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Portal Vein, Superior Mesenteric Vein Resection and Reconstruction during Pancreaticoduodenectomy: Type of reconstruction and results

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Abstract

Pancreatic cancer is ranked as the fourteenth commonest cancer in the world as well as the 7th highest cause for cancer related mortality with a survival rate at 5 year after the diagnosis about of 5%. Only 10% to 20% are resectable cancer or fit patients. Liver metasteses, carcinosis, invasion of celiak trunk or hepatic artery, invasion of Portal Vein (PV) or Superior Mesenteric Vein (SMV) amout about of 80%. Vascular resections (VR) are typically needed in cases often defined as having "borderline resectable" findings. Borderline resectable carcinoma is defined as per 2009, exert consensus statement and encompasses involvement of short superior mesenteric vein/portal vein with free proximal and distal venous segments, allowing secure reconstruction and superior mesenteric artery less than 180° or involvement of short hepatic artery with intact truncus coeliacus. Of these, about thirty to thirty five percent are graded as un-resectable due to the isolated participation of the portal vein/superior mesenteric. Nowday, resection of portal vein or SMV is become a systematic procedure in high volume pancreatic surgery center. VR in pancreatic cancer is feasible but no safe procedure in high volume center.It can be used only if surgeon can achieve R0 resection changing the outcomes of the patients compared to palliative surgery. Some studies demonstrated that VR during pancreatectomy is associated with worse survival due to larger tumor size and the higher rate of positive margins.

Keywords: Pancreatic Cancer, Superior Mesenteric Vein, Portal Vein, Resection, Reconstruction

Introduction

Pancreatic cancer (PC) is ranked as the fourteenth commonest cancer in the world as well as the 7th highest cause for cancer related mortality with a survival rate at 5 year after the diagnosis about of 5% .Only 10% to 20% of PC are resectable cancer or fit patients. This tumor is charachterized by late diagnosis and poor prognosis. Radical surgery is the only hope and choice for this type of cancer. Radical surgery plus adjuvant chemotherapy can give an estimated long term 5 year survival about 20%-25%. Liver metasteses, carcinosis, invasion of celiak trunk or hepatic artery, invasion of portal vein or mesenteric vein amout about of 80%. Of these, about thirty to thirty five percent are

graded as un-resectable due to the isolated participation of Portal Vein (PV) or Superior Mesenteric Vein (SMV). Vascular resections (VR) are typically needed in cases often defined as having “borderline resectable” findings. Borderline resectable carcinoma is defined as per 2009, exert consensus statement and encompasses involvement of short superior mesenteric vein/portal vein with free proximal and distal venous segments, allowing secure reconstruction and superior mesenteric artery less than 180° or involvement of short hepatic artery with intact truncus coeliacus(1). In these patients with localized pancreatic cancer, only Portal Vein-Superior Mesenteric Vein Resection (PV-SMV-R) can achieve negative margins. For this technique, literature demonstrated that long-term outcome of patients after pancreaticoduodenectomy (PD) with or without venous resection is strictly the same.(2,3,4,5).Combined PV resection with pancreatectomy ought to be addressed with a view to attain clear margins of resection based on pre-operative imaging in suspectable cases of portal vein invasion instead of deciding purely on the basis of operational findings. All subjects ought to go through CT (contrast-enhanced tomography) as regular pre-operative work up. For the first time, Fortner systematically presented the resection idea of the PV for complete tumour removal. The surgical technique for reconstruction may vary. from primary end-to-end venous anastomosis as the most used to the use of a venous graft when the segment of portal vein to be resected is long . Graft venous conduit such as splenic, common femoral, iliac, internal jugular have already been used (6). In minimal invasion cases, a partial resection and reconstruction with an autologous patch may be performed. A peritoneal patch has been described as feasible. In cases of broader invasion, segmental resection and reconstruction should be performed. When an end-to end anastomosis isn’t possible, autologous, homologues, or prosthetic (ring) grafts are the options (1). Nowday, resection of portal vein or SMV is become a systematic procedure in high volume pancreatic surgery center to achive R0 resection in locally advanced pancreatic cancer.(1). To date, literature can't established the impact on overall survival depending the correlation between different surgical techniques and perioperative risk.(7) Peraphs only the depth of tumour invasion of PV-SMV wall seems to influence on clinical outcome.

Materials and Methods

We have retrospectively evaluated PUBMED databases, Embase and the Cochrane Library by applying various combinations of the terms related to pancreatic cancer and PV-SMV-R. The search terms were identified with Medical Subject Heading (MeSH) were: “Pancreatic Cancer”, “Pancreatic Ductal Adenocarcinoma”, Superior Mesenteric Vein” ,“Portal Vein”,”Resection”,”Reconstruction”. Studies were evaluated from 2000 to 2020. Inclusion criteria were the following: results of pancreatectomy with PV-SMV-R; type of reconstruction techniques; results. Exclusion criteria: case reports, letters, comments, abstracts, duplicate reports and studies that contained non-cancer patients, arterial resection were also excluded. No language restriction was applied in the search strategy. Two independent research DC and SL performed the review. The outcomes were Venous Resection(VR), type of reconstruction techniques; results of various reconstruction techniques. After rejecting repetitive reports, the relevant literature for this review article included 8 manuscripts.

