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Key Imaging Findings for the Prospective Diagnosis of Rare Diseases of the Gallbladder and Cystic Duct

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There are various diseases of the gallbladder and cystic duct, and imaging diagnosis is challenging for the rare among them. However, some rare diseases show characteristic imaging findings or patient history; therefore, familiarity with the imaging presentation of rare diseases may improve diagnostic accuracy and patient management. The purpose of this article is to describe the imaging findings of rare diseases of the gallbladder and cystic duct and identify their pathological correlations with these diseases.

Keywords: *Multiseptate gallbladder; Tubular adenoma; Intracystic papillary neoplasm; Mucinous carcinoma; Granular cell tumor*

INTRODUCTION

Computed tomography (CT) and magnetic resonance imaging (MRI) are useful tools for the diagnosis of gallbladder and cystic duct abnormalities because they facilitate an accurate and reproducible diagnosis. The most common gallbladder diseases observed in daily practice are acute or chronic cholecystitis, gallbladder stones, adenomyomatosis, and gallbladder cancer. However, physicians encounter a variety of other diseases as well, though lesions confined to the cystic duct are rare. Imaging diagnosis is challenging for rare cases. However, some rare diseases show characteristic imaging findings or patient history; therefore, familiarity with the characteristic findings of these cases can improve diagnostic accuracy and patient management. The purpose of this article is to describe the imaging findings of rare diseases of the gallbladder and cystic duct and identify their pathological correlations with these diseases.

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Gallbladder

Congenital Variants

Congenital variants of the gallbladder are uncommon and occasionally found incidentally on imaging. These include agenesis, hypoplasia, duplicated, intrahepatic, left-sided, or multiseptate gallbladder [1]. The exact prevalence of multiseptate gallbladder is unknown. Most patients present with long-term abdominal pain or tenderness; however, multiseptate gallbladder can also be diagnosed incidentally [2]. The pathogenesis of multiseptate gallbladder is not fully understood, but it most likely results from incomplete vacuolization of the developing gallbladder bud [2]. Although rare, multiseptate gallbladder shows characteristic imaging findings (Fig. 1). Multiple linear structures can be seen crossing the gallbladder lumen and producing a honeycomb appearance on imaging [2]. Numerous septa are smooth, thin, and show contrast enhancement on CT and MRI (Fig. 1A). The gallbladder can show heterogeneous signal intensity on T1-weighted image (T1WI) and T2-weighted image (T2WI). The gallbladder wall and septum can have high signal intensities on diffusion-weighted images, representing chronic inflammation. A grape-like cluster of the gallbladder was observed on magnetic resonance cholangiopancreatography (MRCP) (Fig. 1B) [2]. A proper understanding of the characteristic imaging findings avoids unnecessary examinations and misdiagnoses.

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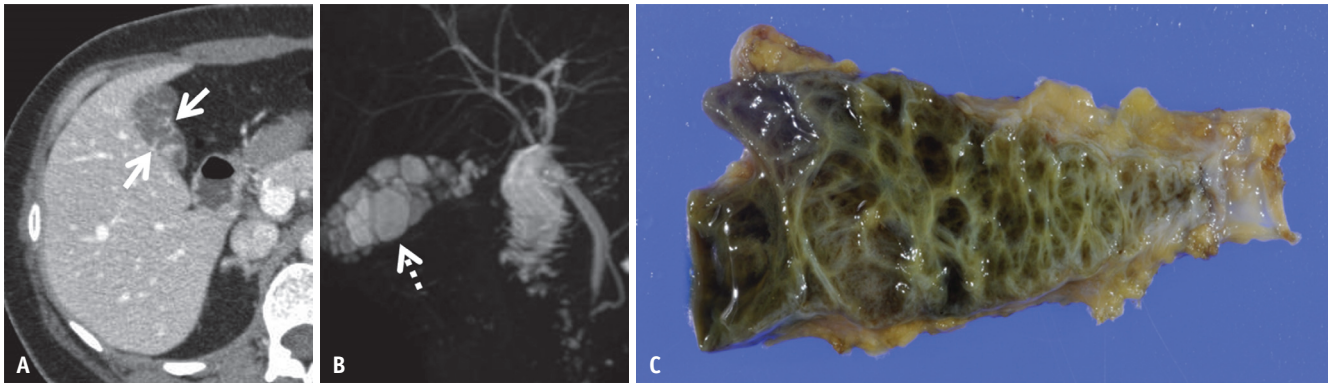

Fig. 1. Multiseptate gallbladder in an asymptomatic 77-year-old male. Gallbladder wall thickening incidentally found on contrast-enhanced computed tomography. Laboratory test results including tumor markers were negative.
A. Contrast-enhanced computed tomography demonstrates multiple linear structures with a honeycomb pattern in the gallbladder lumen (arrows). **B.** A grape-like cluster in the gallbladder with heterogeneous signal intensity is observed on magnetic resonance cholangiopancreatography (dotted arrow). **C.** Gross pathology after laparoscopic cholecystectomy reveals multiple edematous septa dividing the gallbladder lumen into many compartments.

