Post–Pancreatic Resection
General Overview and Unique Complications

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Pancreatic cancer is one of the most silently lethal forms of malignancy. With a lack of evidence-based research regarding pancreatic cancer, the evidence-based treatment options are limited. Currently, the best chance for a curative treatment is a pancreatic resection that typically is combined with chemotherapy and/or radiation therapy. The long-term treatment course and overall survival of the patient depend largely on the pathology report generated from the expurgated tissue analysis. After pancreatic resection, patients may experience both general and unique complications that, if not treated appropriately and assessed correctly, can be lethal. Provided here is a general overview of pancreatic resections and their unique postoperative complications for critical-care nurses. As the first-line provider, critical-care nurses assess and manage acute complications, in addition to educating patients to the long-term complications and how to manage them.

Keywords: Pancreatic cancer, Pancreatic resection, Postpancreatic resection


**PANCREATIC CANCER**

Pancreatic cancer is characterized by its very aggressive biological behavior. It can quickly become a rapidly disseminating and deadly tumor. Additionally, with pancreatic cancer’s silent behavior, the diagnosis is often made after it is too late to pursue a curative treatment. The National Cancer Institute’s Surveillance Epidemiological and End Results cancer statistics analysis reports that, in 2009 alone, there will be more than 40,470 people diagnosed with pancreatic cancer, whereas 35,240 people will succumb to the disease.1 Of those diagnosed, only 7% of cases are diagnosed while the cancer is still locally confined at the primary site; 26% are diagnosed after the cancer has spread to regional lymph nodes or directly beyond the primary site; 53% are diagnosed after the cancer had already metastasized, and the remaining 14% of patients had unknown staging information.1,2

The overall outcome of pancreatic cancer has not improved much over the last decade, with mortality continuing to soar above 95%.1 Between 1998 and 2002, the median age at diagnosis for pancreatic cancer was 72 years, whereas the median age at death was 73 years.1 The overall 5-year relative survival rate for a person diagnosed with pancreatic cancer between 1999 and 2005 was 5.5%. The corresponding 5-year relative survival rates were 22.2% for localized, 8.7% for regional, 1.8% for distant, and 4.9% for unstaged survivors.1 Furthermore, upon surgery, approximately 1 in 10 patients considered preoperatively to have resectable tumors was found to have nonresectable disease intraoperatively. Pancreatic cancer is a very aggressive tumor, and although most diagnosed are treated by nonsurgical methods, the best chance for long-term survival is to pursue a potentially curative pancreatic resection. Because of the nature
of the high degree of technical expertise required to perform a pancreatic resection, consultation at a specialized, high-volume pancreatic center will help to minimize operative mortality. Not only do post-pancreatic-resection patients require technically skilled surgeons, but they also depend greatly on the specially trained and educated critical-care nurses who treat them postoperatively.\textsuperscript{1-3}

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If the patient who is about to undergo a pancreatic resection is correctly counseled prior to having an operation, he/she would have been told about the possibility of having to experience several postoperative complications (Table 1).\textsuperscript{3-13} However, it is important to keep in mind that, even with the most in-depth and detailed preoperative counseling, the patient is mostly likely extremely overwhelmed and will be in need of counseling more than once to allow the perioperative education time to be processed and absorbed. The patient is going to turn to the care providers whom he/she has first contact with after the operation, when the postoperative complications begin, for guidance in what to expect during the normal postoperative course. Therefore, critical-care nurses have become the first provider that the patients turn to for education, reassurance, and support.

\textbf{THE PANCREAS}

The pancreas is a comet-shaped organ, with a round head, a body, and a tapered tail. It sits between the spine

