J Gastrointest Surg (2016) 20:300–306
DOI 10.1007/s11605-015-3001-2

2015 SSAT POSTER PRESENTATION

Modified Appleby Procedure with Arterial Reconstruction for Locally Advanced Pancreatic Adenocarcinoma: A Literature Review and Report of Three Unusual Cases

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Received: 19 August 2015 / Accepted: 8 October 2015 / Published online: 2 November 2015

Abstract

Background Pancreatic body and tail ductal adenocarcinomas are often diagnosed with local vascular invasion of the celiac axis (CA) and its various branches. With such involvement, these tumors have traditionally been considered unresectable. The modified Appleby procedure allows for margin negative resection of some such locally advanced tumors. This procedure involves distal pancreatectomy with en bloc splenectomy and CA resection and relies on the presence of collateral arterial circulation via an intact pancreaticoduodenal arcade and the gastroduodenal artery to maintain prograde hepatic arterial perfusion. When the resultant collateral circulation is inadequate to provide sufficient hepatic and gastric arterial inflow, arterial reconstruction (AR) is necessary to "supercharge" the inflow. Herein, we review all reported cases of AR with modified Appleby procedures that we have identified in the literature, and we report our experience of three recent cases with arterial reconstruction including two cases with arterial bypasses not requiring interposition grafting.

Methods Perioperative and oncologic outcomes from our Institutional Review Board-approved database of pancreatic resections at the Thomas Jefferson University were reviewed. Additionally, PubMed search for cases of distal or total pancreatectomy with celiac axis resection and concurrent AR was performed.

Results From the literature, 12 reports involving 28 patients were identified of distal and total pancreatectomy with AR after CA resection. The most common AR in the literature, performed in 12 patients, was a bypass from the aorta to the common hepatic artery (CHA) using a variety of interposition conduits. In our institutional experience, patient #1 had a primary side-to-end aorto-CHA bypass, patient #2 had a primary end-to-end bypass of the transected distal CHA to the left gastric artery in the setting a replaced left hepatic artery, and patient #3 required an aortic to proper hepatic artery bypass with saphenous vein graft and portal venous reconstruction. All patients recovered from their operations without ischemic complications, and they are currently 16, 15, and 13 months post-op, respectively.

Conclusions The criteria for resectability in patients with locally advanced pancreatic body and tail neoplasms are expanding due to increasing experience with AR in the setting of the modified Appleby procedure. When performing AR, primary arterial re-anastomosis may be considered preferable to interposition grafting as it decreases the potential for the infectious and thrombotic complications associated with conduits and it reduces the number of vascular anastomoses from two to one. Consideration must also be given to normal variant anatomy of the hepatic circulation during operative planning as the origin of the left gastric artery is resected with the CA. The modified Appleby procedure with AR, when used in appropriately selected patients, offers the potential for safe, margin negative resection of locally advanced pancreatic body and tail tumors.

Presented as a poster at the Society for Surgery of the Alimentary Tract and the Pancreas Club; Washington, DC: May 2015

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Keywords Celiac axis · Pancreatic cancer · Resection · Appleby procedure · Arterial reconstruction

Introduction

Pancreatic body and tail ductal adenocarcinomas account for approximately one-third of all pancreatic cancers. They are frequently identified at a late stage compared to pancreatic

head cancers, as symptoms are often not manifested until there is local invasion of major vessels and associated neural plexuses. Consequently, systemic metastases, retroperitoneal invasion, or involvement of major vessels (such as the common hepatic artery and celiac artery) have traditionally rendered these tumors to be unresectable. Unresected patients have a predictable clinical decline suffering from back pain from local nerve invasion, tumor-related cachexia, or ileus-related to peritoneal, dissemination, and ultimately a median survival of only 6 to 12 months. In the last decades, improved computerized tomographic (CT) imaging protocols to visualize local invasion, aggressive neoadjuvant protocols, and an aggressive surgical approach via the modified Appleby procedure have allowed some traditionally unresectable lesions in this area to be resected, improving patient outcomes and palliating pain.

