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The Gallbladder Beyond the Stones

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- To exemplify some situations in wich gallbladder diseases not related to stones can be misinterpreted;
- To highlight the radiological aspects of these situations and their therapeutics implications.
- To demonstrate that the knowledge of their main imaging findings may avoid misdiagnosis and impact the conduction of the cases.

Multiple gallbladder diseases not related to stones will be discussed, including: Vascular and Less frequent Malignant Development Miscelania inflammatory lymphatic neoplasias anomalies abnormalities changes Adenomyomatosis Duplication Gangrenous Mucinous neoplasia cholecystitis Lymphangioma Polyps **Multiseptated** Hemorrhagic Gallbladder bleeding Lymphoma cholecystitis Ectopic Reactional edema Gallbladder varices **Xanthogranulomatous** Melanoma cholecystitis Agenesis Volvulus





A. MR coronal T2-weighted

B. MR axial T2-weighted

C. 3D MRI cholangiopancreatogram

Two pear-shapped structures with high T2 signal intensity (arrows in A, B and C) in gallbladder fossa, findings compatible with **DUPLICATED GALLBLADDER**, with separated cystic ducts (C).

Gallbladder Duplication

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Teaching points

- Increased risk of laparoscopy related complications
- Can be associated with the development of cholelityasis
- Two types:
 - Bi-lobed gallbladder
 - Double gallbladder

• Key findings

• 2 separated gallbladders with their own cystic ducts (arrows)





A. MR coronal T2-weighted

B. MR SSFP coronal

C. MR axial venous phase

Sixteen years-old asymptomatic patient. Lobulated gallbladder with honeycomb appearance due to multiple internal septs (arrows in A, B and C). No signs of inflammation were present. The findings are compatible with **MULTISEPTATED GALLBLADDER**.

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Multiseptated Gallbladder

Teaching points

- Very rare congenital anomaly.
- Septation may lead to bile stasis, stone formation and recurrent abdominal pain.

- Galbladder normal in size and position.
- Bossaleted external surface
- Multiple septa with different sizes.





Ectopic gallbladder





Ectopic gallbladder in intrahepatic position (arrows).

Teaching points

- The gallbladder is usually located along the unthersurface of the liver in line with the interlobar fissure.
- Can be misdiagnosed, simulating hepatic focal lesions
- May difficult the diagnosis of cholecystitis.
- May difficult the surgical techniques of biliary disorders.

- Hepatic tissue around the gallbladder in axial plane.
- There isn't a gallbladder fossa in the liver.

Gallbladder agenesis





3D MRI cholangiopancreatogram

Patient submitted to MRI due to non-visualization of the gallbladder (GB) in previous ultrasound. MR images show **Gallbladder agenesis** associated to a choledochal cyst (arrow).

Teaching points

- May cause misdiagnosis in ultrasound.
- In one third of patients gallbladder agenesis occurs in association with additional malformations.
- In patients with intraoperative diagnosis there is increased morbidity due to all possible ectopic sites exploration.

- Cystic dilatation of choledochal duct. (Todani type I)
- Absence of the gallbladder without history of surgery (empty gallbladder fossa).



A. CT axial arterial phase

B. CT axial venous phase

C. CT coronal venous phase

Cystic lesion involving the gallbladder, showing no enhancement, compression or infiltration of adjacent structures (arrows in A, B e C). The imaging features along with the stability of the lesion in comparison with previous studies suggest **VENOLYMPHATIC MALFORMATION**.

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Venolymphatic Malformation

Teaching points

- 1% of the abdominal lymphangiomas.
- In MRI cholangiopancreatogram it is important to find the cystic duct and bile duct separated from the lymphangioma

• Key findings

• Preserved gallbladder mucosa inside the cystic formation, without compression.



CT coronal venous phase



A. CT axial venous phase

B. CT axial venous phase

C. CT coronal venous phase

Patient with chronic liver disease and cavernomatous transformation of portal vein (arrow in A), with consequent collateral vessels and GALLBLADDER VARICES (arrows in B and C).



Gallbladder Varices



Teaching points

- Occurs as venous collaterals due to extrahepatic portal vein occlusion.
- Up to 30% of patients with portal vein thrombosis.
- May difficult surgical procedures due the increase of bleeding risks.

• Key findings

- Nodular diffuse enhancement of the gallbladder wall.
- Multiple enhancing small vessels in the pericholecystic fat.



