

# World Journal of *Gastrointestinal Surgery*

*World J Gastrointest Surg* 2024 July 27; 16(7): 1956-2364



**EDITORIAL**

- 1956 Unveiling the potential of electrocautery-enhanced lumen-apposing metal stents in endoscopic ultrasound-guided biliary drainage  
*Chisthi MM*
- 1960 Minimally invasive pelvic exenteration for primary or recurrent locally advanced rectal cancer: A glimpse into the future  
*Kehagias D, Lampropoulos C, Kehagias I*
- 1965 Endoscopic submucosal dissection for early gastric cancer: A major challenge for the west  
*Schlottmann F*
- 1969 Impact of immunotherapy on liver metastasis  
*Fu Z, Wang MW, Liu YH, Jiao Y*
- 1973 Occurrence and prevention of incisional hernia following laparoscopic colorectal surgery  
*Wu XW, Yang DQ, Wang MW, Jiao Y*
- 1981 Role of endoscopic-ultrasound-guided biliary drainage with electrocautery-enhanced lumen-apposing metal stent for palliation of malignant biliary obstruction  
*Deliwala SS, Qayed E*

**REVIEW**

- 1986 Pancreatic pseudocyst: The past, the present, and the future  
*Koo JG, Liao MYQ, Kryvoruchko IA, Habeeb TA, Chia C, Shelat VG*

**ORIGINAL ARTICLE****Case Control Study**

- 2003 Diagnostic significance of serum levels of serum amyloid A, procalcitonin, and high-mobility group box 1 in identifying necrotising enterocolitis in newborns  
*Guo LM, Jiang ZH, Liu HZ, Zhang L*

**Retrospective Cohort Study**

- 2012 Clinical efficacy and safety of double-channel anastomosis and tubular gastroesophageal anastomosis in gastrectomy  
*Liu BY, Wu S, Xu Y*
- 2023 Application of radioactive iodine-125 microparticles in hepatocellular carcinoma with portal vein embolus  
*Meng P, Ma JP, Huang XF, Zhang KL*

**Retrospective Study**

- 2031** Reproducibility study of intravoxel incoherent motion and apparent diffusion coefficient parameters in normal pancreas  
*Liu X, Wang YF, Qi XH, Zhang ZL, Pan JY, Fan XL, Du Y, Zhai YM, Wang Q*
- 2040** Weight regain after intragastric balloon for pre-surgical weight loss  
*Abbitt D, Choy K, Kovar A, Jones TS, Wikiel KJ, Jones EL*
- 2047** Retrospective analysis based on a clinical grading system for patients with hepatic hemangioma: A single center experience  
*Zhou CM, Cao J, Chen SK, Tuxun T, Apaer S, Wu J, Zhao JM, Wen H*
- 2054** Spleen volume is associated with overt hepatic encephalopathy after transjugular intrahepatic portosystemic shunt in patients with portal hypertension  
*Zhao CJ, Ren C, Yuan Z, Bai GH, Li JY, Gao L, Li JH, Duan ZQ, Feng DP, Zhang H*
- 2065** Evaluation of the clinical effects of atropine in combination with remifentanyl in children undergoing surgery for acute appendicitis  
*Li YJ, Chen YY, Lin XL, Zhang WZ*
- 2073** The combined detection of carcinoembryonic antigen, carcinogenic antigen 125, and carcinogenic antigen 19-9 in colorectal cancer patients  
*Gong LZ, Wang QW, Zhu JW*
- 2080** Clinical efficacy of laparoscopic cholecystectomy plus cholangioscopy for the treatment of cholelithiasis combined with choledocholithiasis  
*Liu CH, Chen ZW, Yu Z, Liu HY, Pan JS, Qiu SS*
- 2088** Association between operative position and postoperative nausea and vomiting in patients undergoing laparoscopic sleeve gastrectomy  
*Li ZP, Song YC, Li YL, Guo D, Chen D, Li Y*
- 2096** Preoperative albumin-bilirubin score predicts short-term outcomes and long-term prognosis in colorectal cancer patients undergoing radical surgery  
*Diao YH, Shu XP, Tan C, Wang LJ, Cheng Y*
- 2106** Association of preoperative antiviral treatment with incidences of post-hepatectomy liver failure in hepatitis B virus-related hepatocellular carcinoma  
*Wang X, Lin ZY, Zhou Y, Zhong Q, Li ZR, Lin XX, Hu MG, He KL*
- 2119** Effect of rapid rehabilitation nursing on improving clinical outcomes in postoperative patients with colorectal cancer  
*Song JY, Cao J, Mao J, Wang JL*
- 2127** Interaction between the albumin-bilirubin score and nutritional risk index in the prediction of post-hepatectomy liver failure  
*Qin FF, Deng FL, Huang CT, Lin SL, Huang H, Nong JJ, Wei MJ*

- 2135** Effectiveness of magnetic resonance imaging and spiral computed tomography in the staging and treatment prognosis of colorectal cancer  
*Bai LN, Zhang LX*
- 2145** Correlation between abdominal computed tomography signs and postoperative prognosis for patients with colorectal cancer  
*Yang SM, Liu JM, Wen RP, Qian YD, He JB, Sun JS*
- 2157** Study on the occurrence and influencing factors of gastrointestinal symptoms in hemodialysis patients with uremia  
*Yuan D, Wang XQ, Shao F, Zhou JJ, Li ZX*
- 2167** "Hepatic hilum area priority, liver posterior first": An optimized strategy in laparoscopic resection for type III-IV hilar cholangiocarcinoma  
*Hu XS, Wang Y, Pan HT, Zhu C, Chen SL, Zhou S, Liu HC, Pang Q, Jin H*
- 2175** Impact of nutritional support on immunity, nutrition, inflammation, and outcomes in elderly gastric cancer patients after surgery  
*Chen XW, Guo XC, Cheng F*
- 2183** Therapeutic effects of Buzhong Yiqi decoction in patients with spleen and stomach qi deficiency after routine surgery and chemotherapy for colorectal cancer  
*Hu Q, Chen XP, Tang ZJ, Zhu XY, Liu C*
- 2194** Influencing factors and risk prediction model for emergence agitation after general anesthesia for primary liver cancer  
*Song SS, Lin L, Li L, Han XD*
- 2202** Potential applications of single-incision laparoscopic totally preperitoneal hernioplasty  
*Wang XJ, Fei T, Xiang XH, Wang Q, Zhou EC*
- 2211** Clinical significance of preoperative nutritional status in elderly gastric cancer patients undergoing radical gastrectomy: A single-center retrospective study  
*Zhao XN, Lu J, He HY, Ge SJ*
- 2221** Establishment and validation of a predictive model for peripherally inserted central catheter-related thrombosis in patients with liver cancer  
*Chen XF, Wu HJ, Li T, Liu JB, Zhou WJ, Guo Q*
- Observational Study**
- 2232** Effect of information-motivation-behavioral skills model based perioperative nursing on pain in patients with gallstones  
*Ma L, Yu Y, Zhao BJ, Yu YN, Li Y*
- 2242** Postoperative body weight change and its influencing factors in patients with gastric cancer  
*Li Y, Huang LH, Zhu HD, He P, Li BB, Wen LJ*
- 2255** Cost burden following esophagectomy: A single centre observational study  
*Buchholz V, Lee DK, Liu DS, Aly A, Barnett SA, Hazard R, Le P, Kioussis B, Muralidharan V, Weinberg L*

