

PANCREATIC TRAUMA: The other abdominal injury



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OBJECTIVES

- ◉ Participants will have an increased understanding of:
 - Pancreatic anatomy
 - Pancreatic trauma facts & figures
 - Presentation of pancreatic trauma patients
 - Diagnosis of pancreatic injury
 - Treatment of pancreatic injury
 - Implications for EMS

WHY TALK ABOUT THIS?

- ◉ Pancreatic trauma is relatively infrequent
- ◉ Initially very hard to diagnose
- ◉ However, a delayed diagnosis can lead to a treatment challenge for the medical team and a potentially disastrous situation for the patient
- ◉ Important for EMS providers to develop an awareness of pancreatic trauma

■ **WHY?**

CASE STUDY

- ⦿ 26 year old male -high-speed rear impact motor vehicle collision
- ⦿ Seat belt separated from car at impact
- ⦿ Initial vital signs on scene
 - SBP 90 mm Hg, 140 HR, RR 30
 - Retrograde amnesia for event
 - c/o abdominal pain, left forearm pain

⦿ Upon arrival at ED

- 130/90, 130 HR, A&O x 3, GCS 15
- Abd soft, nondistended, mild tenderness to palpation both upper quadrants
- Ecchymosis- epigastric, RUQ
- Tenderness, deformity left forearm

- ◉ Radiography
 - Left radial fx
- ◉ Abdominal CT & ultrasound
 - Grade V liver laceration extending to portal vein
 - Grade III splenic laceration with large hematoma
 - Grade II right kidney injury
 - Small amount free fluid between posterior pancreas & splenic vein, suggestive of pancreatic injury
- ◉ ERP showed injury of minor pancreatic duct at junction of body & head of pancreas

- ◉ During ERP, became tachycardic, hypoxic
- ◉ Required fluid resuscitation, intubation
- ◉ Stabilized then to OR
- ◉ Operative findings
 - Large nonbleeding lacerations of liver & spleen
 - Retroperitoneal hematoma
 - Pancreatic head necrosis with surrounding saponification
- ◉ Pancreas debrided and drained

