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Clinical effect of percutaneous hepatic puncture biliary drainage combined with metal stent implantation in the treatment of malignant obstructive jaundice

Shoulin Zhang[1†], Shaopeng Huang[2†], Zheng Xing[1], Youwen Song[1] and Fujian Yuan[1,3*]

Abstract

Objective To evaluate the clinical efficacy of percutaneous hepatic puncture biliary drainage combined with metal stent implantation in the treatment of malignant obstructive jaundice, focusing on improvements in liver function, bile duct patency time, and reduction of postoperative complications.

Methods 181 patients with malignant obstructive jaundice were retrospectively selected from a hospital in Ganzhou City, Jiangxi Province, from April 2021 to May 2024, of which 132 underwent routine percutaneous liver puncture biliary drainage and 49 underwent percutaneous liver puncture biliary drainage combined with metal stent implantation as the observation group.

Results The clinical efficacy of the observation group was higher ($P < 0.05$), and the bile duct patency time was longer ($P < 0.05$). The AST, ALT, DBIL and TBIL levels were decreased 1 week and 1 month after surgery, and the decrease was more significant in the observation group ($P < 0.05$). In addition, the incidence of postoperative complications (bile duct infection and electrolyte disturbance) in the observation group was lower ($P < 0.05$).

Conclusion Percutaneous hepatic puncture biliary drainage combined with metal stent implantation has significant clinical efficacy, which can effectively improve the clinical symptoms of patients, prolong the biliary patency time, reduce the level of bilirubin, promote the improvement of liver function, and lower the incidence of postoperative complications.

Clinical trial number not applicable.

Keywords Percutaneous hepatic puncture biliary drainage, Metal stent implantation, Malignant obstructive jaundice

†Shoulin Zhang and Shaopeng Huang contributed equally to the present work.

*Correspondence:
Fujian Yuan
gz362yyjrk@126.com

[1]Department of Interventional Therapy, Ganzhou Cancer Hospital, Ganzhou city, Jiangxi Province, China
[2]Department of Oncology, Ganzhou Dayu County People's Hospital, Ganzhou city, Jiangxi Province, China
[3]Department of Interventional Therapy, Ganzhou Cancer Hospital, No.19, Garden Front, Shuidong Town, Zhanggong District, Ganzhou City, Jiangxi Province, China

Introduction

Malignant obstructive jaundice is a condition that predominantly affects the elderly and is commonly caused by the compression or invasion of the biliary tract by liver cancer, cholangiocarcinoma, metastatic cancer, or pancreatic cancer. This leads to biliary tract stenosis or obstruction, cholestasis, and a marked increase in bilirubin levels, which ultimately result in significant liver function impairment and related symptoms [1–3]. The early symptoms of malignant obstructive jaundice are not obvious, and the best opportunity for diagnosis and treatment is often missed, making surgical treatment difficult [4]. Even if radical surgery is performed, the survival rate is not optimistic, and the general survival time is no more than 3 to 5 months [5, 6]. It has been reported that the 5-year survival rate of patients is about 5–8% [7]. As the incidence of biliary malignancy continues to rise, it will cause relatively serious adverse effects on patients' physical and mental health and daily activities [8–10].

Malignant obstructive jaundice is treated by surgical removal of the obstruction, followed by bile drainage to decompress the bile duct and restore its normal shape and physiological function [11, 12]. Compared with traditional surgery, percutaneous hepatic puncture biliary drainage has the advantages of simple operation and good drainage effect, which can improve the condition to a certain extent. However, due to the complex anatomical structure of the lesion area, the success rate of blind puncture is low, the bile duct is easily obstructed again, and postoperative complications are easy to occur [13–15]. Studies have shown that percutaneous hepatic puncture biliary drainage combined with stent implantation can significantly reduce the level of total bilirubin in serum, improve the liver function of patients, prolong the survival time, and reduce the damage to tissues and organs and fast recovery after surgery, which has been gradually promoted and applied at home and abroad [16, 17]. The metal stent has the characteristics of a long opening time, reintervention rate and low overall cost [18–20].

Based on percutaneous hepatic puncture biliary drainage combined with metal stent implantation, this study retrospectively selected and compared patients with malignant obstructive jaundice, aiming to analyse the clinical efficacy and impact on liver function of the combination treatment.

