# **R E V I E W P A P E R S**

## PORTAL VEIN RESECTION DURING PANCREATECTOMY FOR PANCREATIC HEAD ADENOCARCINOMA. SCOPE OF CURRENT OPINIONS AND OWN EXPERIENCES\*

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According to expert consensus, cases with distal metastases, radiographic evidence of superior mesenteric vein (SMV) and portal vein abutment, distortion, tumor thrombus or venous encasement or no clear fat plane around the celiac axis, hepatic artery and superior mesenteric artery (SMA) are not treated as resectable (1). Some tumors can be treated as borderline resectable (1). Cancer infiltrating arteries is suspected to spread through nerve plexuses and lymphatic tissue surrounding those vessels which gives positive margins of resections. That fact limits oncological radicality of procedures which involve arterial resection (2-4). In contrast, portal vein confluence is not surrounded by perivascular neural plexuses and lyphatic tissue. Involvement of the portal vein, such as tumor abutment with or without impingement, narrowing of the lumen, encasement or thrombus with a patent lumen, encasement or thrombus with patent lumen, does not impede the achievement of a R0, oncologically radical resection (1, 4). Also some selected cases of arterial involvement are bordeline resectable (gastroduodenal artery encasement up to the hepatic artery with either short segment encasement or direct abutment of hepatic artery, without extension to the celiac axis, and cases of SMA abutment not exceed >180 of the circumference of the vessel wall) (1).

Surgical Technique

Portal vein resection has some technical limitations and reconstruction has to be gualified as technically possible. In the case of marginal resection, a simple running suture closure (6-0 polypropylene) or patch plasty is possible. To avoid intestinal venous congestion or splenic intraoperative swelling, tangental clamping may be performed. For segmental resection (if the resected segment is less than 3cm) in most cases, tension free end-to-end anastomosis is possible (6-0 polypropylene suture- running intramural suturing of posterior wall and over-and-over suturing to the anterior wall). If direct anastomosis is not possible or safe, venous grafts (homografts- eg. the right external iliac vein can be harvested extraperitoneally through a right groin incision, eventually jugular vein or the left renal vein can be harvested) or prostesis has also can be used. In cases with spleno-mesenteric confluence resection following end-to-end portal anastomosis, a spleno-portal end-to-side anastomosis can be performed. To avoid intestinal venous congestion, SMV clamping time should not exceed 30 minutes (5, 6). Depending on the localization of the tumor, different types of reconstruction methods are possible. Kaneoka et al. (6) publisheed a simple classification of reconstructive techniques (fig. 1). Pa-

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Fig. 1. Types of reconstruction after portal vein resection, splenic vein (SV), superior messenteric vein (SMV), graft (G) (based on (6) by J. Łaski)

tients with marginal resections should receive low-dose heparin therapy as thrombosis prophylaxis. In cases of segmental resection, partial thromboplastin (PT) time-guided anticoagulation (PT time 40-50 seconds) for 5 days is advised (7).

#### Scope of current opinions

After pancreatoduodenectomy (PD) for pancreatic head adenocarcinoma, perioperative morbidity and long-term survival in patients with portal vein resection is similar to patients without need of portral vein resection (7-10, 21). In the case of tumor adherence or venous infiltration, a combined resection of the pancreatic head and the vein should always be considered in the absence of other contraindications for resection (7-10). The author believes that PVR should become a standard procedure during PD. Furthermore, there are many publications describing more aggressive types of resections in selected groups of patients including arterial resection, but are not considered routine and thus cannot yet be recommended (11, 12, 13).

We have to remember that portal vein resection should be performed only when a marginnegative resection (R0) is expected to be achieved. PV invasion is not associated with histologic parameters suggesting a poor prognosis (14). These results support the hypothesis that the presence of vascular tumor involvement of the peripancreatic vessels seem to be an indicator of unfavorable tumor topography instead of being a sign of adverse tumor biology (15, 16). Aggressive surgical resection should be attempted in cases with suspected portal vein invasion because 21.1% of patients had no, "true invasion" (microscopically proven infiltration of the vein wall) and showed better survival than those with true invasion (17). Even if radiological suspicion of true invasion was put, in final pathological examination, wall invasion was observed only in 51% of patients (18). However, deep invasion in the tunica intima may be a poor prognostic factor for survival even after a margin-negative PD for pancreatic adenocarcinoma (17).

In patients with PVR, there are no statistical differences in survival between those resected with or without a venous allograft and those with unilateral or circumferential involvement. However, short PVR showed better 5-year survival than long PVR despite similar positive rates of histologic venous invasion (6). PVR has comparable survival compared with no PVR only in patients undergoing a R0 resection. The short PV or SMV invasion that requires PVR < 3 cm in length can result in respectable survival rates (6). Extended resection for oncological purposes in borderline resectability tumors is a safe and feasible option in well experienced centers. In one publication, the 30-day mortality rate was 0% and the survival rates were comparable to patients with a standard resection (19). The 81 patients (37%) aged 70 or older had a 30-day mortality and survival rate similar to younger patients (19). In other research, postoperative morbidity was similar for patients with and without PVR (13.7%) vs. PD alone (5.1%). Overall survival was similar in both groups (median PD alone 14.8 months vs. 14.5 months PD+PVR) (20).