**REMEMBER THIS PATIENT'S PRESENTATION
FOR LATER**

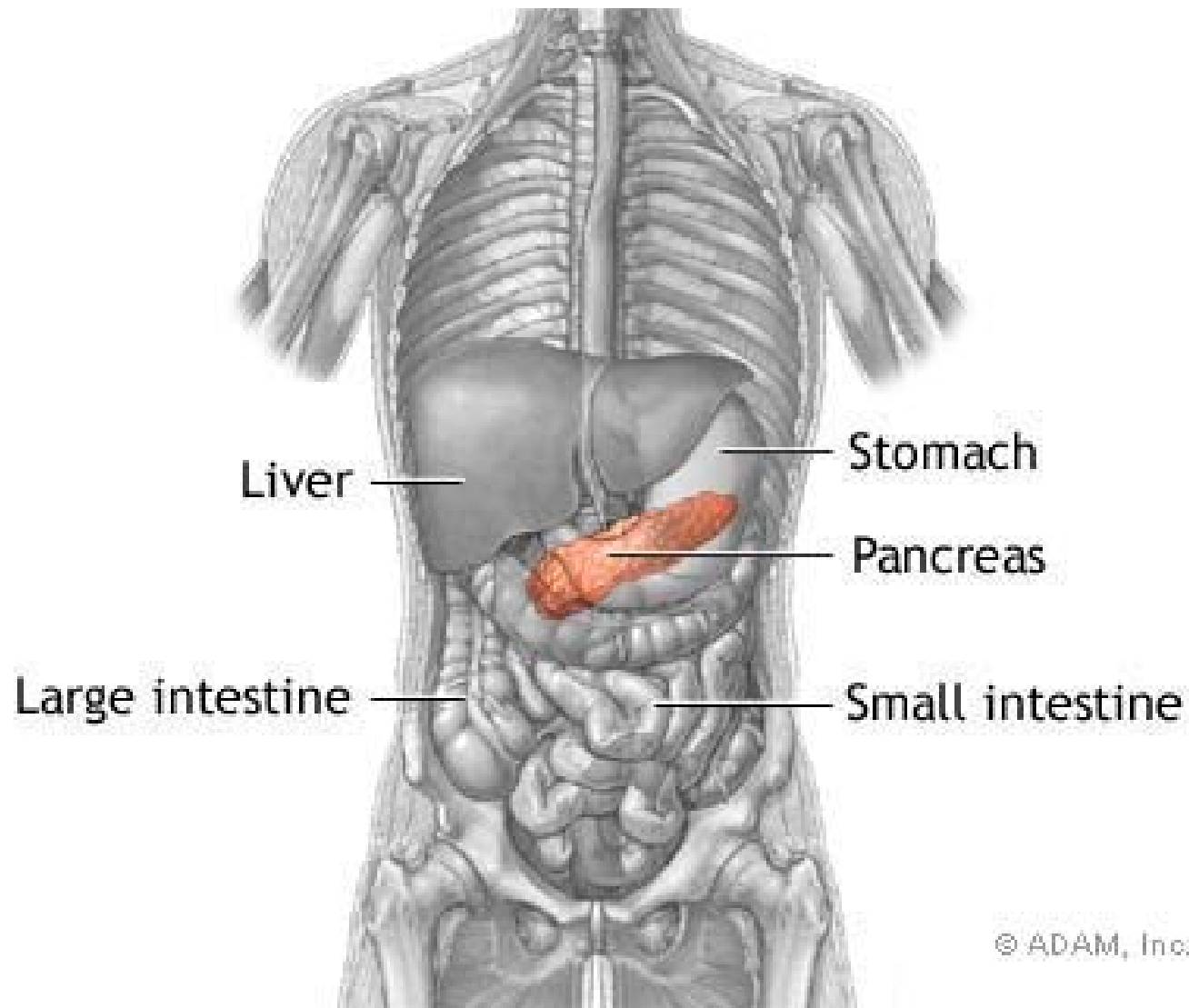
BRIEF OVERVIEW

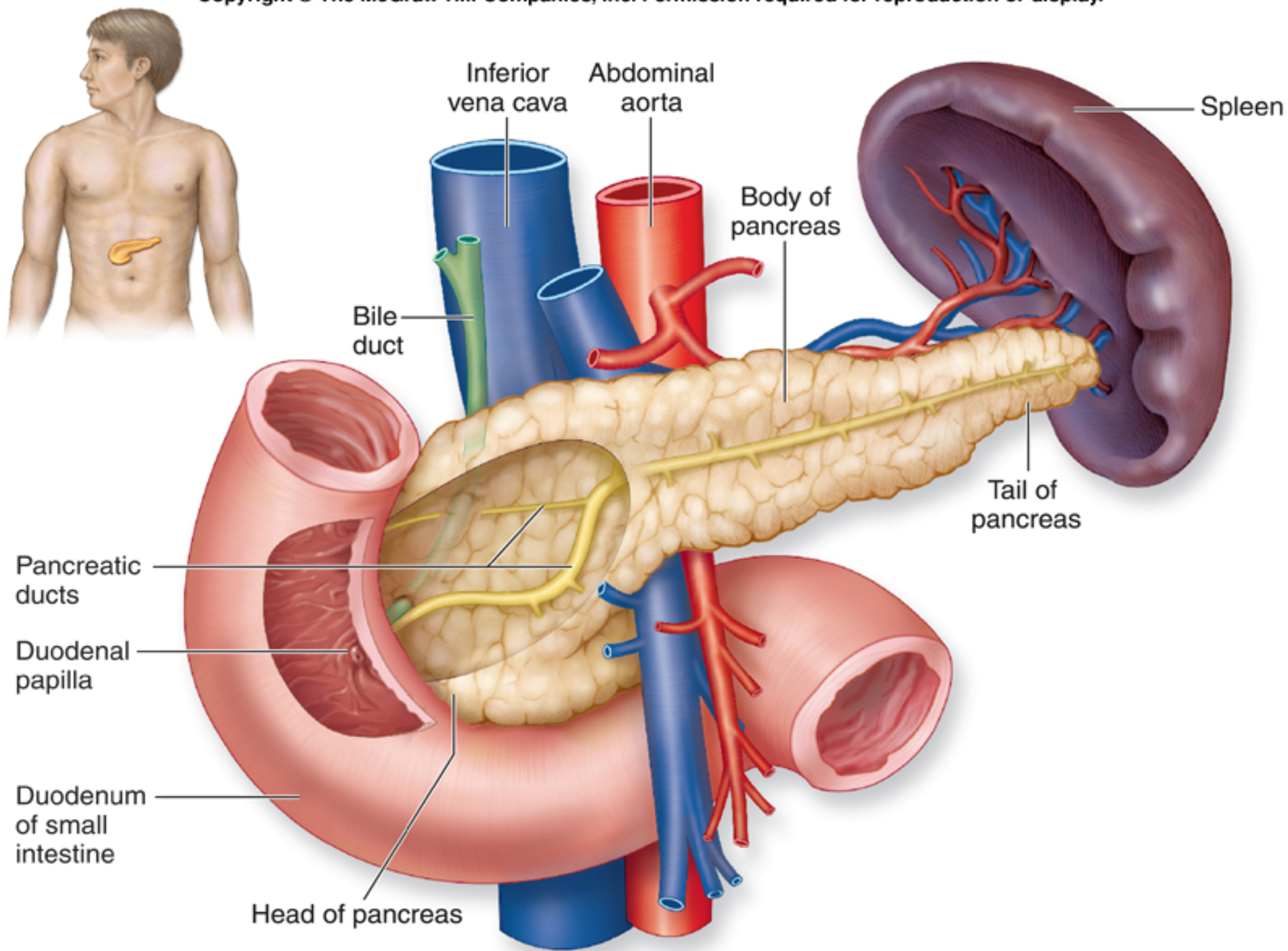
PANCREATIC ANATOMY & PHYSIOLOGY

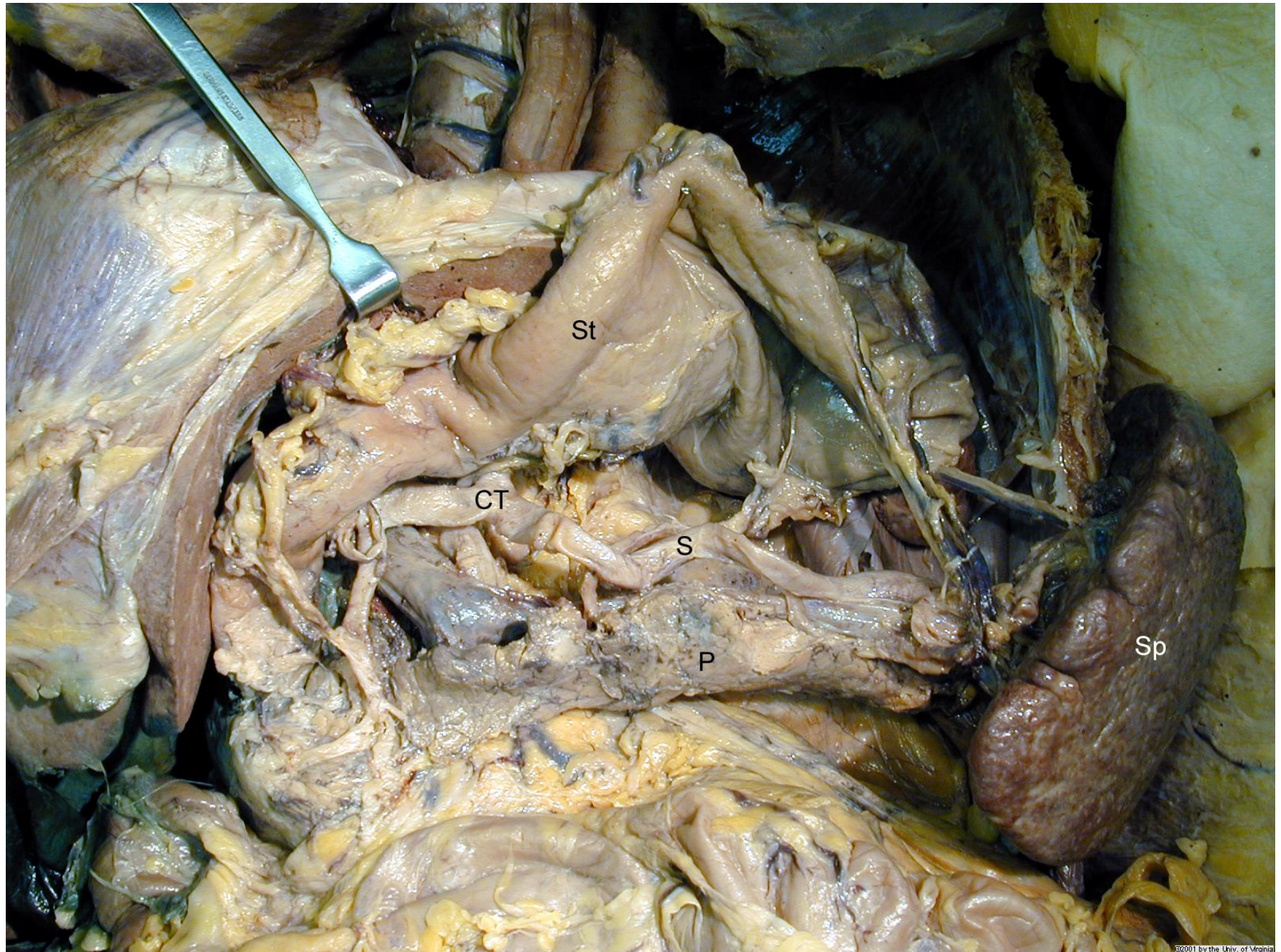


PANCREAS

- ◉ Gland with both exocrine and endocrine functions
- ◉ 6-10 inches in length
- ◉ 60-100 grams in weight
- ◉ Location: retro-peritoneum, 2nd lumbar vertebral level, across midline
- ◉ Extends in an oblique, transverse position