Previous studies lack detailed analysis of stent specifications and practical selection criteria. Our study addresses this gap by evaluating domestic metal stents (e.g., 8 mm × 6 cm or 8 mm × 8 cm) tailored to individual obstruction lengths, ensuring optimal drainage(21–22). Moreover, unlike prior studies, which focus primarily on general outcomes [23, 24], we provide a comprehensive assessment of specific complications such as bile duct infections and electrolyte disturbances, demonstrating their significant reduction with combined therapy. Additionally, we emphasize the cost-effectiveness and accessibility of domestic stents, which are crucial in resource-limited settings. This practical perspective, along with detailed short-term liver function assessments, highlights the unique contributions of our study in advancing MOJ management.

Methods

General information

One hundred eighty-one patients with malignant obstructive jaundice were retrospectively selected from the hospital from April 2021 to May 2024. The patients were divided into two groups in a 2:1 ratio, as 132 patients underwent routine percutaneous hepatic puncture biliary drainage as the control group and 49 patients underwent percutaneous hepatic puncture biliary drainage combined with metal stent implantation as the observation group. Inclusion criteria: [1] Patients diagnosed with malignant obstructive jaundice based on pathological examination, liver function tests, abdominal X-ray examination, and typical symptoms such as abdominal pain, scleral and skin yellowing, and intermittent fever; [2] The diagnosis of the primary tumor was confirmed based on specific diagnostic criteria, such as imaging (e.g., CT, MRI), biopsy, or other diagnostic methods; [3] All patients had varying degrees of liver function impairment; [4] Patients with surgical indications for Percutaneous Transhepatic Cholangiographic Drainage (PTCD) or (and) metal stenting were included in this study. Exclusion criteria: [1] Patients with unclear obstruction sites; [2] Patients with contraindications for puncture or surgery, puncture site infections, or severe intolerance to surgical procedures; [3] Patients with incomplete clinical data.

This study was approved by the Ethics Committee of Ganzhou Cancer Hospital on 23rd October 2024 by regulatory and ethical guidelines related to retrospective research studies (Approval No.2024kelunshen61). Informed consent was waived for this retrospective study due to the exclusive use of de-identified patient data, which posed no potential harm or impact on patient care.

Intervention method

[1] Control group: The bile duct was punctured with the aid of digital subtraction angiography, dredging the drainage tube after the operation, rinse in time, replace, and a 21G trocar was selected. After removing the needle core, the mucous bile was extracted. A metal stent was placed 3 to 7 days after surgery. The external drainage tube was removed after confirming that the stent was smooth. For catheter drainage, pay attention to dredging

the drainage tube after the operation, rinse in time, and replace it according to the situation.

[2] Observation group: of based on the above, a domestic metal stent was implanted 3 days after surgery, a guide wire was placed along the drainage channel, a balloon catheter was used to expand the narrow segment, the stent was implanted and a released, drainage catheter was replaced, and the stent was confirmed to be smoothly removed 1 ~ 2 days later. The metal stents used in this study were domestically manufactured by Nanjing Micro-Tech Medical Co., Ltd. Stents were self-expanding and available in different specifications, including diameters of 8 mm and lengths of 6–8 cm. The choice of stent was determined based on the length of the obstructed bile duct segment in each patient, ensuring optimal coverage and adequate biliary drainage. The stents were selected to align with obstruction each case's clinical needs, considering the obstruction's anatomical and pathological features.

External drainage and anti-infection therapy were given after the operation to both groups.

Observation indicators

[1] Clinical efficacy: According to the symptoms of malignant obstructive jaundice and improved bilirubin, the clinical efficacy was evaluated 2 weeks after surgery [22]. ① Obvious effect: the symptoms of abdominal pain, sclera and skin staining, and the level of bilirubin was reduced by more than 50%; ② Effective: the symptoms of abdominal pain, sclera and skin staining were improved to some extent, and the level of bilirubin was reduced by 25–50%; ③ Ineffective: The symptoms of abdominal pain, sclera and skin staining were not significantly improved, or aggravated. The total clinical effective rate is the sum of significant efficiency and effective rate.

