Solving the Mystery of Triads: The Beautiful Threesomes of Radiology

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Purpose

• Several disease processes can present as constellations of clinical, laboratory, & radiological findings - known as triads
• The clinical significance of each triad varies
• Many times, initial imaging findings may incite further investigation, such as advising CT abdomen contrast study in a patient with pulmonary chondroma to look for gastrointestinal stromal tumors and extra-adrenal paraganglioma

Our goal is to present cases in quiz format of several classic triads to assist in review of conditions & to sharpen the acuity of the radiologist’s eye to suggest further imaging when needed to aid in diagnosis
Case

- 26 year-old male who presents with shortness of breath and chest pain
- History of sickle cell disease

Bilateral lower lobe infiltrates, pleural effusions, cardiomegaly, and auto-splenectomy

What is the name of triad?

Acute Chest Syndrome

Case: What is the name of triad?

- 44 year old man with right upper quadrant pain with acute onset after eating a fatty meal, vomiting, and fever
- Also seen with possible leukocytosis, fever, elevated transaminases

Sonographic and CT Findings (Triad):
- Pericholecystic fluid
- Gallbladder wall thickening
- Positive USG murphy’s sign

Answer: Acute Cholecystitis Triad

Case: What is the name of triad?

Cardiomegaly with pericardial tamponade. Patients also had distended neck veins

Answer: Beck’s Triad (1935)

- It's components are:
  - Distended neck veins
  - Distant heart sounds
  - Hypotension
- Seen with rising venous pressure, falling arterial pressure, and decreased heart sounds

Case What is the name of triad?

61 year old male with shortness of breath & altered mental status

Bergman’s Triad (1873)

Bergman’s triad is seen with fat emboli syndrome and consists of
• Mental status changes
• Petichiae
• Dyspnea

Left proximal femoral fracture.  
Left-sided Hampton’s hump and pulmonary arterial filling defects.

Capp Triad refers to the constellation of clinical and imaging findings in patients with retropharyngeal haematomas, and consists of:

1. Tracheal and esophageal compression
2. Anterior displacement of the trachea
3. Subcutaneous bruising over the neck and anterior chest

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Case

- 48-year-old man presenting with acute onset of retropharyngeal pain, dysphonia, dyspnea, and dysphagia
- Status post MVC
- Clinical examination: Neck bruise

Large retropharyngeal hematoma (red arrows) compressing and pushing oropharyngeal airway (yellow arrows)

Case: What is the name of triad?

- 31-year-old male who presented with diarrhea, lower extremity edema, and “hot flashes”

Small bowel mass in the right lower quadrant and multiple hypodense hepatic lesions

Answer: Carcinoid Triad

- Classic "carcinoid triad" includes flushing, diarrhea, and cardiac involvement
- The hormone largely responsible for most of these symptoms is serotonin

Case: What is the name of triad?

34 year old female presented with abdominal pain

Further imaging was done which showed multiple gastric masses (GISTs) (blue arrows), pulmonary chondroma (green arrow), and left adrenal tumor (yellow arrow).

Answer: Carney’s Triad (1977)

Triad: Multifocal gastrointestinal stromal tumors (GISTs) (97%), Pulmonary chondromas (83%), & Extra-adrenal paragangliomas (53%)

- 33% have all three findings
- 10x more common in females
- Paraganglioma usually nonfunctional
- Screening of family members not recommended

Case

56-year-old male presented with **triad** of **with RUQ pain, fever and jaundice**

**Imaging findings**
- Biliary Obstruction
- Enhancing Duct Walls
- Cholangitic abscesses
- Managed with PTBD

**What is the name of triad?**

**Answer:** Charcot’s Cholangitis Triad

Case: What is the name of triad?

28-year-old female with weakness and tremor
Also had staccato speech, nystagmus, & Intention tremor (triad)

- Multiple T2 hyperintense demyelinating plaques within the callosal, pericallosal, & subcortical white matter, & in the cervicothoracic spinal cord.

Answer: Charcot’s Neurologic Triad

- Associated with multiple sclerosis
- Named after Jean-Martin Charcot

Case: What is the name of triad?

