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Original Article

The clinical efficacy and safety of different biliary drainages in malignant obstructive jaundice treatment

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Abstract: To study the clinical efficacy and safety of different biliary drainages in malignant obstructive jaundice (MOJ) treatment. Methods: 69 patients with MOJ admitted to our hospital from October 2016 to March 2019 were recruited as the study cohort and divided into an endoscopic retrograde cholangiopancreatography group (the ERCP group, n=38) and a percutaneous transhepatic cholangial drainage group (the PTCD group, n=31) according to the different drainage approaches each patient underwent. We compared the two groups' hepatic function indexes (total serum bilirubin (TB), alanine aminotransferase (ALT), and aspartate aminotransferase (AST)), their immune cells (CD3+ T cells, CD4+ T cells, and CD8+ T cells), surgical success rates, jaundice reduction response rates, and postoperative complications. Results: The surgical success rates and the jaundice reduction response rates were similar in the two groups ($P > 0.05$). No statistically significant differences were observed in the hepatic function indexes or in the immune cells before and after treatment in the two groups (all $P > 0.05$). Moreover, all the indexes we measured were lower post-treatment than they were pre-treatment (TB, ALT, AST, and CD8+) except for the CD3+ and CD4+ levels (all $P < 0.05$). The incidence of postoperative complications in the ERCP group was significantly lower than the incidence in the PTCD group ($P < 0.05$). Conclusion: Both ERCP and PTCD can contribute to better clinical results in the treatment of MOJ, relieve obstructions effectively, improve hepatic function, and enhance immune function, but there are fewer complications after ERCP.

Keywords: Malignant obstructive jaundice, endoscopic retrograde cholangiopancreatography, percutaneous transhepatic cholangial drainage, efficacy, safety

Introduction

Malignant obstructive jaundice (MOJ), an obstructive jaundice attributable to biliary stenosis and the blockage of bile excretions, mainly results from the compression or direct metastasis of a malignant tumor. MOI can lead to pathophysiological disorders in multiple organs and systems, including malnutrition, electrolyte disorders, low immunity, coagulation disorders, decreased digestion, and absorption. MOI seriously affects patients' physical and mental health and daily activities. If the obstruction is not relieved in time, it may cause biliary tract infections, liver and kidney failure, and even death [1, 2]. With the development of interventional therapy techniques, palliative intervention has gradually become the most potent technology known to relieve MOJ, which can effectively reduce the blood bilirubin levels, protect liver function, ease jaundice, improve the nutritional status, prolong life, and thus improve the quality of life. The endoscopic retrograde cholangiopancreatography (ERCP) and the percutaneous transhepatic cholangial drainage (PTCD) are fundamental to palliative intervention. PTCD has emerged as a powerful technology due to its relatively low trauma level, broad indications, and excellent economic efficiency. It can contribute to restoring the physiological continuity of the biliary tract in situ and rapidly alleviates symptoms. Evidence suggests that PTCD has a significant effect on reducing jaundice and may improve patient prognosis, but its postoperative complication rate remains relatively high [3]. ERCP is more in line with patients' physiological characteristics, better restores the physiological drainage function of the bile, improves patients' quality of life, and delays liver failure while relieving

Table 1. The baseline data of the two groups

	PTCD (n=31)	ERCP (n=38)	*t*	*P*
Age ($\bar{x}$ ± s, years)	69.26±6.84	71.25±8.19	1.080	0.284
Sex (M/F)	17/14	24/14	1.592	0.207
Site of obstruction (n, %)			16.846	0.000
Low	23	27		
High	8	11		
Cause of obstruction (n, %)			0.012	0.913
Cholangiocarcinoma	20	25		
Pancreatic head carcinoma	6	7		
Ampullary carcinoma	3	3		
Others	2	3		

symptoms [4]. The specific objective of this study was to analyze the clinical efficacy and safety of bile duct metal stenting for the treatment of MOJ by ERCP and PTCD and to provide clinical data for the treatment of MOJ.