**Randomized Controlled Trial**

- 2270 Effectiveness of colonoscopy, immune fecal occult blood testing, and risk-graded screening strategies in colorectal cancer screening  
*Xu M, Yang JY, Meng T*

**Clinical and Translational Research**

- 2281 Construction of prognostic markers for gastric cancer and comprehensive analysis of pyroptosis-related long non-coding RNAs  
*Wang Y, Li D, Xun J, Wu Y, Wang HL*

**Basic Study**

- 2296 Yangyin Huowei mixture alleviates chronic atrophic gastritis by inhibiting the IL-10/JAK1/STAT3 pathway  
*Xie SS, Zhi Y, Shao CM, Zeng BF*
- 2308 Impacts of different pancreatic resection ranges on endocrine function in *Suncus murinus*  
*Li RJ, Yang T, Zeng YH, Natsuyama Y, Ren K, Li J, Nagakawa Y, Yi SQ*

**SYSTEMATIC REVIEWS**

- 2319 Impact of frailty on postoperative outcomes after hepatectomy: A systematic review and meta-analysis  
*Lv YJ, Xu GX, Lan JR*

**CASE REPORT**

- 2329 Multidisciplinary management of ulcerative colitis complicated by immune checkpoint inhibitor-associated colitis with life-threatening gastrointestinal hemorrhage: A case report  
*Hong N, Wang B, Zhou HC, Wu ZX, Fang HY, Song GQ, Yu Y*
- 2337 Sequential bowel necrosis and large gastric ulcer in a patient with a ruptured femoral artery: A case report  
*Wang P, Wang TG, Yu AY*
- 2343 Colon signet-ring cell carcinoma with chylous ascites caused by immunosuppressants following liver transplantation: A case report  
*Li Y, Tai Y, Wu H*
- 2351 Misdiagnosis of hemangioma of left triangular ligament of the liver as gastric submucosal stromal tumor: Two case reports  
*Wang JJ, Zhang FM, Chen W, Zhu HT, Gui NL, Li AQ, Chen HT*

**LETTER TO THE EDITOR**

- 2358 Revolutionizing palliative care: Electrocautery-enhanced lumen-apposing metal stents in endoscopic-ultrasound-guided biliary drainage for malignant obstructions  
*Onteddu NKR, Mareddy NSR, Vulasala SSR, Onteddu J, Virarkar M*

- 2362** Preservation of superior rectal artery in laparoscopic colectomy: The best choice for slow transit constipation?

*Liu YL, Liu WC*



**ABOUT COVER**

Peer Reviewer of *World Journal of Gastrointestinal Surgery*, Hideki Aoki, MD, PhD, Chief Doctor, Surgeon, Department of Surgery, Iwakuni Clinical Center, Iwakuni 740-8510, Japan. aoki.hideki.hy@mail.hosp.go.jp

**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 2024 Edition of Journal Citation Reports® cites the 2023 journal impact factor (JIF) for WJGS as 1.8; JIF without journal self cites: 1.7; 5-year JIF: 1.9; JIF Rank: 123/290 in surgery; JIF Quartile: Q2; and 5-year JIF Quartile: Q3.

**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: Zi-Hang Xu, Production Department Director: Xiang Li, Cover Editor: 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**

July 27, 2024

**COPYRIGHT**

© 2024 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 Cohort Study

## Application of radioactive iodine-125 microparticles in hepatocellular carcinoma with portal vein embolus

Peng Meng, Ji-Peng Ma, Xiao-Fei Huang, Kang-Le Zhang

**Specialty type:** Gastroenterology and hepatology**Provenance and peer review:** Unsolicited article; Externally peer reviewed.**Peer-review model:** Single blind**Peer-review report's classification****Scientific Quality:** Grade B**Novelty:** Grade B**Creativity or Innovation:** Grade B**Scientific Significance:** Grade B**P-Reviewer:** Balbaa ME**Received:** May 2, 2024**Revised:** May 22, 2024**Accepted:** June 13, 2024**Published online:** July 27, 2024**Processing time:** 80 Days and 19.1 Hours**Peng Meng**, The Fourth Department of Oncology, Yantai Hospital of Traditional Chinese Medicine, Yantai 264001, Shandong Province, China**Ji-Peng Ma**, Department of Medical Services, Yantai Hospital of Traditional Chinese Medicine, Yantai 264001, Shandong Province, China**Xiao-Fei Huang**, Department of Hepatobiliary Surgery, The First Affiliated Hospital of Sun Yat-sen University, Guangzhou 510062, Guangdong Province, China**Kang-Le Zhang**, The Third Department of Oncology, Yantai Hospital of Traditional Chinese Medicine, Yantai 264001, Shandong Province, China**Co-first authors:** Peng Meng and Ji-Peng Ma.**Corresponding author:** Kang-Le Zhang, Doctor, The Third Department of Oncology, Yantai Hospital of Traditional Chinese Medicine, No. 39 Xingfu Road, Zhifu District, Yantai 264001, Shandong Province, China. [zhangkangle1987@163.com](mailto:zhangkangle1987@163.com)**Abstract****BACKGROUND**

Radioactive iodine-125 (<sup>125</sup>I) microparticle therapy is a new type of internal radiation therapy that has shown unique advantages in the treatment of malignant tumors, especially hepatocellular carcinoma. Patients with hepatocellular carcinoma frequently experience portal vein embolism, which exacerbates the difficulty and complexity of treatment. <sup>125</sup>I particles, used in local radiotherapy, can directly act on tumor tissue and reduce damage to surrounding healthy tissue. Through retrospective analysis, this study discussed the efficacy and safety of radioactive <sup>125</sup>I particles in portal vein embolization patients with hepatocellular carcinoma in order to provide more powerful evidence supporting clinical treatment.

**AIM**

To investigate the effect of transcatheter arterial chemoembolization combined with portal vein <sup>125</sup>I particle implantation in the treatment of primary liver cancer patients with portal vein tumor thrombus and its influence on liver function.

