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PICTORIAL REVIEW

Dropped gallstones: spectrum of imaging findings, complications and diagnostic pitfalls

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ABSTRACT

Spillage of gallstones into the abdominal cavity, referred to as “dropped gallstones” (DGs), occurs commonly during laparoscopic cholecystectomy. The majority of these spilled stones remain clinically silent; however, if uncomplicated DGs are not correctly identified on subsequent imaging, they may mimic peritoneal implants and cause undue concern. A small percentage of DGs cause complications, including abscess and fistula formation. Recognising the DG within the abscess is critical for definitive treatment. This pictorial review illustrates the imaging appearances and complications of DGs on CT, MRI and ultrasound and emphasises pitfalls in diagnosis.

Laparoscopic cholecystectomy (LC) is the procedure of choice for routine gallbladder removal and is the most common major abdominal procedure performed in Western countries [1]. The use of laparoscopic technique has resulted in an increased incidence of spillage of stones into the intraperitoneal space (~30%) owing to perforation of the gallbladder during cholecystectomy [1,2]. Spilled gallstones, “dropped gallstones” (DGs), were initially considered to be harmless; however, it is now well recognized that DGs can result in complications, mainly abscess and fistula formation [2]. The purpose of this essay is to illustrate the spectrum of CT, sonographic and MRI findings of DGs, describe associated complications, and present diagnostic mimics and pitfalls.

IMAGING FINDINGS OF UNCOMPLICATED DROPPED GALLSTONES

DGs are often located near the liver, in Morison’s pouch or the gallbladder fossa and in the pelvis.

On CT, DGs with high calcium content appear as one or more calcified high-attenuation foci (Figures 1 and 2). Wide window settings are beneficial in discerning calcified stones (Figure 1c,d). Pure cholesterol DGs and those with low calcium content may go undetected.

On MR, pigmented DGs may appear as hyperintense on T_1 weighted images, whereas other stones are hypointense on both T_1 and T_2 weighted images (Figure 2b). Lack of

contrast enhancement is useful for making the correct diagnosis [1,3,4].

On ultrasound, DGs appear as mobile hyperechoic foci casting marked posterior acoustic shadowing [5].

SPECTRUM OF COMPLICATIONS RELATED TO DROPPED GALLSTONES

Abscess

The most common complication of DGs is the formation of an abscess around the DG, which is presumably the source of infection [1].

The non-specific clinical symptoms (fever and abdominal pain) and variable time to presentation (days, weeks, months or even years after the initial surgery) often contribute to delayed diagnosis. Abscesses related to DGs are most frequently located near the liver (Figures 3–5). Contrast-enhanced CT demonstrates a perihepatic, complex multiloculated fluid collection (Figures 3–5). If the DG is densely calcified, it will appear as a high-attenuation focus within the collection, rendering the correct diagnosis straightforward (Figure 3b) [1,4]. However, when the DG within the abscess is very small or non-calcified, it may easily be overlooked, accounting for failure to associate the abscess with a DG (Figures 4 and 5). Corresponding ultrasound demonstrates a hypoechoic fluid collection containing hyperechoic foci with posterior shadowing (Figure 3c). MRI shows a perihepatic fluid collection with foci of low T_2

Figure 1. Multiple tiny dropped gallstones 3 years after laparoscopic cholecystectomy. Axial contrast-enhanced CT, soft tissue window, shows tiny dense foci (arrow) clustered in Morison's pouch (a) and the gallbladder fossa (b). It is easier to differentiate the calcified stones from the metallic clips on wider windows (c, d). Note the surgical clip (arrowhead) in the gallbladder fossa (b, d).

signal (corresponding to the DGs) (Figure 3d) [3,4]. Recognising the DG within the abscess in any of these modalities is crucial because, unlike other abdominal abscesses, which are treated with antibiotics and/or percutaneous drainage, the definitive treatment for an abscess associated with a DG requires removal of retained gallstones [1]. Unless the stone is removed, the abscess will recur, resulting in a prolonged course and increased morbidity. Moreover, even when a gallstone cannot be identified within a perihepatic abscess, diagnosis of an abscess owing to a radiolucent DG should be considered in a patient with prior LC.