- ◉ Parts of pancreas: head, neck, body and tail
 - Head lies in curve of duodenum
 - Tail “tickles” the spleen







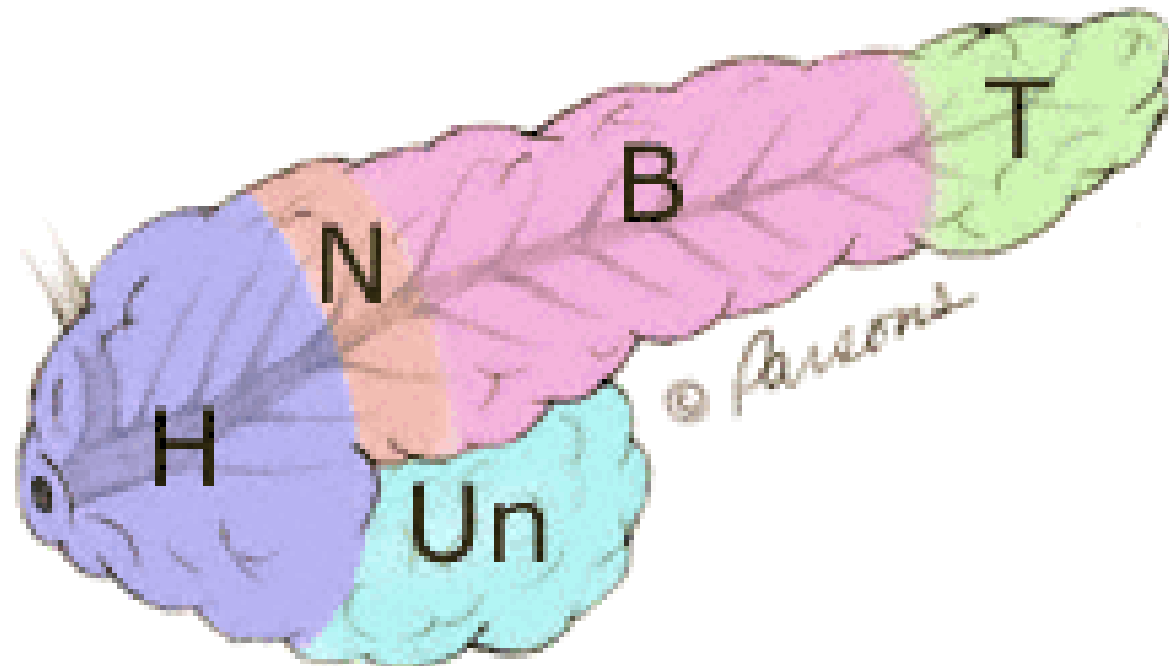
B=body

H=head

N=neck

T=tail

Un=uncinate



NECK OF PANCREAS

- ◉ 2.5 cm in length
- ◉ Antero-superior surface supports the pylorus
- ◉ Superior mesenteric vessels emerge from the inferior border
- ◉ Posteriorly, SMV and splenic vein confluence to form portal vein

