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Original Article

Efficacy and influencing factors of percutaneous transhepatic cholangiography and biliary drainage in malignant obstructive jaundice patients

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Abstract: Objectives: To analyze the efficacy and influencing factors of percutaneous transhepatic cholangiography and biliary drainage (PTCD) in patients with malignant obstructive jaundice (MOJ). Methods: The study included 151 MOJ patients admitted from January 2021 to January 2024. Seventy patients in the control group received endoscopic retrograde cholangiopancreatography (ERCP), while 81 patients in the research group underwent PTCD. Clinical outcomes, including surgical success rate, efficacy (overall remission, high- and low-level intestinal obstruction remission), safety (bile leakage, septicemia, hemobilia, pancreatitis, and gastrointestinal bleeding), and clinical-related indicators (hospital stay, surgical cost, treatment cost), as well as serum biochemical markers (alanine aminotransferase [ALT], direct bilirubin [DBIL], and total bilirubin [TBIL]), were compared between the groups. Binary logistic regression was used to identify factors influencing PTCD efficacy. Results: The surgical success rate was significantly higher in the research group than that in the control group ($P < 0.05$). Although the overall remission rates were similar between the groups ($P > 0.05$), the research group had a lower low-level intestinal obstruction remission rate and a higher high-level intestinal obstruction remission rate ($P < 0.05$). Safety profiles and changes in pre- and post-operative serum biochemical markers did not differ significantly between the groups (all $P > 0.05$). The research group experienced longer hospital stays and lower surgical costs compared to the control group (both $P < 0.05$), while treatment costs were similar ($P > 0.05$). Binary logistic regression identified obstruction site, and preoperative liver dysfunction as factors influencing PTCD efficacy. Conclusions: PTCD demonstrated a higher surgical success rate than ERCP in MOJ patients, with comparable overall efficacy, safety, and treatment costs. PTCD was associated with longer hospital stays and lower surgical costs. Both procedures similarly improved ALT, DBIL, and TBIL levels. PTCD showed the greatest therapeutic benefit in cases of high-level intestinal obstruction.

Keywords: Malignant obstructive jaundice, percutaneous transhepatic cholangiography and biliary drainage, efficacy, influencing factors

Introduction

Malignant obstructive jaundice (MOJ) occurs when bile flow from the liver and gallbladder to the duodenum is partially or completely blocked, leading to excessive accumulation of bile salts and related products in the blood [1]. This condition is primarily caused by compression or direct metastasis of malignancies [2, 3]. MOJ can result in multiple system physiopathological disorders, including malnutrition, digestive dysfunction, coagulation abnormalities, immune system impairment, and electrolyte imbalance [4]. These complications not only affect the patient's overall health but also severely impact their quality of life [5].

Treatment of MOJ primarily aims to alleviate symptoms and improve quality of life, making timely and effective intervention critical [6, 7]. Without appropriate treatment, patients may develop biliary tract infections, liver and kidney failure, and even face life-threatening complications [8]. Therefore, exploring effective treatment strategies for MOJ and identifying factors influencing treatment outcomes hold significant clinical value.

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Endoscopic retrograde cholangiopancreatography (ERCP) is widely used to treat various biliary and pancreatic conditions, including benign and malignant strictures, ductal stones, and bile or pancreatic leakage. ERCP is also effective in managing MOJ [9]. This procedure involves inserting an endoscope into the descending duodenum to access the bile duct, allowing for the placement of a biliary stent through the obstruction site. This approach facilitates bile drainage, alleviates biliary obstruction, and improves liver function [10, 11]. In addition to reducing jaundice, ERCP can relieve associated symptoms such as pruritus, anorexia, diarrhea, and sleep disturbances [12].

Percutaneous transhepatic cholangiography and biliary drainage (PTCD) involves inserting an internal drainage catheter into the dilated bile duct through the liver under X-ray or ultrasound guidance to achieve rapid bile drainage and relieve jaundice [13]. A meta-analysis has shown that PTCD is associated with higher technical success rates than ERCP in treating MOJ and carries a lower risk of postoperative pancreatitis [4].

