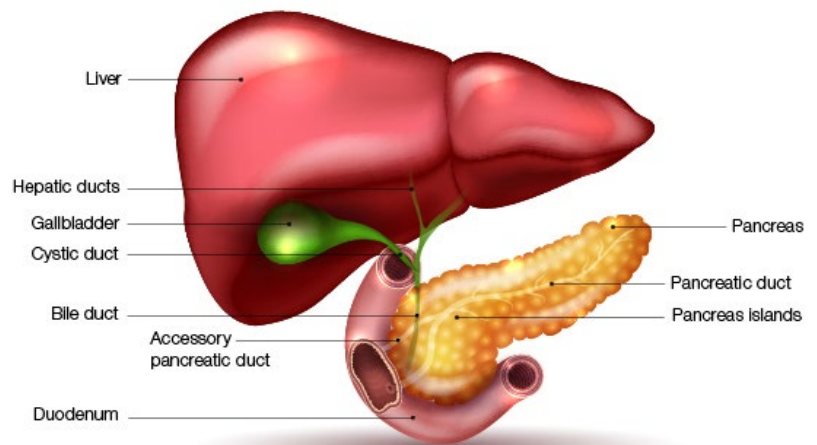


LABORATORY TESTS RELATED TO PANCREATIC DISEASES AND CANCER

*Pancreatic diseases can affect people of all genders. In this material, the terms “male” and “man” are used to refer to people assigned male at birth. The terms “female” and “woman” are used to refer to people assigned female at birth.

WHAT IS THE PANCREAS?

The pancreas is a gland that is located in the abdomen. It is located behind the stomach and it is surrounded by the liver, spleen, stomach, and small intestine. The pancreas is also surrounded by major blood vessels that supply blood to the pancreas and other organs in the abdomen. The pancreas is about six inches long and it has two main functions: an exocrine function (it releases enzymes into the digestive tract) to help with digestion and an endocrine function (it releases molecules into the blood stream) to regulate blood sugar.



PANCREATIC DISEASES

ACUTE PANCREATITIS

The inflammatory condition where the pancreas becomes acutely inflamed in response to damage in the body. The causes of acute pancreatitis include stones in the gallbladder, excessive alcohol consumption, high levels of calcium in the blood, high levels of triglycerides, and certain medications. Signs and symptoms include nausea, vomiting, fever, swollen or tender abdomen, severe pain in the abdomen and a rapid pulse.

CHRONIC PANCREATITIS

This is a condition where the pancreas is inflamed over a long period of time (continuously or in bouts). Chronic pancreatitis cannot be healed and eventually leads to permanent damage of the pancreas. Factors that lead to chronic pancreatitis include recurrent acute pancreatitis of any cause, blocked pancreatic or common bile duct, excessive alcohol use, genetic mutations due to cystic fibrosis and autoimmune conditions, such as lupus. The signs and symptoms include diarrhea, weight loss, oily stools, vomiting and nausea. Because of the damage to the endocrine pancreas, patients may develop diabetes.

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TYPES OF PANCREATIC CANCER

EXOCRINE TUMORS

Exocrine tumors are located in the exocrine cells of the pancreas; whose function is to help the body digest food.

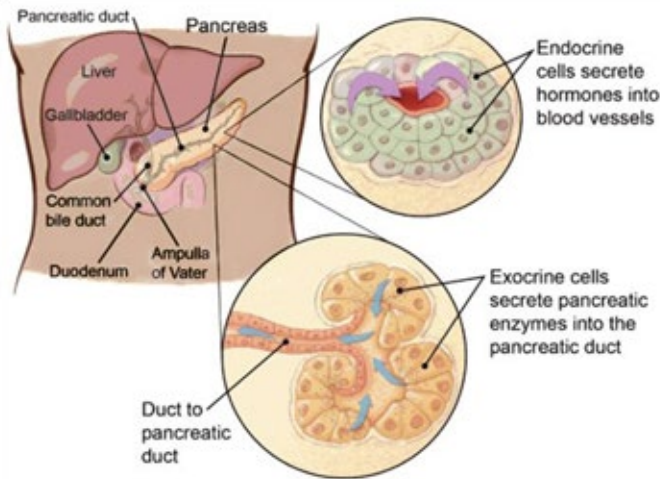
ACINAR CELL CARCINOMA: This is a rare type of pancreatic cancer that begins in the exocrine cells that produce pancreatic enzymes. Signs and symptoms include pain in the abdomen, nausea, unexplained weight loss, pain in the joints and skin rashes. This type of cancer contributes to about 2% of exocrine cancers.

