. The tumor: Stable with a reduction of $< 30\%$ or an increase but an increase of $< 20\%$; Disease progression was characterized by tumor enlargement $\geq 25\%$, new tumors, or metastatic lesions. Objective response rate (ORR) = (PR + CR) cases/total cases $\times 100\%$.

Serum tumor markers: Precisely, 5.0 mL of venous blood was collected from the enrolled patients before treatment and 4 wk after treatment. The serum of the collected blood was separated using centrifugation and stored in a specially insulated refrigerator for drugs at 2–6°C. The serum levels of carbohydrate antigen 19-9 (CA19-9), alpha-fetoprotein (AFP), and carcinoembryonic antigen (CEA) in the two groups were measured using an i2000 automatic microparticle chemiluminescence immunoanalyzer (Abbott Laboratories, United States).

Survival: The patients were followed up for 1 year after treatment (until January 2022). The recurrence, metastasis, and death rates in the single and combined groups were recorded, and prognostic factors related to the patients with mid-late PHC were analyzed.

Statistical analysis

Data were analyzed using IBM SPSS software (version 26.0). Counting variables are expressed as [n (%)], and continuous variables are reported as mean $\pm$ SD. These variables were tested using t-tests (also known as Student's t test) and χ^2 tests, respectively. The survival rate was analyzed using the Kaplan–Meier method, while prognostic factors were assessed using the COX method. Inspection level as the $\alpha = 0.05$. Statistical significance was set at $P < 0.05$.

RESULTS

Clinical effect

The combined group had 21 and 35 cases of CR and PR, respectively. The single group had 13 and 24 cases of CR and PR, respectively. The ORR of the combined group was higher (74.67%, $P < 0.05$) than that of the single group (49.33%), as shown in [Table 2](#).

Serum tumor marker levels

Before treatment, the levels of serum tumor markers in the single and combined groups were compared (all $P > 0.05$). After 4 wk of treatment, the serum CA19-9, CEA, and AFP levels in the single and combined groups decreased. The decrease in the combined group was more significant ($P < 0.05$) ([Table 3](#)).

Survival after 1 year

By the end of the follow-up period, the recurrence and metastasis rates in both the combined and single groups yielded P values greater than 0.05. The 1-year survival rate was significantly higher in the combined group (80.00%) compared to

Table 1 Comparison of baseline data between the single and combined groups

Group	Gender		Age (yr)	Tumor number (cases)		Tumor diameter (cm)
	Male	Female		Single	Multiple	
Combined group (<i>n</i> = 75)	41 (54.67)	34 (45.33)	53.05 ± 13.43	47 (62.67)	28 (37.33)	5.11 ± 1.27
Single group (<i>n</i> = 75)	43 (57.33)	32 (42.67)	52.51 ± 12.06	49 (65.33)	26 (34.67)	5.49 ± 1.23
χ^2/t value	0.108		-0.558	0.262		-1.900
<i>P</i> value	0.742		0.580	0.793		0.059

Table 2 Comparison of clinical efficacy between the single and combined groups

Group	CR	PR	SD	PD	ORR (%)
Combined group (<i>n</i> = 75)	21 (28.00)	35 (46.67)	15 (20.00)	4 (5.33)	56 (74.67) ¹
Single group (<i>n</i> = 75)	13 (17.33)	24 (32.00)	28 (37.33)	10 (13.33)	38 (49.33)
χ^2 value					9.233
<i>P</i> value					0.002

¹*P* < 0.01 *vs* single group.

CR: Complete remission; PR: Partial remission; SD: Stable; PD: Disease progression; ORR: Objective response rate.

Table 3 Comparison of serum tumor marker levels between the two groups before treatment and 4 wk after treatment

Group	AFP (g/L)		CEA (g/mg)		CA19-9 (U/mL)	
	Pre-treatment	After 4 wk of treatment	Pre-treatment	After 4 wk of treatment	Pre-treatment	After 4 wk of treatment
Combined group (<i>n</i> = 75)	364.17 ± 50.46	212.52 ± 39.52 ²	19.44 ± 2.05	11.02 ± 2.18 ²	239.87 ± 40.16	170.25 ± 28.28 ¹
Single group (<i>n</i> = 75)	361.74 ± 51.78	256.23 ± 42.11	19.32 ± 2.11	13.56 ± 2.40	240.56 ± 40.22	189.54 ± 38.84
<i>t</i> value	-0.290	-6.553	0.325	-6.770	-0.105	-3.477
<i>P</i> value	0.772	< 0.001	0.746	< 0.001	0.916	0.001

¹*P* < 0.01 *vs* single group.²*P* < 0.001 *vs* single group.

