About the Whipple Procedure

A pancreaticoduodenectomy, also known as a Whipple Procedure, is a major surgical operation most often performed to remove cancerous tumors from the head of the pancreas. It is also used for the treatment of pancreatic or duodenal trauma, or chronic pancreatitis. Due to the shared blood supply of organs in the proximal gastrointestinal system, surgical removal of the head of the pancreas also necessitates removal of the duodenum, proximal jejunum, gallbladder, and, occasionally, part of the stomach.

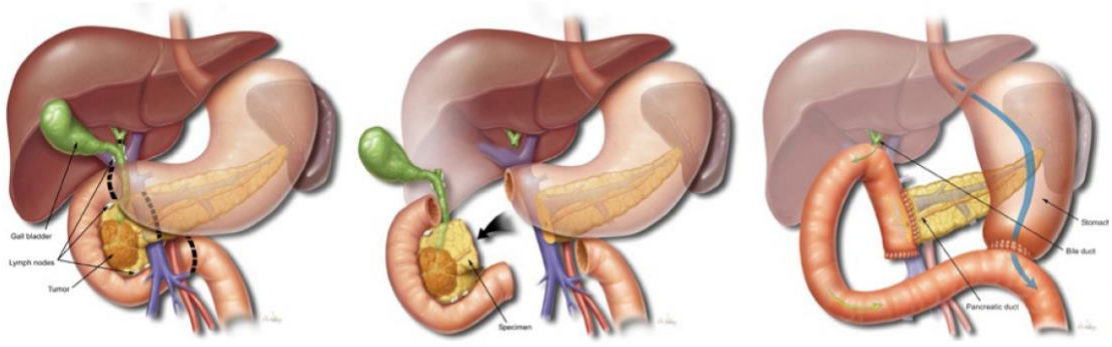

Figure 1: Typical Whipple surgery resecting (removing) just the head of the pancreas. This example is pyloric-saving and does not remove the spleen.

The most common technique of a pancreaticoduodenectomy consists of the en bloc removal of the distal segment (antrum) of the stomach, the first and second portions of the duodenum, the head of the pancreas, the common bile duct, and the gallbladder. Lymph nodes in the area are often removed during the operation as well (lymphadenectomy). However, not all lymph nodes are removed in the most common type of pancreaticoduodenectomy because studies showed that patients did not benefit from the more extensive surgery.

At the very beginning of the procedure, after the surgeons have gained access to the abdomen, the surfaces of the peritoneum and the liver are inspected for disease that has metastasized. This is an important first step as the presence of active metastatic disease is a contraindication to performing the operation.

The vascular supply of the pancreas is from the celiac artery via the superior pancreaticoduodenal artery and the superior mesenteric artery from the inferior pancreaticoduodenal artery. There are additional smaller branches given off by the right gastric artery which is also derived from the celiac artery. The reason for the removal of the duodenum along with the head of the pancreas is that they share the same arterial blood supply (the superior pancreaticoduodenal artery and inferior pancreaticoduodenal artery). These arteries run through the head of the pancreas, so that both organs must be removed if the single blood supply is severed. If only the head of the pancreas were removed it would compromise blood flow to the duodenum, resulting in tissue necrosis.

While blood supply to the liver is left intact, the common bile duct is removed. This means that while the liver remains with a good blood supply the surgeon must make a new connection to drain bile produced in the liver. This is done at the end of the surgery. The surgeon will make a new attachment between the pancreatic duct and the jejunum or stomach. During the surgery a cholecystectomy is performed to remove the gallbladder. This portion is not done en bloc, as the gallbladder is removed separately.

Relevant nearby anatomy not removed during the procedure include the major vascular structures in the area: the portal vein, the superior mesenteric vein, and the superior

mesenteric artery, the inferior vena cava. These structures are important to consider in this operation especially if done for resection of a tumor located in the head of the pancreas. If the tumor encases (wraps around 50% or more of the vessel) the celiac artery, superior mesenteric artery, or inferior vena cava it is considered unresectable due to the lack of patient benefit from the operation while having very high risk. Occasionally a portion of the superior mesenteric vein or portal vein is attached or inseparable from the tumor. In this setting vascular surgeons resect the involved portion of the vessel, and the vessel is repaired either via end-to-end anastomosis, repair of the side wall of the vein, or a vein graft.

Pancreaticoduodenectomy is the only potentially curative intervention for malignant tumors of the pancreas. However, the majority of patients with pancreatic cancer present with metastatic or locally advanced un-resectable disease; thus only 15-20% of patients are candidates for the Whipple procedure. Surgery may follow neoadjuvant chemotherapy, which aims to shrink the tumor and increasing the likelihood of complete resection. Post-operative death and complications associated with pancreaticoduodenectomy have become less common, with rates of post-operative mortality falling from 10 to 30% in the 1980s to less than 5% in the 2000s.

Whipple Contraindications

Absolute contraindications for the procedure are metastatic disease in the abdominal cavity or nearby organs. These are found most often on the peritoneum, in the liver, and in the omentum. To determine if there are metastases, surgeons will inspect the abdomen at the beginning of the procedure after gaining access. Alternatively, they may perform a separate procedure called a diagnostic laparoscopy which involves insertion of a small camera through a small incision to look inside the abdomen. This may spare the patient the large abdominal incision that would occur if they were to undergo the initial part of a pancreaticoduodenectomy that was cancelled due to metastatic disease.

Further contraindications include encasement of major vessels (such as celiac artery, inferior vena cava, or superior mesenteric artery) as mentioned above.

Pylorus-Sparing Pancreaticoduodenectomy

Clinical trials have failed to demonstrate significant survival benefits of total pancreatectomy, mostly because patients who submit to this operation tend to develop a particularly severe form of diabetes mellitus called brittle diabetes (Type-3c).

Sometimes the pancreaticojejunostomy may not hold properly after the completion of the operation and infection may spread inside the patient. This may lead to another operation shortly thereafter in which the remainder of the pancreas (and sometimes the spleen) is removed to prevent further spread of infection and possible morbidity. In recent years the pylorus-preserving pancreaticoduodenectomy (also known as Traverso-Longmire procedure/PPPD) has been gaining popularity, especially among European surgeons. The main advantage of this technique is that the pylorus, and thus normal gastric emptying, should in theory be preserved. There is conflicting data as to whether pylorus-preserving pancreaticoduodenectomy is associated with increased likelihood of gastric emptying. In practice, it shows similar long-term survival as a Whipple's (pancreaticoduodenectomy + hemigastrectomy), but patients benefit from improved recovery of weight after a PPPD, so this should be performed when the tumor does not involve the stomach and the lymph nodes along the gastric curvatures are not enlarged. There are cases where even without cancer involvement of the stomach, the bottom of the stomach and pyloric sphincter cannot be saved.

Compared to the standard Whipple procedure, the pylorus preserving pancreaticoduodenectomy technique is associated with shorter operation time and less intraoperative blood loss, requiring less blood transfusion. Post-operative complications, hospital mortality and survival do not differ between the two methods.