Materials and methods

General data

A total of 69 patients with MOJ admitted to our hospital between July 2017 and June 2020 were recruited as the study cohort. Inclusion criteria: 1. Patients with MOJ caused by a malignant tumor as confirmed by pathology and imaging. 2. Patients treated using ERCP or PTCD. 3. Patients with a loss of access to surgery. 4. Patients with complete clinical data. 5. Patients who agreed to participate in the study and who signed an informed consent form. Exclusion criteria: 1. Patients with a systemic dysfunction of the vital organs. 2. Patients who underwent ERCP or PTCD for the second or more times. 3. Patients with obstructive jaundice stemming from benign lesions. The patients were divided into the PTCD group (n=31) or the ERCP group (n=38) according to the treatment each received. The study was approved by the ethics committee of our hospital. The baseline data of both groups of patients are displayed in **Table 1**.

Therapeutic methods

Preoperative preparation: It was necessary to perfect the relevant examinations. All the patients underwent corresponding treatment to correct their electrolytes, improve their coagulation function, inhibit acid, and get nutritional support.

Surgical procedures: The ERCP group: The intubation was done using a duodenal papilla, followed by a bolus injection of the contrast agent through which the sites, nature, extents, and lengths of the biliary stenoses were visualized with radiation, and then a metal mesh biliary stent of an appropriate length was selected and placed at the site of the biliary stenosis to drain the bile. Afterward, the drainage effect was also observed endoscopically.

The PTCD group: The puncture site was determined based on the imaging results, the ultrasound-guided puncture was performed using an 18G (PTC) needle, the bile was drawn back to make sure that the correct bile duct was punctured, and the locations, degrees, and extents of the obstructions were determined using contrast examinations. Subsequently, a guidewire was introduced and extended, crossing the biliary stricture. Then a stent was placed in the common bile duct and duodenum. It was confirmed again using angiography that the drainage tube was well unblocked. Later, a multifunctional drainage tube was indwelled.

Postoperative management: ECG monitoring and oxygen inhalation were used after the operations, and the patients' vital signs and drainage fluid statuses were observed. The patients were administered regular liver protection, fluid supporting therapy, and anti-infective treatment. Their hematology, electrolytes, liver function, and other indicators were retested.

Observation indicators

The patients' hepatic function indexes, including total serum bilirubin (TB), alanine aminotransferase (ALT), aspartate aminotransferase (AST) and immune cell levels, including CD3+ T cells, CD4+ T cells, and CD8+ T cells, the incidence of postoperative complications, the hospital stay durations and costs, the surgery success rates, and the jaundice reduction response rates were determined and recorded before and after the surgeries. For the jaundice reduc-

Table 2. The surgery success rates and the jaundice reduction response rates in the two groups [n, %]

	Success rate of surgery		Response rate of jaundice reduction			
	Number of cases	Success rate	Significant	Effective	Ineffective	Response rate
PTCD (n=31)	31	100	11 (35.48)	17 (54.48)	3 (9.68)	28 (90.32)
ERCP (n=38)	36	94.74	13 (34.21)	21 (55.26)	4 (10.53)	34 (89.47)
χ^2	3.499					2.098
P	0.061					0.148

Table 3. The liver function indicators in the two groups ($\bar{x} \pm s$)

	ALT (U/L)		AST (U/L)		TB (umol/L)	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
PTCD (n=31)	163.27±63.29	113.26±37.83[a]	150.53±65.28	80.57±37.83[a]	237.81±83.28	168.25±50.28[a]
ERCP (n=38)	155.72±75.28	102.76±32.53[a]	138.96±52.37	95.72±35.61[a]	231.75±72.36	173.81±55.39[a]
t	0.445	1.239	0.817	1.709	0.323	0.432
P	0.658	0.219	0.417	0.092	0.747	0.667

Note: a represents the intra-group comparison between the two groups, $P < 0.05$.

tion rates, the efficacy criteria were developed based on relevant studies [5] as follows: Significant: The TB was decreased by more than 1/3 within one week, and more than 50% within two weeks. Effective: The TB was decreased by less than 1/3 within one week, and less than 50% within two weeks. Ineffective: The TB did not improve or even increased. Response rate = (significant + effective) cases/total cases × 100%.