BODY OF PANCREAS

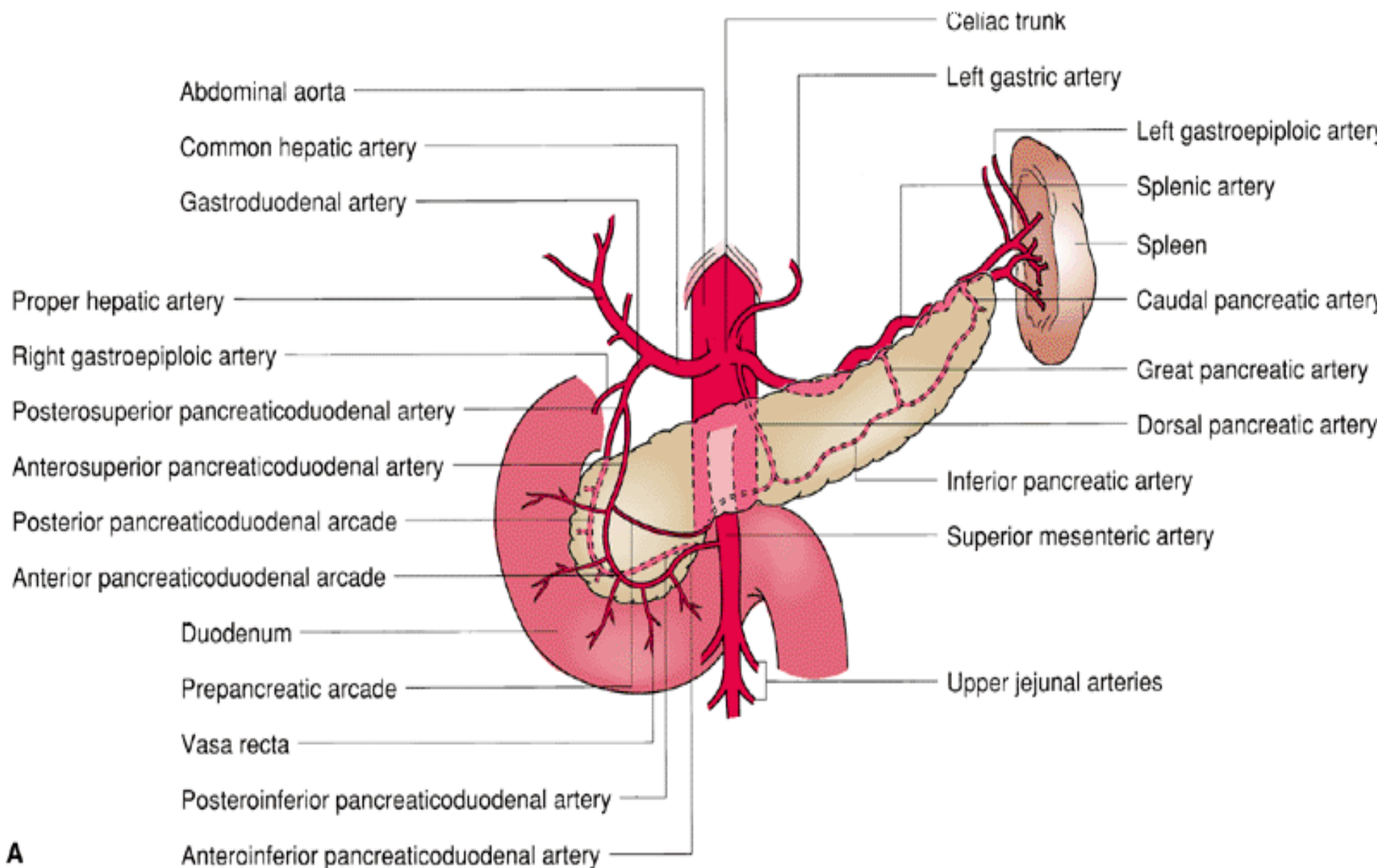
- ◉ Elongated, long structure
- ◉ Anterior surface, separated from stomach by lesser sac
- ◉ Posterior surface, related to aorta, lt. adrenal gland, lt. renal vessels and upper 1/3rd of lt. kidney
- ◉ Splenic vein runs embedded in the posterior surface
- ◉ Inferior surface is covered by transverse mesocolon

PANCREATIC DUCT

- ⦿ Main duct runs the entire length of pancreas
- ⦿ Joins common bile duct at the ampulla of Vater
- ⦿ 2 – 4 mm in diameter, 20 secondary branches
- ⦿ Lesser duct drains superior portion of head and empties separately into 2nd portion of duodenum

ARTERIAL SUPPLY OF PANCREAS

- ◉ Variety of major arterial sources
 - celiac, SMA and splenic
- ◉ Celiac → Common Hepatic Artery → Gastrooduodenal Artery → Superior pancreaticoduodenal artery which divides into anterior and posterior branches
- ◉ SMA → Inferior pancreaticoduodenal artery which divides into anterior and posterior branches
- ◉ Body and tail supplied by splenic artery by about 10 branches (can be up to 25)



A

EXOCRINE

- ◉ Constitutes 80% to 90% of the pancreatic mass
- ◉ Colorless, odorless, and isosmotic alkaline fluid that contains digestive enzymes (amylase, lipase, and trypsinogen)
- ◉ Inactive as move through pancreatic duct to bile duct
- ◉ Activated when enter duodenum

PHYSIOLOGY - EXOCRINE PANCREAS

- ⦿ 500 to 800 ml pancreatic fluid secreted per day
- ⦿ Enzymes digest carbohydrates, proteins, and fats
- ⦿ Alkaline pH results from secreted bicarbonate which serves to neutralize gastric acid and regulate the pH of the intestine

ENZYMES

⦿ Amylase

- only digestive enzyme secreted by the pancreas in an active form
- functions optimally at a pH of 7
- hydrolyzes starch and glycogen to glucose, maltose, others

⦿ Lipase

- function optimally at a pH of 7 to 9
- emulsify and hydrolyze fat in the presence of bile salts

IF PANCREATIC ENZYMES LEAK

⦿BAD NEWS FOR PATIENT

- ⦿ **Digest fat**
- ⦿ **Surrounding tissue**
- ⦿ **Saponification, necrosis**

ENDOCRINE

- ⦿ Accounts for only 2% of the pancreatic mass
- ⦿ Nests of cells - islets of Langerhans
- ⦿ Four major cell types
 - Alpha (A) cells secrete glucagon
 - Beta (B) cells secrete insulin
 - Delta (D) cells secrete somatostatin
 - F cells secrete pancreatic polypeptide
- ⦿ Secreted into blood capillaries instead of ducts

