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Current Status of Ultrasound-guided Percutaneous Transhepatic Cholangial Drainage in the Treatment of Malignant Obstructive Jaundice

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Abstract: *Malignant obstructive jaundice (MOJ) is mostly biliary obstruction caused by digestive malignant tumor, which causes serious complications such as hyperbilirubinemia and which greatly affects the life of patients. The traditional treatment of MOJ is Laparotomy. In recent years, palliative treatment such as percutaneous transhepatic cholangial drainage (PTCD) has been widely implemented. Although the method of PTCD is simple and safe, some controversies about its efficacy, complications and contraindications are still being debated. This paper reviews the clinical application and research status of PTCD in the treatment of MOJ.*

Keywords: *Malignant obstructive jaundice, Percutaneous transhepatic cholangial drainage, Biliary stent implantation, Complications*

1. Introduction

Tumor resection combined with choledochojejunostomy is an early surgical treatment for the MOJ disease. Palliative choledochojunostomy can also be used for patients who are not suitable for surgical resection of tumors. However, the onset of MOJ is really hidden, so the most patients are in the late stage while they are found. About 80% of them have lost the opportunity to operate (the incidence and mortality of postoperative complications are very high, and the prognosis is poor) [3]. Effective biliary drainage has become the main way to alleviate complications and improve prognosis [4]. Percutaneous transhepatic cholangio-drainage (PTCD) is a safe, efficient and simple surgical method, which has good efficacy of reducing jaundice. It not only has diagnostic value for biliary diseases, but also plays a role in surgical drainage, reducing pressure and eliminating jaundice for patients with biliary obstruction.

At present, common methods used in biliary drainage include open surgical drainage, endoscopic retrograde cholangiao-pancreatography (ERCP), palliative biliary intestinal drainage, and so on. Nowadays, to some extent, real-time ultrasound-guided PTCD has the advantages of higher accuracy, better safety and fewer complications, and is more favored by hepatobiliary surgery [5].

2. Surgical Method of PTCDs for MOJ

The commonly used PTCD puncture method in clinic is to let the patient lie flat, inject 2% lidocaine as local anesthetic, and penetrate layer by layer from the subcutis to the liver capsule. Then, under the real-time guidance of color Doppler ultrasound or DSA, the most obstructive and dilated bile duct was determined and selected as the appropriate location for puncture. After conventional surgery area disinfection, shop sterile surgical towels single, the puncture needle shall be inserted into the appropriate target bile duct which is in level III and below, after that, the needle core shall be pulled out, and the syringe shall be pulled back. The successful puncture can be preliminarily judged by the smooth bile flow shadow under ultrasound.

After injection of contrast agent, intrahepatic dendritic bile duct development can be seen. Continue to inject contrast agent until the target bile duct is clearly developed, pull out the syringe, insert the super-slip guide wire, send the catheter into the duodenum, replace the super hard guide wire through the catheter, then, withdraw the catheter, and send it into the balloon catheter along the super-stiff guide wire.

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After expensing the bile duct at the obstructive site, withdraw the balloon catheter, remove the expansion tube, and replace it with the drainage tube. Finally, pull out the guide wire and draw out the bile, fix the drainage tube, and connect with the drainage bag. Patients who have PTCD combined with stent placement surgery should place the stent along the guide wire delivery catheter across the obstructive segment after balloon withdrawal.

3. Preoperative Preparation and Prediction

In addition to routine preparation and examination, the preoperative preparation for the treatment of MOJ with PTCD also needs some targeted special preparation.

Routine preparation includes ASA classification, pathophysiological status correction, preoperative visit, gastrointestinal preparation, nutritional status improvement, preoperative medication, etc. physical examination, laboratory examination and imaging examination are also required for preoperative evaluation. In addition, it is also necessary to ensure that the patient has a full rest.

Patients with MOJ may have itchy skin due to the stimulation of nerve endings by cholestasis. Before operation, patients should be correctly instructed not to scratch, wipe with warm water to ensure comfort and pay attention to rest. In addition, psychologically, patients with MOJ may have trouble or even negative fear due to poor complexion caused by jaundice. At this time, doctors need to make full preoperative communication to help patients build confidence and reduce their anxiety.