Inflammatory Manifestations

Xanthogranulomatous cholecystitis (XGC) is a rare variant of chronic cholecystitis with an incidence of 0.3% [3]. Male preponderance has been reported, with a male-to-female ratio of 2:1 [3]. XGC is characterized by a destructive inflammatory process followed by marked proliferative fibrosis along with the infiltration of lipid-laden macrophages (foamy histiocytes) [3]. The pathogenesis of XGC is related to an increase in pressure in the gallbladder, which can have various etiologies. As a result of the increased pressure in the gallbladder, micro-ulcerations and tears in the gallbladder mucosa cause chemical inflammation as biliary juice enters the gallbladder wall, leading to more severe inflammation than that observed in normal cholecystitis [3]. Patients may present with features of cholecystitis, including right upper quadrant pain, fever, nausea, and vomiting. Preoperative differential diagnosis to distinguish XGC from gallbladder cancer is often difficult because both diseases can show thickening of the gallbladder wall and extensive inflammatory infiltration to the surrounding tissues on imaging. Proper imaging diagnosis is crucial to prevent excessive and extensive resection of the expected cancer. The following five CT findings have been reported to be useful for differentiating XGC from gallbladder cancer: diffuse gallbladder wall thickening, continuous mucosal line, intramural hypoattenuating nodules, absence of macroscopic hepatic invasion, and absence of intrahepatic bile duct dilatation (Fig. 2) [4]. A combination of three of the five CT findings common in XGC can facilitate the differentiation of XGC from gallbladder cancer with high sensitivity (83.3%) and specificity (100%) [4]. Among these, intramural hypoattenuating nodules, which reflect foamy histiocytes, can be most clearly observed on MRI as a signal loss during phase-shift imaging (Fig. 3) [3]. A thickened wall shows moderately high signal intensity on T2WI and delayed enhancement on a dynamic study [3]. Diffusion-weighted imaging has been reported to be useful for differentiating XGC from gallbladder cancer [5]. Diffusion restriction and a lower apparent diffusion coefficient were more frequently observed for gallbladder cancers than for XGC [5]. On ultrasonography, focal or diffuse thickening of the gallbladder wall, which is hyperechoic relative to the liver, is a characteristic finding of XGC. Hypoechoic nodules or bands in a thickened wall can also be observed [6].

Rare Tumorous Polyps

Intracystic Papillary Neoplasm

Intracholecystic papillary neoplasm (ICPN) is a rare entity that accounts for only 0.1?0.6% of gallbladder neoplasms [7]. ICPN is a grossly visible mass-forming noninvasive epithelial neoplasm characterized by papillary growth in the gallbladder. In the fifth edition of the World Health Organization classification published in 2019, intestinal adenoma, papillary adenoma, and tubulopapillary papilloma, which were among the adenomas proposed in the fourth edition, are included in the definition of ICPN [8]. Pyloric gland adenoma (PGA) is defined as an independent disease in the fifth edition [8]. A three-tiered classification has been introduced: low-grade (Fig. 4) or high-grade (Fig. 5) intraepithelial neoplasia and associated

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invasive carcinoma [8]. ICPN has a better prognosis than gallbladder cancer, even when accompanied by invasive cancer [7]. However, differentiating ICPN from gallbladder cancer using preoperative imaging is challenging. On CT and MRI, the mass was well-enhanced during the early phases of the contrast-enhanced study. On MRI, it appears as a hypointense signal on T2WI, and a hypointense stalk may be identified on T2WI. Diffusion-weighted images