<table>
<thead>
<tr>
<th>Complications</th>
<th>Pathology</th>
<th>S/Sx</th>
<th>Treatment</th>
<th>Time of Onset and Duration</th>
</tr>
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<tbody>
<tr>
<td>Gastric ileus</td>
<td>Gastrointestinal paralysis secondary to the trauma of an operation combined with delayed motility secondary to perioperative medications</td>
<td>Early satiety, postprandial nausea and vomiting, decreased bowel sounds, constipation, anorexia</td>
<td>Liquid diet, use of medications to stimulate gastric emptying, gastric decompression via gastrostomy tube release or possible nasogastric tube placement</td>
<td>POD 0-7; typically short term during initial healing of gastrointestinal trauma, but can continue with constipating pain medications</td>
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<tr>
<td>Endocrine insufficiency</td>
<td>If not enough healthy pancreatic tissue remains after resection, islet/acinar cell trauma, death, or removal</td>
<td>Hyperglycemia and associated symptoms</td>
<td>Exogenous insulin is typically required; it should be noted some oral antidiabetes medications can adversely affect the pancreas and should be avoided</td>
<td>POD 0-30; can be lifelong</td>
</tr>
<tr>
<td>Fistula</td>
<td>An abnormal connection between the pancreatic/bile ducts that cause the seepage of pancreatic and bilious fluids that can cause digestions of surrounding tissues in the peritoneal and abdominal cavity</td>
<td>Abdominal pain/distension, dullness to percussion, fever, chest pain, copious amounts of pancreatic enzyme/bilious fluid containing drainage</td>
<td>In acute situations, there is a possibility that the patient may need operative intervention, or possible insertion of, or reinsertion of, a percutaneous intra-abdominal drainage tube such as a Jackson-Pratt, combined with supportive therapies such as antipyretics</td>
<td>POD 0-7</td>
</tr>
<tr>
<td>Biliary reflux</td>
<td>The flow of bile upward from the small intestines to the stomach or esophagus due to biliary dyskinesia or biliary stricture</td>
<td>Chronic acid reflux, chronic nausea with bilious emesis, dyspepsia, halitosis, tooth enamel decay</td>
<td>Acid-suppressing medications and antiemetics</td>
<td>POD 0-45</td>
</tr>
<tr>
<td>Exocrine insufficiency</td>
<td>If not enough healthy pancreatic tissue remains after resection, islet/acinar cell trauma, death, or removal</td>
<td>Postprandial hyperperistalsis and diarrhea, malnutrition secondary to lack of fat absorption, weight loss</td>
<td>Exogenous pancreatic enzymes, antiarrhea medications, nutritional counseling and support</td>
<td>POD 0-30; can be lifelong</td>
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Abbreviations: POD, postoperative day; S/Sx, signs and symptoms.
and the stomach, with the head nestled in the curve of the duodenum, whereas the tail of the pancreas is tucked into the spleen. The pancreas is one of the major digestive and endocrine organs; it provides both endocrine and exocrine functions. The pancreas secretes digestive enzymes, such as amylase and lipase, into the small intestines from the main pancreatic duct where they help to digest carbohydrates, proteins, and fats to be later absorbed. The pancreas produces hormones such as insulin, glucagon, and somatostatin, which help regulate the endocrine system.\textsuperscript{14,15}

### PANCREATIC RESECTIONS

There are several different types of pancreatic resections, and the type used is greatly dependent on the location of the mass that needs to be removed. Pancreatic resections vary widely; there is a total pancreatectomy, in addition to several other distinct subtotal pancreatectomies (Table 2).\textsuperscript{3-13,16-21} Total pancreatectomies are less common than subtotal resections as the postoperative complication of type 1 diabetes can seriously and permanently impact the quality of the patient’s life. This is particularly true as, according to the American Cancer Society, the average age of a person diagnosed with pancreatic cancer is 72 years, and the effect of diabetes in this population can be devastating on his/her overall health.\textsuperscript{2,6} The most common subtotal pancreatic resections include the pancreaticoduodenectomy and central or distal pancreatectomies. Although each resection is unique in the technical aspects of the operation, several of the postoperative complications are similar (Tables 1 and 2). There are a few complications that are very unique to pancreatic resection, and those 3 are addressed in this article. The remaining complications are listed in Tables 1 and 2.

#### POSTOPERATIVE COMPLICATIONS

### Pancreatic Fistula

Patients who have undergone pancreatic resection experience general postoperative complications such as hemorrhage and infection; however, several postoperative complications specific to pancreatic resection occur. Particularly, there is a tremendous amount of gastrointestinal and endocrine dysfunction including gastric ileus, pancreatic fistula, biliary reflux, pancreatic exocrine insufficiency, and pancreatic endocrine insufficiency (Table 2).

Several postoperative complications specific to pancreatic resection occur.

Pancreatic fistulas are one of the highest reported postoperative complications that occur after resection.\textsuperscript{18}