- 65-year-old male presented to the emergency center with severe mid thoracic pain, hematemesis, and hemodynamic instability

Non-contrast, arterial, and venous axial CT images of the chest demonstrate a large aorto-enteric fistula and thoracic aortic aneurysm

Answer: Chiari’s Triad (1914)
Aortoesophageal fistula and hematoma

Aortic diseases associated with esophageal fistula and consequent hematoma includes
- Thoracic aortic aneurysm
- Penetrating aortic ulcer and aortic dissection
- Prosthetic graft

Case: Child with deformity


Currarino syndrome is an autosomal dominant disorder, characterized by triad of partial agenesis of the sacrum with additional pelvic malformation – anal atresia and presacral teratoma. Presentation may be delayed to childhood, and even young adulthood. There is also a risk for malignant degeneration of the presacral teratoma.
Case: What is the name of triad?

Hint: This triad suggests a cerebral hemorrhage in the setting of trauma or an space occupying lesion (e.g. brain tumor) that is growing and a possible impending fatal herniation of the brain.

Red arrows - Hemorrhagic contusions
Yellow arrows - Vasogenic edema
Green arrow - Tonsillar herniation

Answer: Cushing’s Triad

- **Triad**: altered mental status, bradycardia, irregular breathing (impaired brainstem function), and systolic hypertension (widening pulse pressure)
- Clinical **triad** with variable physiological nervous system response to increased intracranial pressure

Case: What is the name of triad?

- A 3 week old infant with vomiting, jaundice, pale stools, & dark urine
- A right upper quadrant USG & nuclear HIDA scan was performed

USG findings (Triad)
- Atretic gallbladder, length less than 19 mm
- Lack of smooth/complete echogenic mucosal lining with an indistinct GB wall
- Irregular or lobular liver contour

Answer: Gall Bladder Ghost Triad
Biliary Atresia

Case

• 35 year old female presented with fatigue, cough, intermittent shortness of breath, and swollen lymph nodes

CXR and axial CT images of the chest demonstrate the “1-2-3 sign” also known as “Pawnbreaker’s sign,” characterized by bulky right hilar lymphadenopathy (blue arrow), left hilar lymphadenopathy (green arrow), and right para-tracheal lymphadenopathy (yellow arrow).

What is the name of triad?

Answer: Garland Triad

Case: What is the name of triad?

47-year-old male presented with concern for pneumonia

Answer: Kartananger syndrome

Initially described in 1904 by Siewert. Also known as immotile cilia syndrome.

**Triad:** situs-inversus, chronic sinusitis, and bronchiectasis

Other findings: Male infertility and lack of smell

Patients present with repeated chest infections and can be clinically confused with immunodeficient conditions.
Case: What is the name of triad?

- 58-year-old female presents with sepsis and a right-sided neck mass and pain

- Extensive soft tissue infection of the neck (yellow arrow)
- Thrombosis of the right internal jugular vein (blue arrows)
- Septic pulmonary emboli and parenchymal infection (red arrows)

Answer: Lemierre’s Syndrome

Diagnosis rests on a high index of suspicion and is confirmed by culture of Fusobacterium spp. from blood or infected sites.

Case: What is the diagnosis?

- 69-year-old man presenting with **triat** of intermittent claudication, impotence & diminished peripheral pulses

Reconstructed MDCT coronal, sagittal, and SSD images showing aortic occlusion (**blue arrows**) and multiple collaterals (**yellow arrows**)

Diagnosis: Leriche Syndrome

- Aortoiliac occlusive disease: Atheromatous occlusion of the infrarenal aorta, common iliac arteries, or both
- First described by French Surgeon Rene Leriche as a thrombotic occlusion of the end of the aorta with a **unique triad** of claudication, impotence, and decreased peripheral pulses

Case: What is the name of triad?

- 47 year old male who presents with severe chest pain after vomiting secondary to excessive alcohol use

  Pneumomediastinum, pneumothorax, (yellow arrows) left pleural effusion with mild esophageal wall thickening and irregularity with contrast extravasation into the left hemi-thorax (blue arrows)

Answer: Mackler’s Triad (1724)

- **Mackler's triad**: Vomiting, chest pain, & subcutaneous emphysema
- Indicates Boerhaave’s syndrome, also known as esophageal rupture secondary to forceful vomiting and retching

Case: What is the name of triad?

- A 35 year old female, G2P2, presented with weight loss, increasing abdominal circumference, and palpable pelvic mass.

Answer: Meigs’ Syndrome (1937)

**Meigs syndrome** is defined as the presence of ascites and pleural effusion/hydrothorax in association with a benign, usually solid, ovarian tumor usually an ovarian fibroma (80-90%).