This study compares the clinical efficacy of ERCP and PTCD in treating MOJ and investigates factors influencing the effectiveness of PTCD, providing updated clinical references for the management of this condition.

Materials and methods

Patient information

This retrospective study included 151 MOJ patients admitted to the Second Affiliated Hospital of Anhui Medical University between January 2021 and January 2024. Among these, 70 patients in the control group underwent ERCP treatment, while 81 patients in the research group received PTCD. The study was approved by the Ethics Committee of the Second Affiliated Hospital of Anhui Medical University, and written informed consent was obtained from all participants. The sample size was determined using a sample size estimation formula $n = \frac{((Z_{1-\alpha/2} + Z_{\beta})^2 \times p_1(1 - p_1) + p_2(1 - p_2))}{(p_1 - p_2)^2}$, with both groups meeting the minimum requirement of 44 cases.

Patient selection criteria

Inclusion: (1) Patients diagnosed with MOJ caused by primary or metastatic malignant tumors through magnetic resonance cholangiopancreatography and ultrasonography [14], who were ineligible for radical surgery. (2) Patients presented with intrahepatic and extrahepatic bile duct dilatation, met the indications for PTCD/ERCP [15], and were receiving treatment for the first time.

Exclusion criteria: (1) Obstructive jaundice caused by benign lesions. (2) Previous ERCP or PTCD treatment. (3) Cardiopulmonary insufficiency, digestive tract obstruction, or iodine allergy precluding ERCP. (4) Ineligibility for PTCD due to liver failure, coagulation disorders, massive ascites, or inability to avoid major blood vessels or lesions in the puncture path. (5) Multi-organ failure. (6) Cognitive, psychiatric, or communication impairments. (7) Incomplete clinical data.

Methods

All patients underwent preoperative imaging to confirm their condition, along with routine biochemical and coagulation tests. Electrolyte imbalances were corrected, and intravenous nutrition support was optimized. Patients were required to fast on the day of the procedure.

ERCP procedure (Control group): Medical staff prepared for cholangiography by locating the major duodenal papilla. A papillotome with a guidewire was inserted into the common bile duct via the papilla, and a contrast agent was injected for cholangiography. The location, length, and severity of the biliary stricture were evaluated. Based on these findings, the optimal drainage site was selected, and the choice of plastic or metal stent was made.

For high-level obstructions, the lower end of the metal stent was positioned slightly beyond the papilla, while for obstructions involving secondary bile ducts, plastic double stents were placed in the left and right intrahepatic bile ducts. After placement, cholangiography was performed to confirm the stent position and expansion. Postoperatively, patients were treated with somatostatin and trypsin inhibitors, and liver function was routinely monitored to prevent complications.

PTCD procedure (Research group): The puncture site was chosen at the upper edge of the 8th or 9th rib along the right axillary midline. Local infiltration anesthesia with 5 ml of 2% lidocaine was administered. Guided by ultrasound, the depth and angle of the puncture needle were determined. The needle was inserted into the dilated intrahepatic bile duct, and bile was extracted.

A 0.89 mm guidewire was advanced into the bile duct, and the needle was withdrawn. A 2.95 mm dilation tube was inserted over the guidewire, followed by an 8 Fr external drainage catheter. After guidewire removal, the catheter was fixed and connected to a drainage bag. Approximately one week later, cholangiography was performed again, and the drainage tube was removed upon meeting the necessary criteria.

Evaluation indexes

Surgical success rate: A surgical success was defined as the successful placement of a biliary metal stent during the operation; otherwise, it was considered a surgical failure.

Efficacy: The condition of jaundice was assessed by bilirubin levels on the 5th postoperative day. If bilirubin levels decreased by more than one-third compared to preoperative levels, and clinical symptoms improved, jaundice was considered relieved. A comparative analysis of the overall response rate, as well as the low- and high-level intestinal obstruction remission rates, was conducted after one week of treatment.

Safety: The incidence of adverse events, including bile leakage, septicemia, hemobilia, pancreatitis, and gastrointestinal bleeding, was observed and recorded in both groups, and the incidence rates were calculated.