Statistical methods

The data were analyzed using SPSS 20.0 statistical software. The measurement data were represented as ($\bar{x} \pm s$), and analyzed using t-tests. The enumeration data were analyzed using χ^2 tests. $P < 0.05$ was deemed a statistically significant difference.

Results

Comparison of the surgery success rates and the jaundice reduction response rates in the two groups

The PTCD group and ERCP group success rates were 100% (31/31) and 94.74% (36/38), with no significant difference between the two groups ($P > 0.05$). The jaundice reduction in the PTCD and ERCP groups were 90.32% (28/31) and 89.47% (34/38), with no significant difference between the two groups ($P > 0.05$). See **Table 2**.

Comparison of the liver function indicators between the two groups

Before and after the treatment, no statistically significant differences were observed in the ALT, AST, or TB levels between the two groups ($P > 0.05$). After the treatment, the above indicators were all markedly reduced compared with before the treatment ($P < 0.05$). See **Table 3**.

Comparison of the immune cell levels in the two groups

Before and after the treatment, no statistically significant differences were observed in the CD3+, CD4+, or CD8+ cell percentages between the two groups ($P > 0.05$). After the treatment the CD3+ and CD4+ cell percentages were all markedly increased compared with before the treatment ($P < 0.05$). See **Table 4**.

Comparison of the postoperative complication rates in the two groups

The postoperative complications rates of PTCD group and ERCP group were 22.58% (7/31) and 7.89% (3/38), significantly higher in PTCD group ($P < 0.05$). See **Table 5**.

Discussion

Overall, our results indicate that the post-surgery ALT, AST, and TB levels in the two groups

Table 4. The immune function indicators in the two groups ($\bar{x} \pm s$, %)

	CD3+		CD4+		CD8+	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
PTCD (n=31)	53.78±8.72	71.65±10.37a	29.83±6.52	36.76±7.61a	25.29±5.62	20.28±7.53a
ERCP (n=38)	55.26±9.15	73.26±11.56a	30.52±7.85	37.23±8.27a	25.73±6.21	21.39±6.58a
t	0.682	0.602	0.391	0.243	0.305	0.653
P	0.497	0.549	0.697	0.809	0.701	0.516

Note: a represents the intra-group comparison between the two groups, $P < 0.05$.

Table 5. The postoperative complications in the two groups [n, %]

	Acute pancreatitis	Biliary infection	Stent displacement or blockage	Bleeding	Incidence of complications
PTCD (n=31)	0 (0)	3 (9.68)	3 (9.68)	1 (3.23)	7 (22.58)
ERCP (n=38)	2 (5.26)	1 (2.63)	0 (0)	0 (0)	3 (7.89)
χ^2					4.075
P					0.044