**METHODS**

The clinical data of 96 patients with primary liver cancer combined with portal



vein tumor thrombus admitted to our hospital between January 2020 and December 2023 were retrospectively analyzed. Fifty-two patients received treatment with transcatheter arterial chemoembolization and implantation of  $^{125}\text{I}$  particles in the portal vein (combination group), while 44 patients received treatment with transcatheter arterial chemoembolization alone (control group). The therapeutic effects on tumor lesions, primary liver cancer, and portal vein tumor embolisms were compared between the two groups. Changes in relevant laboratory indexes before and after treatment were evaluated. The *t* test was used to compare the measurement data between the two groups, and the  $\chi^2$  test was used to compare the counting data between groups.

## RESULTS

The tumor lesion response rate in the combination group (59.62% *vs* 38.64%) and the response rate of patients with primary liver cancer complicated with portal vein tumor thrombus (80.77% *vs* 59.09%) were significantly greater than those in the control group ( $\chi^2 = 4.196, 5.421; P = 0.041, 0.020$ ). At 8 wk after surgery, the serum alpha-feto-protein, portal vein main diameter, and platelet of the combined group were significantly lower than those of the control group, and the serum alanine aminotransferase, aspartate aminotransferase, and total bilirubin were significantly greater than those of the control group ( $t = 3.891, 3.291, 2.330, 3.729, 3.582, 4.126; P < 0.05$ ). The serum aspartate aminotransferase, alanine aminotransferase, and total bilirubin levels of the two groups were significantly greater than those of the same group 8 wk after surgery ( $P < 0.05$ ), and the peripheral blood platelet, alpha-fetoprotein, and main portal vein diameter were significantly less than those of the same group before surgery ( $P < 0.05$ ).

## CONCLUSION

In patients with primary liver cancer and a thrombus in the portal vein, transcatheter arterial chemoembolization plus portal vein  $^{125}\text{I}$  implantation is more effective than transcatheter arterial chemoembolization alone. However, during treatment it is crucial to pay attention to liver function injury caused by transcatheter arterial chemoembolization.

**Key Words:** Radioactive iodine-125; Hepatocellular carcinoma; Transcatheter arterial chemoembolization; Portal vein embolus; Retrospective study

©The Author(s) 2024. Published by Baishideng Publishing Group Inc. All rights reserved.

**Core Tip:** This study investigated the clinical value of radioactive iodine-125 ( $^{125}\text{I}$ ) particles in the treatment of hepatocellular carcinoma with portal vein embolism. The study reviewed data from patients who received  $^{125}\text{I}$  microparticle implantation to evaluate its effect on tumor control and survival. At the same time, monitoring treatment-related safety and complications provided a basis for evaluating the efficacy and risk of  $^{125}\text{I}$  particles in this pathological scenario.

**Citation:** Meng P, Ma JP, Huang XF, Zhang KL. Application of radioactive iodine-125 microparticles in hepatocellular carcinoma with portal vein embolus. *World J Gastrointest Surg* 2024; 16(7): 2023-2030

**URL:** <https://www.wjgnet.com/1948-9366/full/v16/i7/2023.htm>

**DOI:** <https://dx.doi.org/10.4240/wjgs.v16.i7.2023>

## INTRODUCTION

Primary hepatocellular carcinoma (PHC) is a common malignant tumor with high morbidity and mortality[1-3]. PHC patients often have portal vein tumor thrombosis (PVTTs), which are risk factors for tumor recurrence, metastasis and blood-borne transmission[4-6]. In particular, when the tumor thrombus grows along the main portal vein, the prognosis of patients is worse, and the tumor may metastasize extensively from the liver[7]. It induces esophageal and gastric varices, resulting in rupture bleeding and other fatal consequences[8-10]. For PHC combined with PVTT, surgical procedures, portal stent implantation, radiotherapy, radiofrequency ablation, alcohol embolization, transhepatic arterial chemoembolization (TACE), and other methods have been applied, but a standardized treatment scheme has not been established in the clinic[11].

Hepatocellular carcinoma (HCC) is one of the most common types of primary liver cancer worldwide[12]. Patients with PVTT have a poor prognosis and are difficult to treat[13]. There is much interest in using radioactive iodine-125 ( $^{125}\text{I}$ ) particles as an interventional radiation therapy method in the current treatment plan. However, their use in patients with HCC who undergo portal vein embolization is still in the exploratory stage[14-16]. Therefore, the goal of this study was to evaluate the use of  $^{125}\text{I}$  particles in this treatment method, to determine how well the particles worked and whether they were safe, and to provide doctors with a better foundation for their work. This study investigated how well  $^{125}\text{I}$  particles worked in treating HCC with portal vein embolization and how they affect survival, quality of life, and the number of complications[17].

Traditional treatment methods, such as interventional embolization or radiotherapy, have limited efficacy in treating HCC with portal vein embolization and are prone to serious side effects[18-20]. In recent years, <sup>125</sup>I particles have gradually attracted increased amounts of attention as a means of interventional radiation therapy because of their ability to accurately target tumor tissue and release high doses of radioactive energy[21]. However, its application in patients with HCC who underwent portal vein embolization has not been fully verified or demonstrated. The results of this study will contribute to a comprehensive understanding of the efficacy and safety of <sup>125</sup>I particles in the treatment of HCC combined with portal vein embolization and provide a scientific basis for the promotion of this treatment mode in clinical practice[22-24]. At the same time, exploring the possible challenges and solutions in the course of treatment is highly important for improving therapeutic efficacy and reducing the incidence of complications[25].

This study evaluated the efficacy and safety of <sup>125</sup>I particles in the treatment of HCC combined with portal vein embolization through retrospective analysis of collected clinical data and explored possible intraoperative challenges and corresponding solutions. Ultimately, we hope to provide scientific treatment strategies and recommendations for clinical practice and promote improvements in treatment efficacy and quality of life for HCC patients with PVTT.

## MATERIALS AND METHODS

### Research subjects

The clinical data of PHC patients with PVTT admitted to our hospital between January 2020 and December 2023 were retrospectively analyzed, and the patients were divided into a combination group and a control group according to treatment method.

**Inclusion criteria:** (1) PHC and PVTT confirmed by computed tomography (CT), magnetic resonance imaging, and pathological diagnosis; (2) Lesions that could be measured by imaging; (3) American Eastern Cancer Collaboration score < 2; (4) Liver function Child-Pugh grade A-B; and (5) Provided informed consent to the patient before treatment.

**Exclusion criteria:** (1) Had metastatic liver cancer; (2) Had tumors at other sites; (3) History of hepatic fibrosis; and (4) Cerebrovascular diseases, respiratory diseases, thyroid dysfunction, *etc.*

### Treatment method

The control group was treated with TACE only. Briefly, after successful puncture of the right femoral artery by the Seldinger technique under local anesthesia, superselective intubation was performed into the tumor-supplying artery, and 1 g of fluorouracil, 40 mg of epirubicin, and a iodol emulsifier were injected. The injection dose of iodized oil was determined according to the tumor volume, and the dose was 2-3 mL/cm<sup>3</sup>. To make chemotherapy drugs in direct contact with tumor cells and release them slowly, TACE treatment should be performed again at a minimum 1-mo interval.

