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Original article

Comparison of patency rates and clinical impact of different reconstruction methods following portal/superior mesenteric vein resection during pancreatectomy

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ABSTRACT

Introduction: Few studies have compared patency rates of the different methods of venous reconstruction (VR) during a pancreatectomy. This study aimed to evaluate the patency rates and the clinical impact of various reconstruction methods.

Methods: For the meta-analysis, databases were systematically searched to identify studies reporting the outcomes of patients who underwent PVR/SMVR. For the retrospective study, clinical data were retrospectively analyzed from patients who underwent a pancreatectomy and VR between Feb. 2009 and Oct. 2015. Patency was assessed by CT and/or ultrasound.

Results: For the meta-analysis, the long-term patency rates of the primary repair group and the autologous graft group were significantly higher than that of the synthetic graft group. For the retrospective study, the reconstruction consisted of primary repair in 62 cases (89.8%) and synthetic grafting in 7 cases (10.1%). Synthetic grafting was more likely to cause acute thrombosis compared with primary repair for PVR/SMVR (85.7% versus 16.7%). Acute thrombosis was associated with decreased median survival (12 versus 6 months) and increased hazard of death. Late thrombosis and stenosis were not associated with survival or serious clinical impact. Median survival for the primary repair group and the synthetic grafting group was 12 and 7 months, respectively.

Conclusion: Primary repair following PVR/SMVR is preferred and can be achieved in most situations. Stenosis should be noted when with risk factors (long segmental and tension), but it produced little clinical impact. Synthetic grafting was associated with a higher thrombosis rate. Acute thrombosis is associated with increased mortality and decreased survival.

1. Introduction

Radical resection offers the only chance for a cure in patients with pancreatic cancer. However, the majority of pancreatic cancer is diagnosed at an advanced stage when the deep and close anatomic relationship between the pancreas and the rear vessels make it particularly easy for the tumor to invade the portal vein/superior mesenteric vein (PV/SMV) directly [1]. If invaded, the PV/SMV can be resected and reconstructed. A pancreatectomy combined with PV/SMV resection aiming for R0 resection has become acceptable at high-volume pancreas centers [2–4].

Although increasingly common, portal vein reconstruction/superior mesenteric vein reconstruction (PVR/SMVR) has non-standardized options ranging from primary repair to autologous grafting to synthetic grafting. Primary repair is convenient and simple but might not be applicable for high tension associated with long segmental resections. Autologous grafting for PVR/SMVR requires a suitable length and caliber. The left renal vein is a good candidate, but harvesting this vein increases the operation time and injury. Synthetic grafting is convenient to use but has a higher thrombosis rate and may produce consistent infection when combined with pancreatic fistula [5,7].

The short- and long-term patency rates of various PVR/SMVR methods and the clinical impact and morbidity associated with

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thrombosis and stenosis have rarely been reported in detail.

In our experience, we prefer primary repair in most situations even though stenosis may occur due to high tension associated with long segmental resections. However, there is no significant clinical impact from the resulting stenosis. Here, we review the current data to evaluate the short- and long-term patency rates and clinical impact of different PVR/SMVR methods to improve intraoperative decision making.

2. Method

2.1. Meta-analysis

To assess PVR/SMVR during a pancreatectomy, we performed a computerized search of PubMed, the Cochrane library, ISI Web of Knowledge, OVID, and Google scholar from Jan. 1995 to Oct. 2015. The following search terms were used: "Pancreatectomy", "Pancreaticoduodenectomy", "Portal vein", "Superior mesenteric vein", and "Venous reconstruction". Two reviewers (*Xinglong Dai & Wentao Gao*) independently extracted each full-text article with the following information: author, country, year of publication, study type, patient demographics, types of operation, resection margin status, types of PVR/SMVR, number of patients with PVR/SMVR, and number of patients with loss of patency. The flow chart of the search history is shown in Fig. 1.

Inclusion in this study was according to the following criteria. First, patients underwent pancreatectomies with PVR/SMVR that were suitable for the comparison of the results of primary repair versus autologous or synthetic grafting. Second, the study included full and detailed data to evaluate the patency rates. Third, a Newcastle-Ottawa Scale (NOS) score >6 should be achieved in terms of selection, comparability, and outcome, and a score of 6 or greater was considered high quality for inclusion [30]. Fourth, reviews without original data, case reports, articles on artery reconstruction, articles with less than 4 patients who underwent the PVR/SMVR, overlapping literature, animal experiments, and studies written in languages other than English were excluded.