In a meta-analysis reviewing nineteen nonrandomized studies (comprising 2,247 patients), there was no difference in perioperative morbidity, morality, or 5-year overall survival between borderline and standard resections (21). Furthermore, patients undergoing PD with PVR usually had larger tumors but did not have different rates of tumor-free margins or lymph node metastases. The PVR group had higher median blood loss, but no differences in mortality, complication rates, length of hospital stay, or readmission rates were found. Overall survival rates were similar (22).

In properly qualified patients, systemic chemotherapy is indispensable as the common events of perineural invasion and lymph node involvement of the pancreatic carcinoma with local venous invasion (23). Adjuvant chemotherapy using gemcitabine improves the prognosis of patients with resectable pancreatic cancer. Its effect on the prognosis of patients with borderline resectable pancreatic cancer is not clear, but it can be improved by combination therapy with PV resection and gemcitabine adjuvant chemotherapy (24).

#### Author's experience

In the Department of General, Endocrine and Transplant Surgery at the Medical University in Gdańsk, from 2008 to 2012, 105 curative pancreatic operations (with intention to treat) for pancreatic head adenocarcinoma were performed. 84 pancreatoduodenectomies (47 Whipple procedure, 37 Longmire-Traverso procedure) and 21 total pancreatectomies (indication to total pancreatectomy in cancer of pancreatic head was risk of insufficient blood supply in the tail of pancreas). In 7 cases (6.6%), the portal vein was involved in the neoplastic process and resection was necessary to achieve R0 (tab. 1).

In final histopathological examinations, G2 adenocarcinoma was found in 6 out of 7 cases. Most cases were locally advanced pT3N1 tu-

Patient	Procedure	PV resection type	Final histopathology	PV wall invasion	Complications – DaOliveira score	Mean survival (months)
P. Z.	PD – Traverso – Longmire	A1	adenocarcinoma ductale R0 – pT3, pN1 (1/14), pMx	inflammatory – non malignant	0	20,8
С. К.	total pancreatectomy	marginal resection – simple suture	adenocarcinoma ductale R0 – pT2, pN1 (7/17), pMx	inflammatory – non malignant	2 – non vascular	6,8 (myocardial infarct)
O. Z.	PD – Traverso – Longmire	B1	adenocarcinoma ductale R0 – pT3 pN1 (1/12) pMx	inflammatory – non malignant	0	28,2
S. E.	PD – Traverso – Longmire	marginal resection – simple suture	adenocarcinoma ductale R0 – pT3, pN1 (1/14), pMx	malignant but superficial invasion	2 – non vascular	alive (11,7)
T. Z.	PD – Traverso – Longmire	marginal resection – simple suture	adenocarcinoma ductale R1 – pT3, pN1 (2/9), pMx	deep invasion	0	11,3
P. D.	total pancreatectomy	A1	adenocarcinoma ductale R1 – pT3, pN1 (2/10), pMx	deep invasion	2 – non vascular	17,5
J. S.	PD – Whipple	A1	adenocarcinoma in intraoperative frozen section, chronic pancreatitis in final histopathology	-	4 – non vascular	1,9

 Table 1. Patients with PVR during pancreatectomy in General, Endocrine and Transplant Surgery Department

 – Medical University in Gdańsk 2008-2012

mors. R0 resections were achieved in 4 out of 6 cases and true PV invasion was histopatholgically confirmed in only one case. 3 cases were confirmed as an inflammatory perineoplastic reaction of the tissue. In 2 cases, R1 resection was achieved. The mean survival rate was 17 months.

Complications were scored with the Da Oliveira Score (25). Complications occurred in about 60% of patients: 3 cases of mild infectious complications (Da Oliveira  $\leq 2$ ) and conservative treatment with antibiotics was sufficient. In one case (non-malignant in final histopathology), serious complications occurred leading reoperation and placement in the Intensive Care Unit (ICU). In our group, pancreatic fistula was not seen. No vascular complications such as anastomotic leakage, hemorrhage, stricture of the PV, or liver insufficiency were seen. A1 reconstructions were made in 3 cases (fig. 2), B1 in a single case (fig. 3), and in 3 cases only local resection of the PV wall with simple suturing was sufficient.

### Conclusion

Based on the current state of knowledge, it can be concluded that portal vein resection during a pancreatectomy for adenocarcinoma of the pancreas is a feasible and safe procedure in an experienced center. The complication



Fig. 2. Resection and end-to-end anastomosis of PV (A1)



Fig. 3. Resection and end-to-end anastomosis of PV (B1)

rate is similar to a population with standardly performed pancreatoduodenectomy and vascular complications are not common. It also improves the survival time if a R0 resection is possible.

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