

# Multidisciplinary Teaching Atlas of the Pancreas

Radiological, Surgical,  
and Pathological Correlations

Javier Casillas

Joe U. Levi

Alexander O. Quiroz

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*Wherever the art of medicine is loved, there is also a love of  
Humanity*

*Hippocrates*



*I dedicate this book to my beloved wife and best friend Paty; to my children Javier, Patricio, and Emilio for their patience and encouragement to make this book possible; and to the youngest members of the family, my grandsons Nicolas and Sebastian.*

*To my mother and in memory of my father for their love and support throughout my life.*

*Javier Casillas*

*To my wife Linda, for putting up with me for 45 years; to all the surgery residents who have trained in our hepatobiliary and pancreas service, and to the future residents who will use this atlas as an invaluable resource.*

*Joe Levi*





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J Casillas, M.D.



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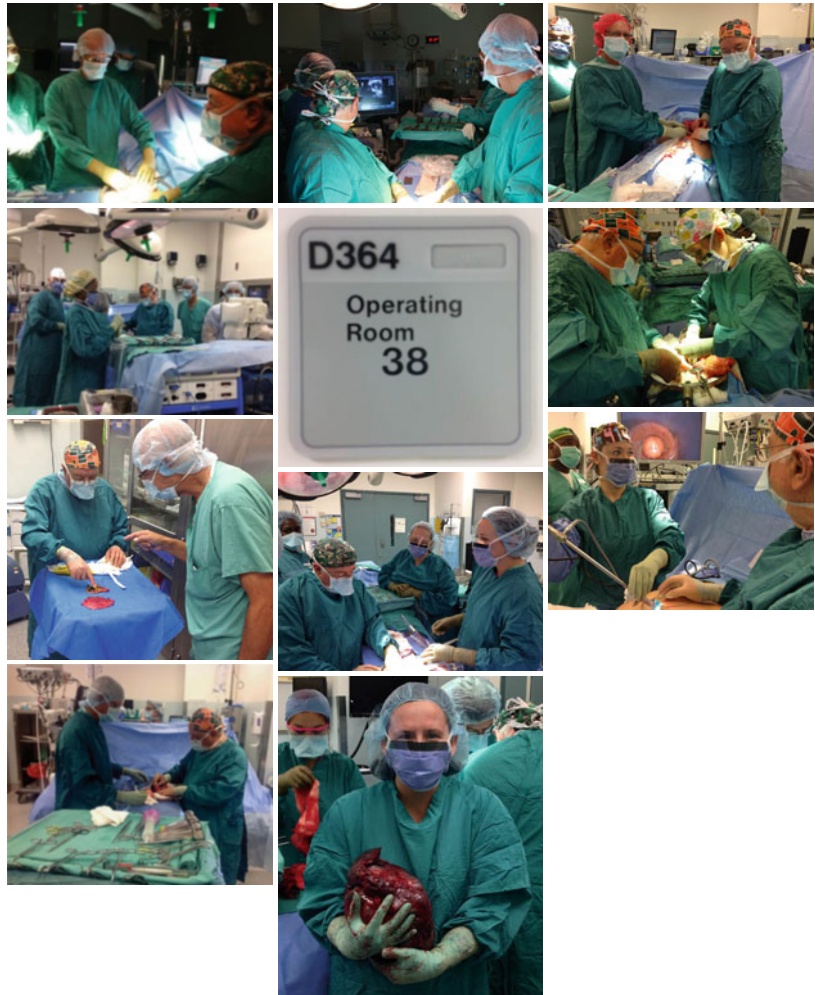
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## OR 38



Numbers are associated with experiences that span multiple categories, emotions, and events. OR 38 is the birthplace of the majority of the surgical cases described in this text. Not only does this room honor the lives that were saved or extended, but it also honors the steadfast determination of the physicians to provide the best patient care possible. OR 38 encompasses a lifetime of experiences, relationships, and learning for many of us at University of Miami Miller School of Medicine and Jackson Memorial Hospital.



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## Quick Facts About the Pancreas

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### Discovery

Herophilus of Chalcedon (*b.* 336 B.C.), Greek anatomist and surgeon, was apparently first to describe the pancreas.

---

### Name

The name “pancreas” was given by Ruphos (100 A.D.), Greek anatomist-surgeon of Ephesus.

The word “pancreas” originates from the Greek words *pan* meaning “all” and *kreas* meaning “flesh or meat.” All flesh or meat.

It was possibly named so, due to the absence of bone or cartilage.

---

### Attributed Ancient Function

Claudius Galenus (c. 138 A.D. – c. 201 A.D.) was born in Pergamum (modern-day Turkey) of Greek parentage.

Galen’s position was that of physician to the Roman Emperor Marcus Aurelius and physician to the gladiators.