Results

Xiaobo et al(8) in their systematic review including 41 studies, revealed a p value of 0.006 comparing PD with

PVR for what concern median overall survival with VR and no VR and similar long term survival. Only 18 of 41 studies with 932 patients, reported the type of reconstruction techniques. End to end anastomosis, patch venoplasty, venorrhaphy and graft interposition were analyzed. 57% were end to end suture performed by a continuous running 5-0 polypropylene. A vascular graft was considered when VR was 5 cm to avoid tension in anastomosis. Zhu et al.(9)proposed a PV-SMV vascular classification and published the association relating this calssification about median survival time in 52 patients. They divided PV-SMV-R in five types: I:wedge resection, II resection with end to end anastomosis, III allogenic graft to joint portal vein, SMV and splenic vein anastomosis, IV allogenic graft for a longer resection just the branches of SMV. They noted that the median survival time of type Ⅰ was 9.1% (22 months), those of types Ⅱ 46.7% (17 months) and Ⅲ (44.4%, 16 months; $p < 0.05$), and type Ⅳ 87.5% (10 months; $p < 0.01$), respectively. Machado et al.(6), described a technique based on portal vein resection and SMV stump closure describing an anastomosis with portal vein with an allograft end to end and then an end-to-side anastomosis between allograft and SMV. Ravikumar et al.(7) in a retrospective review of 229 patients with portal vein resection noted 56.3 per cent underwent primary closure, 28 per cent an end-to-end anastomosis and 15 per cent an interposition graft. They demonstrated there was no difference between the three groups for what concerns overall morbidity ($P = 0.82$) or in-hospital mortality ($P = 0.80$). Of these, 47.5 per cent had histological vein involvement. Patients with VR and primary closure had median survival of 18.8 months , 27.6 months for end-to-end anastomosis and 13.0 months for patients with an allograft. Patients with and without histological vein involvement had similar median survival (20.9 *versus* 22.8 months; $P = 0.48$). Carry K.Chu et al.(10),in their systematic review , found 16 patients who underwent PV/SMV resection usying graf reconstruction. Negative margin resection was achieved in 63.6% of cases, 54.8% of these had confirmed PV/SMV histological involvement. No patients developed PTFE graft infection. Graft patency was 63.6% while thrombosis was identified in 14.2% of cases. Thirty-day mortality was 6%. Malinka et al.(11), presented a new technique reconstruction in their database of eleven consecutive patients who underwent pancreatic resections with venous reconstruction usying the falciform ligament. Only 4/11 cases had complete resection of tumor tissue.The perioperative mortality rate was 0%. Two patients developed POPF grade B, while two patients had post operative haemorrhage. Two cases had portal thrombosis. On discharge , all other patents presented grafts patency. They confirmed that the use of falciform ligament was a feasible technique for mesenteric and portal vein reconstruction with high patency and reliability. Wei Song et al.(12) used a meta-analysis based on 14 studies including 257 patients with vein grafts and 570 patients without vein grafts. The study demonstrated no difference in perioperative morbidity, mortality and in 1-year, 3-year, or 5-year survival between the two groups. The only difference was a 6 months venous thrombosis rate in the graft group. Prosthetic veins seem to be more effective than autologous veins in PV-SMV reconstruction in long-term PV-SMV patency. Monica M. Dua et al.(13),stated that end-to-end portal vein anastomosis and and transverse venorrhaphy (TV) have superior patency compared with longitudinal venorrhaphy (LV) patch venoplasty (PV) and

interposition graft. Primary end-to-end and TV should be the preferred when resection/reconstruction was <3cm. This study demonstrated TV closure had 100% patency rates, LVclosure (71.3%), Interposition Graft (IG) (63.2%) or patch venoplasty (67.1%) . Clark et al.(14) examined 1003 PD of which twenty-two percent underwent a major vascular resection In this VR group , they noted that the causes of early death were related of vascular bleeding in 26%, including both thrombosis and a haemorrhage indipendently of type of reconstruction. Natalia O. Glebova et al.(15), examined four types of PV-SMV reconstruction in prospective database of 6522 patients who underwent pancreatic resection an 173 had VR. They noted that the most used reconstruction was primary repair in 83% of cases but that the use of prosthetic graft placement was more likely to have thrombosis.