CT axial venous phase

A. MR axial TI-weighted



D. MR axial delayed phase

B. MR axia T2-weighted

Asymptomatic 82 years-old patient under investigation following sonographic abnormal findings. The MR images demonstrate linear membrane inside the gallbladder, which shows hyperintense signal in TI- weighted images (arrow in A) and hypointense signal in T2- weighted images (arrow in B). The gallbladder also shows lack of mural enhancement (arrows in C and D). Pathological study confirmed

GANGRENOUS CHOLECYSTITIS.

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Gangrenous cholecystitis

Teaching points

- Presence of GC increases patients' postoperative complications, morbidity and mortality.
- Predictive factors for GC include:
 - age >45,
 - male gender
 - white blood cell count >13,000/mm³
 - negative Murphy's sign.

- Linear membranes inside the gallbladder (arrow).
- Lack of mural enhancement.



3D MRI cholangiopancreatogram





A. CT coronal venous phase

B. CT axial precontrast

C. CT coronal arterial phase

Patient under anticoagulant terapy due to an orthopedic surgery, now complaining of epigastric pain. The first CT shows thickness, edema and hyperenhancement of the gallbladder wall (arrow in A). CT images obtained 2 weeks later show high attenuation (ROI = 75UH) content in the gallbladder (arrows in B and C). Pathological study confirmed HEMORRHAGIC CHOLECYSTITIS.



Hemorrhagic Cholecystitis



Teaching points

- Rare complication of acute cholecistytis.
- Transmural wall inflammation causes infarction and erosion of the mucosa.
- Reported in both presence or abscense of gallstones.
- Associated with high morbidity and mortality rates

• Key findings

- Wall thickening of the distended gallbladder
- Heterogenous content



CT axial precontrast

A. MR axial T2-weighted fatsat B. MR axial T1-weighted





Sixty-five years old patient with right hypochondrium pain. The MRI shows diffuse and heterogenous wall thickening (arrows in A, B, C and D), with internal areas of high T2 signal intensity (arrowhead in A) and showing early (C)and persistent (D) enhancement. Early enhancement of surounding parenchyma (* in C) is also present. Pathological study confirmed **XANTHOGRANULOMATOUS CHOLECYSTITIS.**

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Xanthogranulomatous Cholecystitis dava

Teaching points

- 20% can occur without stones
- Nodular thyckening of gallbladder wall
- Most important differential diagnosis are:
 - Adenocarcinoma.
 - Adenomyomatosis
- May present chemichal shift artifact

• Key findings

- Diffuse nodular thyckening
- Areas of slightly high signal intensity on T2-weighted images, with early and persistent enhancement
 - Areas of abundant xanthogranulomas



MR axial T2-weighted fatsat

A. MR coronal T2-weighted









C. MR axial TI-weighted



D. MR axial arterial phase

Patient with long term abdominal pain. The MR images show bulky and heterogenous involving the gallbladder (arrows in A and B), with areas high signal intensity in TI-weighted images (arrow in C). Abdominal fluid collections are also present (* in B, C and D). Pathological study confirmed **MUCINOUS NEOPLASIA.**



Mucinous Gallbladder Neoplasia

• Teaching points

- Mucinous carcinoma comprises 2,5% -5,5% of gallbladder carcinomas.
- May not enhance because of the presence of abundant mucin and reduced tumor stromal volume.

• Key Findings

- Low intensity areas in T2- weighted images that can represent calcifications.
- High signal intensity in TI-weighted images that can represent mucin.
- Cystic formations suggestive of peritoneal dissemination.



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MR coronal T2-weighted



A. CT axial venous phase

B. CT axial venous phase

C. CT coronal venous phase

Patient with diagnostic of lymphoma previously treated by chemotherapy now complaining of epigastric pain weight and loss (11 kg in six months). The first CT shows an irregular thickening of the gallbladder wall (arrow in A). CT images obtained 2 months later show increase of the gallbladder wall thickening, now associated with ascitis and peritoneal nodules (arrowheads in B and C). Pathological study confirmed infiltration by **B-CELLS LYMPHOMA.**

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Gallbladder Lymphoma



• Teaching points

- Secondary involvement is more common than primary gallbladder lymphoma.
- Most important differential diagnosis:
 - Adenomyomatosis.
 - Adenocarcinoma.

• Key findings

 New focal thickening of gallbladder wall in patients with history of lymphoma.