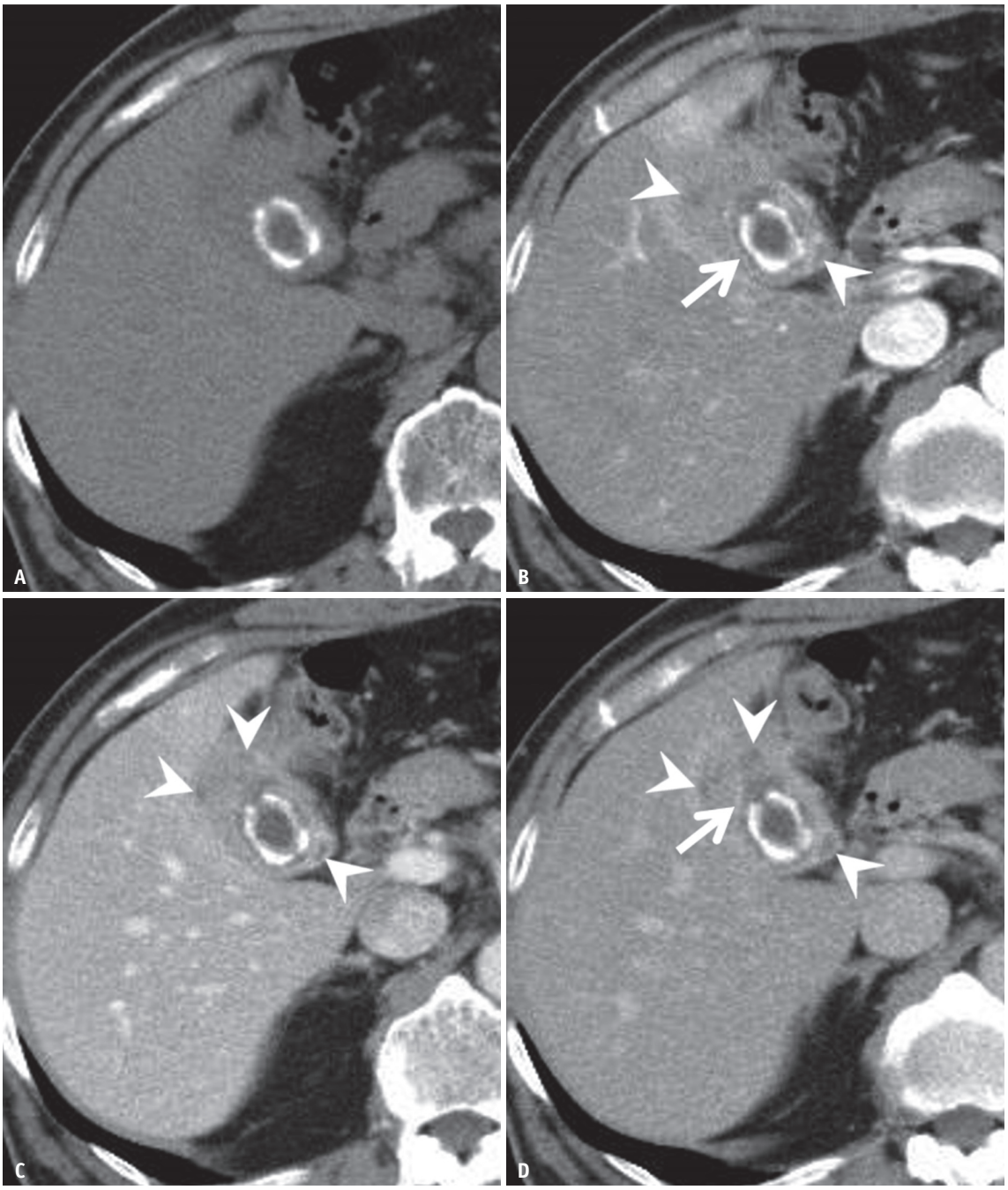

Fig. 2. Xanthogranulomatous cholecystitis in an asymptomatic 71-year-old male. Gallbladder wall thickening found on ultrasonography during an annual medical checkup. Serum C reactive protein was slightly elevated (6.2 mg/L), while other laboratory test results, including tumor markers, were negative.
A-D. Precontract **(A)**, arterial phase **(B)**, portal venous phase **(C)**, and delayed phase contrast-enhanced computed tomography **(D)** reveal diffuse gallbladder wall thickening, continuous mucosal line (arrows), and intra-mural hypoattenuating nodules (arrowheads). Macroscopic hepatic invasion and intrahepatic bile duct dilatation are not observed. Open cholecystectomy was performed, and xanthogranulomatous cholecystitis was diagnosed.

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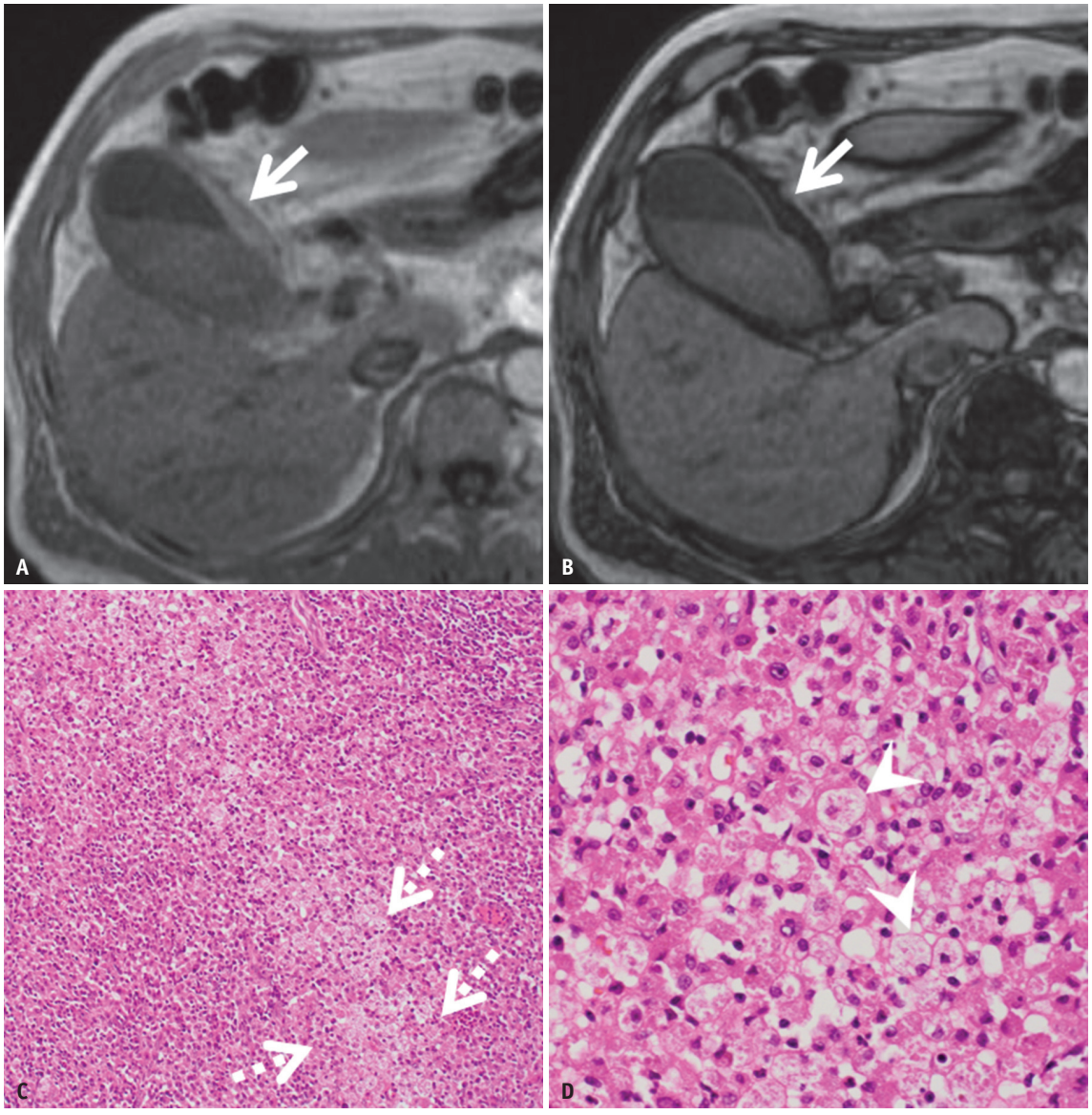