He believed that the role of the pancreas was to serve as a pad or cushion to protect the large blood vessels lying immediately behind it.

Galen’s concept of the pancreas’ function was not challenged for a thousand years.

---

### Duct of Wirsung

In 1642, Johann Georg Wirsung, a German anatomist, in the San Francisco monastery of Padua, Italy, discovered the pancreatic duct (duct of Wirsung) during the dissection of a man who had been recently hanged for murder.

Wirsung was murdered in 1643, reportedly the result of an argument as to who had discovered the pancreatic duct. Five years after Wirsung’s death, a

former student of his, Moritz Hoffman, claimed that it was he and not Wirsung who had actually discovered of the duct.

Wirsung never knew the function of this duct.

---

## **Pancreatic Acini**

The first description of histology of the pancreas with a drawing of the structure of the exocrine acini may have been provided by D. Moysé in his thesis, 1852, Paris, France.

---

## **Islet of Langerhans**

This was described in 1869 by Paul Langerhans in his thesis presented at the Berlin Institute of Pathology in Germany.

---

## **Insulin**

Insulin is derived from the Latin word *insula* meaning “island.” This is so called because the hormone is secreted by the islet of Langerhans.

Insulin was discovered in 1921 at the University of Toronto, Canada, by Frederick Grant Banting (orthopedic surgeon) and Charles Herbert Best (medical student). They discovered the insulin hormone in pancreatic extracts of dogs and its effectiveness when they injected the hormone into a diabetic dog and found that lowered the dog’s blood glucose levels to normal.

In 1958, the Nobel Prize in Chemistry was awarded to Frederick Sanger of England for determining of the molecular structure of insulin.

---

## **Diabetes**

The existence of diabetes has been known since the first century (B.C.E.) when a Greek physician, Aretaeus the Cappadocian, named it diabainein, meaning “a siphon” referring to the excessive urination associated with the disease.

The word *diabetes* was first recorded in 1425 and 1675.

The Greek word *mellitus* meaning “like honey,” was added to reflect the sweet smell and taste of the patient’s urine.

---

## **Digestive Enzymes of the Pancreas (Amylase, Lipase, Trypsin)**

These enzymes were discovered in the mid to late nineteenth century. Demonstration of the effectiveness of each digestive pancreatic enzyme in the intestine was discovered in a gradual manner through observation of the breakdown of fats, proteins, and starches into smaller molecules.

Contributors were Johann Nepomuk Eberle of Bavaria, Germany; Claude Bernard, Paris, France; Alexander Danilevsky, St Petersburg, Russia; and Willy Kuhne of Amsterdam, the Netherlands.

In 1908, Julian Wohlgemuth of Berlin, Germany, designed a method for measuring the concentration of amylase in the serum.

---

## **Secretin**

This hormone was discovered in 1902, by W.B. Bayliss and E.H. Starling in London, England.

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## **Pancreaticoduodenectomy**

From 1898 to 1922 a group of surgeons began performing pancreatic head and duodenal resections for pancreatic or ampullary carcinomas (Alessandro Codivilla, William S. Halstead, Desjardins, Sauve, Hirschel, and Tenani).

### **1940**

Allen W. Whipple (Columbia Presbyterian Hospital in New York, USA) performed the first recorded one-stage procedure for complete excision of the head of the pancreas and the entire duodenum.

Unaware of Whipple's procedure, I.R. Trimble, J.W. Parsons, and C.P. Sherman, from Johns Hopkins Hospital in Baltimore, Maryland, performed a similar one-stage radical resection a few weeks after Whipple. Trimble added a distal gastrectomy to avoid blow out of the duodenal stump.

Verne C. Hunt added a pancreaticojejunostomy to avoid leakage of the pancreatic stump.

### **1946**

Whipple published his 10-year experience of radical excisions of the head of the pancreas and duodenum. In this report, he proposed several modifications to his original procedure and advocated a one-stage procedure.

---

## **Pancreatic Transplant**

### **1966**

The first human renal and segmental pancreatic transplantation was performed at the University of Minnesota, USA, by the surgical team of Kelly, Lillehei, Merkel, Idezuki, and Goetz.

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**Part I**  
**General**



# Embryology of the Pancreas and Normal Variants

# 1

Javier Casillas, Chris Granville, Alexander Quiroz,  
and Roberto Ruiz-Cordero

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## 1.1 Self-Assessment Questions

1. The uncinate process of the pancreas derives from the dorsal pancreatic bud.
  - a. True
  - b. False
2. What is the most common type of congenital anomaly of the pancreas?
  - a. Ectopic pancreas
  - b. Aggenesis of the pancreas
  - c. Congenital short pancreas
  - d. Annular pancreas
  - e. Pancreas divisum
3. Where is heterotopic pancreatic tissue most commonly found in the body?
  - a. Stomach
  - b. Duodenum
  - c. Jejunum
  - d. Meckel's diverticulum
  - e. Spleen

4. **The annular pancreas may be associated with all of these, *except*:**
- Esophageal atresia
  - Imperforate anus
  - Congenital heart disease
  - Malrotation of the gut
  - Omphalocele
5. **All of these statements about pancreatic divisum are true, *except*:**
- Endoscopic cholangiopancreatography (ERCP) is the current modality used to diagnose this anomaly.