INSULIN

- ◉ Synthesized in the B cells of the islets of Langerhans
- ◉ 80% of the islet cell mass must be surgically removed before diabetes becomes clinically apparent

GLUCAGON

- ◉ Secreted by the A cells of the islet
- ◉ Glucagon elevates blood glucose levels through the stimulation of glycogenolysis and gluconeogenesis

SOMATOSTATIN

- ◉ Secreted by the D cells of the islet
- ◉ Inhibits the release of growth hormone
- ◉ Inhibits the release of almost all peptide hormones
- ◉ Inhibits gastric, pancreatic, and biliary secretion
- ◉ Used to treat both endocrine and exocrine disorders

EXCITING STATISTICS

- ◉ Overall rate of blunt pancreatic injury seen in Level I trauma centers is relatively low
- ◉ Pancreas estimated to be 10th most injured organ
 - Usually requires significant force
- ◉ Of 100 patients with blunt trauma, fewer than 10 will have documented pancreatic injury

BLUNT TRAUMA

- ◉ Relatively protected position high in retroperitoneum
- ◉ Injured much less frequently with typical blunt trauma (MVC, sports, etc) than spleen and liver
- ◉ MVC's are cause of 90% of major non-penetrating injuries of pancreas
- ◉ 50% of those from impact of steering column on upper abdomen
- ◉ Compressed against vertebra
 - Often causes transection

PENETRATING TRAUMA

- ◉ Incidence of pancreatic injury with penetrating trauma is much higher
- ◉ GSW, stabbings to back, flank and abdomen frequently include pancreatic injury
 - 20-30% of patients with penetrating trauma
- ◉ Highest frequency of pancreatic injury occurs from GSW and is almost always associated with concurrent injury to other abdominal organs

KEY POINT WITH PANCREATIC TRAUMA

- ◉ Because the blunt force required to injure the pancreas is so significant and penetrating trauma usually injures multiple organs, a pancreatic injury is rarely a solitary injury
- ◉ Multiple organ injury is a red flag suggesting the possibility of a pancreatic injury.

- ◉ In one multi-year review, in only 2% of closed abdominal injuries was a major pancreatic laceration the only injury
- ◉ Because of anatomic position, isolated pancreatic injury may occur with penetrating trauma to the midback (stabbing, impalement)

MORBIDITY & MORTALITY

- ◉ Many blunt pancreatic injuries are not immediately recognized
- ◉ So higher morbidity and mortality rates
- ◉ Not so much with penetrating because usually mandates emergency surgical exploration

MORBIDITY & MORTALITY

- ◉ Delay of diagnosis of blunt pancreatic injury more than 24 hours has been reported as the leading cause of increased morbidity
- ◉ Major ductal injuries result in mortality rates of 13-31%, increasing with number of associated vascular injuries
- ◉ Overall mortality

PRESENTATION

- ◎ **PANCREATIC INJURY CAN BE FRIGHTENLY SYMPTOM FREE** early post-injury
- ◎ No signs, symptoms, lab findings specific to pancreatic injury
- ◎ Symptoms of injury to other structures commonly mask or supersede those of pancreatic injury
- ◎ Notoriously difficult to detect by physical findings and as illustrated by our case study, patients may have minimal (or nebulous) physical signs

PRESENTATION

- ⦿ High index of suspicion based on location of trauma/injury
 - Seat belt marks
 - Flank ecchymosis
 - Penetrating injuries (flank, mid back)
- ⦿ Trauma from anterior-posterior force vector with deceleration and an anterior truncal seat belt mark
 - aortic, small bowel, pancreas

PRESENTATION

- ◉ Epigastric pain out of proportion to physical findings could be one possible sign of pancreatic injury
- ◉ May see abdominal distension, signs of peritoneal irritation, retroperitoneal fluid or air, pleural effusion, back pain

POSSIBLE INJURIES TO PANCREAS

- ◉ Simple puncture of body or tail of pancreas
 - highly complex & difficult injury
- ◉ Injury to pancreatic head with involvement of biliary & pancreatic ductal systems
- ◉ Proximity of portal vein, abdominal aorta & inferior vena cava to pancreatic head increases risk of exsanguinating hemorrhage
 - Exsanguinating hemorrhage due to concurrent vascular injury accounts for greatest number of deaths in patients with pancreatic trauma

COMMON ASSOCIATED INJURIES

- ◉ Spleen
- ◉ Liver, common bile duct
- ◉ Stomach
- ◉ Intestinal- duodenal, colon
- ◉ Diaphragm
- ◉ Ribs
- ◉ Spinal
 - With isolated injury from blunt trauma, spinal fracture usually seen with small children
 - Caused by direct abdominal blows from malpositioned seat belts or child abuse
- ◉ Head- simply based on common MOI

DIAGNOSIS OF PANCREATIC INJURY

- ⦿ Physical findings?
- ⦿ Routine chest, abdominal X-rays?
- ⦿ Peritoneal lavage?
- ⦿ CT scan- inaccurate, incomplete
 - Read as negative in up to 40% of pts with operatively proven pancreatic injury
 - Can be suggestive of pancreatic injury- fluid between splenic vein & posterior border of pancreas

DIAGNOSIS

- ⦿ Ultrasound

- Prehospital?
- Not helpful with acute injury

- ⦿ ERP or ERCP

- Endoscopic retrograde cholangiopancreatography
- Direct visualization of biliary tract
- Injection of radiographic dye into ducts
- Absence or presence of ductal injury

LABORATORY FINDINGS

- ⦿ Serum amylase levels
 - Persistently elevated or rising levels after blunt abd injury may be a sign of pancreatic injury
- ⦿ Poor correlation between actual level of amylase and extent of pancreatic damage
- ⦿ Enough to prompt further testing
 - Elevations can also be caused by duodenal or hepatic injury or pt intoxication