The Appleby operation (en bloc resection of the celiac axis, distal pancreatectomy with splenectomy, and total gastrectomy) was first performed in 1953 in order to achieve a more complete resection of celiac axis lymph nodes in locally advanced gastric cancer. [1] Nimura adopted this procedure for the resection of a pancreatic body and tail adenocarcinoma in 1976. [2] Since then, such an extended resection and radical lymphadenectomy has been widely practiced and reported by Japanese surgeons, [3] while its adoption by Western surgeons has been somewhat delayed. In 2005, Makary and colleagues became the first American group to report their experience with an Appleby procedure in a 72-year-old male with a pancreatic body cancer invading the posterior stomach. [4] Subsequently, the modified Appleby procedure has gained some popularity in treating locally advanced pancreatic cancer. Specifically, this procedure includes a distal pancreatectomy with en bloc splenectomy combined with celiac axis resection with ligation of the celiac artery at its aortic takeoff, extirpation of the common hepatic artery (CHA) proximal to the gastroduodenal artery (GDA) and often the left gastric artery (LGA), without gastric resection. The feasibility of the procedure is based on the presence of collateral arterial circulation between the superior mesenteric artery (SMA) and the proper hepatic artery via intact pancreaticoduodenal arcades and the GDA.

This procedure has been utilized in locally advanced lesions involving the celiac axis without invasion of the pancreatic head, proper hepatic or superior mesenteric arteries, or abnormal SMA anatomy (such as a totally replaced CHA originating from the SMA). The celiac artery must be resectable at its aortic origin, and the CHA must be transected proximal to the takeoff of the GDA. Of utmost importance, there should be clear pulsations and arterial Doppler signals at the proper hepatic artery (PHA) after occlusion of the common hepatic artery to be confident that resection of the CHA will not result in potentially catastrophic hepatic ischemia.

The most dreaded complications of this procedure are ischemic in nature. Hepatic ischemia can develop related to insufficient flow via the PHA after ligation of the CHA. Moreover, attention to the normal variants of the hepatic artery should be observed, particularly when the left hepatic artery is replaced and originating from the left gastric artery. Additionally, gastric ischemia can occur due to poor collateral flow in the setting of disruption of the left gastric and left gastroepiploic arteries. Yamamoto et al. reported an incidence of ischemic complications in up to 92 % of patients with this procedure. [5] In an effort to decrease the rates of ischemic complications, strategies such as preoperative coil embolization and intraoperative vascular reconstruction have been employed. Hirano et al. performed preoperative embolization of the CHA and CA to promote collateralization to the hepatobiliary system via the pancreaticoduodenal arcade and stomach via the right gastric, right gastroepipoloic, and the left phrenic arteries, respectively. [6] Intraoperatively, if hepatic inflow appears to be insufficient as established via palpation, Doppler ultrasonography, [6] hepatic vein oxygen saturation, [7] fluorescein staining, [8] or pre- and post-clamping common hepatic arterial stump pressures, [9] then arterial reconstruction is performed when necessary. Various approaches to vascular reconstruction have been described (see Table 1).

Herein, we describe our experience with three patients who underwent a modified Appleby procedure with (1) primary aorta to CHA anastomosis, (2) a primary CHA to LGA and replaced left hepatic artery bypass, and (3) an aortic to PHA bypass with saphenous vein graft and concomitant mesenteroportal venous reconstruction.

Methods

Our Institutional Review Board-approved database of pancreatic resections was reviewed for cases of distal or total pancreatectomy with en bloc celiac axis resection at the Thomas Jefferson University Hospital between 2005 and 2015. We identified a total of 11 patients who were resected using the modified Appleby procedure of which three required arterial reconstruction. Perioperative and oncologic outcomes were reviewed and reported, and operative notes were carefully reviewed. Additionally, a systematic PubMed search was performed for reports of cases of distal pancreatectomy with en bloc splenectomy and celiac artery resection, and subsequent arterial resection published between 1997 and 2015 (Table 1).