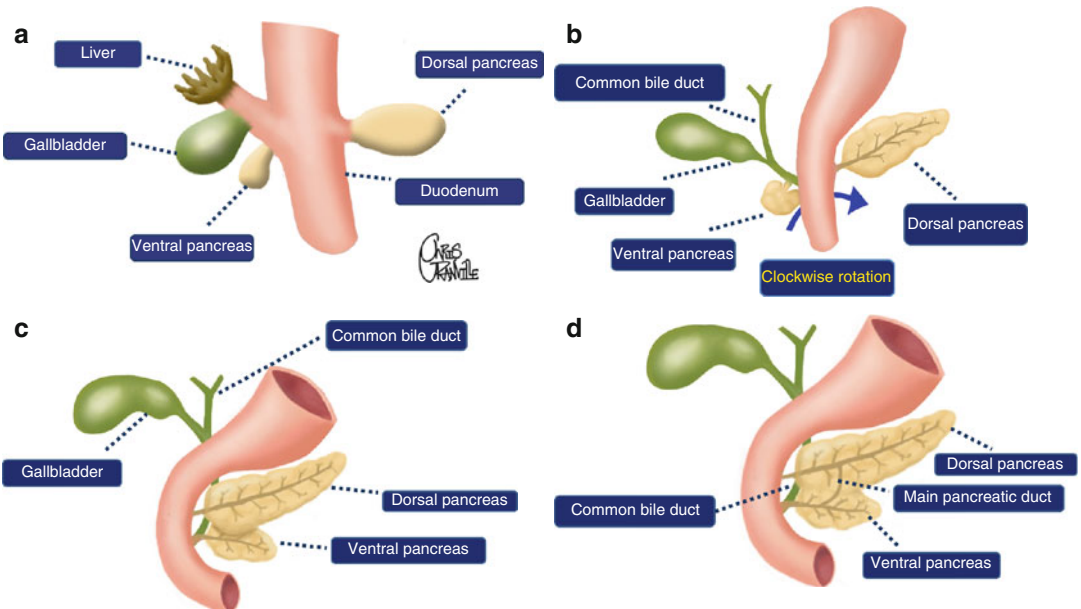
- It is the most common congenital anomaly of the pancreas.
- This anomaly can be associated with pancreatitis.
- Magnetic resonance cholangiopancreatography (MRCP) is the best imaging modality to diagnose this anomaly.
- Most patients with this anomaly are asymptomatic.

**Answers: 1. b, 2. e, 3. a, 4. e, 5. a.**

## 1.2 Organogenesis of the Pancreas (Fig. 1.1)

- It starts during the fourth week of gestation.
- The pancreas originates from the endodermal lining of the duodenum.
- Two outpouchings develop at the junction of the foregut and midgut:
  - One ventral bud (caudal)
  - One dorsal bud (cranial)
- The ventral pancreatic bud forms the posterior part of the head and the uncinus process.
- The dorsal pancreatic bud forms the anterior part of the head, body, and tail of the pancreas.
- The main pancreatic duct (Wirsung) is formed from the ventral duct and the distal portion of the dorsal duct.

- The accessory duct (Santorini) may be present due to the persistence of the proximal portion of the dorsal pancreatic duct.
- At the sixth week of gestation, as the foregut elongates, the ventral pancreas, gallbladder, and bile duct rotate clockwise posterior to the duodenum and join the dorsal pancreas.
- At the seventh week of gestation, the ventral pancreatic bud fuses with the dorsal bud, forming a single pancreas.
- The ventral pancreatic duct and the common bile duct (CBD) are linked by the embryonic origins, which results in the adult configuration of the common entrance into the duodenum at the major papilla.



**Fig. 1.1** Schematic illustration of the embryologic development of the pancreas. (a) At about 4 weeks of gestation, the primitive pancreas is formed by a dorsal pancreatic and ventral pancreatic bud that arises from the endodermal lining of the duodenum. (b) At 6 weeks, the ventral bud and the bile duct rotate clockwise behind the duode-

num (curved arrow). (c) The ventral pancreatic bud lays posteroinferior to the dorsal pancreatic bud. (d) By about 7 weeks, upon reaching its final destination, the dorsal pancreatic bud fuses with the ventral pancreatic bud to form the final pancreas