The patients in the combination group received TACE, portal vein intracavitary therapy, and radioactive <sup>125</sup>I implantation intracavitary therapy 1 wk after the first TACE. The Beijing Kelinon Institute of Medical Technology's radiation therapy planning system helped us make the treatment plan, determine how many particles were needed, determine how many were needed at each layer, determine the dose, and determine the radioactive activity. It also helped us predict how the particles would decay after being implanted and determine how far they could be from nearby important tissues without causing harm. We selected the appropriate body position, affixed a metal marker needle, and used a CT plain scan to determine the injection point. The puncture needle was used to drain the particles, which were then implanted. We performed a percutaneous transhepatic puncture under local anesthesia, selected the TACE embolization site to inject the needle as far as possible, and implanted radioactive particles once the needle reached the ideal location of the main PVTT. We used CT to pinpoint the optimal implantation location, modify the orientation of the needle, and distribute the implants uniformly across various layers. Following the injection, we implanted the first particle 1 cm from the distal edge of the tumor, the second particle 1 cm from the needle withdrawal site, and the final particle 1 cm from the proximal edge of the tumor. Once the operation was complete, we removed the puncture needle and applied local pressure to halt the bleeding. We conducted another CT scan to verify the absence of bleeding and the displacement of particles, among other factors. We performed a postoperative therapy planning system dose assessment and quality verification and administered hemostasis, liver protection, antiemesis, acid inhibition, anti-infection, and supportive treatments. electrocardiogram monitoring continued for 12 h.

### Observation indices and detection methods

Our study evaluated clinical efficacy using the MRECIST standard. A complete response (CR) occurred when the enhancement signal in the arterial phase disappeared. Partial response (PR) occurred when the diameter of the target lesion decreased by more than 30% compared to that before treatment. Stable disease (SD) occurred when the PR or progression (PD) standards were not met. PD occurred when the diameter of the target lesion increased by more than 20% or a new tumor lesion appeared.

### Evaluation of the clinical therapeutic effect of cancer suppositories

The following factors were considered when evaluating the therapeutic effect: (1) CR and enhanced CT showed that the PVTT disappeared completely; (2) PR and enhanced CT revealed that the PVTT was reduced by more than 50%; (3) SD and enhanced CT showed that the PVTT decreased by < 50% or increased by < 20%; and (4) PD and PVTT increased by

more than 20% or new PVTT appeared. The following calculations were used: Response rate = (CR + PR)/sample size × 100%; and total response rate = (CR + PR + SD)/sample size × 100%.

### Testing instruments used

Our study compared the serum levels of alpha-fetoprotein (AFP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), total bilirubin (TBIL), platelet (PLT), white blood counts (WBC), and portal vein diameter between the two groups before and 8 wk after the operation. We collected fasting venous blood before and 8 wk after surgery. The Roche Cobas e601 electrochemiluminescence immunoassay and its matching kit detected AFP. A Hitachi 7060 automatic biochemical analyzer detected ALT, AST, and TBIL. We used a blood cell analyzer to detect the PLT and WBC and used color Doppler ultrasound to detect the portal vein diameter.

### Statistical analysis

SPSS 23.0 statistical software was used for data analysis. Measurement data were expressed as the mean ± standard deviation, and a *t* test was used for comparisons between two groups.  $\chi^2$  test was used for comparisons among data groups, and *P* < 0.05 was considered to indicate statistical significance.

## RESULTS

### General clinical data analysis

The study included 96 patients with PHC and PVTT, with 52 patients in the combination group and 44 patients in the control group. There was no significant difference in the comparison of general data between the two groups (*P* > 0.05) (Table 1).

### The efficacy of tumor lesion and PVTT treatment was compared between the two groups in the combined group

The rates of tumor lesion remission and PVTT remission were significantly greater in the combined group than in the control group (*P* < 0.05). There was no significant difference in the total tumor lesion effective rate or total PVTT effective rate between the combined group and the control group (*P* > 0.05) (Tables 2 and 3).

### Analysis of portal vein diameter, liver function index, AFP, WBC, and PLT

At 8 wk after surgery, the serum AFP, portal vein main diameter, and PLT of the combined group were significantly lower than those of the control group, and the serum ALT, AST, and TBIL levels were significantly greater than those of the control group (*P* < 0.05). The serum AST, ALT, and TBIL levels in the two groups were significantly greater than those in the same group 8 wk after surgery (*P* < 0.05), and the peripheral blood PLT, AFP, and portal vein main diameter were significantly less than those in the same group before surgery (*P* < 0.05) (Table 4).

### Compared complications

In the combined group, there were 29 patients with abdominal pain, 14 patients with fever, 2 patients with vomiting, 1 patient with dyspnea, and 1 patient with chest pain. In the control group, there were 18 patients with abdominal pain, 8 patients with fever, and 2 patients with vomiting. There was no significant difference in the incidence of postoperative complications between the two groups (90.38% vs 63.64%) (*P* > 0.05).

## DISCUSSION

The onset of PHC is insidious, and most patients have no typical clinical symptoms or signs in the early stage and have reached the late stage at diagnosis[26-28]. There are many types of cancer in PHC, and it is easy for it to spread to other parts of the body. When liver cancer grows to a certain size, PVTT can easily form, which worsens portal hypertension, accelerates the spread of intrahepatic tumors, and accelerates disease progression[29]. It is also one of the main reasons PHC patients die. PVTT is an important factor in the prognosis of PHC patients. Therefore, it is very important to treat PVTT, increase portal vein blood flow, and reduce portal vein pressure[30]. TACE also works directly on the local lesion, contacts tumor cells, and slowly releases them. This approach directly targets the tumor and circumvents the detrimental side effects of chemotherapy drugs administered to the entire body[31]. However, other studies[32-34] have shown that repeated TACE treatment significantly decreases or even stops blood flow in the hepatic artery, causing the liver to develop steatosis, *etc.* The presence of a tumor thrombus will reduce the therapeutic efficacy of TACE.

PHC patients with PVTT often have a large tumor load. Conventional radiation therapy requires a large radiation dose and causes certain damage to surrounding tissues. Therefore, its use is not recommended. In recent years, with the rapid development of medical imaging technology, a large number of new treatment measures for PHC combined with PVTT have emerged[35]. Intracavitary treatment of the portal vein is one of the most widely used new methods. The portal vein cavity seals radioactive iodine particles, which do not absorb into the human body, cause little damage to normal tissues, do not participate in metabolism, do not pollute the environment, and offer high safety.