Clinical-related indicators: Clinical indicators, such as hospital stay duration, surgical costs, and treatment costs, were statistically analyzed.

Serum biochemical indexes: Venous blood samples (3 mL) were collected from patients in a fasting state before and after surgery. Liver function indicators, including alanine aminotransferase (ALT), direct bilirubin (DBIL), and total bilirubin (TBIL), were tested using an automatic biochemical analyzer.

Data processing and statistical methods

Continuous data were expressed as mean ± SEM and compared between groups using independent samples t-tests. For within-group comparisons before and after treatment, paired t-tests were used. Count data were presented as rates (percentages), and the comparison between two groups was performed using the chi-square test. All data were analyzed using SPSS 22.0, and differences were considered statistically significant at $P < 0.05$.

Results

Comparative analysis of general data

There were no significant differences between the control and research groups in terms of sex, age, hypertension, diabetes, pancreatic malignancy, preoperative biliary tract infection, and preoperative liver dysfunction (all $P > 0.05$). However, a significant difference was observed in the obstruction site ($P < 0.001$). See **Table 1**.

Comparative analysis of the surgical success rate

The surgical success rate in the research group was 100%, with biliary metal stents successfully placed in all 81 patients. In the control group, the surgical success rate was 90%, with 7 patients failing to have biliary metal stents placed. Among these, 4 cases were due to tumor invasion causing duodenal bulb deformity, which prevented the endoscope from reaching the duodenal papilla. In 3 additional cases, although the endoscope reached the papilla, tumor invasion had displaced it, making papilla intubation unsuccessful. The surgical success rate was significantly higher in the research group compared to the control group (100% vs. 90%, $\chi^2=8.494$, $P=0.004$). See **Figure 1**.

Comparative analysis of efficacy

Efficacy was evaluated in terms of overall remission and remission rates for low- and high-level intestinal obstruction. There was no significant difference between the groups in

Table 1. Comparative analysis of general data

General data	n	Control group (n=70)	Research group (n=81)	χ^2	P
Sex				0.004	0.951
Male	91	42 (60.00)	49 (60.49)		
Female	60	28 (40.00)	32 (39.51)		
Age (years old)	151	65.76±13.69	66.22±10.91	0.230	0.819
Obstruction site				39.107	< 0.001
High-level	94	25 (35.71)	69 (85.19)		
Low-level	57	45 (64.29)	12 (14.81)		
Hypertension				0.062	0.803
With	49	22 (31.43)	27 (33.33)		
Without	102	48 (68.57)	54 (66.67)		
Diabetes				0.090	0.764
With	23	10 (14.29)	13 (16.05)		
Without	128	60 (85.71)	68 (83.95)		
Pancreatic malignancy				0.263	0.608
With	33	14 (20.00)	19 (23.46)		
Without	118	56 (80.00)	62 (76.54)		
Preoperative biliary tract infection				0.653	0.419
With	9	3 (4.29)	6 (7.41)		
Without	142	67 (95.71)	75 (92.59)		
Preoperative liver dysfunction				2.860	0.091
With	97	40 (57.14)	57 (70.37)		
Without	54	30 (42.86)	24 (29.63)		

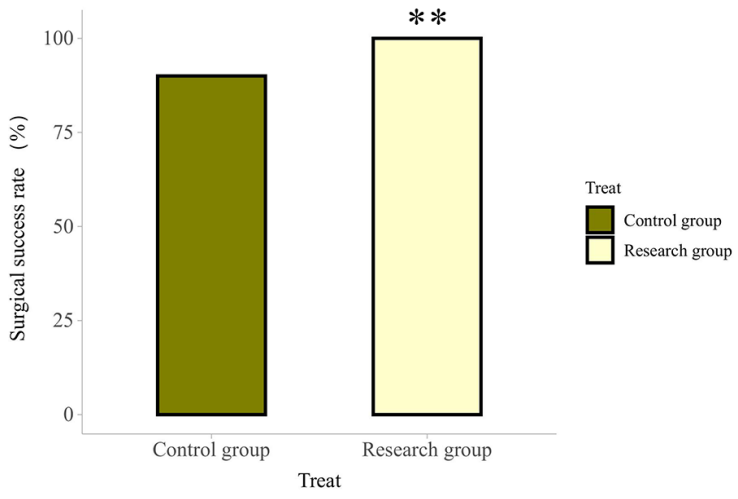

Figure 1. Comparative analysis of the surgical success rate. **P < 0.01.

the overall remission rate (P > 0.05). However, the low-level intestinal obstruction remission rate was higher in the control group compared to the research group, while the high-level intestinal obstruction remission rate was lower in the control group (P < 0.05). See **Table 2**.

