Pancreaticoduodenectomy in a patient with previous left ventricular assist device: a case report with specific emphasis on peri-operative logistics

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Abstract
To the best of our knowledge this is the first case of this nature described in the literature. Sharing the authors experience with this case, particularly the technical challenges and post-operative management may aid other physicians facing similar scenarios. In this report, we describe a pancreaticoduodenectomy for pancreatic adenocarcinoma in a patient with a previous left ventricular assist device (LVAD). A multidisciplinary approach, particularly close involvement of the advanced heart failure, mechanical heart and pancreas surgery teams was key to the success of this case. Major abdominal surgery in the setting of previous LVAD should be considered carefully, however, the LVAD should not be generalized as an absolute contraindication.

INTRODUCTION
Over 2500 continuous left ventricular assist devices (LVAD) devices were implanted in United States in 2014 and over 20,000 have been implanted worldwide to date [1]. With the increasing prevalence of ventricular assist devices, non-cardiac surgeries for this patient population are becoming a more frequently encountered clinical scenario. Patients with adenocarcinoma of the head of the pancreas who undergo surgery and adjuvant therapy have a 5-year survival of approximately 20% [2]. Patients with adenocarcinoma of the pancreas who are not surgical candidates and receive only chemotherapy with or without radiation have a median survival of ~7–10 months [3]. Clearly, surgery plays a critical role in the potential survival of patients with adenocarcinoma of the pancreas. Herein, we present a patient with an LVAD who was subsequently diagnosed with adenocarcinoma of the head of the pancreas. After careful consideration of the overall prognosis in this patient with this complex clinical presentation, we elected to perform a pancreaticoduodenectomy.

CASE REPORT
A 66-year-old male with New York Heart Association (NYHA) stage IV heart failure, severe aortic stenosis, severe aortic insufficiency and porcelain aorta underwent implantation of a HeartMate II LVAD as destination therapy by the Cardiac Transplant and Mechanical Heart Service at our institution on October 26, 2013. Nine months later, routine laboratory follow up done July 20, 2014 revealed an elevated total bilirubin of 6.3 (0.2–1.1 mg/dL). Abdominal ultrasound showed cholelithiasis and intra- and extra-hepatic biliary ductal dilation. Abdominal computed tomography (CT) was not able to delineate the distal common bile duct or pancreas head area due to LVAD artifact (Figs. 1a and b). At this point, the patient’s anticoagulation was
reversed and the patient underwent endoscopic retrograde cho-
langiopancreatography (ERCP). Fluoroscopy for the ERCP was
limited by the LVAD, however, a tight distal common bile duct
stricture of about 2 cm in length was noted (Fig. 2). ERCP was
followed immediately by endoscopic ultrasound (EUS) that
showed a 2.8 cm pancreatic head mass (Fig. 3). On EUS, the
mass was not abutting the portal vein, superior mesenteric
vein, superior mesenteric artery or celiac artery. Also, there
was no significant lymphadenopathy per EUS. Fine needle
aspiration of the pancreatic head mass was consistent with
adenocarcinoma. Rest of the work-up included a chest-CT
which was negative for metastatic disease, CA19-9 was 27
(0–37 U/mL). The case was discussed at our multidisciplinary
liver and pancreas tumor board and after several care confer-
ences with the family and involved providers, the decision
was made to proceed with a pancreaticoduodenectomy on
August 14, 2014.

Initial diagnostic laparoscopy was negative for metastatic
disease, and confirmed expected adhesions to the LVAD Gortex
pouch that is fashioned from the diaphragm (Fig. 4). After con-
firming the absence of metastatic disease, we then proceeded
with a standard pancreaticoduodenectomy. We also had to do
a small segment side bite resection of the portal vein with pri-
mary repair due to suspected involvement. He tolerated the

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Figure 1: (a) Cross sectional imaging as a pre-operative study to define the pan-
creatic anatomy is limited by the LVAD artifact. (b) Computed tomography
scout film shows the location of the LVAD and LVAD driveline in the chest and
abdomen.

Figure 2: ERCP images illustrate the common bile duct with distal stricture, par-
tially obstructed by the LVAD.

Figure 3: Endoscopic ultrasound images of the adenocarcinoma of the head of
the pancreas.

Figure 4: A pouch made of Gortex and secured to the inferior face of the dia-
aphragm houses the LVAD and sits over the mid and upper quadrants of the
abdomen.
procedure well and without any blood transfusions, estimated blood loss was 200 mL. He was extubated at the end of the case and was transferred to the Cardiac Intensive Care Unit for further care. A drain left around the hepatico and pancreatico jejunal anastomosis was removed on post-operative Day #3 after checking the amylase level per our institutional protocol. By post-operative Day #8 he was tolerating a regular soft diet and having regular bowel function. He did not have any infectious or bleeding complications post-operatively. He stayed in the hospital until post-operative Day #17 mainly for close management of his overall fluid status and optimizing anticoagulation per the Mechanical Heart team.

Final pathology showed a 3.0 cm, well differentiated tumor, without lymphovascular invasion, with peri-neural invasion, with three lymph nodes positive by direct extension out of 17 total, surgical margins clear of cancer, Stage IIB, T3N1M0.

Approximately 6 weeks after surgery, he was started on adjuvant chemotherapy with single agent Gemcitabine. He completed total of 6 months of Gemcitabine without major side effects.

At the time this report was drafted, the patient was 30 months out from surgery with no evidence of recurrent disease.

DISCUSSION

Pancreatic cancer pre-operative imaging

Due to LVAD streaking artifact on CT, pre-operative good quality imaging of the pancreas was only possible with endoscopic ultrasound.

Surgical challenges

Incision (presence of the LVAD driveline—Fig. 3)

Our incision had to be altered from our standard midline suprumbilical incision in order to avoid the driveline (Fig. 5). As depicted in Figs 1a and b, the LVAD pump occupies a significant amount of the left abdominal wall from the costal margin to the umbilicus. The driveline also loops across the abdomen and exits in the left abdominal wall. The surgeon needs to be aware of these factors and be flexible with the location of the incision.

Retraction and exposure

Components of the inflow and outflow cannulas of the LVAD are made of pliable materials, therefore continuous intraoperative flow monitoring by a mechanical heart engineer is required for these cases.

Linear flow (HeartMate CF) and identification of vascular structures

Identification of the superior mesenteric artery, celiac artery, hepatic artery, gastroduodenal artery or any arterial anatomic variants (i.e. replace right hepatic artery) is key to the operation. In patients with previous LVAD the lack of arterial pulsatile flow makes identification of these structures by palpation or Doppler not possible. Intra-operative ultrasound plays a bigger role for identification of vascular structures.

Post-operative anticoagulation

LVAD patients are routinely kept anticoagulated with a target INR (international normalized ratio) between 1.8 and 2.5. In our case, the INR was corrected and the patient was kept on a heparin drip until two hours prior to surgery. Full dose intravenous heparin drip was started on post-operative Day 2 and Coumadin was started on post-operative Day 3.

CONCLUSION

Close collaboration with the LVAD team is key to the successful care of these patients. Based on our limited experience, currently at our institution previous history of LVAD is not an absolute contraindication for major abdominal oncologic surgery.

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CONFLICT OF INTEREST STATEMENT

None declared.

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