ADENOCARCINOMA: This type of malignant growth begins in the exocrine cells that line the pancreatic duct, whose function is to make enzymes for digestion. Signs and symptoms include bloating in the abdomen, indigestion, poor appetite, nausea, jaundice (a yellowing of the skin or the whites of the eyes), diarrhea, oily stool and unexplained weight loss. This type of cancer contributes to about 95% of exocrine pancreatic cancers.

ADENOSQUAMOUS CARCINOMA: This is a rare and aggressive type of malignant growth that contains squamous cells and gland-like cells. This type of cancer contributes to between 1 to 4% of pancreatic exocrine cancers.

COLLOID CARCINOMA: This is a rare type of malignant growth that begins from a benign cyst called an intraductal papillary mucinous neoplasm. The malignant cells float in a gelatinous substance called mucin. This type of cancer contributes to 1 to 3 percent of pancreatic exocrine cancers.

SQUAMOUS CELL CARCINOMA: This is an extremely rare type of exocrine pancreatic cancer that begins in the pancreatic duct. The malignant growth consists of squamous cells. This cancer is very rare such that its origins are not well understood.



PANCREAS TRANSPLANT

A pancreas transplant is a surgical procedure where a person with a non-functioning pancreas receives a healthy pancreas from a deceased donor. One of the main endocrine functions of the pancreas is to produce and secrete insulin into the bloodstream. Pancreas transplants are usually done as a potential cure for type 1 diabetes. It is rare but pancreas transplants may be recommended as treatment for pancreatic and bile duct cancers. Sometimes, a pancreas transplant is done at the same time as a kidney transplant for people with kidneys that have been damaged by diabetes. Because the transplant goal is to replace the endocrine function (but not the exocrine function), there are multiple surgical procedures and approaches to placing the pancreas transplant; thus, each patient may have a slightly different organ placement.

PANCREATIC CANCER

Pancreatic cancer is a malignant growth that begins in the pancreas. The types of pancreatic cancer depend on the type of cell from which the malignant tumor develops. The two types of cells in the pancreas are exocrine cells and (neuro)endocrine cells. Exocrine tumors are the most common type of pancreatic cancer and contribute to about 93% of the cases. (Neuro)endocrine tumors contribute to about 7% of pancreatic cancers.

NEUROENDOCRINE TUMORS (NETS)

Pancreatic neuroendocrine tumors are less common compared to pancreatic exocrine tumors. They are located in the endocrine cells of the pancreas; whose function is to regulate blood sugar. Pancreatic neuroendocrine tumors are also known as islet cell tumors.

There are two categories of pancreatic NETs, functional and non-functional:

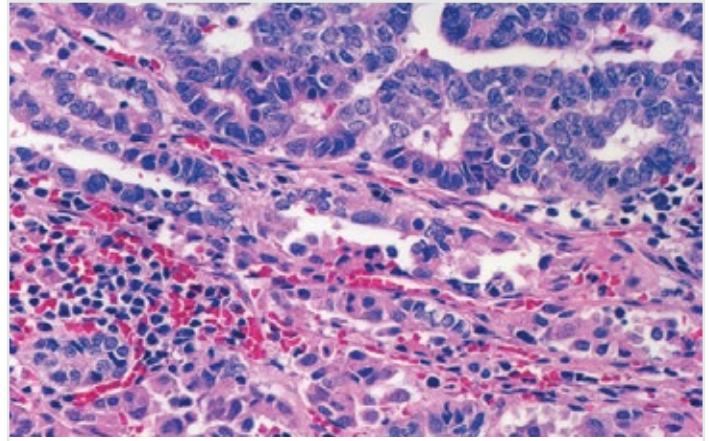
- Functional pancreatic NETs produce extra hormones that cause signs and symptoms. These types of tumors can be either malignant or benign. Majority of pancreatic NETs are functional tumors.
- Non-functional pancreatic NETs do not produce extra hormones and signs and symptoms appear after the tumor has spread. Most non-functional pancreatic NETs are malignant.