Comparative analysis of safety

There was no significant difference in the total incidence of adverse events (bile leakage, septicemia, hemobilia, pancreatitis, and gastrointestinal bleeding) between the research and control groups (P > 0.05). See **Table 3**.

Comparative analysis of clinical-related indexes

As shown in **Table 4**, the research group had a significantly longer hospital stay and lower surgical costs (both P < 0.01) compared to the control group, while treatment costs were comparable between the two groups (P > 0.05).

Comparative analysis of serum biochemical indices

No significant inter-group differences were observed in serum biochemical indices, such

Table 2. Comparative analysis of efficacy

Efficacy	n	Control group (n=70)	Research group (n=81)	χ^2	P
Overall remission				0.207	0.649
Yes	134	63/70 (90.00)	71 (87.65)		
No	17	7/70 (10.00)	10 (12.35)		
Low-level intestinal obstruction remission				11.459	0.007
Yes	51	44/45 (97.78)	8/12 (66.67)		
No	6	1/45 (2.22)	4/12 (33.33)		
High-level intestinal obstruction remission				5.739	0.017
Yes	85	19/25 (72.00)	63/69 (91.30)		
No	9	7/25 (28.00)	6/69 (8.70)		

Table 3. Comparative analysis of safety

Safety	Control group (n=70)	Research group (n=81)	χ^2	P
Bile leakage	0 (0.00)	3 (3.70)		
Septicemia	0 (0.00)	2 (2.47)		
Haemobilia	0 (0.00)	3 (3.70)		
Pancreatitis	4 (5.71)	0 (0.00)		
Gastrointestinal bleeding	2 (2.86)	0 (0.00)		
Total	6 (8.57)	8 (9.88)	0.076	0.783

Table 4. Comparative analysis of clinical-related indexes

Clinical-related indexes	Control group (n=70)	Research group (n=81)	t	P
Hospital stay (days)	15.49±3.52	20.41±3.99	7.977	< 0.001
Surgical cost (ten thousand yuan)	2.48±0.49	2.18±0.61	3.297	0.001
Treatment cost (ten thousand yuan)	4.91±0.95	4.84±1.31	0.371	0.711

as ALT, DBIL, and TBIL, before surgery (all P > 0.05). However, ALT, DBIL, and TBIL levels showed significant decreases in both groups postoperatively (all P < 0.05), with no statistical differences between the groups (P > 0.05). See **Figure 2**.

Analysis of factors affecting the efficacy of PTCD treatment in MOJ patients

According to the results of binary logistic regression analysis (**Tables 5**, **6**), the obstruction site and preoperative liver dysfunction were identified as factors affecting the efficacy of PTCD treatment in MOJ patients (P < 0.05), while factors such as sex, age, hospital stay, hypertension, diabetes, pancreatic malignancy, and preoperative biliary tract infection showed no significant association.

Discussion

MOJ patients experience clinical symptoms such as pain, itching, jaundice, and cholangitis, which cause significant discomfort and severely affect their quality of life [16]. To alleviate these symptoms and optimize treatment outcomes, we analyzed the application of ERCP and PTCD in MOJ patients and explored factors influencing PTCD efficacy to improve management strategies for these patients.