Brief Case Reports

Patient #1

A 65-year-old male with a history of Roux-en-Y gastric bypass for morbid obesity presented with non-radiating abdominal pain along with a decrease in appetite and early satiety. His work-up included an endoscopic ultrasound,

Table 1 Reported cases of vascular reconstruction during the modified Appleby procedure

First author (year)	Bypass	Reason for bypass	Conduit
Konishi (1992–1998)	CA to CHA (*n*=2)	Poor pulsatility of PHA after clamping CA	Splenic artery autograft
Miyakawa (2002)	CA to CHA	Measured hepatic venous hemoglobin saturation =39 % after clamping CHA	IMV graft
Kondo (1997–2001)	Left branch of middle colic artery to GEA (*n*=2)	Accidental injury to inferior PDA with visual evidence of gastric ischemia	Microsurgical anastomosis
Gagandeep (2002–2004)	CA to left gastric artery	Fluorescein evidence of delayed gastric perfusion	None
Machado (2009)	Left external iliac artery to hepatic artery	Poor pulsatility of PHA after clamping CHA	Dacron graft
Wu (2003–2008)	CA to CHA (*n*=4)	Poor pulsatility of PHA after clamping CHA	end-to-end anastomosis if feasible, IMV graft or SVG
Bockhorn (1994–2007)	Aorta/SMA to PHA (*n*=7); Aberrant left hepatic artery to PHA	Not specified	Cryopreserved graft; SVG
Baumgartner (2012)	Supra-celiac aorta to CHA	Prior ligation of GDA	Yes
Ielpo (2013)	Aorta to hepatic artery	Inadequate hepatic inflow by intraoperative Doppler ultrasonography	Dacron graft
Suzuki (2013)	PHA to middle colic artery	Inability to preserve GDA due to close proximity to CA	None
Christians (2001–2013)	CA to CHA (n=4)	Default unless palpable pulses in PHA and right GEA after CA resection	SVG
Mittal (2015)	CA to CHA (*n*=2)	>25 % decrease in CHA pressure upon clamping CA	SVG, PTFE graft

Abbreviations: *CA* celiac artery, *CHA* common hepatic artery, *PHA* proper hepatic artery, *IMV* inferior mesenteric vein, *GEA* gastroepiploic artery, *PDA* pancreaticoduodenal artery, *SVG* saphenous vein graft, *SMA* superior mesenteric artery, *HA* hepatic artery, *GDA* gastroduodenal artery

demonstrating a hypoechoic mixed solid-cystic mass in the body of the pancreas. This was subsequently proven to be pancreatic adenocarcinoma by fine needle aspiration. His Ca 19-9 was elevated to 1440 units/ml. Multidetector CT imaging revealed a hypodense mass extensively involving the body of the pancreas and encasement of the splenic artery and vein, with suspicion that the mass also abutted other branches of the celiac axis (Fig. 1a). The patient chose to undergo elective primary resection, refusing preoperative chemotherapy despite our recommendations.

Intraoperatively, thorough exploration of the abdominal cavity revealed no evidence of distant metastases and an intact Roux-en-Y gastric bypass. Exploration of the pancreas revealed a firm mass involving the body of the pancreas with extension into the retroperitoneum which also involved the CHA at its takeoff from the celiac axis and the proximal LGA. The spleen and pancreas were elevated out of the retroperitoneum, and the pancreas was divided in the vertical plane of the superior mesenteric vein-portal vein (SMV-PV) axis. The CHA was transected as close as possible to the celiac artery, yet outside the field of the tumor. Doppler signals were evaluated at the level of CHA, PHA, GDA, and right gastric artery (RGA), with poor signals noted in the hepatic inflow. Markedly reduced inflow was confirmed by transducing the pressure within the CHA. To restore adequate arterial flow to the liver, the CHA was reimplanted directly into the aorta (Fig. 1b). Pathology revealed a G2 T4 N1 M0 pancreatic ductal adenocarcinoma with negative resection margins. The patient's postoperative course was without complication, and he was discharged home on postoperative day 6. He subsequently completed a course of adjuvant chemotherapy with gemcitabine and paclitaxel followed by 45 Gy external beam radiation to the tumor bed and nodal area in combination with 5-fluorouracil five times per week for a total of 5 ½weeks. He remains disease-free at 16 months post-resection.

Patient #2

A 57-year-old male presented with lower abdominal cramping, change in bowel habits, and new-onset rapidly progressing diabetes. CT imaging identified a hypodense mass in the central pancreas involving the distal celiac, splenic, and proximal common hepatic arteries with possible splenic and portal vein thrombosis (Fig. 2a). At the time of evaluation, his Ca 19–9 level was elevated at 10,334 units/ml.