AFP: Alpha-fetoprotein; CEA: Carcinoembryonic antigen; CA19-9: Carbohydrate antigen 19-9.

the single group (60.00%, *P* < 0.05), as shown in Table 4. Additionally, the average survival time in the combined group (299.38 ± 61.13 d) was longer than that in the single group (214.41 ± 72.97 d, *P* < 0.05, Figure 1).

Analysis of factors influencing prognosis in patients with mid-late PHC

The patients were divided into survival (*n* = 104) and death (*n* = 46) groups. Univariate analysis indicated a significant relationship between prognosis and tumor diameter, tumor number, and treatment method (*P* < 0.05), as shown in Table 5.

Cox analysis of factors influencing prognosis of patients with mid-late PHC

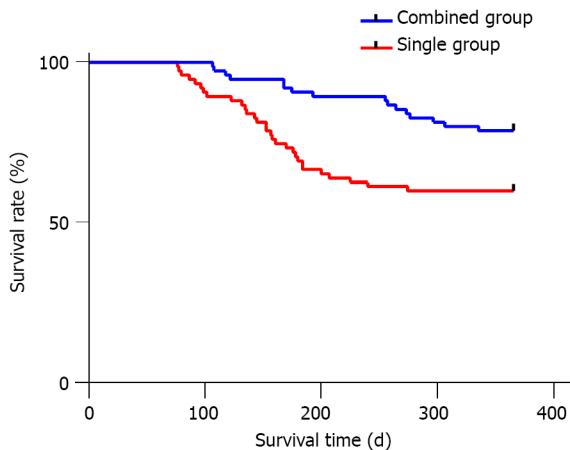
The COX proportional risk model was used to analyze and assign the study variables (Table 6). The results showed that the factors influencing the prognosis of patients with middle and advanced PHC were tumor diameter, tumor number, and treatment methods (*P* < 0.05, Table 7).

DISCUSSION

Owing to the hidden onset and rapid progression of PHC, most patients are diagnosed at the mid-late stage, and the opportunity for surgery is lost. Local intervention, thermal ablation, and chemotherapy have become primary treatments.

Table 4 Comparison of survival after 1 year between the single and combined groups

Group	Recrudescence	Transfer	Death
Combined group (<i>n</i> = 75)	22 (29.33)	5 (6.67)	16 (21.33) ¹
Single group (<i>n</i> = 75)	32 (42.67)	10 (13.33)	30 (40.00)
χ^2 value	2.894	1.852	6.145
<i>P</i> value	0.089	0.174	0.013

¹*P* < 0.05 *vs* single group.

DOI: 10.4240/wjgs.v15.i12.2783 Copyright ©The Author(s) 2023.

Figure 1 Survival curves for the single and combined groups. The survival rate of the two groups was compared by log-rank test. The survival rate of the single group was significantly lower than that of the combined group (log-rank $\chi^2 = 7.503$, *P* = 0.006).

As the preferred treatment for middle-late PHC, TACE can achieve a 1-year survival rate of more than 80% [14]. However, it has been reported in relevant literature that TACE treatment cannot improve the survival rate of patients with tumor diameter > 5 cm, and that the local hypoxia caused by a single TACE treatment may promote the regeneration of tumor blood vessels, resulting in high recurrence and metastasis rates for advanced liver cancer [15,16]. Therefore, combining TACE therapy with other treatment options has become the consensus for treating patients with PHC, especially those with mid-late disease who cannot be treated with surgery [17].