Fig. 3. Xanthogranulomatous cholecystitis in a 77-year-old male with recurrent right upper quadrant pain. Serum C reactive protein was slightly elevated (6.2 mg/L), while other laboratory test results including tumor markers were negative.
A, B. In-phase **(A)** and opposed-phase **(B)** T1-weighted images show diffuse thickening of the gallbladder wall. A signal drop on the opposed-phase image, compared with the in-phase image, reflecting lipid-laden macrophages is observed (arrows). **C.** Microscopic pathology (hematoxylin and eosin stain, x 100) after open cholecystectomy shows severe inflammatory cell infiltration, hemorrhage, and the accumulation of foamy histiocytes (dotted arrows). **D.** Magnified image (hematoxylin and eosin stain, x 400) of foamy histiocytes (arrowheads).

usually show restricted diffusion. No abnormalities in the gallbladder wall were observed [7,9].

Pyloric Gland Adenoma

The exact frequency of PGA is unknown because of the revision of the WHO classification. PGA is a grossly visible noninvasive neoplasm composed of pyloric-type or Brunner-like glands with abundant apical mucinous cytoplasm with a tubular configuration [8]. ICPN is defined independently of the PGA, although it is a related entity. A three-tiered classification has been introduced: low-grade (Fig. 6) and high-grade intraepithelial neoplasias and an associated invasive carcinoma [8]. Surgery is indicated for the following: mass diameter of > 10 mm; symptomatic; mass diameter of > 6 mm with associated risk factors for cancer (age > 50 years, sessile polyp, Indian ethnicity, or patients with primary sclerosing cholangitis) or an increase in the size of the mass by more than 2 mm at a follow-up assessment [10]. It is often challenging to distinguish PGA from hyperplastic polyps or gallbladder cancer using

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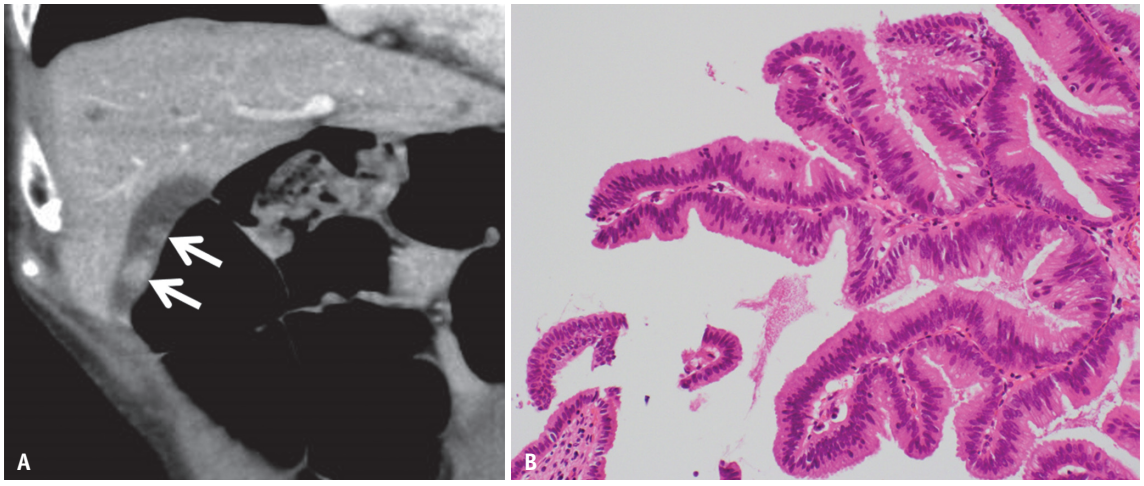

Fig. 4. Intracystic papillary neoplasm (low grade) in an asymptomatic 75-year-old female. Nodular lesions in the gallbladder found on ultrasonography during an annual medical checkup. Serum carcinoembryonic antigen was slightly elevated (8.4 μg/L), while other laboratory test results were negative.
A. Contrast-enhanced coronal computed tomography reveals two enhanced nodular lesions protruding into the gallbladder (arrows).
B. Microscopic pathology (hematoxylin and eosin stain, x 200) after laparoscopic cholecystectomy shows papillary proliferation with cellular atypia characteristic of low-grade dysplasia.