were decreased to various extents compared with their pre-surgery levels. Nevertheless, the preoperative and postoperative ALT, AST, and TB levels showed statistically significant differences between the two groups. No statistically significant difference was noted in the jaundice reduction response rates. This indicated that both procedures led to a significant decrease in the serum bilirubin and the hepatic function impairment recovery due to biliary obstructions. Still no significant difference in the jaundice reduction effect was reported. This finding is consistent with Zhang et al. [6], who found that ERCP and PTCD can be regarded as two effective methods for the treatment of MOJ, with their response rates of jaundice reduction at 89.06% and 89.47%, respectively. The postoperative ALT, direct bilirubin (DBIL), and TB levels were reduced compared to their preoperative levels in the two groups, yet the differences between the two groups were not statistically significant. Several lines of evidence [7] suggest that both ERCP and PTCD can relieve biliary obstruction induced by malignant lesions effectively, achieve better therapeutic effects in the relief of jaundice symptoms and a vast improvement in hepatic function, and markedly delay liver failure, without a significant difference in the overall response. In previous studies, Chai et al. [7] concluded that the placement of biliary metal stents via PTCD and ERCP, an effective procedure for MOJ, is helpful in the amelioration of jaundice and the completion of biliary drainage. Data from several sources [9, 10] have shown that PTCD and ERCP have a similar effect on hepatic function and postoperative survival, but ERCP has a lower incidence of complications and shorter hospital stays and a lower cost than PTCD. However, ERCP has certain surgical indications [11, 12]. Hence it is appropriate to for PTCD patients with poor cardiopulmonary function, old or weak patients, patients with severe shock, and other high surgical risks, as well as those with severe high biliary obstruction and a complex anatomy of the surgical site that makes it difficult to locate the duodenal papilla to undergo ERCP.

In this study, all the surgeries in the PTCD group were successful, and two patients in the ERCP group failed the tube placement procedure and were converted to PTCD. It has been demonstrated that [13] several factors can affect the success of ERCP surgery, including the ability of the guidewire to be successfully inserted into the bile duct and the ability to cross the narrow segment of the bile duct, and the ability to locate the opening of the papilla. Smooth punctures into the dilated bile duct are critical to the success of the PTCD procedure, and the internal diameter of the dilated bile duct should be > 0.4 cm for a high success rate. It has conclusively been shown that ultrasound localization and PTCD under X-ray guidance can objectively show the whole puncture process, distinguish the blood vessels and dilated bile ducts, accurately avoid the blood vessels on the puncture channel, and improve the success rate of the

operation [8]. A possible explanation for the increasing success rate of ERCP procedures is attributed to the excellent ERCP supporting facilities concerning endoscopic ultrasonography and duodenoscopic viewing, and the application of adjunctive intubation methods to increase intubation success, reduce complications, and alleviate patient pain [9]. Safety measures can be leveraged to greatly increase the intubation rate and reduce the overall complication rate and the risk of pancreatitis [10].

Data from several sources have shown that malignant tumors show a distinct immunosuppression on the body and exert direct effects on the occurrence, progression, response, and prognosis of tumors, with CD8+ T cells as the true effector cells [11]. Thanks to long-term biliary obstructions, MOJ patients experienced substantially elevated blood bilirubin level to induce hepatocyte degeneration and necrosis, decrease endotoxin inactivation and reduce the barrier capacity of the intestinal mucosa. Relieving biliary obstructions and reducing jaundice would improve the general condition, the function of various organs, and the immune status of the body. These results reflect the findings of Zhu et al. [12], who also found that patients had notably improved ALT and TB levels, markedly increased CD4, CD3, and CD4/CD8 in the serum, yet remarkably decreased CD8 after receiving PTCD for advanced MOJ compared with those preoperatively. Also, the human cellular immunity was significantly strengthened after internal biliary drainage.

The most frequently reported ERCP complications include pancreatitis, bleeding, perforation, and cholangitis [13]. PTCD is prone to complications such as biliary tract infections, bile leakage, and stent displacement. In this study, the incidence of complications in the PTCD group was higher than it was in ERCP, which was consistent with domestic studies [6]. Biliary infection was a major complication after PTCD. We summarized our experience based on the relevant literature and surgical procedures as follows [14]: (1) intraoperative and postoperative disinfection in an aseptic way and the preoperative active control of infection, (2) ultrasound-guided PTCD punctures combined with stent placement under x-ray monitoring. Careful selection of the puncture route to avoid important blood vessels and reduce bleeding, (3) timely protein supplementation before and after surgery, (4) increasing the number of flushes for patients with more blood clots in the drainage fluid.