PMCT is a commonly used thermal ablation therapy for tumors. The basic principle is that the polar molecules within a substance can vibrate violently under the action of a rapidly changing electromagnetic field, generating a large amount of heat. Cancer cells stop proliferating when the lesion site is heated to an appropriate temperature, and tumor tissues begin to coagulate and necrose [12,18]. Studies have shown that PMCT has good clinical value because it offers advantages such as a good anti-heat sink effect, a wide MWA range, rapid local lesion warming, short surgical operation time, and no intraoperative current generation [19]. In addition, TACE can induce ischemia and hypoxia in tumor tissues, enhance thermal sensitivity, and enhance the high-temperature killing effect of PMCT on tumor cells [20].

Li *et al* [21] recently published a study in patients with hepatocellular carcinoma (HCC) treated with TACE combined with MWA, which showed that the CR of TACE + MWA was higher compared to TACE alone (65% *vs* 46%). Simultaneously, progression-free survival was significantly prolonged in the TACE + MWA treatment group (29 *vs* 19 mo), and conventional TACE + MWA did not increase the risk of adverse events. A meta-analysis by Wang *et al* [22] showed that the survival of patients treated with TACE + MWA was significantly better than that of patients treated with TACE alone, especially in patients with tumor diameters > 5 cm. This study found that, compared to the single group, the combined group had a higher CR (28% *vs* 17.33%) and a higher ORR (74.67% *vs* 50.67%). After 1 year of follow-up, there were no statistically significant differences in the recurrence and metastasis rates between the combined and single groups (*P* > 0.05). The survival rate in the combined group (80.00%) was higher than that in the single group. The average survival time of the combined group (299.38 ± 61.13 d) was longer than that of the single group (214.41 ± 72.97 d). These results suggest that TACE combined with PMCT can effectively treat middle-late PHC and improve patient survival rates.

Tumor markers are important indicators of tumor progression and are related to biological behaviors. As a new type of digestive system-specific antigen, CEA can comprehensively reflect the growth and ablation of malignant tumor cells [23, 24]. AFP is a protein produced by embryonic stem cells and is mainly derived from undifferentiated hepatocytes and the fetal yolk sac. Related studies have reported that more than 70% of TACE patients have elevated serum AFP levels, and the more severe the patient's condition, the higher the serum AFP level [25,26]. CA19-9 is an oligosaccharide antigen secreted by digestive tract tumor cells, and its expression is upregulated in patients with liver cancer [27]. This study

Table 5 Univariate analysis affecting the prognosis of patients with mid-late PHC

Item	Death group (n = 46)	Survival group (n = 104)	χ^2	P value
Gender (male/female)	21/25	63/41	2.883	0.090
Age (yr)			0.403	0.836
≥ 60	16 (34.78)	38 (36.54)		
< 60	30 (65.22)	66 (63.46)		
Tumor diameter (cm)			17.559	< 0.001 ²
≥ 6	31 (67.39)	32 (30.77)		
< 6	15 (32.61)	72 (69.23)		
Tumor number (cases)			23.588	< 0.001 ²
Single	17 (36.96)	81 (77.88)		
Multiple	29 (63.04)	23 (22.12)		
Treatment method (cases)			6.145	0.013 ¹
Single TACE	30 (65.22)	45 (43.27)		
TACE + PMCT	16 (34.78)	59 (56.73)		

¹P < 0.05.²P < 0.0001.

TACE: Transcatheter arterial chemoembolization; PMCT: Percutaneous microwave coagulation therapy.

Table 6 Specific values

Variable	
Gender	Male = 1, female = 0
Age	≥ 60 yr = 1, < 60 yr = 0
Tumor diameter	≥ 6 cm = 1, < 6 cm = 0
Tumor number	Single = 1, Multiple = 0
Treatment method	Single TACE = 1, TACE + PMCT = 0

TACE: Transcatheter arterial chemoembolization; PMCT: Percutaneous microwave coagulation therapy.

Table 7 Cox analysis of effects of various factors on the prognosis of patients with mid-late primary hepatic carcinoma

Item	B	SE	Wald	P value	OR	95%CI
Tumor diameter	0.989	0.339	8.495	0.004	2.689	1.383-5.230
Tumor number	1.076	0.330	10.659	0.001	2.934	1.537-5.598
Treatment method	1.006	0.329	9.336	0.002	1.735	1.434-5.215

95%CI: 95% confidence interval; OR: Odds ratio.

found that after 4 wk of treatment, the serum levels of CA19-9, AFP, and CEA in the single and combined groups decreased. However, the decrease was more obvious in the combined group, suggesting that combining TACE with PMCT can effectively reduce serum levels of CA19-9, AFP, and CEA in patients with advanced PHC.