[2] biliary duct patency time: biliary duct patency time was from the first day of surgery to the day of jaundice again. Criteria for recurrence of jaundice: it is clear that the jaundice has entirely resolved, the obstruction is repeated or progressive, and the direct bilirubin (DBIL) accounts for more than 35% of the total bilirubin (TBIL), and the cholangiography shows intrahepatic bile duct dilatation.

[3] Alanine Transaminase (ALT), Aspartate Aminotransferase [23] (AST) and bilirubin (including DBIL and TBIL).

[4] The incidence of postoperative complications, including infection, bile leakage, bile duct bleeding and electrolyte disturbance, were compared between the two groups.

Electrolyte disturbance refers to an imbalance in the concentrations of critical electrolytes (e.g., potassium, sodium, calcium, magnesium, and phosphorus) in the body, exceeding normal physiological ranges, which may result in neurological, cardiovascular, renal, or gastrointestinal dysfunction, and, in severe cases, life-threatening conditions. Specifically, hyponatremia is defined as serum sodium concentration < 136 mmol/L, while hypernatremia refers to serum sodium concentration > 145 mmol/L. Hypokalemia is by serum potassium concentration < 3.5 mmol/L, and hyperkalemia is indicated by serum potassium concentration > 5.0 mmol/L. Hypocalcemia refers to serum calcium concentration < 2.1 mmol/L and hypomagnesemia is serum magnesium concentration < 0.7 mmol/L. These disturbances are commonly observed in postoperative patients due to a combination of factors such as surgical stress responses, fluid loss, intravenous therapy, and metabolic imbalances. They are associated with complications including arrhythmias, muscle spasms, and metabolic acidosis [25]. Monitoring and timely correction of electrolyte levels postoperatively can significantly reduce the incidence and mortality of related complications [26].

Statistical method

Statistical Package for the Social Sciences (SPSS) 21.0 software (IBM Corp., Armonk, N.Y., USA) was used for statistical analysis. For continuous variables, normality tests were conducted if measurement data conforming to normal distribution were expressed as mean ± Standard Deviation (SD) and compared using Student's t-test, while non-normally distributed variables were presented as median (inter-quartile range, IQR) and compared using Mann-Whitney U test. Categorical variables are expressed as numbers and percentages, and the chi-squared (X^2) test was used for comparison between groups. $P < 0.05$ meant that the difference was statistically significant.

Results

Baseline data

The data of 181 patients with malignant obstructive jaundice were retrospectively analysed. According to the treatment received were divided into the control group ($n = 132$), who underwent routine percutaneous hepatic puncture biliary drainage, and the observation group ($n = 49$), who underwent percutaneous hepatic puncture biliary drainage combined with metal stent implantation. There were 74 males and 58 females in the control group and 30 males and 19 females in the observation group, with no significant difference in sex distribution between the two groups ($P = 0.649$). The average age was 58.52 ± 6.26 years in the control group and 57.70 ± 7.30 years in the observation group, with no statistically significant difference ($P = 0.069$). The BMI was comparable between the two groups ($P = 0.749$). The distribution of disease diagnosis showed no statistically significant difference between the two groups ($P = 0.976$). The baseline

Table 1 Baseline characteristics of patients

Parameter	Control Group (*n* = 132)	Observation Group (*n* = 49)	X^2/t	*P*
Male/Female	74/58	30/19	0.207	0.649
Age (Mean ± SD)	58.52 ± 6.26	57.70 ± 7.30	1.840	0.069
BMI (Mean ± SD)	24.8 ± 3.2	24.8 ± 3.2	-0.320	0.749
Disease Diagnosis			0.048	0.976
Pancreatic Cancer	16.7% (22/132)	16.3% (8/49)		
Liver Cancer	18.9% (25/132)	18.4% (9/49)		
Colon Cancer	13.6% (18/132)	12.2% (6/49)		
Bile Duct Cancer	11.4% (15/132)	16.3% (8/49)		
Stomach Cancer	15.2% (20/132)	12.2% (6/49)		
Obstructive Jaundice	16.7% (22/132)	18.4% (9/49)		
Others	7.58% (10/132)	6.12% (3/49)		
ALT (U/L)	139.89 ± 3.02	139.78 ± 2.98	-0.220	0.826
AST (U/L)	151.80 ± 3.78	151.67 ± 3.45	-0.198	0.844
TBil (μmol/L)	328.17 ± 5.16	327.37 ± 4.12	-0.985	0.326
DBil (μmol/L)	182.70 ± 10.46	181.10 ± 12.27	-0.873	0.384