He was initially enrolled in a multi-center clinical trial in which he was randomized and received 5 cycles of neoadjuvant FOLFIRINOX chemotherapy. He de-enrolled from the study to pursue 59.4 Gy proton beam radiation therapy for 6 weeks. His neoadjuvant treatments resulted in some tumor regression. Repeat CT scan after neoadjuvant treatment revealed a smaller tumor with continued involvement of branches of the celiac artery, patency of the SMV and portal vein, but without evidence of dissemination. A PET-CT scan was without evidence of distant metastasis. His Ca 19–9 level

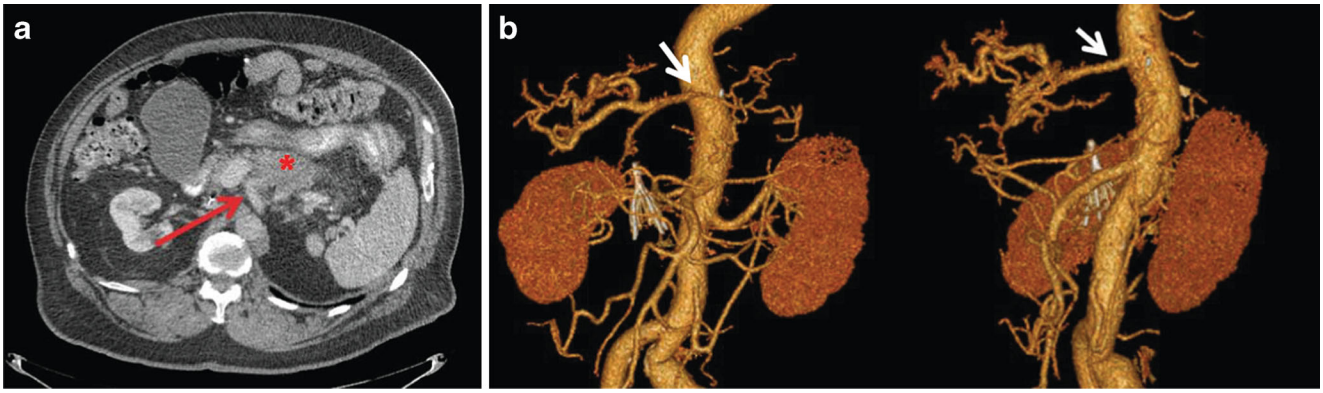

Fig. 1 Representative imaging of case #1. **a** Preoperative CT imaging revealing a hypodense mass in the body of the pancreas (*) in relation to the celiac axis vessels (*red arrow*). **b** Postoperative three-dimensional CT angiogram showing the patency of the primary aortic to common hepatic artery bypass (*white arrows*)

had decremented to 92 units/ml. Upon reevaluation, it was felt that he was a candidate for a modified Appleby operation.

Approximately 7 months from the time of his initial diagnosis, he underwent distal pancreatectomy and en bloc splenectomy with en bloc resection of the celiac artery with a primary common hepatic artery to LGA anastomosis. Splenomegaly and left-side portal hypertension were apparent. The SMV and PV were then separated from the pancreatic neck allowing for division of the pancreatic neck. The pancreatic body/tail and spleen were then mobilized out of the retroperitoneum. Subsequently, it was noted that the patient's left hepatic artery (LHA) arose from the LGA. When the celiac axis was clamped, poor inflow into the LHA was noted. Also, when the LGA was compressed, gastric arterial Doppler signals were diminished. To remedy this ischemia, an end-to-end anastomosis of the distal stump of the CHA to LGA was performed (Fig. 2b), improving perfusion to both the left hepatic lobe and the stomach. The celiac artery at the aortic origin was then oversewn, and the specimen was removed en bloc. Final pathology revealed a T4 N0 M0 pancreatic ductal adenocarcinoma with 98 % response to neoadjuvant therapy. His postoperative course was uncomplicated, and he was discharged 6 days postoperatively. He subsequently received adjuvant gemcitabine and paclitaxel chemotherapy. He had a prolonged convalescence and was found to have metastatic disease 6 months postoperatively. He continues to undergo novel adjuvant therapies with an experimental immunotherapeutic agent—ipafricept. He remains alive 15 months post-resection.