This study revealed a significantly higher surgical success rate in the research group (100% vs. 90%), suggesting that PTCD may have a higher success rate than ERCP. Furthermore, both groups showed similar overall remission rates. However, the research group achieved a higher remission rate for high-level intestinal obstruction, while the control group had a better outcome for low-level obstruction. These results suggest that PTCD may be more suitable for high-level intestinal obstructions, while ERCP may be more effective for low-level obstructions. ERCP enters the lesion site via the upper digestive tract, retrogradely accessing the biliary tract, and as the obstruction location

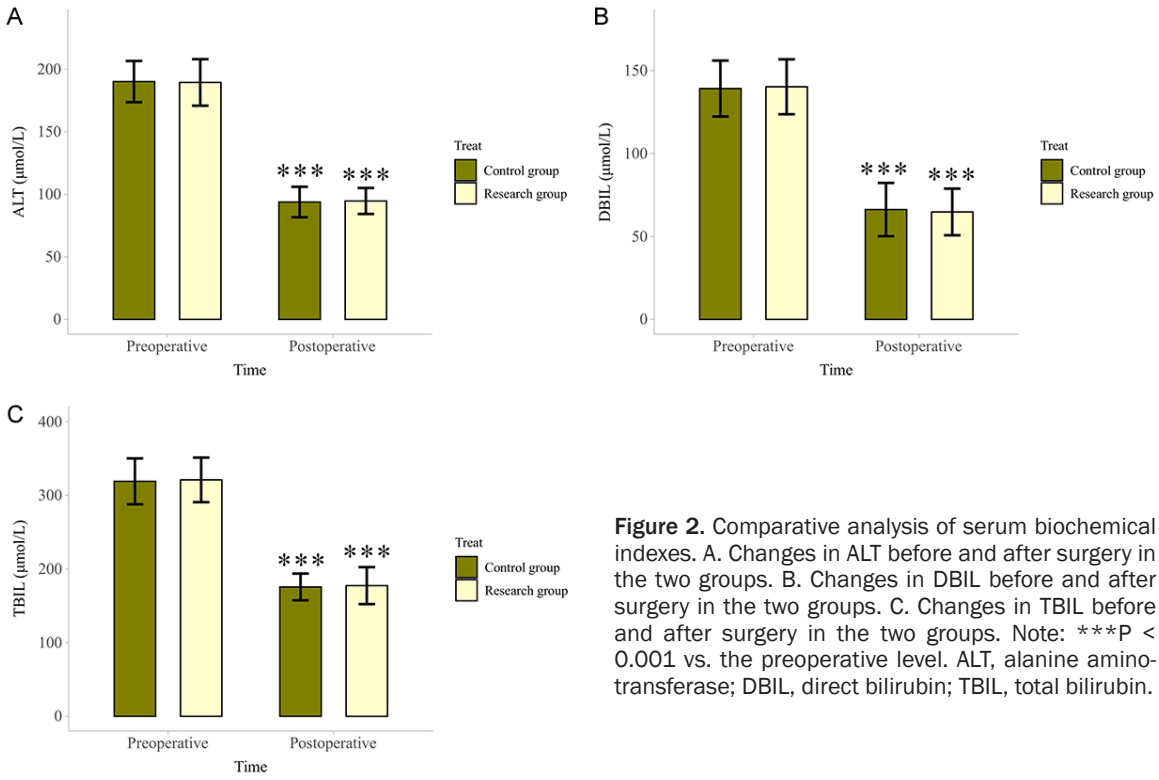

Figure 2. Comparative analysis of serum biochemical indexes. A. Changes in ALT before and after surgery in the two groups. B. Changes in DBIL before and after surgery in the two groups. C. Changes in TBIL before and after surgery in the two groups. Note: ***P < 0.001 vs. the preoperative level. ALT, alanine aminotransferase; DBIL, direct bilirubin; TBIL, total bilirubin.

Table 5. Assignment

Influencing factor	Variable	Assignment
Sex	X1	Male =1, female =0
Age (years old)	X2	≥ 65=1, < 65=0
Hospital stay (days)	X3	≥ 20=1, < 20=0
Obstruction site	X4	Low-level =1, high-level =0
Hypertension	X5	With =1, without =0
Diabetes	X6	With =1, without =0
Pancreatic malignancy	X7	With =1, without =0
Preoperative biliary tract infection	X8	With =1, without =0
Preoperative liver dysfunction	X9	With =1, without =0

becomes higher, the difficulty of the procedure and technical requirements increase [17, 18]. In contrast, PTCD can directly target the liver's surface, making it easier to reach higher obstruction sites through skin and liver puncture [19, 20].