CT axial venous phase



A. MR axial T2-weighted

B. MR axial TI-weighted

C. MR axial arterial phase subtraction

Patient with a history of previously treated cutaneous melanoma. Follow-up MR images show a focal heterogeneous thickening of the gallbladder wall (arrows in A, B and C), containing areas of high signal intensity in TI (B) and showing enhancement by the contrast media (C), findings compatible with **METASTASIS OF MELANOMA**.

Gallbladder Melanoma Metastasis

Teaching points

- Although rare, melanoma is the most common origin of metastatic gallbladder's tumors.
- The high signal intensity on TIweighted images depends on the percentage of melanin-containing cells

• Key Findings

 Solid lesion containing highsignal intensity foci on TI-weighted images (arrow).



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MR axial TI-weighted

A. MR coronal T2-weighted









Focal wall thickening of the gallbladder fundus (arrow in A and B) and body (arrow in C and D), with cystic appearance, the latter one showing annular envolvement also known as "hourglass-shaped". Both cases are compatible with **ADENOMYOMATOSIS**.

• Teaching points

- Can be found in 9% of patients
- Identification of Rokitansky– Aschoff sinuses (RAS) is crucial for diagnosis
- Key findings
 - "Pearl necklace sign" (arrow in A).
 - "Hourglass-shaped" (arrow in C).
 - Rokitansky–Aschoff sinuses: cystic apperance



D. MR coronal T2-weighted

A. MR axial T2-weighted B. MR axial arterial phase



Incidental finding in an MRI performed for abdominal pain investigation, compatible with pedunculated GALLBLADDER POLYP (arrow in A, B, C and D)

Teaching points

- Cholecystectomy is recommended for polyps >10mm
- In case of multiple polyps, the largest should be used in the management decision.
- Management algorithm depends on symptoms, risk factors and polyp size.
- Sessile morphology is an independent risk factor.
- Key findings
 - Polyps show enhancement.

C. MR axial portal phase D. MR coronal portal phase



Patient with a history of haemophilia and abdominal trauma. MR images show high-signal intensity content in both TI and T2 (arrows in A and B), compatible with **GALLBLADDER BLEEDING.**

Teaching points

- Can be caused by trauma, anticoagulant therapy, lupus, liver biopsy, or ruptured aneurysms of either the hepatic or cystic artery.
- It's important to distinguish from hemobilia resulting from mucosal erosion in pre-existing cholecystitis, that can lead to gallbladder rupture and hemoperitoneum.

Key findings

- High-signal intensity material inside the gallbladder in both T1 and T2 sequences.
- Absence of inflammation signs.

This case is a courtesy by Dr. Glaucy Lane Neme, SP, Brazil.



Patient with abdominal pain and increased liver enzymes, along with other clinical signs of acute hepatitis. CT images show periportal edema (arrow in A) and gallbladder wall thickening (arrowheads in B). MR image confirms the diffuse **GALLBLADDER REACTIONAL EDEMA** (arrow in C).

Teaching points

- Can be caused by systemic disorders or inflammatory processes located in the right hypochondrium.
- Be careful to avoid erroneous interpretation of acalculous cholecystitis.

Key findings

• Preservation of mucosal integrity

A. CT axial venous phase

B. CT axial venous phase





C. MR SSFP coronal



A. CT axial venous phase





B. CT axial venous phase

C. CT coronal venous phase



This case is a courtesy by Dr. Clara Palhano, SP, Brazil.

Patient with abdominal pain, nausea, vomits and leukocytosis. The CT images show a "whirl sign" in the infundibulum of the gallbladder (arrow in A) which is located in the mesogastric position, out of its original fossa (arrow in B and C), with thickeness and irregularity of its walls. Adjacent edema is also present (arrowheads in B and C). The surgery and pathological study confirmed GALLBLADDER **VOLVULUS**.

Gallbladder Volvulus

• Teaching points

- More common in elderly women (3W:IM).
- Same symptons of acute cholecystitis.
- The pathophysiology involves torsion of the gallbladder around the cystic pedicle.

• Key Findings

- "Whirl sign"
- Gallbladder out if it's fossa.



CT axial venous phase



- Imaging studies play a fundamental role in evaluating the structures morphology and in detecting and characterizing lesions in general;
- The combined analysis of clinical, epidemiological, radiological and evolutionary aspects may help in the correct interpretation of gallbladder diseases, avoiding unnecessary examinations and procedures;
- It is important for the radiologist to be aware of the imaging aspects related to the gallbladder diseases, so that the management can be correctly oriented.

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