This study further explored the factors affecting the prognosis of patients with middle-late PHC. We found that tumor diameter, tumor number, and treatment method ($P < 0.05$) are factors affecting the prognosis of patients with middle-late PHC. The rationale behind this analysis is that large tumors are not easily inactivated as a whole during treatment, which can easily cause residual tumors and recurrence. In addition, patients with large tumors have a low liver reserve compensatory function, which can easily cause liver failure and death during treatment[28,29]. The number of tumors predicts the degree of intrahepatic spread; the higher the number of tumors, the higher the chance of recurrence[30]. This

study proved that the combination of TACE and PMCT can improve patient prognosis.

This was a retrospective study, which was limited by the sample size and follow-up time. Therefore, to further demonstrate the role of combination therapy in patients with mid-late PHC, prospective randomized controlled studies of this nature should be conducted.

CONCLUSION

TACE + PMCT has good clinical efficacy in the treatment of patients with middle-late PHC and can effectively improve the survival rate of these patients. Tumor diameter, tumor number, and treatment methods are factors associated with the prognosis of patients with middle-late PHC.

ARTICLE HIGHLIGHTS

Research background

Patients with middle-late primary hepatic carcinoma (PHC) exhibit distinct characteristics, such as large tumors, multiple tumor lesions, and satellite lesions. Achieving a good embolization effect after multiple transcatheter arterial chemoembolization (TACE) treatments can often be challenging. percutaneous microwave coagulation therapy (PMCT) can accurately reach the tumor site, heat the tumor locally, and cause coagulation necrosis. Currently, TACE plus PMCT is more effective than interventional therapy alone and can improve survival time. However, there are few reports on the effects of TACE and PMCT on serum markers and the prognosis of patients with advanced PHC.

Research motivation

Compared to single TACE therapy, TACE + PMCT has a better effect in clinical applications. However, most studies have focused on efficacy and safety, and there are few reports on the factors affecting the prognosis of patients with middle-late PHC and the improvement of tumor markers in patients treated with TACE + PMCT.

Research objectives

To explore the effect of TACE + PMCT on tumor markers and prognosis in patients with mid-late PHC.

Research methods

Patients were divided into a single group (TACE treatment) and a combination group (TACE + PMCT treatment), according to the treatment methods. Serum tumor markers [alpha-fetoprotein (AFP), carcinoembryonic antigen (CEA), carbohydrate antigen 19-9 (CA19-9)] and the clinical efficacy of the single and combined groups were observed before treatment and 4 wk after treatment. The 1-year survival rates and prognostic factors of the two groups were analyzed.

Research results

The objective response rate in the combined group was 74.67%, higher than that in the single group (50.67%) ($P < 0.05$). After 4 wk of treatment, the serum AFP, CEA, and CA19-9 Levels in the single and combined groups decreased, with the decrease in the combined group being more significant ($P < 0.05$). The 1-year survival rate at the end of the follow-up period was 80.00% in the combined group and 60.00% in the single group ($P < 0.05$). The average survival time in the combined group was 299.38 ± 61.13 days, longer than that in the single group (214.41 ± 72.97 d, $P < 0.05$). COX analysis revealed the effect of tumor diameter, the number of tumors, and the treatment method on the prognosis of patients with middle-to-the newest PHC ($P < 0.05$).

Research conclusions

TACE + PMCT has good clinical efficacy in the treatment of mid-late PHC and can effectively improve the survival rate of patients. Tumor diameter, number, and treatment method were related to the prognosis of patients with mid-late PHC.

Research perspectives

This study provides a reference for the clinical management of patients with mid-late PHC.

FOOTNOTES

Author contributions: Lin ZP performed the research and wrote the paper; Huang DB designed the research; Zou XG contributed to the analysis; Chen Y and Li XQ organized the materials; Zhang Jie guided and supervised the research.

Institutional review board statement: The study was reviewed and approved by the Zhongshan People's Hospital Institutional Review Board (Approval No. 2023-038).