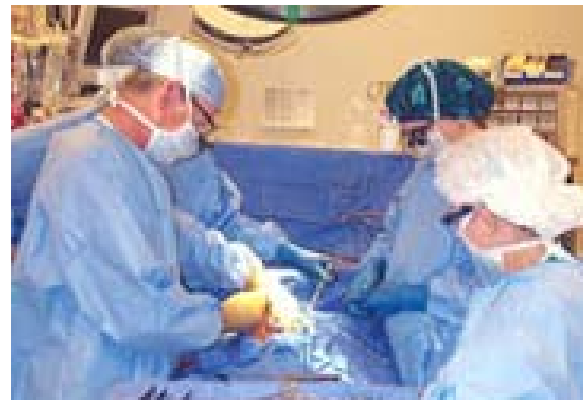
PREHOSPITAL TREATMENT

- ⦿ Prehospital care dependent on MOI and pt presentation
 - PMH, meds, physical exam
- ⦿ **RAPID TRANSPORT**
- ⦿ Maintain airway, oxygenation
- ⦿ Pain control??
- ⦿ Q 5 min vitals
- ⦿ Resuscitation and support as needed

Trust your judgment!!!

HOSPITAL COURSE

- ◉ Operative management remains the rule
- ◉ Rapid hemorrhage control
- ◉ High index of suspicion and recognition of pancreatic injury



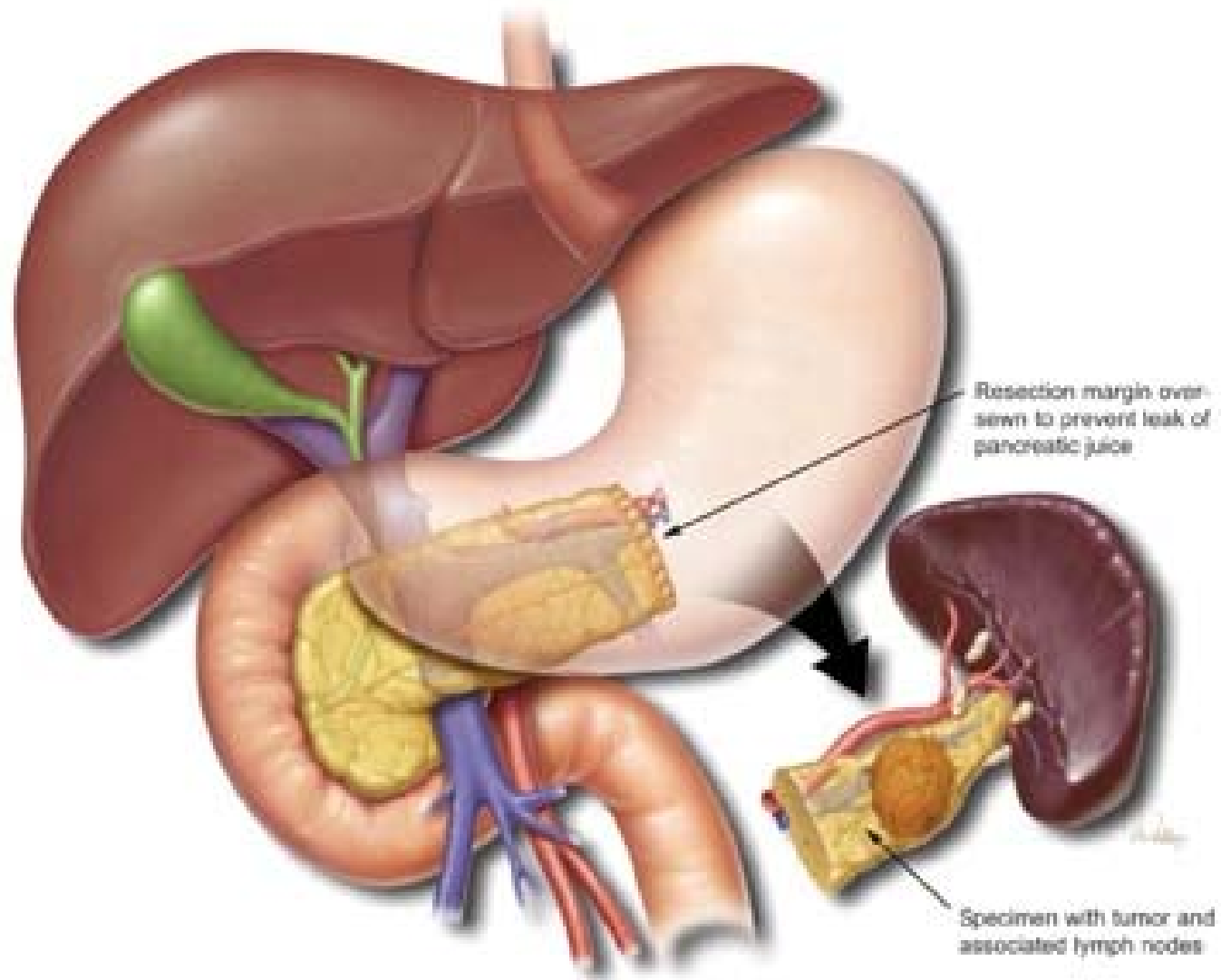
TREATMENT OF PANCREATIC TRAUMA

- ⦿ Prohibitive morbidity of conservative management makes surgery the treatment of choice
- ⦿ Presence of retroperitoneal hematoma isn't always recognized as significant evidence for pancreatic injury