Case: What is the name of triad?

O'Donoghue's unhappy triad

- Results from valgus stress with rotation of the knee
  - ACL, MCL, MEDIAL MENISCUS TEAR

Case: What is the name of triad?

• Newborn baby boy with abdominal distention and undescended testes
Prune belly syndrome, also known as Eagle Barrett syndrome or triad syndrome, is a rare anomaly comprising a specific constellation of features.

**Three major findings:**
- gross ureteric dilatation
- anterior abdominal wall maldevelopment (giving "prune belly" appearance)
- bilateral undescended testes

Other associations include respiratory, gastrointestinal, musculoskeletal, and cardiovascular anomalies.

Case

- 38-years-old female presenting with the **triad** of sustained hypertension, hematuria and postmicturition syncope

What is the diagnosis?

Bladder pheochromocytoma presenting as hypertensive emergency

- Arise in the paraganglia of the visceral (autonomic) nervous system
- Location: submucosal either dome or posterior wall, close to the trigone
- Imaging is useful in localization and for determining multiple sites or metastases

What is the name of triad?

Saint’s Triad

Saint's triad is a medical condition of concurrence of the following:
- Cholelithiasis
- Hiatal Hernia
- Colonic Diverticulosis Diverticular disease

Case: What is the name of triad?

- 10 year old male with elbow injury

Radiographic findings:
- Posterior elbow dislocation
- Coronoid process fracture
- Radial head fracture

Terrible Triad of the Elbow

- The terrible triad of the elbow is a severe elbow fracture-dislocation pattern and is so-called because it has poor medium-to-long term outcome

Case: Identify findings and triad

- 3-year-old female with history of congenital heart disease
  - Pulmonary valve stenosis
  - Right ventricular hypertrophy
  - Atrial Septal Defect

Trilogy of Fallot

Case: What is the name of triad?

45-year-old woman with pain in abdomen

Arrows
- Pneumobilia (yellow)
- Small bowel obstruction (red)
- Gallstone (blue)

Rigler’s triad in gallstone ileus

Lassandro Francesco et al. “Role of Helical CT in Diagnosis of Gallstone Ileus and Related Conditions.” Am. J. Roentgenol. 185, no. 5 (November 1, 2005): 1159-1165
Case: What is the name of triad?

- 38 year old female on oral contraceptive pills presents with left lower extremity pain and edema after an overseas flight

Answer: Virchow Triad

- **Virchow's triad** describes 3 broad categories of factors that contribute thrombosis:
  - Hypercoagulability
  - Hemodynamic changes to flow (stasis, turbulence)
  - Endothelial injury/dysfunction

Case

15 yo male, MV vs. pedestrian

What is the name of the triad?

Waddell’s Triad

- Femur fracture
- Intra-abdominal or intra-thoracic injury
- Head injury

Case

33-year-old obese female with right upper quadrant pain

Single thin curvilinear hyperechoic line representing gallbladder wall & near surface of gallstone with posterior acoustic shadowing distal to the gallstone

What is the name of triad?

"WES" – Wall Echo Shadow Triad

The "WES" triad is the demonstration of the gallbladder Wall, Echo of the stone, and the acoustic shadow. It permits the specific diagnosis of stones in a contracted gallbladder & helps to differentiate the contracted gallbladder with stones from a gas filled bowel loop

Case: What is the name of triad?

Two different patients with severe hypoglycemia & immediate response to IV glucose

Whipple’s Triad

Whipple triad is the clinical presentation of pancreatic insulinoma

- Fasting hypoglycemia (<50 mg/dl)
- Symptoms of hypoglycemia
- Immediate relief of symptoms after the administration of IV glucose

Case 25: What is the name of triad?

41 year old female with left flank pain

**Answer: Xanthogranulomatous Pyeleonephritis**

- Classic radiology triad of
  - Unilateral large kidney
  - Renal pelvis stone
  - Nonfunctioning or poorly functioning kidney

Case: What is the name of triad?

37-year-old male presented with perineal pain, recurrent prostatitis, painful ejaculation, and infertility

Answer: Zinner Triad (1914)

Maldevelopment of the distal part of the mesonephric duct results in atresia of the ejaculatory duct (leading to obstruction and dilatation of the seminal vesicle) while abnormal ureteral budding (leads to renal agenesis/dysplasia)


Thank you