GASTRINOMA: This type of tumor begins in the neuroendocrine cells that make the gastrin hormone. Gastrin causes the stomach to release an acid that helps digest food. High levels of gastrin result in high levels of stomach acid which lead to stomach ulcers and diarrhea. The tumor usually forms in the head of the pancreas and small intestine. Most gastrinomas are malignant.

GLUCAGONOMA: This type of tumor begins in the neuroendocrine cells that produce the hormone glucagon. Glucagon increases the amount of glucose in the blood and helps the liver break down glycogen, which is the stored form of glucose. The glucagonoma tumor causes the release of high levels of glucagon in the blood which leads to high blood sugar (hyperglycemia). High levels of glucagon in the blood may cause a rash on the face, stomach or legs, headaches, frequent urination, diarrhea and tongue sores. Most glucagonomas are malignant.

INSULINOMA: This type of tumor begins in the neuroendocrine cells that produce the hormone insulin. Insulin is responsible for controlling the amount of glucose in the blood and moves the glucose into the cells to be used for energy in the body. High levels of insulin in the blood result in low blood sugar which causes blurred vision, headaches or lightheadedness and a fast heartbeat. Insulinomas are usually slow growing, rarely spread and are mostly benign.

NON-FUNCTIONING NEUROENDOCRINE TUMORS: This is a tumor that begins in neuroendocrine cells and does not produce any extra hormones. The signs and symptoms of a non-functioning NET include diarrhea, indigestion pain in the abdomen, unexplained weight loss and jaundice, a yellowing of the skin or the whites of the eyes. Most non-functioning neuroendocrine tumors are malignant.



UNDER THE MICROSCOPE

Normal pancreatic glands (left) at the interface with a neuroendocrine tumor of the pancreas (right). Note that the collection of tumor cells is monomorphic (all look the same) while the normal gland is heterogeneous (all look different).

STAGES OF PANCREATIC CANCER

The stages of pancreatic cancer determine how far the cancer has spread and what parts of the body it has spread to. Your treatment plan and prognosis will depend on the staging portion of your diagnosis. Below is a short description of each stage:

STAGE 0: There are abnormal cells in the lining of the pancreas. The cells may or may not be cancerous and spread into nearby tissue.

STAGE I: The cancer is only in the pancreas and has not spread to nearby tissue.

- Stage IA: The tumor is less than 2 centimeters (cm)
- Stage IB: The tumor is larger than 2cm.

STAGE II: The cancer has spread to nearby tissues, organs or lymph nodes near the pancreas.

- Stage IIA: The cancer has spread to nearby tissues and organs but has not spread to the lymph nodes or major blood vessels.
- Stage IIB: The cancer has spread to nearby lymph nodes and nearby tissues and organs but it has not spread to major blood vessels.

STAGE III: The cancer has spread to major blood vessels near the pancreas and nearby lymph nodes but it has not spread to other parts of the body.

STAGE IV: The cancer is of any size and has spread to other parts of the body such as the liver and the lungs. It may have spread to the lymph nodes as well. Another way to describe this stage is that the cancer has metastasized.

LAB TESTS RELATED TO PANCREATIC DISEASES AND CANCER

**Please note that reference ranges are set by individual laboratories for their specific populations so reference ranges might differ slightly.*

BIOPSY: This procedure is the removal of a small tissue sample from the pancreas to be analyzed under a microscope. The sample can be collected using a needle through the skin and into the pancreas (fine-needle aspiration). This test is important because it helps determine whether the cells are cancerous.

CANCER ANTIGEN 19-9 (CA 19-9): This test measures the amount of CA 19-9 in the blood. The test is important because CA 19-9 is a tumor marker that indicates the presence of cancer in the body and elevated levels can indicate pancreatic cancer. The typical reference range* is between 0-37 U/mL.

SCREENING TESTS RELATED TO PANCREATIC DISEASES AND CANCER

COMPUTED TOMOGRAPHY SCAN (CT SCAN): This is a type of x-ray scan, usually of the whole body if there is any suggestion from a clinical examination or blood test that a cancer present in the pancreas has spread beyond the pancreas, for example to the liver.

MAGNETIC RESONANCE IMAGING (MRI): This test uses strong magnets and radio waves to take detailed images of the pancreas. This test is important because it identifies abnormalities in the pancreas such as cancer.

