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ORIGINAL ARTICLE

Modified Appleby procedure for borderline resectable/locally advanced distal pancreatic adenocarcinoma: A major procedure for selected patients



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KEYWORDS

Pancreas;
Adenocarcinoma;
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Neoadjuvant
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Summary

Background: In distal pancreatic ductal adenocarcinoma (PDAC), distal pancreatectomy with *en bloc* splenectomy and celiac axis resection (DP-CAR) can allow curative resection in case of tumor extension to celiac axis.

Methods: From 2008 to 2013, of 102 patients with localized distal PDAC, 7 patients with celiac axis involvement were planned to undergo DP-CAR with curative intent. All patients received neoadjuvant treatment followed by preoperative coil embolization to enlarge collateral arterial pathways, except if a replaced right hepatic artery arising from superior mesenteric artery was present and sufficient for the blood supply. We herein analyzed indications, technique and outcomes of DP-CAR.

Results: After neoadjuvant treatment and arterial embolization, two patients experienced tumor progression and were not operated while five underwent DP-CAR. No patient required arterial reconstruction. Postoperative mortality was nil, but morbidity was 100%, mainly represented by pancreatic fistula. Postoperatively, there was a complete pain relief but chronic diarrhea was observed in all patients. Resections were R0 in three patients. One operated patient was alive and disease free at 60 months whereas median overall survival of patients who underwent resection was 24 months.

Conclusions: DP-CAR for borderline resectable/locally advanced distal PDAC is associated with high morbidity and mixed long-term functional results. Neoadjuvant treatment may prevent from unnecessary surgery for patients with progressive disease and may facilitate resection with acceptable long-term survival.

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Abbreviations: CA, Celiac axis; CHA, Common hepatic artery; DP, Distal pancreatectomy; DP-CAR, Distal pancreatectomy with *en bloc* splenectomy and celiac axis resection; PDAC, Pancreatic ductal adenocarcinoma; RECIST, Response evaluation criteria in solid tumors; SMA, Superior mesenteric artery.

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Introduction

Surgery still represents the only curative accepted treatment for pancreatic ductal adenocarcinoma (PDAC) in a context of multimodal strategy. R0 resection should be aimed to offer the best chances of prolonged survival [1]. At the time of diagnosis, only 20% of the head-located and 10% of the body-located PDAC are upfront resectable, main reasons of unresectability being distant metastases and vascular invasion. The late and non specific symptoms in distal PDAC lead to less frequent R0 resections than in head-located tumors [2].

While distant metastasis is a worldwide-accepted contraindication to surgery, management of PDAC with vascular invasion, especially arterial infiltration, is still debated. Regarding pancreaticoduodenectomy, most authors perform associated venous resection [3] whereas arterial resection is exceptionally performed [4,5].

The modified Appleby procedure has been proposed in 1976 by Nimura et al. in order to achieve complete resection of distal PDAC with invasion of the celiac axis (CA) [6]. This procedure includes distal pancreatectomy with *en bloc* splenectomy and resection of celiac axis, relying on collateral arterial pathways (pancreaticoduodenal arcades, gastroduodenal artery) for the arterial supply to the liver and the stomach [7]. These collateral pathways can be enlarged in the preoperative period by coil embolization of the common hepatic artery (CHA) [7]. However, this procedure has been scarcely described in the literature and some issues are still a matter of debate, such as the postoperative morbidity, the specific functional disorders and the long-term survival in the setting of neoadjuvant and adjuvant treatments.

The aim of this study is to report our experience of distal pancreatectomy with *en bloc* celiac axis resection (DP-CAR) and to assess these specific endpoints.

Material and methods

Data collection

We retrospectively reviewed data of a prospectively maintained database of patients treated for distal PDAC in our department between 2008 and 2013. Collected data included preoperative demographic characteristics, perioperative treatments, type of surgical procedure, postoperative outcomes, and long-term results.

Initial assessment of resectability

All patients underwent a thoracic, abdominal and pelvic computed-tomography scan with contrast enhancement and an endoscopic ultrasound with assessment of local invasion and fine needle aspiration biopsy. An additional hepatic magnetic resonance imaging was performed from 2010 in the search for hepatic metastases. All cases were discussed in a multidisciplinary board including pancreatic surgeons, radiologists, oncologists and radiotherapists. All patients with upfront resectable distal PDAC underwent distal pancreatectomy (DP). Patients were considered as candidates for DP-CAR:

- in case of involvement of the CA and/or origin of CHA and/or splenic artery;

- in the absence of encasement of the superior mesenteric artery (SMA), venous cavernoma, enlarged para-aortic lymph nodes and distant metastases.

Neoadjuvant treatment

All patients planned for a modified Appleby procedure underwent neoadjuvant treatment with chemotherapy followed by chemoradiation therapy in order to reduce local invasion and exclude patients with rapidly progressive disease. A new evaluation with computed tomography-scan was performed after chemotherapy and additionally 4 to 6 weeks after completion of chemoradiation therapy. DP-CAR was proposed to patients with either treatment response or stable disease according to Response evaluation criteria in solid tumors (RECIST) criteria [8].

Preparation for surgery with embolization of CA branches

When DP-CAR was proposed at the first multidisciplinary assessment, an interventional radiologist carefully examined the arterial anatomy. In case of pre-existing replaced right hepatic artery arising from the SMA, no preparation was considered. If not, an angiography with coil embolization of celiac axis branches was performed in order to enlarge collateral pathways for the liver and the stomach. This embolization took place after the neoadjuvant treatment and at least 1 week before surgery to allow enough time for collaterals development.

During this procedure, selective catheterization of CHA, splenic artery and left gastric artery was performed by a guiding catheter introduced under X-ray guidance via the right femoral artery. Once at the attended level, coils were released to occlude CA branches. After CHA embolization, superior mesenteric arteriography was performed to confirm inversion of blood flow in the gastroduodenal artery from the SMA to the hepatic artery. Splenic artery and left gastric artery were embolized using the same technique. An abdominal computed tomography-scan with arterial phase was performed before surgery to check for gastroduodenal artery patency; however, no systematic control angiography was performed.

DP-CAR procedure

After ruling out liver or peritoneum metastases with a first staging laparoscopy, an *en bloc* DP-CAR was performed. The resection included distal pancreas, spleen, CA, CHA, left gastric artery, celiac plexus, left-sided nerve plexus along SMA, a part of both diaphragm pillars, and left Gerota's fascia. In addition, resection included the retroperitoneal fat tissues bearing lymph nodes above the left renal vein, tissue covering the body of the pancreas, and inferior mesenteric vein. The pancreas was always divided at the head-neck junction 5 to 10 mm from the gastroduodenal artery, which was carefully preserved. The pancreatic stump was closed by interrupted stitches after elective ligation of the main pancreatic duct. When necessary, the resection was extended to portal vein, left adrenal gland, left transverse colon, or greater curvature of the stomach. No arterial reconstruction was done. Cholecystectomy was routinely done to prevent ischemic cholecystitis. No intraoperative radiation therapy was performed.

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