### TABLE 2  Pancreatic Resection Types and Associated Complications

<table>
<thead>
<tr>
<th>Type of Resection</th>
<th>Common Postoperative Complications*</th>
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</thead>
<tbody>
<tr>
<td>Total pancreatectomy: the radical resection of the pancreas</td>
<td>Lifelong pancreatic endocrine insufficiency and pancreatic exocrine insufficiency, biliary reflux</td>
</tr>
<tr>
<td>Pancreatectoduodenectomy: the diseased portion of the head of the pancreas is removed along with a segment of the duodenum, and a new connection between the two is made. Typically, this operation is part of what is known as the Whipple procedure.</td>
<td>Short-term pancreatic endocrine/exocrine insufficiency, gastric ileus, biliary reflux, pancreatic fistula</td>
</tr>
<tr>
<td>Whipple procedure: removal of the diseased portion via a pancreatectoduodenectomy, antrectomy, cholecystectomy, choledochectomy with reconstruction of the anatomy via pancreaticojejunostomy, choledochojejunostomy, and a gastrojejunostomy</td>
<td>Lifelong pancreatic endocrine insufficiency and pancreatic exocrine insufficiency or short-term pancreatic endocrine/exocrine insufficiency, gastric ileus, biliary reflux, pancreatic fistula, postcholecystectomy syndrome</td>
</tr>
<tr>
<td>Central pancreatectomy: a middle or central portion of the pancreas is removed, preserving as much of the remaining tissue as possible</td>
<td>Short-term pancreatic endocrine/exocrine insufficiency, pancreatic fistula</td>
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<tr>
<td>Distal pancreatectomy: the distal portion of the pancreas is resected; typically, the spleen is also removed at this time, given probable involvement of the splenic artery</td>
<td>Short-term pancreatic endocrine/exocrine insufficiency, pancreatic fistula, splenectomy</td>
</tr>
<tr>
<td>Pancreatectojejunostomy: a loop of the jejunum is mobilized and attached to the pancreatic duct to allow for better drainage of the pancreas</td>
<td>Short-term pancreatic endocrine/exocrine insufficiency, gastric ileus, biliary reflux, pancreatic fistula, necrotic bowel syndrome</td>
</tr>
<tr>
<td>Frey procedure: there is local resection at the head of the pancreas with a longitudinal pancreaticojejunostomy</td>
<td>Short-term pancreatic endocrine/exocrine insufficiency, pancreatic fistula</td>
</tr>
</tbody>
</table>

*Excludes general postoperative complications such as infection, DVT/PE, hemorrhage, etc.
Defined as the formation of an abnormal communication between the pancreas and other internal structures or organs that is developed secondary to surgical resection. A pancreatic fistula can be a difficult complication to manage and can occur both in the early and late stages of the postoperative healing course. If a fistula forms, it can allow the passage of digestive enzymes to flow into the peritoneal or pleural cavities, can cause pancreatic ascites, and eventually may track through the retroperitoneum into the mediastinum by way of the aortic or esophageal hiatus. If the secretions break through the mediastinal pleura, then a fistula into 1 or both pleural cavities can result. An internal pancreatic fistula should be suspected in any patient who presents with ascites or with a massive unilateral or bilateral pleural effusion. The diagnosis is confirmed by cross-sectional imaging, and then a therapeutic paracentesis or thoracentesis is performed. The fluid drained should be sent for analysis, the results of which will help to confirm diagnosis.

It is vital that these fistulas are diagnosed and treated early, given the ease with which these complications can progress. Critical-care nurses should be aware of the signs and symptoms of postoperative fistulas. Therefore, routine assessment for abdominal ascites or pulmonary dysfunction consistent with pleural effusions should be performed. Abdominal ascites is typically uncommon in a patient without a history of liver dysfunction, and its development should be followed up on immediately. Postoperative pleural effusions are considered more commonplace and may be associated with many different etiologies. Consideration of cross-sectional imaging to rule out a pancreatic fistula is appropriate in the setting of a persistent malingering or worsening effusion. Particular care should be used when evaluating for or treating pancreatic fistulas, given the limited and poor treatments available. Nurses administering care to patients after pancreatic resection should keep this complication, and the associated signs and symptoms, in mind during physical assessment.

**Pancreatic Endocrine/Exocrine Insufficiency**

When discussing pancreatic resection, it is important to remember the functions of the pancreas. The pancreas has two main functions: exocrine function and endocrine function. The pancreas has one main duct and several smaller tributary ducts that excrete digestive enzymes such as amylase and lipase into the duodenum of the small intestines. The enzymes mix with food to digest carbohydrates, proteins, and fats along the intestinal tract, so that the body is able to absorb that calories and nutrients it needs to maintain energy. This secretion of enzymes to digest food is the exocrine function of the pancreas. When the pancreas is damaged, or there is less healthy tissue remaining to provide exocrine function, the patient experiences digestive dysfunction most commonly diagnosed by postprandial abdominal pain, diarrhea, and steatorrhea. Exocrine insufficiency can be treated by the intake of exogenous digestive enzymes a few minutes prior to eating, but if untreated both long- and short-term complications arise. In the short term, lack of nutritional absorption can cause poor wound healing, diarrhea-induced dehydration, electrolyte imbalance, and lethargy. Long-term exocrine insufficiency can lead to malnutrition and weight loss, and it is considered a poor prognostic indicator. A patient may develop pancreatic insufficiency as a result of intraoperative trauma to the pancreas, and as the pancreas heals, this complication may diminish; however, if there is not enough healthy pancreatic exocrine tissue remaining, this complication may be lifelong.