Patient #3

A 56-year-old female who initially presented with jaundice was found to have an unresectable locally advanced pancreatic ductal adenocarcinoma encasing the celiac axis, SMA and splenic artery. She was treated with endoscopic biliary stent placement and neoadjuvant chemotherapy with 12 cycles of FOLFIRINOX, 1 cycle of gemcitabine and paclitaxel, and 50.4 Gy external beam radiation to the tumor bed and nodal area with concurrent 5-fluorouracil five times per week for 5 ½weeks. Her Ca 19–9 levels decremented post-treatment from 1500 to 31 units/ml.

Fig. 2 Representative imaging of case #2. **a** Preoperative CT images revealing a hypodense central pancreatic mass (*) involving the celiac axis vessels (*red arrow*). **b** Schematic representation of the postoperative arterial reconstruction (*red circle*) with a primary end-to-end bypass of the distal common hepatic artery (CHA) to the left gastric artery (LGA) in the setting of a replaced left hepatic artery (rLHA). *Abbreviations: RHA* right hepatic artery, *PHA* proper hepatic artery, *RGA* right gastric artery, *GDA* gastroduodenal artery

Repeat imaging revealed a pancreatic neck mass encasing the celiac axis, CHA, PHA, proximal splenic artery, and main portal vein (Fig. 3a).

Approximately 1 year after her initial diagnosis, she elected to proceed with an attempt at resection. Upon exploration of the abdomen, no metastatic disease was found. Her celiac axis and SMV-portal vein (PV) confluence were encased with fibrotic tissue, requiring en bloc celiac axis and partial SMV-portal venous resection via a classic total pancreaticoduodenectomy with en bloc splenectomy. An aortic to PHA bypass was performed using a reversed autologous saphenous vein graft, while the SMV-PV confluence was reconstructed with a primary veno-venous anastomosis. When preparing the distal stomach for anastomosis, the antral mucosa was noted to be markedly ischemic, necessitating a subtotal distal gastrectomy, with restoration of enteric continuity via a loop gastrojejunostomy and a downstream Braun enteroenterostomy (Fig. 3b). Final pathology revealed a T4 N0 M0 invasive pancreatic ductal adenocarcinoma with significant treatment effect. All surgical margins were negative. Her postoperative course was prolonged by ventilator dependence and the development of chylous ascites. She was maintained on enteric-coated aspirin for bypass patency and total parenteral nutrition until her discharge on postoperative day 16. She was readmitted on postoperative day 28 for a right-sided empyema and treated with antibiotics, chest tube drainage, and ultimately required video assisted thoracoscopic decortication. Due to her extensive neoadjuvant treatment, she initially declined adjuvant therapy. She ultimately developed a pelvic recurrence at 5 months post-resection and was managed with adjuvant chemotherapy with gemcitabine, paclitaxel, and 4 cycles of FOLFOX, and palliative small bowel luminal stenting. She remains alive 13 months post-resection, in decline.

Discussion

Pancreatic ductal adenocarcinomas arising in the body and tail are frequently identified late in their course, due to lack of symptoms until becoming locally advanced or metastatic. In the case of locally advanced tumors, these patients are typically not considered candidates for upfront surgical resection and instead they are first treated with neoadjuvant chemotherapy or chemoradiation. With improved detection of the primary tumor and delineation of tumor extent by modern imaging techniques as well as more effective neoadjuvant treatment protocols, patients with favorable tumor biology and anatomy are increasingly being assessed by pancreatic surgeons with regression or no progression of their disease following treatment. Even for the experienced surgeon, these tumors present an operative challenge. Utilizing an aggressive surgical approach such as the modified Appleby procedure (with or without arterial reconstruction) allows one to offer patients with traditionally unresectable lesions an opportunity for margin negative (R0) resection and perhaps long-term survival.