Currently, there are few reports[36-38] about the implantation of iodine particles into cancer suppositories, despite the widespread use of intracavitary implantation for the treatment of intracranial tumors, head and neck tumors, pancreatic cancer, prostate cancer, and liver cancer. The rates of tumor lesion remission and PVTT remission were much greater in

**Table 1 Comparison of general information between two groups of patients**

Characteristic	Joint group, n = 52	Control group, n = 44	Statistical value	P value
Male/female	33/19	29/15	$\chi^2 = 0.062$	0.803
Age in yr	62.5 ± 12.0	60.1 ± 13.9	$t = 0.908$	0.366
Maximum diameter of lesion in cm	7.6 ± 3.0	8.0 ± 3.4	$t = 0.612$	0.542
Child Pugh grading			$\chi^2 = 0.019$	0.890
A	30	26		
B	22	18		
PVTT position			$\chi^2 = 0.055$	0.973
Left branch of portal vein	21	17		
Right branch of portal vein	19	16		
Left and right branches of portal vein	12	11		
HBsAg positivity	35	30	$\chi^2 = 0.008$	0.927

HBsAg: Hepatitis B surface antigen; PVTT: Portal vein tumor.

**Table 2 Comparison of tumor lesion efficacy between two groups of patients**

Group	Cases	Curative effect				Remission rate	Total effective rate
		CR	PR	SD	PD		
Joint group	52	3	28	19	2	31 (59.62)	50 (96.15)
Control group	44	1	16	23	4	17 (38.64)	40 (90.91)
$\chi^2$ value						4.196	1.119
P value						0.041	0.290

Data are n (%). CR: Complete response; PD: Progression; PR: Partial response; SD: Stable.

**Table 3 Comparison of portal vein tumors efficacy between two groups of patients**

Group	Cases	Therapeutic effect				Relief rate	Total effective rate
		CR	PR	SD	PD		
Joint group	52	9	33	9	1	42 (80.77)	51 (98.08)
Control group	44	4	22	15	3	26 (59.09)	41 (93.18)
$\chi^2$ value						5.421	1.430
P value						0.020	0.232

Data are n (%). CR: Complete response; PD: Progression; PR: Partial response; SD: Stable.

people who were treated with TACE and portal vein <sup>125</sup>I implantation technology than in people who were only treated with TACE. At 8 wk after surgery, the serum AFP levels in patients treated with TACE and portal vein <sup>125</sup>I were lower than those in patients treated with TACE alone. The main portal vein diameter in patients treated with TACE and portal vein <sup>125</sup>I implantation was smaller than that in patients treated with TACE alone[39]. This is due to the continuous release of gamma rays by radioactive iodine particles in the portal vein cavity, which destroys the double-stranded DNA of tumor cells, directly kills tumor thrombi, produces a more accurate radiotherapy effect, relieves portal hypertension, and reduces damage to surrounding tissues[40].

In addition to particle implantation, portal vein stent implantation and portal vein particle strip implantation are relatively mature intracavity therapy techniques for PVTT[41]. Both of these methods have achieved good clinical efficacy, but there are still some problems, such as stent stenosis and occlusion, hepatic encephalopathy, a high dose of particle chain radiation, and many adverse reactions[42]. Particle implantation therapy is beneficial for the treatment of

**Table 4 Comparison of portal vein diameter, liver function indicators, alpha-fetoprotein level, and platelet level between the two groups of patients before and after treatment**

Time	Cases	AFP in ng/mL	ALT in U/L	AST in U/L	TBIL in $\mu$ mol/L	PLT as $10^9$ /L	Portal vein trunk diameter in mm	WBC as $10^9$ /L
Preoperative								
Joint group	52	557.9 $\pm$ 196.4	57.2 $\pm$ 25.8	66.8 $\pm$ 29.0	20.9 $\pm$ 5.8	162.6 $\pm$ 47.2	13.90 $\pm$ 2.51	5.16 $\pm$ 1.80
Control group	44	570.2 $\pm$ 211.6	54.0 $\pm$ 19.8	61.2 $\pm$ 25.7	22.5 $\pm$ 7.5	167.0 $\pm$ 51.6	14.10 $\pm$ 2.66	5.30 $\pm$ 1.95
<i>t</i> value		0.288	0.651	0.964	1.154	0.426	0.369	0.357
<i>P</i> value		0.774	0.515	0.338	0.251	0.671	0.713	0.722
8 wk after surgery								
Joint group	52	138.2 $\pm$ 69.5	114.2 $\pm$ 47.0	123.0 $\pm$ 51.0	35.0 $\pm$ 9.4	113.0 $\pm$ 55.2	11.20 $\pm$ 2.14	3.72 $\pm$ 1.15
Control group	44	196.4 $\pm$ 73.2	82.6 $\pm$ 29.3	89.6 $\pm$ 33.7	27.1 $\pm$ 8.7	139.0 $\pm$ 50.1	12.64 $\pm$ 2.00	3.90 $\pm$ 1.24
<i>t</i> value		3.890	3.720	3.582	4.126	2.330	3.290	0.719
<i>P</i> value		< 0.001	< 0.001	< 0.001	< 0.001	0.022	0.001	0.473

AFP: Alpha-fetoprotein; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; PLT: Platelet; TBIL: Total bilirubin; WBC: White blood cells.

PVTT with few side effects and has initially achieved good clinical effects, but additional cases are needed for further confirmation[43].

This study revealed that there were no serious complications, such as severe abdominal hemorrhage or bile duct or portal vein injury, in the combined group. Other complications, such as massive abdominal hemorrhage, need further observation. This study also revealed that the serum ALT, AST, and TBIL levels in patients treated with TACE + portal vein intraventricular particle implantation were greater than those in patients treated with TACE alone, which may be related to the radioactive damage caused by radioactive iodine particles to hepatocytes, and the degree of damage can still be improved by clinical drug treatment.

## CONCLUSION

TACE combined with portal vein intraventricular radioactive iodine implantation is an effective treatment, and its therapeutic effect is better than that of TACE alone in patients with PHC combined with PVTT. However, attention should be given to liver function injury caused by TACE during treatment.

## FOOTNOTES

**Author contributions:** Meng P and Ma JP wrote the manuscript and contributed equally to this work; Huang XF collected the data; Zhang KL guided the study; All authors reviewed, edited, and approved the final manuscript and revised it critically for important intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work.

**Institutional review board statement:** This study was approved by the Medical Research Ethics Committee of The First Affiliated Hospital of Sun Yat-sen University.

**Informed consent statement:** This study has obtained the informed consent of the patients and their families who signed the informed consent for treatment.

**Conflict-of-interest statement:** The authors declare no conflicts of interest.

**Data sharing statement:** Statistical analysis plan, informed consent form, and clinical study report will also be shared if requested. E-mail: [zhangkangle1987@163.com](mailto:zhangkangle1987@163.com).

**STROBE statement:** This study complied with STROBE statement, ensuring transparency and accuracy in study design, data analysis and reporting of results.