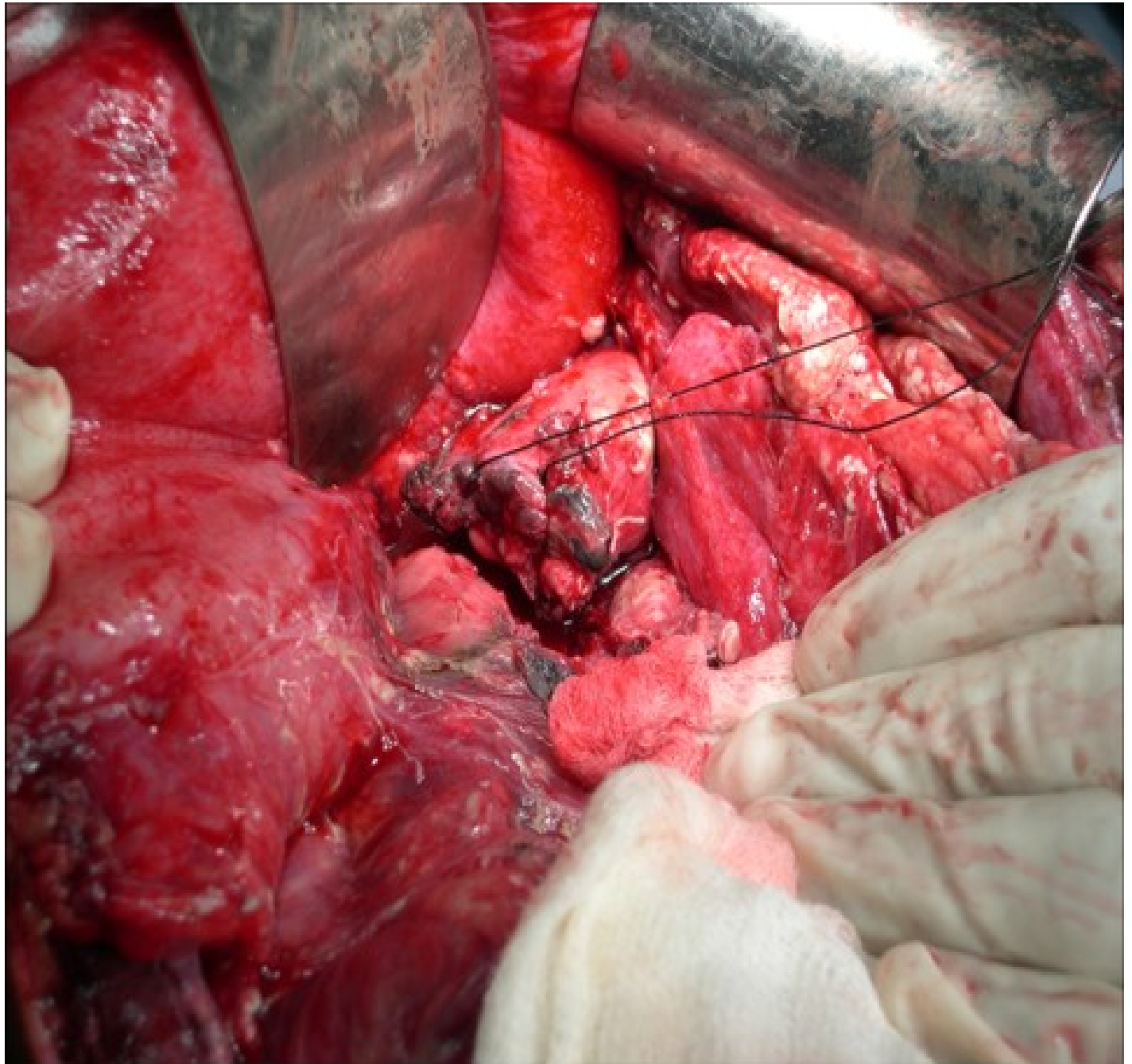
TREATMENT

- ◉ Conservative resection of pancreas is likely to be followed by leakage of enzymes and further tissue destruction
- ◉ Attempts to reconstruct a damaged pancreatic duct system are not justified
 - Little morbidity from distal pancreatectomy
 - Do splenectomy?
 - Endocrine & exocrine deficiency are small and transient
 - Easier to achieve hemostasis

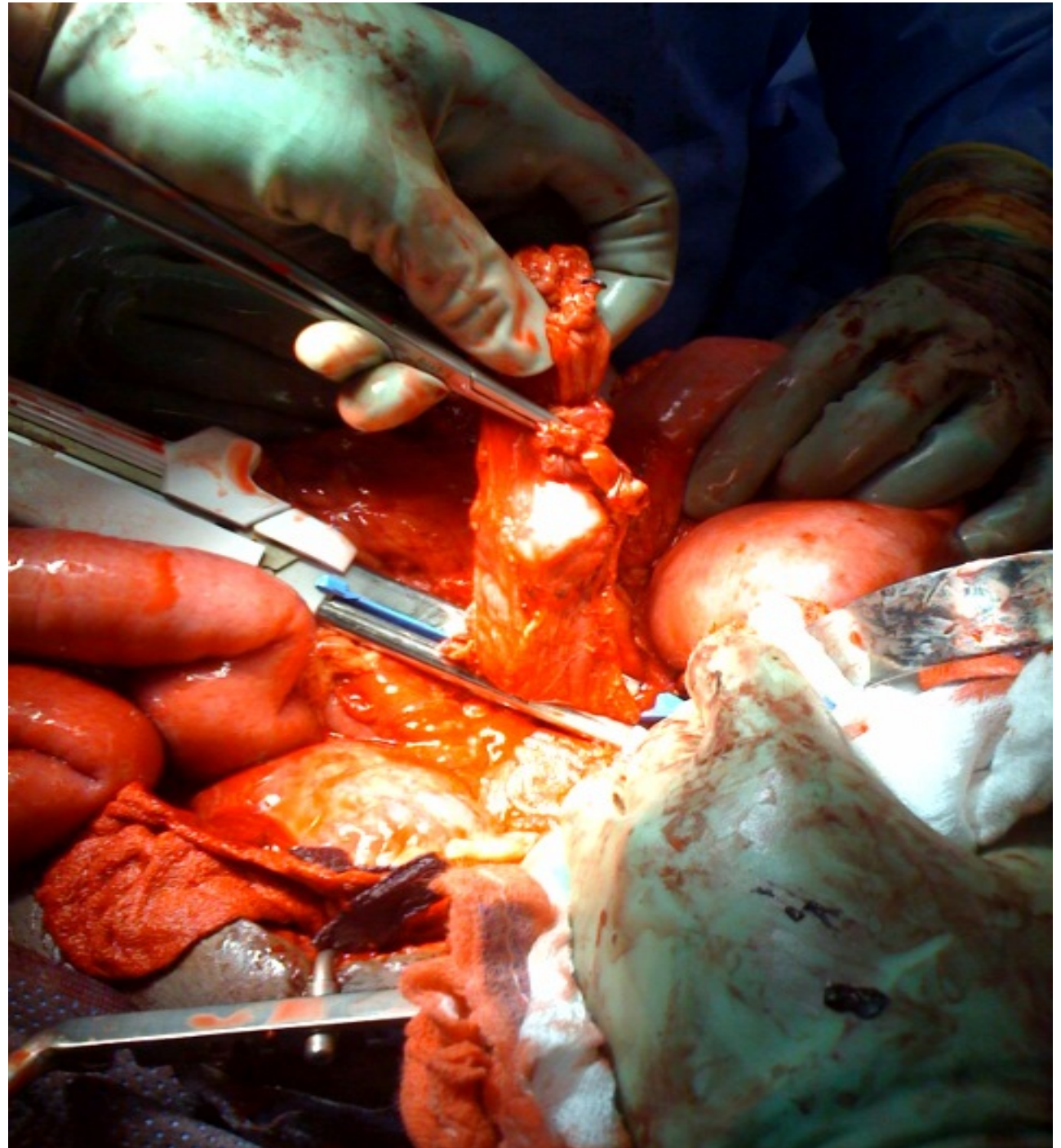
- ◉ Grade 1- contusion/hematoma
 - Simple drainage
- ◉ Grade 2- minor capsular disruption
 - Debridement, drainage
- ◉ Grade 3- major ductal injury
 - Distal pancreatic resection
- ◉ Grade 4- severe crush injury
 - Debridement, drainage and/or resection depending on exact location of injury
- ◉ Whipple ([pancreatoduodenectomy](#))
 - required for up to 3% of isolated pancreatic injuries and 10% of severe pancreatoduodenal trauma