Discussion

PV-SMV resection and reconstruction is suggested in borderline resectable pancreatic tumors(16).CT scan can achive diagnosis in up to 84% of borderline adenocarcinoma (17). Some studies demonstrated that VR during pancreatectomy is associated with worse survival due to to larger tumor size and the higher rate of positive margins. (18,19). However, it is demonstrated that with the use of the VR the surgeon can achieve R0 resection obtaining a 5-year survival of 25% that is different compared to the palliative surgery only in which 5 -year survival rate is only 7%. Some studies demonstrated a similar long term survival between VR compared with no VR but VR group seems to have a reduced R0 rates, longer operation time, as well as increased perioperative blood loss, high dalayed gastric emptyng, post-operative hemorrage risk, high mortality(8). Depending on the extent of the invasion of the PV and SMV, different techniques for resection and reconstruction are used. In minimal invasion cases, a partial resection and reconstruction with direct suture or an autologous patch may be performed. A peritoneal patch has been described as feasible. In cases of broader invasion, segmental resection and reconstruction should be performed. When an end-to end anastomosis isn't possible, autologous, homologues, or prosthetic (ring) grafts are the options.(1).Classification proposed by the International Study Group of Pancreatic Surgery divided the venous resection in 4 types depending on the performed reconstruction: venorrhaphy, patch, primary anastomosis, and interposition conduit(20).In a retrospective examination of a prospectively database of two hundred forty one subjects who went through pancreatectomy with venous resection, no differences in mortality, morbidity and long-term survival were noticed related to patients who underwent a standard resection (21,22). For these reasons, when there is involvement of portal vein or superior mesenteric vein, attempting a resection seems to be legitimated. Widespread acceptability of Pancreaticoduodenectomy (PD) with PV approaches has been achieved in many centers around the world and can be safely performed with no peri-operative mortality or morbidity increased in comparison to standard PD.(23,24,25,26,27,28). VR in pancreatic cancer is feasible procedure in high volume center. It can be used only if surgeon can achieve R0 resection changing the outcomes of the patients compared to palliative surgery.(8). In a large multicenter retrospective review from the United Kingdom that included 1588 subjects with borderline resectable tumors, venous resection in pancreatic cancer surgery was also reported as safe and feasible. Median survival (eighteen months for the standard procedure and18.2 months for patients undergoing

venous resection, P=0.0001) and in hospital mortality were similar in both groups. Thus, if a resection with a tumor negative-margin seems possible, venous resection should be performed if necessary.(1,7,29). Depending of the type of the reconstruction PV thrombosis was described in a range between 4% to 17%.(23,30,31).

Conclusions

Recent studies revealed similar survival rates between patients undergoing PV-SMV reconstruction during PD with VR to those undergoing conventional PD.(3,32,33,34,35). In minimal invasion cases, a partial resection and reconstruction with an autologous patch may be performed. A peritoneal patch has been described as feasible. In cases of broader invasion, segmental resection and reconstruction should be performed. When an end-to end anastomosis isn't possible, autologous, homologues, or prosthetic (ring) grafts are the options (1). Studies give some recommandations when a surgeon should plan PV-SMV resection during PD:1. For operative planning, CT with intravenous augmentation is the proper imaging modality. 2. To reduce the time of liver ischemia, venous resection ought to be performed at the end of resection. 3.The most utilized suture material is Prolene 5/0. 4.Direct anastomosis is the preferential approach for reconstruction in segmental resection cases. 5.Various graft techniques were a good choice: use of saphenous vein,jugular vein,left renal vein,iliac or femoral vein .6.Left renal vein seems to be the ideal graft.(1). Studies demonstrated that the type of venous reconstruction did not influence the short- or long-term outcomes (7).

Human Rights Statement: All procedures met the ethical standards.

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Legend Figure

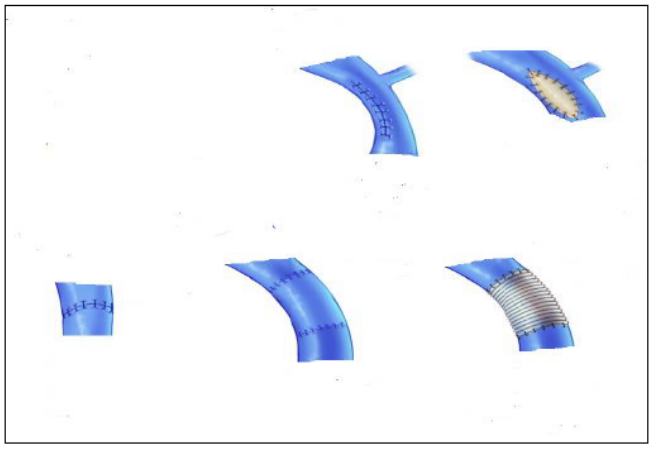

Figure 1: A. Longitudinal Venorraphy.B. Ptch. C. End to end portal vein anastomosis. D. End to end with graft. E. end to end portal vein anastomosis with graft