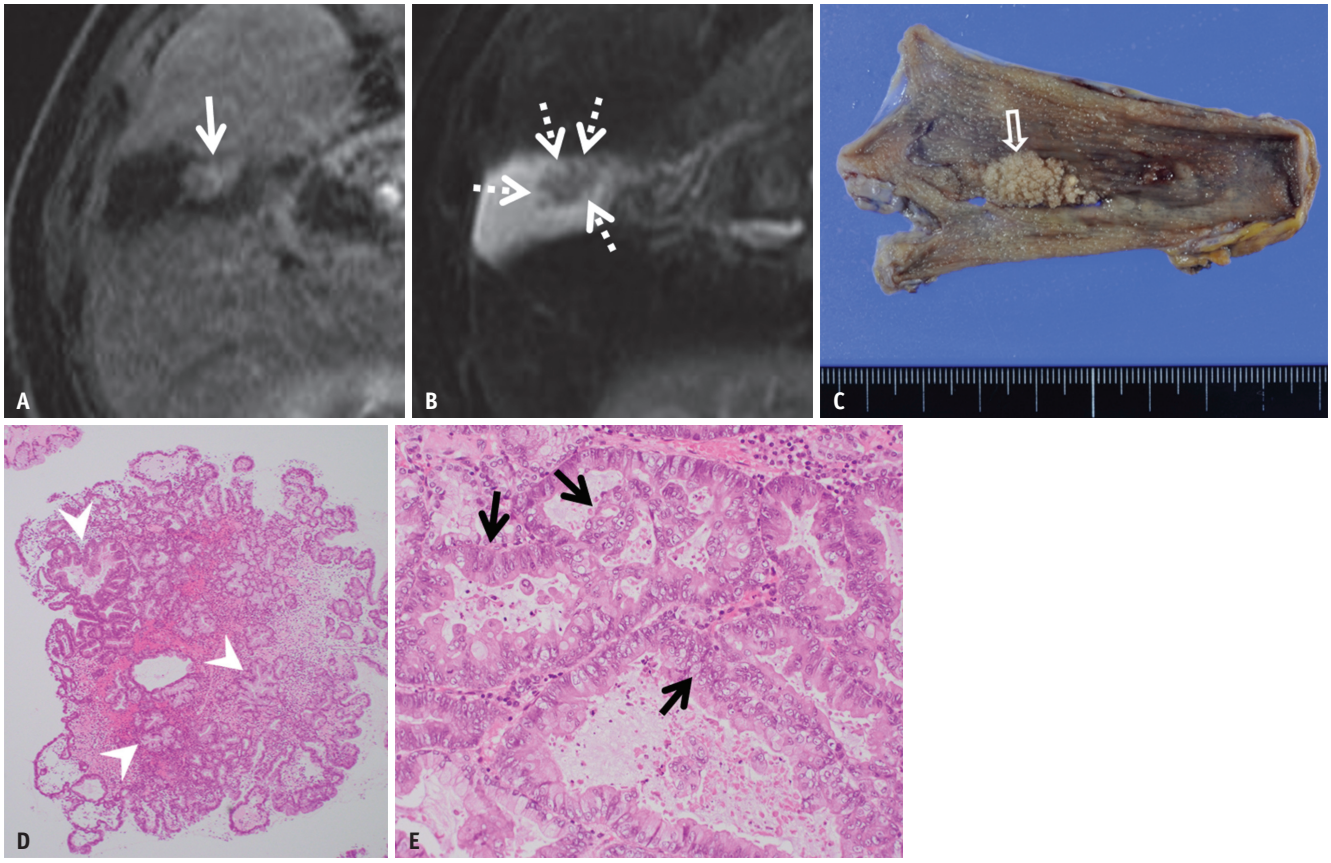

Fig. 5. Intracystic papillary neoplasm (high grade) in an asymptomatic 76-year-old female. A mass lesion in the gallbladder found on ultrasonography during an annual medical checkup. Laboratory test results, including tumor markers, were negative.
A. Arterial phase contrast-enhanced magnetic resonance imaging shows a heterogeneously enhanced mass, measuring 18 mm in diameter, in the body of the gallbladder (arrow). **B.** Fat-saturated T2-weighted imaging shows a mass with peripheral nodular hyperintense areas, which could be intratumoral mucin (dotted arrows). **C.** Gross pathology after laparoscopic cholecystectomy shows a papillary mass measuring 20 mm at its maximum diameter (open arrow). **D, E.** Microscopic pathology (hematoxylin and eosin stain, x 2 **(D)** and x 200 **(E)**) shows papillary or tubular proliferation of atypical glandular ducts with a gastric phenotype (arrowheads) as well as cellular atypia characteristic of high-grade dysplasia (arrows).

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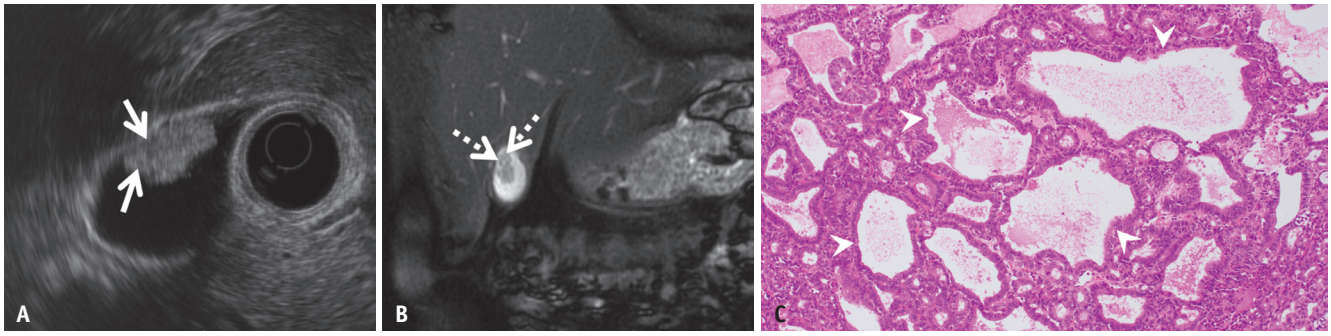

Fig. 6. Pyloric gland adenoma (low grade) in an asymptomatic 37-year-old female. A mass lesion in the gallbladder found on ultrasonography during an annual medical checkup. Laboratory test results, including tumor markers, were negative.
A. Endoscopic ultrasonography reveals a well-defined mass, measuring 12 mm in diameter, in the gallbladder. Small cystic spots are observed within the lesion (arrows). **B.** Fat-saturated coronal T2-weighted imaging shows a mass with hyperintense spots (dotted arrows). These findings may reflect enlarged intratumoral glandular ducts. **C.** Microscopic pathology (hematoxylin and eosin stain, x 200) after laparoscopic cholecystectomy shows papillary or tubular epithelium with mild atypia. Enlarged glandular ducts are also observed (arrowheads).

preoperative imaging, but endoscopic ultrasonography may be useful in this case. For endoscopic ultrasonography, multiple small cystic spots as large as 2 mm in diameter within the polyps suggest PGA (Fig. 6A) [11]. This is thought to reflect an enlarged intratumoral glandular duct.