Gallbllader-heart reflection is one of the common complications in patients with MOJ. Chengxue Li and other researchers reported that prophylactic administration of 0.5 mg atropine before and during operation can effectively reduce the incidence of gallbllader-heart reflection.

In addition, Hu Ying [10]and other researchers pointed out that the independent risk factors leading to poor clinical efficacy include preoperative KPS score <50, postoperative complications, preoperative liver function in grade of Child-PughC and preoperative T-Bil > 300umol/l. Therefore, for such patients, we should actively improve their overall physical conditions and prevent infection before operation, so as to further improve the efficiency of clinical treatment.

4. Efficacy Analysis of PTCD

4.1. Comparison of Efficacy of ERCP and PTCD in the Treatment of MOJ

ERCP and PTCD are commonly used in the treatment of MOJ. At present, ERCP biliary stent implantation is considered as the first-line treatment for malignant obstructive jaundice, and PTCD is considered as an alternative treatment when ERCP fails [6]. However, PTCD guided by real-time ultrasound is widely used in clinic because of its higher accuracy, better safety and fewer complications [7].

Some scholars believe that ERCP is better than simple PTCD along. This was confirmed by Inamdar's research, which showed that the total incidence of ERCP biliary stent implantation was lower than that of PTCD [8]. Speer [9] found that the clinical effective rate of ERCP was significantly higher than that of PTBD, and the mortality in 30 day was significantly lower than that of PTBD. The higher mortality after PTBD is related to bleeding and bile leakage.

However, compared with ERCP stent implantation, real-time ultrasound-guided PTCD has a higher success rate, especially for patients with high obstruction. At the same time, ultrasound-guided PTCD has lower incidence of overall complications, acute pancreatitis and biliary tract infection, especially biliary tract infection. This may be related to incomplete drainage of ERCP [10], excessive use of antibiotics, or sometimes the incision and the destroy structure of the duodenal papilla [11]. Zhao [12] et al. Showed that compared with ERCP biliary stent implantation, PTCD has higher treatment success rate and lower incidence of cholangitis, but the incidence of complications, pancreatitis incidence rate and 30-day mortality of ERCP and PTCD are similar.

Hongfeng Hu et al. Showed that the levels of ALT, ALB, TBIL and DBIL in patients treated with PTCD were lower than those in ERCP group ($p<0.05$), indicating that the treatment method adopted in PTCD group has a relatively better protective effect on liver function. This may be attributed to the fact that ERCP needs to insert the duodenoscope into the descending part of duodenum, which leads to the part of the bile drained out of the body, resulting in the disorder of digestive function, and even the

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disorder of water-electrolyte and acid-base balance. His research also showed that patients treated with PTCD has lower TNF-α and NF-κB levels than those treated with ERCP, indicating lower risk of inflammation after PTCD. Compared with the complication rate of the two groups, the intraperitoneal hemorrhage and catheter displacement (or blockage) in the PTCD group were significantly less than those in the ERCP group, because the drainage range was increased through technical improvement of the PTCD.

Both of the two surgical methods can reduce the symptoms of jaundice and improve liver function, but have different effects on postoperative complications. The research results of Liang Li et al. Showed that compared with PTCD, ERCP treatment could significantly reduce the jaundice level of patients one day after operation, and the serum total bilirubin and direct bilirubin levels decreased rapidly. However, the improvement of liver function in PTCD group was significantly better than that in ERCP group. In aspects of the comparison in common complications after operation, there was no statistical difference between the two groups, but the incidence of acute pancreatitis after ERCP was significantly higher than that before operation.

There was no significant difference in the total effective rate between ERCP and ultrasound-guided PTCD, but ERCP was more effective in the treatment of low obstruction, while PTCD is more effective in the treatment of high obstruction. In addition, ERCP can radically relieve the obstruction of patients, and it is more inclined to be used in calculous obstructive jaundice.