**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 of origin:** China

**ORCID number:** Kang-Le Zhang [0009-0005-9381-9932](https://orcid.org/0009-0005-9381-9932).

**S-Editor:** Yan JP

**L-Editor:** Filipodia

**P-Editor:** Zhao YQ

## REFERENCES

- Guo Y, Wu J, Liang L, Zhu K, Zhou J, Lin L, Chen Y, Cao B, He M, Lian H, Huang W, Cai M. Tyrosine-kinase inhibitor combined with iodine-125 seed brachytherapy for hepatocellular carcinoma refractory to transarterial chemoembolization: a propensity-matched study. *Cancer Imaging* 2023; **23**: 91 [PMID: [37749616](https://pubmed.ncbi.nlm.nih.gov/37749616/) DOI: [10.1186/s40644-023-00604-4](https://doi.org/10.1186/s40644-023-00604-4)]
- Qiu Z, Yu C, Qiu X, Li Q, Li J, Chen Z, Chang S, Zhang S, Fan G, Wang S. Safety and Efficacy of CT-Guided Iodine-125 Brachytherapy for Portal Vein Tumor Thrombus in Hepatocellular Carcinoma. *Acad Radiol* 2023; **30** Suppl 1: S53-S60 [PMID: [36882354](https://pubmed.ncbi.nlm.nih.gov/36882354/) DOI: [10.1016/j.acra.2023.02.006](https://doi.org/10.1016/j.acra.2023.02.006)]
- Ren Y, Dong X, Chen L, Sun T, Alwalid O, Kan X, Su Y, Xiong B, Liang H, Zheng C, Han P. Combined Ultrasound and CT-Guided Iodine-125 Seeds Implantation for Treatment of Residual Hepatocellular Carcinoma Located at Complex Sites After Transcatheter Arterial Chemoembolization. *Front Oncol* 2021; **11**: 582544 [PMID: [33738247](https://pubmed.ncbi.nlm.nih.gov/33738247/) DOI: [10.3389/fonc.2021.582544](https://doi.org/10.3389/fonc.2021.582544)]
- Zhang W, Wu L, Chen L, Ren Y, Sun T, Sun B, Zhu L, Liu Y, Zheng C. The Efficacy and Safety of Transarterial Chemoembolization Plus Iodine 125 Seed Implantation in the Treatment of Hepatocellular Carcinoma With Oligometastases: A Case Series Reports. *Front Oncol* 2022; **12**: 828850 [PMID: [35656512](https://pubmed.ncbi.nlm.nih.gov/35656512/) DOI: [10.3389/fonc.2022.828850](https://doi.org/10.3389/fonc.2022.828850)]
- Zhang ZH, Hou SN, Yu JZ, Zhang W, Ma JQ, Yang MJ, Liu QX, Liu LX, Luo JJ, Qu XD, Yan ZP. Combined iodine-125 seed strand, portal vein stent, transarterial chemoembolization, lenvatinib and anti-PD-1 antibodies therapy for hepatocellular carcinoma and Vp4 portal vein tumor thrombus: A propensity-score analysis. *Front Oncol* 2022; **12**: 1086095 [PMID: [36741718](https://pubmed.ncbi.nlm.nih.gov/36741718/) DOI: [10.3389/fonc.2022.1086095](https://doi.org/10.3389/fonc.2022.1086095)]
- Wu L, Zheng Y, Liu J, Luo R, Wu D, Xu P, Wu D, Li X. Comprehensive evaluation of the efficacy and safety of LPV/r drugs in the treatment of SARS and MERS to provide potential treatment options for COVID-19. *Aging (Albany NY)* 2021; **13**: 10833-10852 [PMID: [33879634](https://pubmed.ncbi.nlm.nih.gov/33879634/) DOI: [10.18632/aging.202860](https://doi.org/10.18632/aging.202860)]
- Chen L, Ying X, Zhang D, Lai L, Wu F, Tu J, Ji J. Iodine-125 Brachytherapy Can Prolong Progression-Free Survival of Patients with Locoregional Recurrence and/or Residual Hepatocellular Carcinoma After Radiofrequency Ablation. *Cancer Biother Radiopharm* 2021; **36**: 820-826 [PMID: [32551979](https://pubmed.ncbi.nlm.nih.gov/32551979/) DOI: [10.1089/cbr.2020.3647](https://doi.org/10.1089/cbr.2020.3647)]
- Yan L, Chen L, Qian K, Kan X, Zhang H, Liang B, Zheng C. Caudate Lobe Hepatocellular Carcinoma Treated with Sequential Transarterial Chemoembolization and Iodine 125 Seeds Implantation: A Single-Center Retrospective Study. *Cancer Manag Res* 2021; **13**: 3901-3912 [PMID: [34012296](https://pubmed.ncbi.nlm.nih.gov/34012296/) DOI: [10.2147/CMAR.S309310](https://doi.org/10.2147/CMAR.S309310)]
- Wu L, Zhong Y, Wu D, Xu P, Ruan X, Yan J, Liu J, Li X. Immunomodulatory Factor TIM3 of Cytolytic Active Genes Affected the Survival and Prognosis of Lung Adenocarcinoma Patients by Multi-Omics Analysis. *Biomedicines* 2022; **10** [PMID: [36140350](https://pubmed.ncbi.nlm.nih.gov/36140350/) DOI: [10.3390/biomedicines10092248](https://doi.org/10.3390/biomedicines10092248)]