Abbreviations: ALT, Alanine Transaminase; AST, Aspartate Aminotransferase; TBil, Total Bilirubin; DBil, Direct Bilirubin; BMI, Body Mass Index

liver function parameters, including ALT, AST, TBil, and DBil, were also comparable between the two groups, with no statistically significant differences ($P > 0.05$ for all). These results indicate that the two groups were balanced and comparable at baseline, as shown in Table 1.

Clinical efficacy and bile duct patency time

Two weeks after the operation, the total clinical effective rate of the observation group was 83.67%, higher than that of the control group (52.27%) ($P < 0.001$). The Bile duct patency time in the observation group was 39 ~ 490 days, and the median patency time was 132.5 days ($P < 0.001$), as shown in Table 2.

Results of liver function indicators

Before the operation, the two groups had no significant difference in liver function ($P > 0.05$). ALT, AST, TBil, and DBil were significantly lower, and the ALT, AST, TBil and DBil levels of the observation group were significantly lower ($P < 0.05$), as shown in Table 3.

Postoperative complication

The incidence of postoperative complications in the observation group was 20.41% lower (39.39%, $P < 0.001$); the incidence of Electrolyte disturbance and Bile duct infection was the highest in both groups (17.42% VS 8.16%, 15.91% VS 6.12%, respectively), as shown in Table 4.

Table 3 Comparison of liver function indexes between the two groups

Group		Control group (*n* = 132)	Observation group (*n* = 49)	t	*P*
ALT (U/L)	Before operation	139.89 ± 3.02	139.78 ± 2.98	-0.220	0.826
	1 week after surgery	54.77 ± 4.93	40.33 ± 2.95	-19.262	< 0.001
	1 month after surgery	32.09 ± 3.65	26.73 ± 3.99	-8.543	< 0.001
AST (U/L)	Before operation	151.80 ± 3.78	151.67 ± 3.45	-0.198	0.844
	1 week after surgery	57.52 ± 8.52	49.73 ± 3.82	-6.161	< 0.001
	1 month after surgery	30.52 ± 3.94	25.51 ± 4.47	-7.328	< 0.001
TBil (μmol/L)	Before operation	328.17 ± 5.16	327.37 ± 4.12	-0.985	0.326
	1 week after surgery	232.29 ± 11.05	128.27 ± 4.00	-64.285	< 0.001
	1 month after surgery	75.45 ± 4.85	51.53 ± 3.65	-31.349	< 0.001
DBiL (μmol/L)	Before operation	182.70 ± 10.46	181.10 ± 12.27	-0.873	0.384
	1 week after surgery	121.39 ± 17.80	83.18 ± 6.10	-14.686	< 0.001
	1 month after surgery	42.64 ± 4.54	27.51 ± 4.56	-19.913	< 0.001

Discussion

Interventional radiology has made significant progress and has gradually become a clinical treatment technology with a high level of treatment, which can effectively widen the biliary tract, ensure the smooth passage of bile and relieve jaundice [27–29]. Percutaneous hepatic puncture biliary drainage has a definite effect on alleviating jaundice symptoms. However, some studies have

Table 2 Comparison of clinical efficacy between the two groups [example (%)]

Group	Sample	Apparent	effective	ineffective	total efficiency	Bile duct patency time
Control group	132	32 (24.24)	37 (28.03)	63 (47.73)	69 (52.27)	39 ~ 490 (132.5)
Observation group	49	16 (32.65)	25 (51.02)	8 (16.33)	41 (83.67)	20 ~ 153 (79)
X^2	181.000					
P	< 0.001					