The meta-analysis was conducted in accordance with the methodology recommended by the Cochrane Collaboration and the previously published PRISMA statement [8]. To assess the overall quality of evidence for the various parameters, a quality assessment was performed using the NOS system for cohort studies. The pooled effect was calculated using a fixed effects model. Heterogeneity was evaluated by means of the I^2 test and P value, with significance set at $P < 0.05$. An I^2 value of more than 50% indicated high statistical heterogeneity [9,10]. Additionally, ten articles that included only one PVR/SMVR technique with no comparison could be compared by a Z-test [31–40]. A sensitivity analysis was also performed by excluding some unique studies and testing with all studies. Publication bias was assessed visually using a funnel plot.

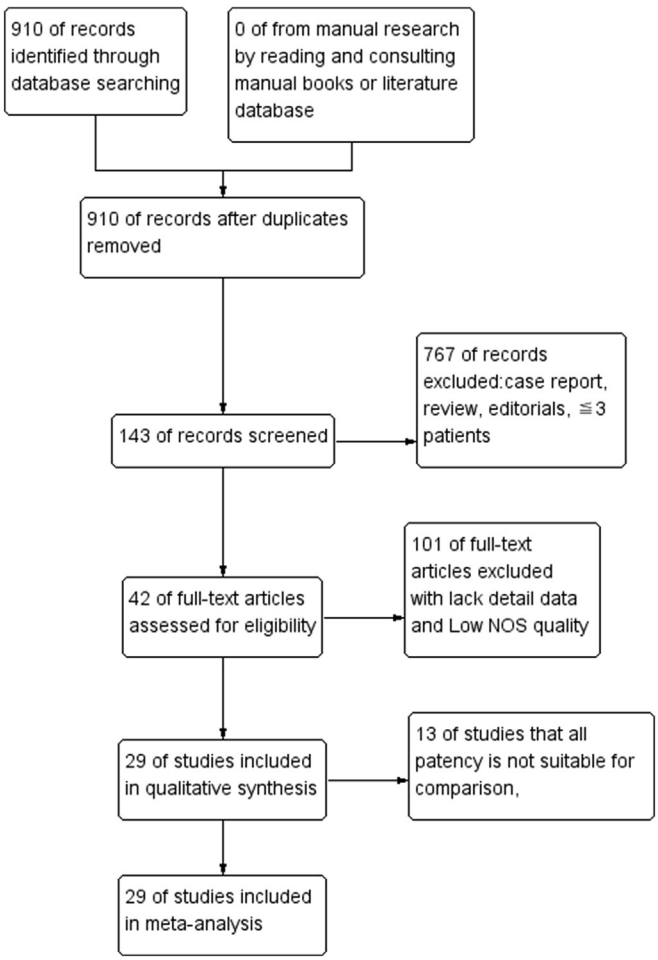

Fig. 1. The flow chart of the search history for meta-analysis.

2.2. Patient selection

A retrospective review of a database of patients who underwent a pancreatectomy with PVR/SMVR from Jan. 2009 and Oct. 2015 at the Pancreas Center of the First Affiliated Hospital of Nanjing Medical University was analyzed. Patients who underwent arterial reconstruction were excluded from the analysis because, in our experience, these patients have significantly higher morbidities and mortalities. Data were analyzed included patient demographics, types of surgery, types of PVR/SMVR, clamp time, tumor margin, short- or long-patency rates, survival, and mortality.

2.3. Operative technique

The pancreatectomies were performed using standard methods as previously described [11,12]. PVR/SMVR were categorized into two groups in our pancreas center: primary repair and synthetic grafting (Vascutek, a Terumo Company, Shanghai, China). Autologous grafting was not used in our center. Wedge or segmental resections of the PV/SMV were also classified as primary repair. PVR/SMVR generally depends on the length of the venous involvement by the tumor. For segmental resections of the PV/SMV shorter than 30 mm, primary repair was possible in all patients. If segmental resections of the PV/SMV were between 30 and 50 mm, we still preferred primary repair by trying adequate mobilization of the mesentery and liver. Synthetic grafting was the next choice. The splenic vein (SV) might be ligated or a primary end-to-side anastomosis was used. Additionally, for tumors that encased the distal SMV and abutted the superior mesenteric artery (SMA), we recently described the use of a mesocaval shunt to ensure the PVR/SMVR. PVR/SMVR was performed using continuous 5-0 Prolene sutures. The cross-clamp time of the PV/SMV was kept to a minimum to avoid edema or congestion of the bowel. Based on the specific diameter of the PV/SMV, the median graft diameter of synthetic grafting was approximately 12 mm (range 8–20 mm).

2.4. Follow-up and patency assessment after PVR/SMVR

Low molecular heparin was used for 2 weeks after surgery, followed by oral warfarin for 6 months. Postoperative CT and ultrasound were used to assess the patency of the reconstructed vein,

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