Rare Malignant Lesions

Mucinous Carcinoma

Almost 90% of primary gallbladder cancers are adenocarcinomas [9]. Gallbladder adenocarcinomas appear as diffuse or focal thickening of the gallbladder wall, a polypoid mass within the gallbladder lumen, or a mass in the gallbladder fossa (Fig. 7) [12]. Asymmetric wall thickening (> 1.0 cm) with mural irregularity is a typical imaging finding of gallbladder adenocarcinoma. Gallbladder adenocarcinoma usually shows hypoattenuation on unenhanced CT. It can exhibit enhancement greater than that of the adjacent liver parenchyma in the arterial phase and prolonged enhancement in the delayed phase due to the fibrous components of the adenocarcinoma [12]. On MRI, gallbladder adenocarcinoma usually shows hypo- or isointensity on T1WI and moderate hyperintensity on T2WI with an enhancement pattern similar to that of CT [12]. In contrast, data describing the epidemiology of mucinous differentiation in the gallbladder are virtually nonexistent in the literature [13]. Mucinous carcinoma is a rare subtype of adenocarcinoma with stromal mucin deposition, and it constitutes > 50% of the tumor [14]. Patients with mucinous carcinoma may have symptoms such as abdominal pain, distension, and jaundice due to the enlarged gallbladder and excess mucin produced; thus, it may be diagnosed at an earlier stage than adenocarcinoma [14]. However, highly aggressive and invasive cases of mucinous carcinoma have also been reported [14,15]. CT and MRI portray mucinous carcinoma as a delayed enhanced papillary lesion in the enlarged gallbladder (Fig. 8) [14]. Delayed enhancement reflects the pathological features of scattered tumor cells within abundant mucus, and the enlargement of the gallbladder is caused by abundant mucus production [14]. The abundance of mucus causes a heterogeneous signal by the gallbladder contents on T2WI (Fig. 8C) [14]. These imaging findings can facilitate the accurate preoperative diagnosis of mucinous carcinoma.

Adenosquamous Carcinoma

Adenosquamous carcinoma is a rare subtype of gallbladder cancer, accounting for 5% of all cases [16]. The pure form of primary squamous cell carcinoma of the gallbladder is extremely rare and often has an adenocarcinoma component [17]. Patients with adenosquamous carcinoma are usually asymptomatic in the early stages and can have nonspecific symptoms, including abdominal pain and discomfort [17]. Adenosquamous carcinoma has a poorer prognosis than adenocarcinoma. The five-year overall survival rates for adenosquamous and adenocarcinoma are 9% and 11%, respectively [16]. On imaging, a large mass is usually observed in the gallbladder fossa. In contrast with adenocarcinoma, adenosquamous carcinoma tends to invade the liver more aggressively and may appear as a hepatic mass (Fig. 9). Contrast-enhanced CT or MRI may demonstrate a large hypovascular mass in the gallbladder fossa with the invasion of the liver and other neighboring organs (Fig. 9) [17].

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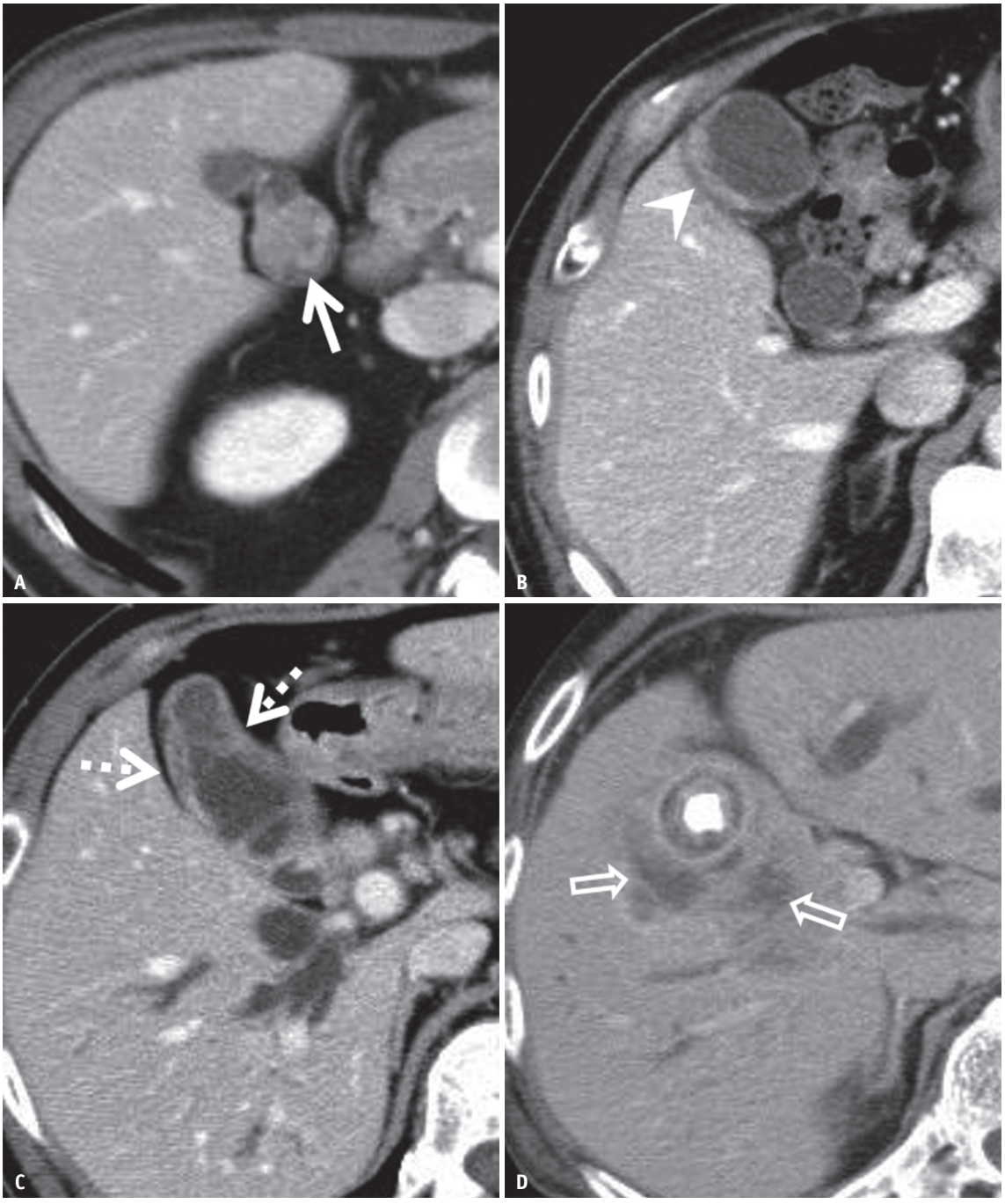