Informed consent statement: This is a retrospective study article, which selected anonymous patients from the hospital system. The

patient's identity information was not disclosed and will not cause any harm to the patient. An application for exemption from informed consent has been made to the ethics committee.

Conflict-of-interest statement: The authors declare no conflicts of interest for this article.

Data sharing statement: Clinical data used in this study can be obtained from the corresponding author.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

Country/Territory of origin: China

ORCID number: Zhi-Peng Lin 0000-0001-5329-8603; Da-Bei Huang 0000-0002-8047-9538; Xu-Gong Zou 0000-0001-6247-2554; Yuan Chen 0009-0007-1750-0545; Xiao-Qun Li 0009-0003-5603-6416; Jian Zhang 0009-0008-1050-5754.

S-Editor: Lin C

L-Editor: A

P-Editor: Lin C

REFERENCES

- 1 Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin* 2021; **71**: 209-249 [PMID: 33538338 DOI: 10.3322/caac.21660]
- 2 Chen W, Zheng R, Baade PD, Zhang S, Zeng H, Bray F, Jemal A, Yu XQ, He J. Cancer statistics in China, 2015. *CA Cancer J Clin* 2016; **66**: 115-132 [PMID: 26808342 DOI: 10.3322/caac.21338]
- 3 Dhir M, Melin AA, Douaiher J, Lin C, Zhen WK, Hussain SM, Geschwind JF, Doyle MB, Abou-Alfa GK, Are C. A Review and Update of Treatment Options and Controversies in the Management of Hepatocellular Carcinoma. *Ann Surg* 2016; **263**: 1112-1125 [PMID: 26813914 DOI: 10.1097/SLA.0000000000001556]
- 4 Ozakyol A. Global Epidemiology of Hepatocellular Carcinoma (HCC Epidemiology). *J Gastrointest Cancer* 2017; **48**: 238-240 [PMID: 28626852 DOI: 10.1007/s12029-017-9959-0]
- 5 Hatanaka T, Naganuma A, Kakizaki S. Lenvatinib for Hepatocellular Carcinoma: A Literature Review. *Pharmaceuticals (Basel)* 2021; **14** [PMID: 33418941 DOI: 10.3390/ph14010036]
- 6 Wu Z, Gao J, Zhuang W, Yang J, Guo W. Efficacy and safety of transcatheter arterial chemoembolization plus hepatic arterial infusion chemotherapy in the treatment of advanced hepatocellular carcinoma with portal vein tumor thrombosis in the main trunk. *J Cancer Res Ther* 2022; **18**: 345-351 [PMID: 35645099 DOI: 10.4103/jert.jert_1078_21]
- 7 Wang YB, Ma R, Wang ZB, Shi QL, Zhang L, Chen WZ, Gong JP, Bai J. Transcatheter Arterial Chemoembolization in Combination With High-Intensity Focused Ultrasound for Intermediate and Advanced Hepatocellular Carcinoma: A Meta-Analysis. *Front Oncol* 2022; **12**: 797349 [PMID: 35419281 DOI: 10.3389/fonc.2022.797349]