In addition to exocrine function, the pancreas is an endocrine gland. The pancreas produces hormones such as insulin and glucagon, in addition to other hormones, which have unique functions throughout the body. Particularly, the pancreas is known for its control of blood glucose levels, which is why, when the pancreas does not have enough healthy or functioning pancreatic endocrine cells remaining, the patient will develop post–pancreatic-resection insulin-dependent diabetes. It should be noted that almost all patients who undergo pancreatic resection will be maintained on exogenous insulin postoperatively for the first week as a result of pancreatic trauma. During the initial postoperative course, blood glucose levels are expected to be quite labile, as the pancreas may first function in short spurts during initial healing. Typically, by the fourth week postoperatively, the patient will know whether he/she will have permanent endocrine insufficiency. During the postoperative course, the patient will be responsible for learning how to check his/her blood glucose levels, so upon discharge home, he/she will be able to monitor and record his/her blood glucose levels. These levels are crucial for the first postoperative outpatient follow-up appointment, and patients typically require checking their blood glucose daily upon discharge home.

Critical-care nurses should be aware of the possible postoperative complications that can arise due to pancreatic endocrine or exocrine insufficiency. Nurses should be prepared to answer questions about the way pancreatic resection can affect the endocrine system. It should be noted that, given the average age of those diagnosed with pancreatic cancer is 72 years, the development of diabetes can be a difficult postoperative complication to learn how to manage. Diabetes education and training can seem daunting and be overwhelming for a patient to experience. The new diagnosis of diabetes can have a heavy emotional
impact, and although this complication can be transient postoperatively, all patients are at risk for developing permanent diabetes after pancreatic resection. It is in the patient’s best interest to be aware of what diabetes is, and how it can affect his/her quality of life. The patient will need support when it comes to diabetes education and training, and the more the patient is exposed to diabetes training and education, the more reinforced the information becomes. Reinforcing this information provides the patient with the ability to take control and responsibility for keeping his/her blood glucose in check and at a safe level. Critical-care nurses should be prepared to facilitate the patient’s diabetes training and education. Additionally, critical-care nurses should be evaluating the patient for diarrhea and postprandial pain that is associated with pancreatic exocrine insufficiency. Symptoms of either pancreatic exocrine or endocrine dysfunction should be evaluated during physical assessment.

Nurses should be prepared to answer questions about the way pancreatic resection can affect the endocrine system.

CONCLUSION

Pancreatic cancer is a very lethal malignancy that is not easily treated. The patient’s limited treatment options include a major abdominal operation preceded and/or followed by oncologic therapies. These treatments are fraught with serious complications that can, if not managed appropriately, leave the patient with a very poor quality of life. To help the patient become his/her own best advocate, it is up to the providers to educate the patient about the complications and how to manage them effectively. As critical-care nurses are the frontline of providers caring for these patients, it is up to them to help the patient focus on what they should expect to experience and how to ensure they maintain a safe, positive treatment course.

Although pancreatic resections are not common-place, particularly at smaller medical institutions, as technology improves and as more research on pancreatic cancer is conducted, there will continue to be an increasing number of patients requiring pancreatic resection. It is imperative that critical-care nurses are prepared to care for patients with pancreatic cancer who are status post pancreatic resection.8,12,13,22,23

Critical-care nurses spend more time with the patient than any other multidisciplinary team member does during postoperative hospitalization. It is up to us to be knowledgeable about pancreatic cancer and the way pancreatic resections affect our patients. By understanding the technical differences between resections, and the pathophysiology of how pancreatic resection affects the endocrine and gastrointestinal systems, assessment for unique complications is more effective. With effective assessment, early diagnosis and treatment of lethal complications can ensue, ultimately preventing mortality and securing improved overall survival, not to mention patient quality of life. We need to evaluate for those postoperative complications that are unique to pancreatic resection, and we need to help educate and inform our patients about what type of complications can arise, and how to be prepared to handle them. A nurse who is able to counsel a patient about what to expect after a pancreatic resection, that the complications are unique, but expected, and how the patient can prevent or handle these complications reduces the enormous amounts of fear and helplessness that the patient experiences.

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References


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