- Lin LW, Yan LY, Ke K, Yang WZ, Lin JQ, Huang N. Efficacy and safety of transarterial chemoembolization combined with lenvatinib, programmed death-1 inhibitor, and iodine-125 seed brachytherapy for hepatocellular carcinoma with portal vein tumor thrombosis. *Brachytherapy* 2023; **22**: 858-871 [PMID: [37574351](https://pubmed.ncbi.nlm.nih.gov/37574351/) DOI: [10.1016/j.brachy.2023.06.229](https://doi.org/10.1016/j.brachy.2023.06.229)]
- Li J, Zhang L, Sun Z, Ge Y, Xiao H, Xie Q, Hu S. Iodine-125 seed implantation for residual hepatocellular carcinoma or cholangiocellular carcinoma in challenging locations after transcatheter arterial chemoembolization: Initial experience and findings. *J Contemp Brachytherapy* 2020; **12**: 233-240 [PMID: [32695194](https://pubmed.ncbi.nlm.nih.gov/32695194/) DOI: [10.5114/jcb.2020.96863](https://doi.org/10.5114/jcb.2020.96863)]
- Yang C, Xiao Y, Du Y, Xiong J, Deng L, Liang Q, Yuan J, He C, He F, Huang X. Iodine-125 Seeds Inhibit Carcinogenesis of Hepatocellular Carcinoma Cells by Suppressing Epithelial-Mesenchymal Transition via TGF- $\beta$ 1/Smad Signaling. *Dis Markers* 2022; **2022**: 9230647 [PMID: [35578690](https://pubmed.ncbi.nlm.nih.gov/35578690/) DOI: [10.1155/2022/9230647](https://doi.org/10.1155/2022/9230647)]
- Zhang L, Wang J, Li Y, Hou L, Xia J, Shen J. Implanting Iodine-125 Seed Strand Inside the Portal Vein Stent: An Improved Approach to Endovascular Brachytherapy for Treatment of Patients with Hepatocellular Carcinoma and Main Portal Vein Tumor Thrombus. *J Hepatocell Carcinoma* 2023; **10**: 2187-2196 [PMID: [38084210](https://pubmed.ncbi.nlm.nih.gov/38084210/) DOI: [10.2147/JHC.S430686](https://doi.org/10.2147/JHC.S430686)]
- Lu J, Guo JH, Ji JS, Li YL, Lv WF, Zhu HD, Sun JH, Ren WX, Zhang FJ, Wang WD, Shao HB, Cao GS, Li HL, Gao K, Yang P, Yin GW, Zhu GY, Wu FZ, Wang WJ, Lu D, Chen SQ, Min J, Zhao Y, Li R, Lu LG, Lau WY, Teng GJ. Irradiation stent with 125 I plus TACE vs sorafenib plus TACE for hepatocellular carcinoma with major portal vein tumor thrombosis: a multicenter randomized trial. *Int J Surg* 2023; **109**: 1188-1198 [PMID: [37038986](https://pubmed.ncbi.nlm.nih.gov/37038986/) DOI: [10.1097/JS9.0000000000000295](https://doi.org/10.1097/JS9.0000000000000295)]
- Huang J, Cai M, Huang W, Guo Y, Zhou J, Liang L, Lin L, Zhou Z, Lian H, He M, Zhu K. Transarterial chemoembolization combined with sorafenib and iodine-125 seed brachytherapy for hepatocellular carcinoma with portal vein tumor thrombus: a retrospective controlled study. *Chin Med J (Engl)* 2022; **135**: 113-115 [PMID: [34507316](https://pubmed.ncbi.nlm.nih.gov/34507316/) DOI: [10.1097/CM9.0000000000001537](https://doi.org/10.1097/CM9.0000000000001537)]
- Li S, Li L, Li B, Wang W. Safety and efficacy of endovascular implantation of a portal vein stent combined with iodine-125 seed-strips followed by transcatheter arterial chemoembolization with sorafenib for the treatment of hepatocellular carcinoma with portal vein tumor thrombosis. *Br J Radiol* 2020; **93**: 20190279 [PMID: [32464068](https://pubmed.ncbi.nlm.nih.gov/32464068/) DOI: [10.1259/bjr.20190279](https://doi.org/10.1259/bjr.20190279)]
- Hong D, Zhou Y, Wan X, Su H, Shao H. Brachytherapy with Iodine-125 seeds for treatment of portal vein-branch tumor thrombus in patients with hepatocellular carcinoma. *BMC Cancer* 2021; **21**: 1020 [PMID: [34521375](https://pubmed.ncbi.nlm.nih.gov/34521375/) DOI: [10.1186/s12885-021-08680-0](https://doi.org/10.1186/s12885-021-08680-0)]
- Wu L, Liu Q, Ruan X, Luan X, Zhong Y, Liu J, Yan J, Li X. Multiple Omics Analysis of the Role of RBM10 Gene Instability in Immune Regulation and Drug Sensitivity in Patients with Lung Adenocarcinoma (LUAD). *Biomedicines* 2023; **11** [PMID: [37509501](https://pubmed.ncbi.nlm.nih.gov/37509501/) DOI: [10.3390/biomedicines11071861](https://doi.org/10.3390/biomedicines11071861)]