- 8 Fang C, Luo R, Zhang Y, Wang J, Feng K, Liu S, Chen C, Yao R, Shi H, Zhong C. Hepatectomy versus transcatheter arterial chemoembolization for resectable BCLC stage A/B hepatocellular carcinoma beyond Milan criteria: A randomized clinical trial. *Front Oncol* 2023; **13**: 1101162 [PMID: 36923427 DOI: 10.3389/fonc.2023.1101162]
- 9 Ma K, Liu J, Wang Y, Zhong Y, Wu Z, Fan R, Guo S. Relationship between plasma cell-free DNA (cfDNA) and prognosis of TACE for primary hepatocellular carcinoma. *J Gastrointest Oncol* 2020; **11**: 1350-1363 [PMID: 33457006 DOI: 10.21037/jgo-20-509]
- 10 Xu LF, Sun HL, Chen YT, Ni JY, Chen D, Luo JH, Zhou JX, Hu RM, Tan QY. Large primary hepatocellular carcinoma: transarterial chemoembolization monotherapy versus combined transarterial chemoembolization-percutaneous microwave coagulation therapy. *J Gastroenterol Hepatol* 2013; **28**: 456-463 [PMID: 23216261 DOI: 10.1111/jgh.12088]
- 11 Ge Y, Jeong S, Luo GJ, Ren YB, Zhang BH, Zhang YJ, Shen F, Cheng QB, Sui CJ, Wang HY, Xia Q, Chen L. Transarterial chemoembolization versus percutaneous microwave coagulation therapy for recurrent unresectable intrahepatic cholangiocarcinoma: Development of a prognostic nomogram. *Hepatobiliary Pancreat Dis Int* 2020; **19**: 138-146 [PMID: 32139295 DOI: 10.1016/j.hbpd.2020.02.005]
- 12 Guo H, Chen B, Li W, Wang H, Zhao S, Chen P, Jiang M, Zhao L, Xu K, Sun H, He Y, Zhou C. Percutaneous Microwave Coagulation Therapy: A Promising Therapeutic Method for Breaking the Barrier of the Intertumor Heterogeneity. *J Healthc Eng* 2021; **2021**: 7773163 [PMID: 34840703 DOI: 10.1155/2021/7773163]
- 13 Lencioni R, Llovet JM. Modified RECIST (mRECIST) assessment for hepatocellular carcinoma. *Semin Liver Dis* 2010; **30**: 52-60 [PMID: 20175033 DOI: 10.1055/s-0030-1247132]
- 14 Lencioni R, de Baere T, Soulen MC, Rilling WS, Geschwind JF. Lipiodol transarterial chemoembolization for hepatocellular carcinoma: A systematic review of efficacy and safety data. *Hepatology* 2016; **64**: 106-116 [PMID: 26765068 DOI: 10.1002/hep.28453]
- 15 Wu Z, Cui L, Qian J, Luo L, Tu S, Cheng F, Yuan L, Zhang W, Lin W, Tang H, Li X, Li H, Zhang Y, Zhu J, Li Y, Xiong Y, Hu Z, Peng P, He Y, Liu L, He K, Shen W. Efficacy of adjuvant TACE on the prognosis of patients with HCC after hepatectomy: a multicenter propensity score matching from China. *BMC Cancer* 2023; **23**: 325 [PMID: 37029339 DOI: 10.1186/s12885-023-10802-9]
- 16 Herber S, Schneider J, Brecher B, Höhler T, Thelen M, Otto G, Pitton MB. [TACE: therapy of the HCC before liver transplantation--experiences]. *Rofa* 2005; **177**: 681-690 [PMID: 15871083 DOI: 10.1055/s-2005-858100]