Fistula

Fistula formation is a much less frequent complication of DGs than abscess formation. DGs can migrate through the abdominal wall, gastrointestinal tract and diaphragm. When a DG erodes through the abdominal wall, fistulas to the skin, umbilicus and gluteolumbar region result (Figure 6) [1,6].

DIAGNOSTIC PITFALLS

DGs may have overlapping imaging features with a variety of abdominal conditions.

Helpful distinguishing clues are the relevant clinical history and familiarity with the imaging features of these conditions.

Peritoneal metastases

DGs around the liver may be confused with peritoneal metastatic implants or lymph nodes, having a similar appearance of round soft-tissue perihepatic nodules with a high attenuation peripheral rim on CT (Figures 7 and 8) [3]. Unenhanced CT may be useful in elucidating the calcified nature of these nodules. However, although the presence of calcification favours the diagnosis of DGs, some mucin producing tumours, such as tumours from the ovary and colon, can contain calcium (Figure 9).

Figure 2. Incidentally detected dropped gallstones 14 years after laparoscopic cholecystectomy. (a) Axial contrast-enhanced CT shows two rounded peripherally calcified nodules adjacent to the liver (arrows). (b) Axial T_1 weighted three-dimensional gradient echo MR shows two rounded foci in Morison's pouch.

Figure 3. An 80-year-old male presenting 3 years after laparoscopic cholecystectomy (LC) with a perihepatic abscess. (a) Axial unenhanced CT, performed 5 days after LC owing to abdominal pain and fever, shows two calcified dropped gallstones (DGs) posterior to the right lobe of the liver. Residual air bubbles (black arrow) reflect recent laparoscopy. The DGs were not removed at that time because the patient's symptoms were not attributed to the stones, and most DGs remain clinically silent. (b) Axial unenhanced CT 3 years after LC, when the patient presented with fever and right upper quadrant pain, shows a round 5-cm fluid collection containing two calcified-dependent foci, typical of a perihepatic abscess secondary to DGs. High-density branching structures within the liver represent opacified bile ducts following recent endoscopic retrograde cholangiopancreatography which was performed to evaluate the biliary tree (black arrow). (c) Ultrasound shows a hypoechoic fluid collection containing rounded echogenic foci (arrow) with posterior acoustic shadowing. (d) Axial T_2 weighted MR demonstrates dependent round hypointense foci within a 5-cm rounded hyperintense fluid collection posterior to the right lobe of the liver.

Figure 4. A 54-year-old female with abdominal pain, 6.8-kg weight loss and night sweats 7 months after laparoscopic cholecystectomy (LC). (a) Axial contrast-enhanced CT 7 months after LC shows a biconvex heterogeneous complex collection (arrow) abutting the right lobe of the liver. No calcified stone to suggest a dropped gallstone is seen. (b) Contrast-enhanced CT 1.5 years later, when the patient presented with persistent symptoms, shows marked interval increase in size of the large, heterogeneous complex collection compatible with a perihepatic abscess (arrow). Again, no calcified stone is seen within the abscess. (c) Drainage (arrow) of the abscess 5 months later (30 months after LC) did not result in its resolution. The patient underwent laparoscopic debridement of the perihepatic abscesses and removal of retained gallstones with subsequent resolution of her symptoms.

Figure 5. A 50-year-old male with several months of severe fatigue, lack of appetite and low-grade fever that started 7 months after laparoscopic cholecystectomy (LC). (a) Axial contrast-enhanced CT 7 months after LC shows a large heterogeneous collection compatible with an abscess adjacent to the right lobe of the liver. No calcified stone is seen to suggest a dropped gallstone (DG). (b) Follow-up axial unenhanced CT several weeks later shows no significant change in size of the perihepatic abscess. However, a faint calcific density is now seen in the centre of the collection, raising the possibility of a DG as a nidus for the abscess formation. The dense focus was initially overlooked, probably owing to the administration of intravenous contrast in the first study.

Figure 6. Fistula formation owing to dropped gallstones (DGs). Patient presenting with a draining wound in the anterior abdominal wall several months after laparoscopic cholecystectomy (LC). (a) Photograph of the anterior abdominal wall demonstrates an indurated focal defect superior to the umbilicus at a trocar entry site from prior LC (arrow). (b) Axial contrast-enhanced CT shows a 1.8-cm peripherally calcified stone (long arrow) within the anterior abdominal wall with stranding of the adjacent subcutaneous fat. Note surgical clips in the gallbladder fossa (short arrow).