This is because low PTCD can destroy the function of Oddi sphincter, intestinal content reflux is easy to cause cholangitis and excessive fiber hyperplasia, resulting in stent stenosis. For patients with duodenal papilla stenosis, history of upper abdominal surgery, and difficulty in endoscopic trans papillary drainage, PTCD is more practicable in drainage. The biggest difference between high bile duct obstruction and low obstruction is whether there can be hepatic duct obstruction or not, which is relatively difficult to operate through endoscopy. So, PTCD has certain advantages as it can be repeatedly punctured and can implant multi branch stent to drain.

PTCD and ERCP both have their own advantages. In clinical practice, PTCD or ERCP should be selected according to the obstruction site, drainage purpose and doctors' experience to biliary drainage, combined with the specific situation of patients.

4.2. Comparison of Curative Effect between PTCD and Open Surgical Drainage

On the one hand, PTCD interventional therapy can reduce patients' body injury and postoperative pain because of its minimally invasive. On the other hand, PTCD treatment can achieve multiple puncture and multiple drainage, which makes more sufficient drainage and stronger effect of relieving liver function inhibition. Thus, compared with traditional open surgical drainage, the detoxification function of PTCD is enhanced, the synthesis ability of immunoglobulin is enhanced, the function of T cells is restored, the activity of Th cells and macrophages is enhanced, and the humoral and cellular immunity of patients are also restored.

Bei Zhang, Xiuwei Da and others have made an experimental study on 96 patients with MOJ. It showed that the DBIL, TBIL and hs-CRP of PTCD interventional treatment group were all lower than those of open surgery drainage treatment group one week after operation, which proved that PTCD interventional treatment had more significant effect in bilirubin reduction, anti-inflammatory level and better curative effect; Their research also showed that the levels of CD3 +, CD4 + and CD4+ / CD8 + in PTCD interventional therapy patients were higher than those in open surgical drainage patients, which proved that PTCD had a better immune promotion effect on patients. The research results of Xiangdong Zhang also showed that the levels of DBIL, DBIL, AST and ALT after PTCD treatment were significantly lower than those in the open treatment group ($p<0.05$), similar to those reported by Ye Liao.

To sum up, as a minimally invasive treatment, ultrasound-guided PTCD has the advantages of smaller trauma, more convenient operation and clearer visual field, which, to some extent, can indirectly improve the postoperative liver function of patients. The advantages include: ① Under the use of ultrasound-guided PTCD, the position and expansion state of bile duct can be clearly determined, which is more convenient for selecting appropriate bile duct to puncture; ② High accuracy of puncture, non-radiation and low incidence of postoperative complications; ③ Ultrasound can dynamically monitor the targeted bile duct of tumor patients in real time, reduce the interference of tumor tissue, and ensure the subsequent selection of appropriate and safe puncture site and path; ④ Ultrasound can accurately distinguish the dilated bile duct from the adjacent blood vessels, which directly reduces the incidence of postoperative

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complications and significantly improves the safety of the operation.

4.3. Comparison of Curative Effect between PTCD and Palliative Biliary Enteric Drainage

Before the 20th century, open surgery was a common method for the treatment of MOJ and the biliary reconstruction. However, most of MOJ are elderly patients, and a series of cachexia has occurred before clinical diagnosis. They are faced with huge perioperative risk during surgical procedure, and the difficulty of operation is greatly increased [13].

With the rapid development of materials technology and imaging techniques such as modern ultrasound, MRI and others, PTCD and palliative biliary enteric drainage and other palliative minimally invasive treatments have gradually replaced surgical treatment, which made it gradually become the main ways to reduce jaundice. Compared with palliative biliary enteric drainage, biliary stent implantation and external drainage via PTCD are easier to operate, less traumatic, and less complications, and cause it can obtain good drainage effect, it has gradually been favored by doctors and patients. Compared with the palliative biliary enteric internal drainage as a biliary enteric anastomosis, PTCD puncture under the guidance of ultrasound is more minimally traumatic, safe and conducive to rehabilitation. On the other hand, PTCD treatment can puncture and drain the dilated bile duct for many times under angiography. For example, drainage tubes can be respectively placed in the left and right hepatic ducts, which can drain bile more fully and effectively and reduce bilirubin more significantly. Kuai Yu has shown that PTCD has the same effect on liver function of patients with MOJ as palliative biliary enteric drainage, and even has better effect on reducing bilirubin and alleviating jaundice. The complications of PTCD patients are similar to those of patients with palliative biliary enteric drainage, but PTCD patients have less intraoperative bleeding, less trauma, more safety, and more benefit to the recovery.