**TRANSECTED
NECK OF
PANCREAS**



DISTAL PANCREATECTOMY



COMPLICATIONS

- ◉ 70% related to vascular injury
- ◉ Hemorrhage
- ◉ Infection, sepsis
- ◉ Fistula
- ◉ Pseudocyst
- ◉ Abscess
- ◉ Others
 - Paralytic ileus, gastric outlet obstruction, ARDS
 - Peritonitis secondary to extravasation of activated pancreatic enzymes- high mortality

IMPACT OF PRE-EXISTING CONDITIONS

- ◉ Unlike spleen, few data suggest that pre-existing diseases of the pancreas result in higher risk of injury or higher mortality rate when pancreas is injured
- ◉ Pre-existing pancreatitis or diabetes negatively affects the overall mortality and morbidity rates
- ◉ Post-injury development of pancreatitis or diabetes mellitus is associated with a significant increase in morbidity and mortality rates

CASE STUDIES



PATIENT # 1

- ⦿ 26 yo female, stepped on by horse over midline upper abdomen
- ⦿ Initial physical exam remarkable only for slight upper abdominal tenderness
- ⦿ During transport, c/o increasing epigastric & back pain with nausea
- ⦿ Developed diffuse abd tenderness and rigidity

- ◉ Trauma surgeon suspects closed pancreatic injury
- ◉ Exploratory laparotomy
 - large retroperitoneal hematoma
- ◉ Further exploration revealed body of pancreas was completely transected just to left of portal vein
 - Gross peripancreatic fat necrosis
- ◉ Splenectomy and distal pancreatectomy performed
- ◉ Many complications, including ARDS, infections, DIC
- ◉ Discharged day 31

PATIENT # 2

- ⦿ 28 yo male mechanic run over by truck while laying on his back, partially beneath another motor vehicle
- ⦿ Wheel of truck passed over his mid-abdomen
- ⦿ Pt demonstrated immediate signs/symptoms of severe shock and was treated appropriately by EMS providers

- ⦿ Upon arrival to hospital, taken for immediate laparotomy without further investigation due to clear evidence of continuing intraperitoneal bleeding
- ⦿ Apparent source of bleeding was tear in transverse mesocolon, which was still bleeding
- ⦿ Large retroperitoneal hematoma noted, but lesser sac not explored
- ⦿ No other lesions noted at that time

POST-INJURY DAY 11

- ◉ Continued deterioration even with assisted ventilation & antibiotic therapy
- ◉ Surgical exploration of lesser sac and abscess cavity
- ◉ Pancreas had been transected at level of neck and was gangrenous
- ◉ Lesser sac was filled with infected hematoma and necrotic tissue
- ◉ Distal pancreatectomy & splenectomy were performed with drainage
- ◉ Slow pt improvement with discharge after 11 weeks

PATIENT # 3

- ◉ 19 yo logger sustained blunt abdominal trauma when crushed under falling timber
- ◉ On scene-Pale, 90/60, no external signs of injury
- ◉ Upon arrival at ED, c/o mild abdominal pain with mild epigastric tenderness with no guarding or rigidity
 - 120/70, 110
- ◉ Normal chest x-ray, free fluid seen on abdominal ultrasound, but no organ injury seen
- ◉ Managed conservatively

- ◉ 8 hours later, developed increasing abd distension with guarding and rigidity
- ◉ Exploratory laparotomy done at 24 hours post-injury
 - 600 cc intraperitoneal blood
 - Liver lac
 - Transection of pancreas at neck
 - Distal pancreatectomy with splenectomy

SUMMARY

- ⦿ Rapid transport, high index of suspicion
- ⦿ Prompt, early operative management
- ⦿ NOM can increase complications
 - No change to outcomes in pancreatic injury over the past 20 years
- ⦿ Delay of > 24 hours will significantly increase complications, length of stay, mortality
- ⦿ Common complications include vascular injuries with hemorrhage, fistula, abscess

QUESTIONS???

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