- 17 **Wei Y**, Dai F, Zhao T, Tao C, Wang L, Ye W, Zhao W. Transcatheter arterial chemoembolization monotherapy vs combined transcatheter arterial chemoembolization-percutaneous microwave coagulation therapy for massive hepatocellular carcinoma (≥ 10 cm). *Cancer Manag Res* 2018; **10**: 5273-5282 [PMID: 30464624 DOI: 10.2147/CMAR.S172395]
- 18 **Shen X**, Ma S, Tang X, Wang T, Qi X, Chi J, Wang Z, Cui D, Zhang Y, Li P, Zhai B. Clinical outcome in elderly Chinese patients with primary hepatocellular carcinoma treated with percutaneous microwave coagulation therapy (PMCT): A Strobe-compliant observational study. *Medicine (Baltimore)* 2018; **97**: e11618 [PMID: 30170369 DOI: 10.1097/MD.00000000000011618]
- 19 **Chu C**, Yi X, Sun J, Zhang X, Liu S, Zhang N, Wang J. Comparison of anesthetic effects of dexmedetomidine and tramadol, respectively, combined with propofol in percutaneous microwave coagulation therapy for hepatocellular carcinoma. *Oncol Lett* 2019; **18**: 3599-3604 [PMID: 31516574 DOI: 10.3892/ol.2019.10717]
- 20 **Hu Q**, Zeng Z, Zhang Y, Fan X. Study of ultrasound-guided percutaneous microwave ablation combined with portal vein embolization for rapid future liver remnant increase of planned hepatectomy. *Front Oncol* 2022; **12**: 926810 [PMID: 36686725 DOI: 10.3389/fonc.2022.926810]
- 21 **Li Z**, Jiao D, Han X, Si G, Li Y, Liu J, Xu Y, Zheng B, Zhang X. Transcatheter arterial chemoembolization combined with simultaneous DynaCT-guided microwave ablation in the treatment of small hepatocellular carcinoma. *Cancer Imaging* 2020; **20**: 13 [PMID: 32000862 DOI: 10.1186/s40644-020-0294-5]
- 22 **Wang L**, Ke Q, Lin N, Huang Q, Zeng Y, Liu J. The efficacy of transarterial chemoembolization combined with microwave ablation for unresectable hepatocellular carcinoma: a systematic review and meta-analysis. *Int J Hyperthermia* 2019; **36**: 1288-1296 [PMID: 31852267 DOI: 10.1080/02656736.2019.1692148]
- 23 **Zhang Q**, Bian SQ, Lv W, Kou D, Hu HL, Guo SS, Cao ZS. Observation of efficacy of TACE combined with HIFU on patients with middle-advanced liver cancer. *Eur Rev Med Pharmacol Sci* 2019; **23**: 239-246 [PMID: 31389607 DOI: 10.26355/eurev_201908_18653]
- 24 **Szemitko M**, Golubinska-Szemitko E, Sienko J, Falkowski A, Wiernicki I. Efficacy of Liver Chemoembolization after Prior Cetuximab Monotherapy in Patients with Metastatic Colorectal Cancer. *Cancers (Basel)* 2023; **15** [PMID: 36672489 DOI: 10.3390/cancers15020541]
- 25 **Chen W**, Peng J, Ye J, Dai W, Li G, He Y. Aberrant AFP expression characterizes a subset of hepatocellular carcinoma with distinct gene expression patterns and inferior prognosis. *J Cancer* 2020; **11**: 403-413 [PMID: 31897235 DOI: 10.7150/jca.31435]
- 26 **Hu S**, Gan W, Qiao L, Ye C, Wu D, Liao B, Yang X, Jiang X. A New Prognostic Algorithm Predicting HCC Recurrence in Patients With Barcelona Clinic Liver Cancer Stage B Who Received PA-TACE. *Front Oncol* 2021; **11**: 742630 [PMID: 34745962 DOI: 10.3389/fonc.2021.742630]
- 27 **Lu H**, Zheng C, Fan L, Xiong B. Efficacy and Safety of TACE Combined with Regorafenib versus TACE in the Third-Line Treatment of Colorectal Liver Metastases. *J Oncol* 2022; **2022**: 5366011 [PMID: 37251557 DOI: 10.1155/2022/5366011]
- 28 **Mack MG**, Straub R, Eichler K, Söllner O, Lehnert T, Vogl TJ. Breast cancer metastases in liver: laser-induced interstitial thermotherapy--local tumor control rate and survival data. *Radiology* 2004; **233**: 400-409 [PMID: 15459328 DOI: 10.1148/radiol.2332030454]
- 29 **Xia Y**, Li J, Liu G, Wang K, Qian G, Lu Z, Yang T, Yan Z, Lei Z, Si A, Wan X, Zhang H, Gao C, Cheng Z, Pawlik TM, Wang H, Lau WY, Wu M, Shen F. Long-term Effects of Repeat Hepatectomy vs Percutaneous Radiofrequency Ablation Among Patients With Recurrent Hepatocellular Carcinoma: A Randomized Clinical Trial. *JAMA Oncol* 2020; **6**: 255-263 [PMID: 31774468 DOI: 10.1001/jamaoncol.2019.4477]
- 30 **Mazzaferro V**, Sposito C, Zhou J, Pinna AD, De Carlis L, Fan J, Cescon M, Di Sandro S, Yi-Feng H, Lauterio A, Bongini M, Cucchetti A. Metroticket 2.0 Model for Analysis of Competing Risks of Death After Liver Transplantation for Hepatocellular Carcinoma. *Gastroenterology* 2018; **154**: 128-139 [PMID: 28989060 DOI: 10.1053/j.gastro.2017.09.025]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

Telephone: +1-925-3991568

E-mail: bpgoffice@wjgnet.com

Help Desk: <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