Fig. 7. Typical images of gallbladder cancer in an asymptomatic 52-year-old male (A), an asymptomatic 72-year-old male (B), a 55-year-old male (C) with abdominal pain and jaundice, and an 83-year-old male (D) with fever and appetite loss. A. Portal venous phase CT demonstrates polypoid mass within the gallbladder lumen (arrow). **B.** Portal venous phase CT reveals focal thickening of the gallbladder wall (arrowhead). **C.** Portal venous phase CT demonstrates diffuse thickening of the gallbladder wall (dotted arrows). **D.** Portal venous phase CT reveals a mass in the gallbladder fossa with severe hepatic invasion (open arrows). CT = computed tomography

Metastatic Tumor

The gallbladder is a rare site of distant metastasis, constituting only 4.8% of pathologically proven gallbladder malignancies [18]. In this study, the primary sites were the stomach, colorectum, liver, kidney, skin, biliary duct, uterus, and appendix [18]. The most common primary tumors are malignant melanoma (Western countries) or gastric cancer (Asian countries) [9]. Other reported primary malignancies include lung [19] and breast cancer [20]. Most of the metastases to the gallbladder are caused by

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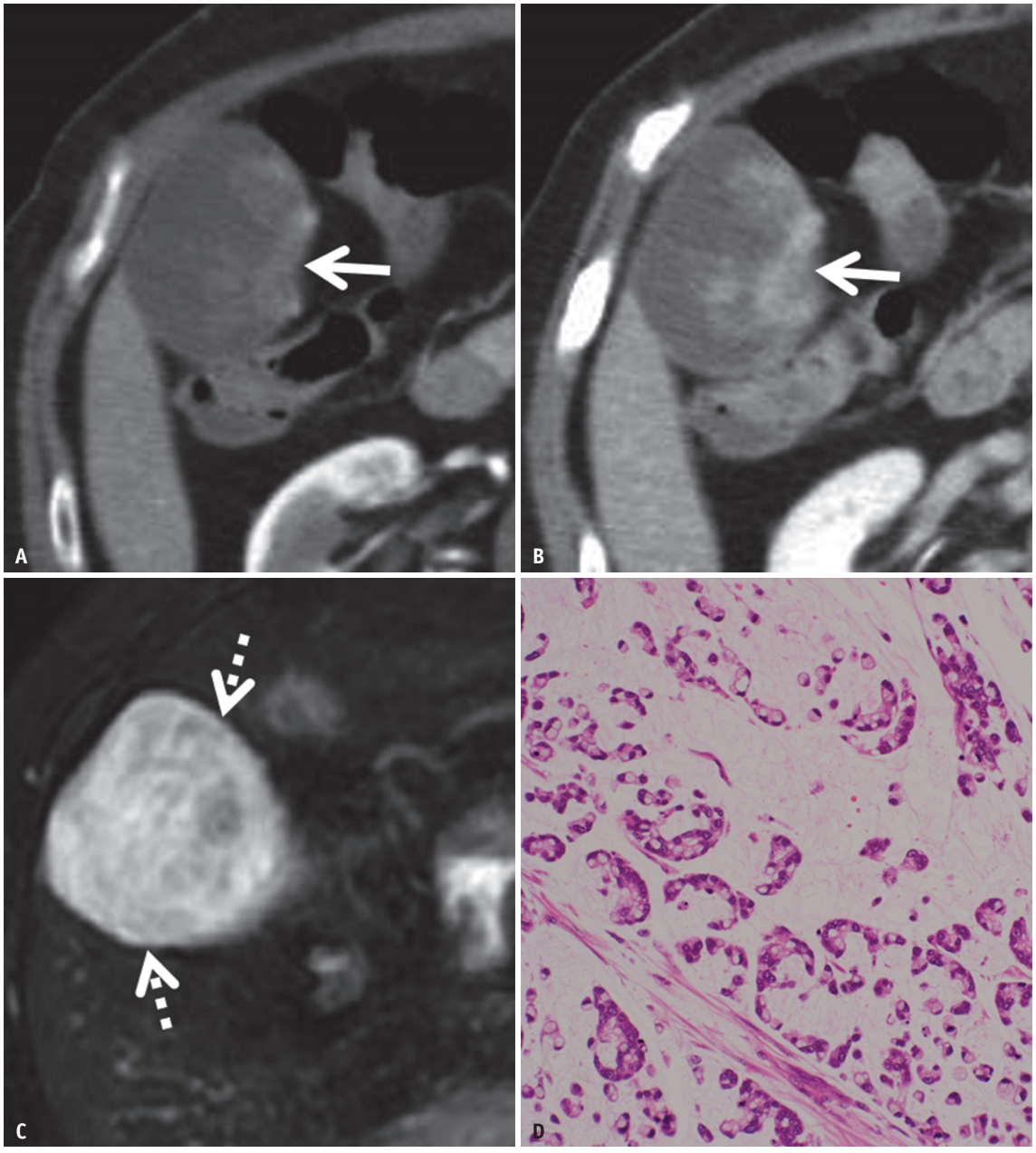