To sum up, both ERCP and PTCD can obtain better clinical effects in MOJ treatment, effectively relieve obstructions, improve hepatic function, and strengthen immune function. Still, we report no significant differences in the jaundice reduction and surgical success rate between the two procedures. However, there are fewer complications post-ERCP. Since ERCP and PTCD have their pros and cons, the most suitable therapeutic regimen for patients should be formulated according to their physical conditions, laboratory and imaging results, economic situations, and other factors.

Disclosure of conflict of interest

None.

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References

[1] Wang J, Sun Z and Niu H. Current status of dual interventional therapy for advanced malignant obstructive jaundice. Chinese Journal of Minimally Invasive Surgery 2016; 16: 1145-1154.

[2] Zhu Y, Wang S, Zhao S, Qi L, Li Z and Bai Y. Obstructive jaundice due to a blood clot after ERCP: a case report and review of the literature. BMC Gastroenterol 2018; 18: 163.

[3] Jin H, Pang Q, Liu H, Li Z, Wang Y, Lu Y, Zhou L, Pan H and Huang W. Prognostic value of inflammation-based markers in patients with recurrent malignant obstructive jaundice treated by reimplantation of biliary metal stents: a retrospective observational study. Medicine (Baltimore) 2017; 96: e5895.

[4] Nalankilli K, Kannuthurai S and Moss A. A modern approach to ERCP: maintaining efficacy while optimising safety. Dig Endosc 2016; 28 Suppl 1: 70-76.

[5] Chen P and Pang L. Comparative study of the placement of biliary metal stent via PTCD and ERCP for malignant obstructive jaundice. Chinese Journal of Bases and Clinics in General Surgery 2016; 23: 947-971.

[6] Zhang X, Zhang L and Zhang S. Comparison of endoscopic retrograde cholangiopancreatography and percutaneous transhepatic cholan-

gial drainage for malignant obstructive jaundice. Chinese Journal of General Practice 2016; 14: 575-577.
[7] Chai CM, Song GD and Fan X. Comparative study of biliary stent placement by percutaneous transhepatic cholangial drainage and endoscopic retrograde cholangiopancreatography in treatment of malignant biliary obstruction. World Chinese Journal of Digestology 2019; 27: 1027-1034.
[8] Li C, Zou S and Yi G. Ultrasound localization combined with x-ray-guided percutaneous transhepatic choledochal drainage for malignant obstructive jaundice. Chinese Journal of General Surgery 2015; 24: 186-189.
[9] Krutsri C, Kida M, Yamauchi H, Iwai T, Imaizumi H and Koizumi W. Current status of endoscopic retrograde cholangiopancreatography in patients with surgically altered anatomy. World J Gastroenterol 2019; 25: 3313-3333.
[10] Sevinç B and Karahan Ö. The role safety steps in success and complication rate of endoscopic retrograde cholangiopancreatography. Surg Laparosc Endosc Percutan Tech 2017; 27: 233-236.
[11] Vigano L, Soldani C, Franceschini B, Cimino M, Lleo A, Donadon M, Roncalli M, Aghemo A, Di Tommaso L and Torzilli G. Tumor-infiltrating lymphocytes and macrophages in intrahepatic cholangiocellular carcinoma. Impact on prognosis after complete surgery. J Gastrointest Surg 2019; 23: 2216-2224.
[12] Zhu L and Chen X. Change and significance of T-cell subsets and TNF-α in patients with advanced malignant obstructive jaundice treated by percutaneous transhepatic biliary external and internal drainage. Front Med China 2007; 1: 364-368.
[13] Pollock A, Campbell P, Struthers C, Synnot A, Nunn J, Hill S, Goodare H, Morris J, Watts C and Morley R. Stakeholder involvement in systematic reviews: a scoping review. Syst Rev 2018; 7: 208.
[14] Chen J, Zhang W and Mo Z. Strategies for the prevention and treatment of ultrasound-guided PTCD complications. Chinese Journal of Hepatic Surgery 2019; 8: 344-348.