Table 4 Incidence of postoperative complications in the two groups

Group	Control group (*n* = 132)	Observation group (*n* = 49)	X^2	*P*
Bile duct infection	21 (15.91)	3 (6.12)	216.969	< 0.001
cholorrhea	0 (0)	0 (0)		
cholangiorrhagia	2 (1.52)	1 (2.04)		
Drain obstruction	2 (1.52)	1 (2.04)		
Recurrent obstruction	4 (3.03)	1 (2.04)		
Electrolyte disturbance	23 (17.42)	4 (8.16)		
Total	52 (39.39)	10 (20.41)		

shown that its complication rate is relatively high, and long-term postoperative drainage is required. Metal stent implantation can remove the drainage bag, reduce the inconvenience and psychological burden of patients, and help improve the quality of life [30–35]. These findings align with previous research, such as that by Zhang et al. [36], who reported that PTCD combined with biliary stent implantation offers higher clinical effectiveness and longer bile duct patency. Similarly, our study demonstrated that this combined approach not only enhances clinical outcomes but also improves patient quality of life by reducing complications and the need for long-term drainage.

The most commonly reported in the clinic is the effect of PTCD combined with biliary stent implantation on liver function [5, 8]. This treatment can quickly relieve biliary pressure, protect liver function and promote liver replacement, improve the blood oxygen supply to the liver, enhance the digestive system function, and provide patients with significant benefits such as improved diet and improved quality of life [37]. This study also confirms that the postoperative blood index test results showed the patient's liver function can be improved in the short term. Percutaneous hepatic puncture biliary drainage is easy to cause bile duct infection and bile. The complications such as juice leakage, bile duct bleeding and electrolyte disturbance were mainly due to infection. Blockage and displacement of the drainage tube caused secondary infection after implantation of the metal stent. It can keep the bile duct continuously unobstructed, helping to reduce secondary infections and bile leakage Symptoms, thereby reducing Adverse reaction complications.

Additionally, our study contributed to the growing body of evidence supporting the combined use of percutaneous hepatic puncture biliary drainage and metal stent implantation for treating malignant obstructive jaundice. Previous studies focused on the recovery of liver function in MOJ patients using a single technique [23, 24], and our study provided unique advantages by focusing on the combination of PTCD and metal stent implantation, highlighting its ability to significantly prolong biliary patency and reduce complications such as bile duct infection and electrolyte imbalance. Our findings were consistent with those of Schmitz et al. [38], demonstrated the effectiveness of combining PTCD with metal stent implantation, highlighting a reduction in adverse events and re-intervention rates, thus presenting a more practical long-term solution for patient care. In addition, unlike the self-expanding metal stent (SEMS) used by Godat et al. [39], we emphasized customized and cost-effective home stents based on patient needs, providing practical solutions for resource limited environments and increasing their clinical benefits and feasibility. Furthermore, our study conducted an in-depth exploration of optimizing PTCD outcomes through the integration of advanced stent implantation techniques, thereby rendering our findings more pertinent to the enhancement of long-term patient care for malignant obstructive jaundice.

However, this study has some limitations as followed. Firstly, the adverse reactions were only observed over a short-term period (2 weeks), which is insufficient to fully assess the long-term efficacy and safety of the combined treatment. Secondly, the study's retrospective design may introduce selection bias and recall bias. Additionally, the sample size is relatively small, and the findings may lack generalizability to a larger population. Future research should focus on conducting large-scale, multi-center, prospective studies to further validate these findings and address these limitations.

Conclusions

In conclusion, percutaneous hepatic puncture biliary drainage combined with metal stent implantation has significant clinical efficacy, which can effectively improve the clinical symptoms of patients, prolong the biliary patency time, reduce the level of bilirubin, promote the improvement of liver function, and lower the incidence of postoperative complications. It is suggested that percutaneous hepatic puncture biliary drainage combined with metal stent implantation should be selected to treat malignant obstructive jaundice in clinical work.

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Author contributions
Shoulin Zhang, Shaopeng Huang: study design, data analysis, drafting the manuscript and revision of the manuscript. Zheng Xing, Youwen Song, Fujian Yuan: data collection and analysis, drafting the manuscript, investigation. All authors read and approved the final version of the manuscript.

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Data availability
All data generated or analyzed in this study are included in the present manuscript.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of Ganzhou Cancer Hospital in accordance with regulatory and ethical guidelines pertaining to retrospective research studies on 23rd October, 2024 (Approval No.2024kelunshen61). Informed consent was waived for this retrospective study due to the exclusive use of de-identified patient data, which posed no potential harm or impact on patient care.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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Not applicable.

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