Figure 7. Dropped gallstones (DGs) mimicking perihepatic nodules. (a) Axial contrast-enhanced CT shows punctuate high-density foci adjacent to the liver, initially interpreted as “enhancing perihepatic nodules”. (b) Repeat unenhanced axial CT study demonstrates that the foci surrounding the liver are also hyperdense in the absence of intravenous contrast. Therefore, these high-density foci more likely represent calcifications, compatible with dropped gallstones, rather than enhancing soft tissue nodules. (c) Pre-operative ultrasound shows multiple tiny stones (arrows) within the gallbladder, with a similar appearance to the “perihepatic nodules” seen on CT, supporting the diagnosis of post-operative DGs in (b).

Figure 8. Dropped gallstones (DGs) misinterpreted as perihepatic lymph nodes. A 68-year-old female with gallbladder cancer incidentally detected in resected specimen. (a) Axial contrast-enhanced CT for staging gallbladder cancer shows a round subcentimetre nodule adjacent to the liver (arrow), interpreted as a suspicious lymph node. (b) Image at the level of the pelvis shows several similar round foci (arrows) adjacent to the uterus. Subsequent surgery proved these “nodules” to be DGs.

Figure 9. Metastatic ovarian cancer with multiple calcified perihepatic metastatic implants. Axial unenhanced CT demonstrates multiple high-density foci abutting the liver (arrow-heads), and at least one round 1-cm focus of fluid density with peripheral calcification (arrow), mimicking a small abscess adjacent to a DG.

Figure 10. Loose body in a 53-year-old male without prior cholecystectomy. (a, b) Axial contrast-enhanced CT images obtained 4 months apart demonstrate a round peripherally calcified soft tissue 1-cm nodule (arrow) located anteriorly in the pelvis (a) and in the rectovesical pouch on the subsequent study (b), such mobility between the two studies is typical of a loose body.

Figure 11. Multiple colonic diverticula. Axial unenhanced CT demonstrates four rounded hyperdense foci (arrows), some with lucent centres, representing colonic diverticula with inspissated dense fluid or contrast material, mimicking dropped gallstones.

Peritoneal loose bodies

Peritoneal loose bodies (“peritoneal mice”) are calcified concretions that grow around a nidus of necrotic tissue, usually fat derived from an autoamputated epiploic appendage. On CT, a peritoneal loose body is a well-circumscribed soft tissue mass, measuring 0.5–2.5 cm, with peripheral or central calcifications, often found in the pelvis (Figure 10) [7].

Colonic diverticulum

Colonic diverticula may appear very dense owing to inspissated dense fluid or contrast material and may then mimic a DG (Figure 11). The contiguity with the colonic wall and multiplicity of diverticula are helpful distinguishing features.

Dropped appendicolith

Appendicoliths can drop into the peritoneal cavity during appendectomy, although this complication is much less frequently reported than DGs. A dropped appendicolith appears as a small focus (<1 cm) of high attenuation adjacent to the caecum or in Morison’s pouch [8]. Their imaging findings are identical to those of a DG, and the clinical history of prior appendectomy is essential for correct diagnosis (Figure 12).

CONCLUSION

DGs have a wide range of imaging features on sonography, CT and MRI. Although most of these remain clinically silent, complications related to DGs can present in a variety of ways and sometimes many years after the LC. DGs should always be considered in a patient with a history of LC presenting with an abdominal abscess or a fistula. The radiologist plays a critical role in recognising these complications, and therefore familiarity with the imaging characteristics of DGs is essential.

Figure 12. Dropped appendicolith. (a) Axial contrast-enhanced CT 3 days after laparoscopic appendectomy shows a dense opacity (arrow), not present on pre-operative CT (not shown), in Morison’s pouch, representing a dropped appendicolith. (b) Axial contrast-enhanced CT obtained 13 months later, when patient presented with fever and abdominal pain, shows a heterogeneous fluid collection surrounding the dropped appendicolith (arrow). Note intact gallbladder (arrowhead).

(a)

(b)

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