The modified Appleby procedure may or may not require arterial reconstruction to remedy the procedure's unique vascular complications, namely hepatic and/or gastric ischemia. Much controversy surrounds the utilization of aggressive surgical approaches like the modified Appleby procedure in treating pancreatic cancer due to the paucity of favorable data available for outcomes after pancreatectomy involving vascular resection. Historically, pancreatectomy involving vascular resection was demonstrated to have increased morbidity with no survival advantage or influence on recurrence. As such, the practice fell out of favor. However, the extensive surgical resections described and outcomes reported by Appleby himself in the 1950s [1] and by Nimura and Fortner in the 1970s [2, 10, 11] were being performed prior to the introduction of induction neoadjuvant treatment, under the past premise that vascular resection was necessary either for removal of the primary

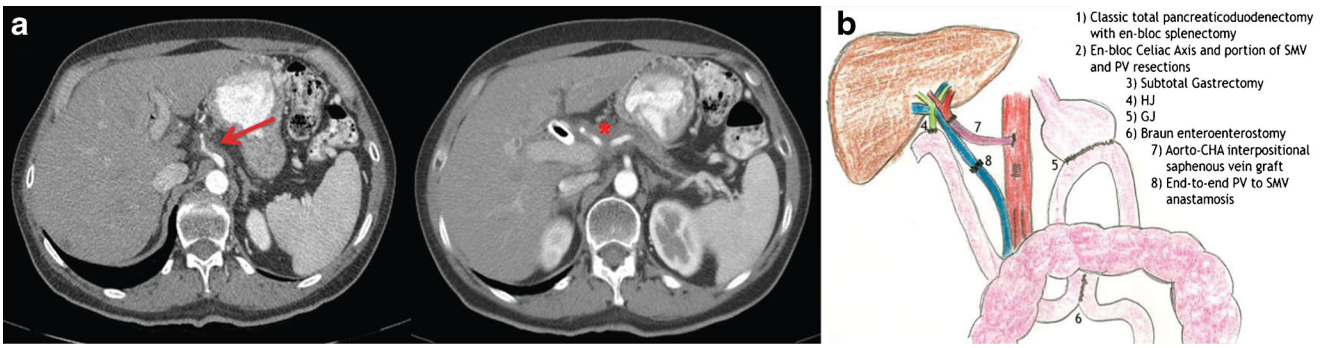

Fig. 3 Representative imaging of case #3. **a** Preoperative CT imaging revealing a hypodense pancreatic head and neck mass (*) involving the celiac axis vessels (*red arrow*). **b** Schematic representation of the postoperative anatomy and vascular reconstruction after classic total pancreatectomy with en bloc splenectomy with celiac axis resection and SMV-portal vein resection and subtotal gastrectomy followed by aortic to CHA bypass with saphenous vein graft (7), primary PV to SMV anastomosis (8), and reconstruction with hepaticojejunostomy (HJ-4), gastrojejunostomy (GJ-5), and Braun enteroenterostomy (6)

tumor due to invasion or for removal of the extensive lymphatic involvement associated with the primary tumor.

Our own recent institutional increase in the frequency of performing the modified Appleby prompted a literature review of the topic. Our literature search yielded 12 reports involving 28 patients who underwent distal or total pancreatectomy with arterial reconstruction after celiac artery resection (Table 1). The most common arterial reconstruction, performed in 13 patients, was a bypass from the aorta to the common hepatic artery using a variety of interposition conduits. In some cases, the bypass was necessitated by an accidental injury of a vessel during the procedure [12] or other technical considerations often involving the gastroduodenal artery. [13, 14] In most cases, arterial reconstruction was prompted by a concern for hepatic ischemia observed by a variety of intraoperative methods to assess hepatic inflow. When arterial bypass was indicated, several techniques for reconstruction were described with the use of autogenous saphenous vein being predominant.

Moreover, when reviewing institutional data regarding outcomes, there appears to be a trend toward improved overall survival when comparing patients with borderline resectable or locally advanced pancreatic body or tail tumors who underwent the modified Appleby procedure with concurrent arterial reconstruction to those who are not offered resection. Out of the 12 reports, nine studies provide outcomes, [3, 8, 9, 13–19] eight of which report median survivals of 12–34 months. In a meta-analysis by Mollberg et al. (the most comprehensive study to date) of all pancreatectomies with arterial reconstruction, the reported median survival was 9.5 to 12 months. While the meta-analysis revealed a significantly increased risk for perioperative mortality and poor survival at 1 and 3 years compared to patients undergoing pancreatectomy without arterial resection, it was demonstrated that pancreatectomy with arterial resection was associated with a more favorable survival (odds ratio =0.49 at 1 year and 0.39 at 3 years) when compared to patients that did not undergo surgical resection for locally advanced disease. [20]