5. Prevention and Treatment of PTCD Related Complications

The complications caused by PTCD mainly include biliary infection, biliary bleeding, acute pancreatitis and so on.

The main manifestations of biliary tract infection are repeated shivering, high fever, and the increased ratio of white blood cells or granulocytes, and even septic shock. The basic principle of prevention and treatment is to remove biliary obstruction at an early stage, select sensitive antibiotics, and for patients with external drainage, we can also try to wash the biliary tract regularly through the external drainage tube.

The predisposing factors of biliary bleeding are vascular injury caused by repeated puncture, liver function damage and coagulation disorders. To prevent which, Doctors can improve their own technical level, improve the coagulation function before operation, and ensure that all the side holes of the drainage tube are wrapped in the bile duct during operation. Once bleeding occurs, it can be treated with hemostatic mixture, thrombin, somatostatin or other symptomatic treatments

The early symptoms of acute pancreatitis caused by PTCD are atypical, mostly manifested as nausea, vomiting, abdominal pain and other postprandial symptoms. The symptoms can be effectively relieved by taking combined treatment measures such as fasting, gastrointestinal decompression, anti-inflammatory, fluid infusion, correction of electrolyte disorders, and the use of somatostatin to inhibit pancreatic secretion.

Other complications include Gallbladder-cardiac reflex, displacement and detachment of drainage tube, obstruction and restenosis of biliary stent and drainage tube, electrolyte disorder, etc., which can be conventionally prevented and targeted treated.

6. Continuous Nursing after PTCD

Due to the severe complications (such as biliary infection, biliary bleeding and acute pancreatitis) and the easily complicated complications (such as the prolapse and obstruction of the drainage tube), the postoperative continuous nursing of PTCD plays an irreplaceable role in the prognosis of the operation. In order to reduce the incidence of complications after PTCD, routine nursing should be carried out in the postoperative management. Other integral managements include informing patients of postoperative precautions, answering patients' questions in time, informing patients of drainage tube related knowledge and disease related knowledge, instruct patients on safe diet and activities, preventing postoperative

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infection, etc.

After discharge, it is equally important to give discharge guidance, including outpatient telephone guidance, establishment of network nursing intervention platform, regular return visit, organization of patient friend exchange meeting, outpatient follow-up consultation and family visit, guiding patients to observe the flow and color of bile, keeping the drainage tube unobstructed, washing the drainage tube, managing diet, and properly caring for skin wounds.

7. Conclusion

Due to changes in lifestyle such as people not eating breakfast and being stressed in recent years, the incidence of tumors in digestive system has increased year by year, and the incidence rate of MOJ has also increased [1]. PTCD drainage stent placement is widely used in clinic because of its simplicity and safety, but as the increase of the cases number, the cases number of stent or tube restenosis and obstruction also show an increasing trend year by year.

In addition to improving the success rate of PTCD and reducing the incidence of complications, the research on new treatment methods has also become a hot topic in the field of hepatobiliary field. Some scholars have proposed that nano silver should be plated on the stent surface to inhibit the formation of bile sludge through the antibacterial effect of silver ions. Some scholars have also proposed that the technique of magnetic pressing anastomosis can be used in the narrow segment of the bile tract to make the tumor cells necrosis and achieve biliary recanalization. In addition, some scholars have proposed one photodynamic therapy, a non-invasive treatment called photosensitization oxidation therapy, and other single drug or combined biological targeted therapy based on related targets. Such new fields have pointed out a new direction for the treatment of MOJ in the future, and their indications and efficacy need to be further studied and discovered by us all.

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