- 19 **Chen L**, Kan X, Sun T, Ren Y, Cao Y, Yan L, Liang B, Xiong B, Zheng C. Transarterial chemoembolization combined with iodine 125 seeds vs transarterial chemoembolization combined with radiofrequency ablation in the treatment of early- and intermediate-stage hepatocellular carcinoma. *BMC Gastroenterol* 2020; **20**: 205 [PMID: 32600349 DOI: 10.1186/s12876-020-01355-3]
- 20 **Wu L**, Zheng Y, Ruan X, Wu D, Xu P, Liu J, Wu D, Li X. Long-chain noncoding ribonucleic acids affect the survival and prognosis of patients with esophageal adenocarcinoma through the autophagy pathway: construction of a prognostic model. *Anticancer Drugs* 2022; **33**: e590-e603 [PMID: 34338240 DOI: 10.1097/CAD.0000000000001189]
- 21 **Chen L**, Sun T, Kan X, Chen S, Ren Y, Cao Y, Yan L, Liang B, Xiong B, Zheng C. Transarterial chemoembolization combined with iodine-125 seed implantation for patients with hepatocellular carcinoma: a retrospective controlled study. *J Int Med Res* 2020; **48**: 300060520944309 [PMID: 33050765 DOI: 10.1177/0300060520944309]
- 22 **Li S**, Li B, Li L, Xu F, Yang X, Wang W. A combination of portal vein stent insertion and endovascular iodine-125 seed-strip implantation, followed by transcatheter arterial chemoembolization with sorafenib for treatment of hepatocellular carcinoma-associated portal vein tumor thrombus. *J Contemp Brachytherapy* 2021; **13**: 670-679 [PMID: 35079254 DOI: 10.5114/jcb.2021.112118]
- 23 **Yang C**, He C, Yu S, Yuan J, Xiao Y, Huang X. Effects of iodine-125 seed brachytherapy on patients with heterochronous pulmonary metastasis from hepatocellular carcinoma: A propensity score matching study. *J Cancer Res Ther* 2023; **19**: 957-963 [PMID: 37675723 DOI: 10.4103/jcr.tjrt.519\_22]
- 24 **Li D**, Wang W, Liu B, Jin D, Wang Y, He G, Guo L, Liu W, Li Y. Characterization of circSEC11A as a novel regulator of Iodine-125 radioactive seed-induced anticancer effects in hepatocellular carcinoma via targeting ZHX2/GADD34 axis. *Cell Death Discov* 2023; **9**: 294 [PMID: 37563132 DOI: 10.1038/s41420-023-01593-w]
- 25 **Tan Z**, Wu D, Guo J, Wang H, Zhang J. Endovascular brachytherapy with iodine-125 seed strand for extensive portal vein tumor thrombus in patients with hepatocellular carcinoma. *Front Oncol* 2023; **13**: 1201381 [PMID: 37534248 DOI: 10.3389/fonc.2023.1201381]
- 26 **Wu L**, Zhong Y, Yu X, Wu D, Xu P, Lv L, Ruan X, Liu Q, Feng Y, Liu J, Li X. Selective poly adenylation predicts the efficacy of immunotherapy in patients with lung adenocarcinoma by multiple omics research. *Anticancer Drugs* 2022; **33**: 943-959 [PMID: 35946526 DOI: 10.1097/CAD.0000000000001319]
- 27 **Yuan Q**, Ma Y, Wu L, Song Y, He C, Huang X, Yang C, Liu B, Han H, Zhang K, Wang J. Clinical Outcome of CT-Guided Iodine-125 Radioactive Seed Implantation for Intrahepatic Recurrent Hepatocellular Carcinoma: A Retrospective, Multicenter Study. *Front Oncol* 2022; **12**: 819934 [PMID: 35463334 DOI: 10.3389/fonc.2022.819934]
- 28 **Wawrowicz K**, Żelechowska-Matysiak K, Majkowska-Pilip A, Wierzbicki M, Bilewicz A. Platinum nanoparticles labelled with iodine-125 for combined "chemo-Auger electron" therapy of hepatocellular carcinoma. *Nanoscale Adv* 2023; **5**: 3293-3303 [PMID: 37325536 DOI: 10.1039/d3na00165b]
- 29 **Chen Z**, Fu X, Qiu Z, Mu M, Jiang W, Wang G, Zhong Z, Qi H, Gao F. CT-guided (125)I brachytherapy for hepatocellular carcinoma in high-risk locations after transarterial chemoembolization combined with microwave ablation: a propensity score-matched study. *Radiol Oncol* 2023; **57**: 127-139 [PMID: 36942903 DOI: 10.2478/raon-2023-0012]
- 30 **Wu L**, Li H, Liu Y, Fan Z, Xu J, Li N, Qian X, Lin Z, Li X, Yan J. Research progress of 3D-bioprinted functional pancreas and *in vitro* tumor models. *IJB* 2024; **10**: 1256 [DOI: 10.36922/ijb.1256]
- 31 **Tian S**, Lu Y, Gao H, Chen Z, Niu M, Wang C, Liu B. Epirubicin may enhance the inhibition of hepatocellular carcinoma induced by iodine-125 seeds through downregulating WNT pathway. *Asia Pac J Clin Oncol* 2023; **19**: 355-364 [PMID: 36464954 DOI: 10.1111/ajco.13873]
- 32 **Li Y**, Li H, Hu H, Yuan H, Zhao Y. Efficacy and safety of transcatheter arterial chemoembolization combined with either (125)I seed implantation or apatinib in hepatocellular carcinoma with portal vein tumor thrombosis: A retrospective comparative study. *J Cancer Res Ther* 2020; **16**: 1691-1697 [PMID: 33565518 DOI: 10.4103/jcr.JCRT\_1587\_20]
- 33 **Wang G**, Ye G, Chen X, Ji Z, Wu L, Liu B. The Effect of Iodine-125 Radioactive Particle Stent with Doxorubicin-loaded Nano-tetrahedrons Combined with Transarterial Chemoembolization on Survival and Prognosis of Patients with Cholangiocarcinoma. *Cell Mol Biol (Noisy-le-grand)* 2022; **68**: 133-138 [PMID: 36800820 DOI: 10.14715/cmb/2022.68.8.24]
- 34 **Song Z**, Ye J, Wang Y, Li Y, Wang W. Computed tomography-guided iodine-125 brachytherapy for unresectable hepatocellular carcinoma. *J Cancer Res Ther* 2019; **15**: 1553-1560 [PMID: 31939437 DOI: 10.4103/jcr.JCRT\_629\_19]
- 35 **Wu L**, Li X, Qian X, Wang S, Liu J, Yan J. Lipid Nanoparticle (LNP) Delivery Carrier-Assisted Targeted Controlled Release mRNA Vaccines in Tumor Immunity. *Vaccines (Basel)* 2024; **12** [PMID: 38400169 DOI: 10.3390/vaccines12020186]
- 36 **Zhao M**, Wen F, Chen G, Xu Y. Computed tomography-guided (125) I radioactive-seed implantation therapy for skull metastasis from hepatocellular carcinoma. *Asian J Surg* 2023; **46**: 1031-1032 [PMID: 35961907 DOI: 10.1016/j.asjsur.2022.07.102]
- 37 **Wang W**, Wang C, Shen J, Ren B, Yin Y, Yang J, Tang H, Zhu X, Ni C. Integrated I-125 Seed Implantation Combined with Transarterial Chemoembolization for Treatment of Hepatocellular Carcinoma with Main Portal Vein Tumor Thrombus. *Cardiovasc Intervent Radiol* 2021; **44**: 1570-1578 [PMID: 34117503 DOI: 10.1007/s00270-021-02887-1]
- 38 **Wu L**, Chen X, Zeng Q, Lai Z, Fan Z, Ruan X, Li X, Yan J. NR5A2 gene affects the overall survival of LUAD patients by regulating the activity of CSCs through SNP pathway by OCLR algorithm and immune score. *Heliyon* 2024; **10**: e28282 [PMID: 38601554 DOI: 10.1016/j.heliyon.2024.e28282]
- 39 **Zhang L**, Hu B, Li W, Huang P, Zhang S, Zhong BY, Ni CF. (125)I Irradiation Stent for Hepatocellular Carcinoma with Main Portal Vein Tumor Thrombosis: A Systematic Review. *Cardiovasc Intervent Radiol* 2020; **43**: 196-203 [PMID: 31602496 DOI: 10.1007/s00270-019-02346-y]
- 40 **Kamarajah SK**, Bundred JR, Littler P, Reeves H, Manas DM, White SA. Treatment strategies for early stage hepatocellular carcinoma: a systematic review and network meta-analysis of randomised clinical trials. *HPB (Oxford)* 2021; **23**: 495-505 [PMID: 33309569 DOI: 10.1016/j.hpb.2020.10.031]
- 41 **Gao FL**, Wang Y, Huang XZ, Pan TF, Guo JH. I-125 seeds brachytherapy with transcatheter arterial chemoembolization for subcapsular hepatocellular carcinoma. *BMC Gastroenterol* 2022; **22**: 273 [PMID: 35650532 DOI: 10.1186/s12876-022-02356-0]
- 42 **Zhang M**, Zhang M, Yu M, Song Y, Wang Y. A study on short-term efficacy and safety of Iodine-125 brachytherapy coupled with preoperative arterial chemoembolization for hypervascular spinal metastasis. *Brachytherapy* 2024; **23**: 207-213 [PMID: 38044181 DOI: 10.1016/j.brachy.2023.10.001]
- 43 **Ye S**, Zhang Y, Xie B, Li Z. Combined Chemoembolization with Iodine-125 Seed Implantation for the Treatment of an Oromaxillary Carcinoma: A Case Report. *J Vasc Interv Radiol* 2022; **33**: 1126-1128 [PMID: 35700909 DOI: 10.1016/j.jvir.2022.06.004]



Published by **Baishideng Publishing Group Inc**  
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA  
**Telephone:** +1-925-3991568  
**E-mail:** [office@baishideng.com](mailto:office@baishideng.com)  
**Help Desk:** <https://www.f6publishing.com/helpdesk>  
<https://www.wjgnet.com>