Bao et al. [21] found that ERCP and PTCD have similar success rates and jaundice reduction in MOJ patients, consistent with our findings. Regarding safety, pancreatitis and gastrointestinal bleeding were more common in the control group, while bile leakage, septicemia, and hemobilia were more frequent in the research group, which findings align with studies by Kim et al. [22] and Handke et al. [23]. Safety comparison showed no significant difference in the total incidence of adverse events, suggesting that PTCD is as safe as ERCP. Zerem et al. [24] also reported that PTCD has clinical safety and efficacy and can be used as a palliative treatment for inoperable advanced MOJ patients. Similarly, Zhang et al. [25] found that PTCD alleviates jaundice and reduces complications, with an overall complication rate of 7.80%, comparable to our finding of 9.88%.

Additionally, the research group had a longer hospital stay but lower surgical costs compared to the control group, with similar treatment costs between the two groups. This suggests that PTCD offers a significant advantage in terms of lower surgical costs, while ERCP is associated with shorter hospital stays, although overall treatment costs are comparable. Given that MOJ can lead to liver dysfunction [21], we also evaluated liver function-related serum bio-

Table 6. Analysis of factors influencing efficacy in patients with malignant obstructive jaundice undergoing PTCD treatment

Influencing factor	β	S.E.	Wald	P	OR	95% CI
Sex	-1.349	0.899	2.251	0.134	0.259	0.045-1.512
Age (years old)	-0.003	0.869	0.000	0.997	0.997	0.182-5.472
Hospital stay (days)	-0.606	0.914	0.439	0.508	0.546	0.091-3.272
Obstruction site	2.137	0.869	6.055	0.014	8.478	1.545-46.519
Hypertension	0.508	0.859	0.350	0.554	1.622	0.309-8.958
Diabetes	-0.044	1.112	0.002	0.969	0.957	0.108-8.458
Pancreatic malignancy	-0.394	1.259	0.098	0.754	0.674	0.057-7.957
Preoperative biliary tract infection	-1.179	1.570	0.563	0.453	0.308	0014-6.680
Preoperative liver dysfunction	1.740	0.865	4.046	0.044	5.700	1.046-31.072

Note: PTCD, percutaneous transhepatic cholangiography and biliary drainage.

chemical markers. Both groups showed significant improvement in ALT, DBIL, and TBIL after surgery, with no statistical difference between them, indicating that both PTCD and ERCP similarly improve liver function in MOJ patients.

Finally, binary logistic regression analysis revealed that the obstruction site and preoperative liver dysfunction are factors influencing PTCD efficacy in MOJ patients, suggesting that low-level obstructions and preoperative liver dysfunction may reduce the treatment effectiveness of PTCD in these patients.

This study has several limitations. First, relevant data on long-term prognosis were not included. Additional research is needed to explore the long-term clinical benefits of the two surgical procedures and their impact on postoperative recurrence. Second, the potential relationship between hospital stay duration and the location or degree of intestinal obstruction requires further investigation. This could help provide more targeted clinical guidance for managing MOJ patients. Third, the potential effects of pharmacological treatments for malignant tumors on the efficacy of PTCD and ERCP have not been fully accounted for. Future clinical trials should aim to minimize these potential influences and continue to refine these aspects.

This study suggests that for MOJ patients, both PTCD and ERCP yield similar effects: overall remission rates, safety profiles, and treatment costs are comparable, and both procedures similarly improve ALT, DBIL, and TBIL levels. However, PTCD is more suitable for high-level obstructions (with relatively lower surgical costs), while ERCP is more effective for low-level obstructions (with relatively shorter hospital stays). Moreover, in patients undergoing PTCD, attention should not only be focused on the obstruction site but also on preoperative liver dysfunction, which may positively influence the treatment's effectiveness. These findings provide valuable insights into the surgical management of MOJ patients and can serve as a reliable reference for improving therapeutic outcomes in this population.

Disclosure of conflict of interest

None.

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