Our institutional experience adds still more heterogeneity to the reported modified Appleby procedures with arterial reconstruction. For example, the first patient in our series underwent a modified Appleby procedure when he was found to have locally advanced disease at the time of exploration, in the absence of preoperative chemotherapy, despite our recommendation. In this way, he differed from many of the reported cases in that he did not undergo neoadjuvant chemoradiation. As part of the resection, he required an aorto to common hepatic artery anastomosis to enhance hepatic inflow. It appears that this is the first reported primary bypass performed from the aorta to the common hepatic artery in this setting, without the use of an additional conduit.

The second case presents another example of an intraoperative observation requiring vascular reconstruction. A replaced left hepatic artery from the left gastric artery was encountered during dissection leading to the need for a bypass after ligation of the left gastric artery. Again, we chose to perform another primary anastomosis of the distal CHA to the LGA in an end-to-end fashion. We felt that such a primary anastomosis was preferable to utilizing interposition grafting because it decreases the potential for the infectious and thrombotic complications associated with conduits and reduces the number of vascular anastomoses. This is important because the increased number of complications following pancreatectomy with vascular reconstruction is well described, and a pancreatic fistula or abscess in the setting of synthetic (or autogenous venous) conduit could be catastrophic.

The last case in our series presented the most complex resection and reconstruction challenge and is a reminder that these cases convey the highest risk of postoperative complications and brings into question the issues of rational use of such resectional strategies. Currently, the criteria for selection are based subjectively on factors including age, comorbidities, performance status, surgeon's assessment of feasibility of the procedure (based on preoperative evaluation of extent and location of tumor, surrounding vasculature for collateral flow, and arteries potentially needed for bypass), and the patient's strong desire for aggressive therapy. As advances in antitumor therapies, technique and postoperative care have led to the expansion of pancreatic resections; additional studies need to be done to identify the objective predictors of outcome for pancreatectomy with arterial reconstruction and the proper selection of patients.

All three of our patients recovered without ischemic complications. Like many of the other reported cases, the patients remain alive at 16, 15, and 13 months, durations which may have exceeded their anticipated life expectancy had they not been offered resection. Further, our experience supports the feasibility of the modified Appleby procedure with arterial reconstruction in patients who have not undergone neoadjuvant chemoradiation, had previously undergone bariatric gastric surgery, or had variant anatomy of the hepatic circulation.

These individual experiences demonstrate a trend toward broadening indications for the surgical resection of pancreatic body and tail tumors. Case reports and series have uncovered a large degree of variability on a number of levels—from the utilization of neoadjuvant chemoradiation therapy to the method used for the intraoperative assessment of hepatic and gastric collaterals in determining the need for an arterial reconstruction and to the type and technique of bypass that is employed in reconstruction. [21–23] These reports lack long-term data that are necessary to appreciate the rates of recurrence, overall survival, and disease-free survival that will ultimately be critical in the standardization of a therapeutic scheme for the treatment of patients with locally advanced pancreatic cancer.

Based on our experience and literature review, the modified Appleby procedure with arterial reconstruction can provide a challenging but potentially curative alternative for patients with locally advanced tumors that have undergone neoadjuvant treatment with regression or no progression of disease. Moreover, cases of altered gastrointestinal or variant anatomy of the hepatic circulation should not be excluded as candidates for resection because novel arterial reconstruction approaches are still feasible. These complex pancreatic resections for pancreatic body and tail cancers remain reserved for select patients and situations. They should be performed by high volume surgeons in centers capable of complex arterial reconstruction. Widespread adoption of this practice should be cautioned until further studies are conducted to evaluate the survival benefits compared to chemotherapeutic interventions alone (without surgery).

Conclusion

Patients with locally advanced pancreatic body and tail carcinomas have traditionally been considered unresectable. With appropriate patient selection, and in the setting of an experienced multidisciplinary team, more patients are meeting expanded resection criteria after preoperative induction chemotherapy or chemoradiation. In some of these cases, arterial reconstruction is necessary to prevent hepatic and gastric ischemia. Based on our own experience and literature review, the modified Appleby procedure with arterial reconstruction provides a potentially successful resectional option for selected patients with the hope of improved long-term survival.

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