ULTRASOUND: This test utilizes sound waves to create images of the pancreas. The two types of ultrasounds used are an abdominal ultrasound or an endoscopic ultrasound. The abdominal ultrasound takes images of the abdomen. For the endoscopic ultrasound, a thin, flexible tube called an endoscope is used to view the digestive tract and get biopsy samples of the pancreatic tumor.

LAB TESTS RELATED TO MONITORING PANCREATIC DISEASES AND CANCER

CANCER ANTIGEN 19-9 (CA 19-9): This test measures the amount of CA 19-9 in the blood. The test is important because CA 19-9 is a tumor marker that indicates the presence of cancer in the body and it can be used to monitor response to treatment. The typical reference range* is between 0-37 U/mL.

CARCINOEMBRYONIC ANTIGEN (CEA): This is a blood test that measures the amount of the tumor marker CEA. This test is important because an increase or decrease in CEA is a sign of whether the treatment is working. Increases in CEA may be a sign that the treatment is not working effectively or that the cancer has returned. The typical reference range* is between 0 – 2.5 ng/mL.

LAB TESTS INVOLVED IN PANCREAS TRANSPLANTS

CROSS-MATCHING: This is a test performed before transplantation to help assess whether the donor organ will be compatible with the recipient.

COMPLETE BLOOD COUNT (CBC): This test determines your overall health status by looking at your overall blood count levels, including your red and white blood cell count, your platelets, and lymphocytes. This test is important because it can indicate if you are having a condition or disease, such as an infection, anemia, inflammation, or cancer.

TYPICAL REFERENCE RANGES FOR MEN*:

Complete Blood Count	Role in Health	Typical Reference Range*
Hematocrit	Plasma in Red Blood Cells	38.3-48.6%
Hemoglobin	Oxygen-Carrying Protein	13.2-16.6 grams/dL
Platelet Count	Blood Clotting	135-317 x 103 /uL
Red Blood Cell Count	Carry Oxygen	Between 4.35-5.65 x 106 /uL
White Blood Cell Count	Fight Infections	3400-9600 cells/uL

TYPICAL REFERENCE RANGES FOR WOMEN*:

Complete Blood Count	Role in Health	Typical Reference Range*
Hematocrit	Plasma in Red Blood Cells	35.5-44.9%
Hemoglobin	Oxygen-Carrying Protein	11.6-15 grams/dL
Platelet Count	Blood Clotting	157-371 x 103 /uL
Red Blood Cell Count	Carry Oxygen	Between 3.92-5.13 x 106 /u
White Blood Cell Count	Fight Infections	3400-9600 cells/uL

ASK YOUR DOCTOR

- What are my treatment options? Which treatment plan do you recommend and why?
- What is my prognosis?
- What is the stage of my cancer? What does this mean?
- Do I need to make any dietary changes?
- Will I need to take pancreatic enzymes? How often?
- What lifestyle changes should I make?
- What other lab tests should I get?
- How should I expect to feel during and after treatment?

BLOOD TYPE COMPATIBILITY

Patient's Blood Type	Donor's Blood Type							
	O-	O+	B-	B+	A-	A+	AB-	AB+
AB+	•	•	•	•	•	•	•	•
AB-	•		•		•		•	
A+	•	•			•	•		
A-	•				•			
B+	•	•	•	•				
B-	•		•					
O+	•	•						
O-	•							

MEET MARISSA



“Without the lab, diagnosis and treatments would be impossible. The information the lab provides guides your plan of care.”

Marissa was diagnosed with Stage 1 pancreatic neuroendocrine cancer in October of 2019. One night, she started experiencing symptoms such as abdominal pain after having dinner. She thought that they were being caused by her gallbladder and scheduled an appointment with the doctor. After a CT scan and a series of laboratory tests she was diagnosed with pancreatic cancer. Her background as a nurse helped her take a clinical approach to navigating her diagnosis and treatment options. Marissa underwent a Whipple procedure to remove the golf ball-sized tumor from her pancreas. After the surgery, she experienced a number of complications that included a GI bleed, bowel anatomic leak and a pancreatic leak, which were all promptly diagnosed by lab personnel. Today, Marissa is cancer free and continues to practice as a nurse.

To learn more about Marissa, go to www.ascp.org/content/patient-champion

ADDITIONAL RESOURCES



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