Fig. 8. Poorly differentiated mucinous carcinoma in an asymptomatic 78-year-old female. Papillary mass in the gallbladder was incidentally found on contrast-enhanced computed tomography. Laboratory test results, including tumor markers, were negative.
A, B. Arterial-phase **(A)** and delayed-phase **(B)** contrast-enhanced computed tomography show a papillary mass with delayed enhancement in the enlarged gallbladder (arrows). **C.** T2-weighted images show a heterogeneous signal by the contents of the gallbladder, representing abundant mucin (dotted arrows). **D.** Extended cholecystectomy was performed and microscopic pathology (hematoxylin and eosin stain, x 200) reveals that the mass contains abundant mucin. Several signet ring cells are also noted.

hematogenous spread, after which they usually develop as serosal implants and grow as polypoid masses [21]. Most patients with metastatic gallbladder tumors are asymptomatic. Patients with solitary metastasis from renal cell carcinoma (RCC) can have a relatively good prognosis after laparoscopic cholecystectomy; therefore, it is essential to diagnose this condition correctly. The imaging features of these metastases are generally similar to those of primary tumors. Metastases from RCC show characteristic findings on dynamic CT and MRI. They show polypoid lesions with marked early enhancement and washout (Fig. 10) [9,22]. Intratumoral hemorrhage and fat can be observed in RCC; therefore, fat-saturated T1WIs and phase-shift images can demonstrate these features of metastases from RCC [22].

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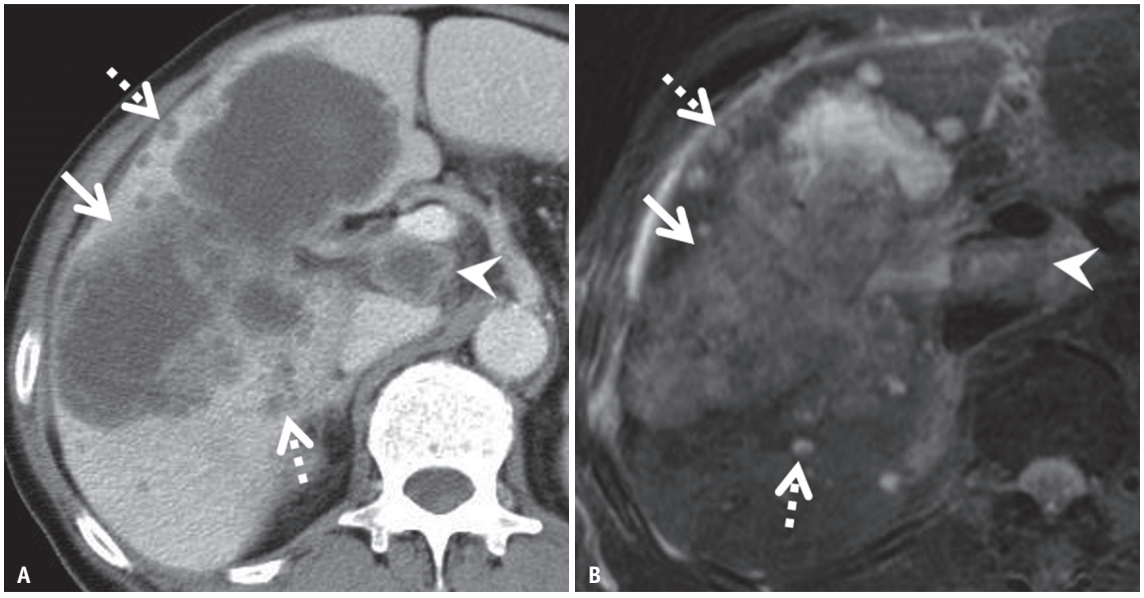

Fig. 9. Adenosquamous carcinoma in an 82-year-old male with a high fever. Serum inflammatory markers (white blood cell count 22560/μL and C reactive protein 137 mg/L) were markedly elevated, while tumor markers were negative.
A, B. Portal venous phase contrast-enhanced computed tomography **(A)** and axial T2-weighted imaging **(B)** show a large hypovascular mass in the gallbladder fossa (arrows). It is difficult to differentiate the mass from a hepatic tumor because this mass shows severe hepatic invasion. Lymph node metastasis (arrowheads) and numerous liver metastases are also noted (dotted arrows). The disease progressed rapidly, and he died two months later. An autopsy was performed, and the gallbladder lesion was diagnosed as adenosquamous carcinoma.

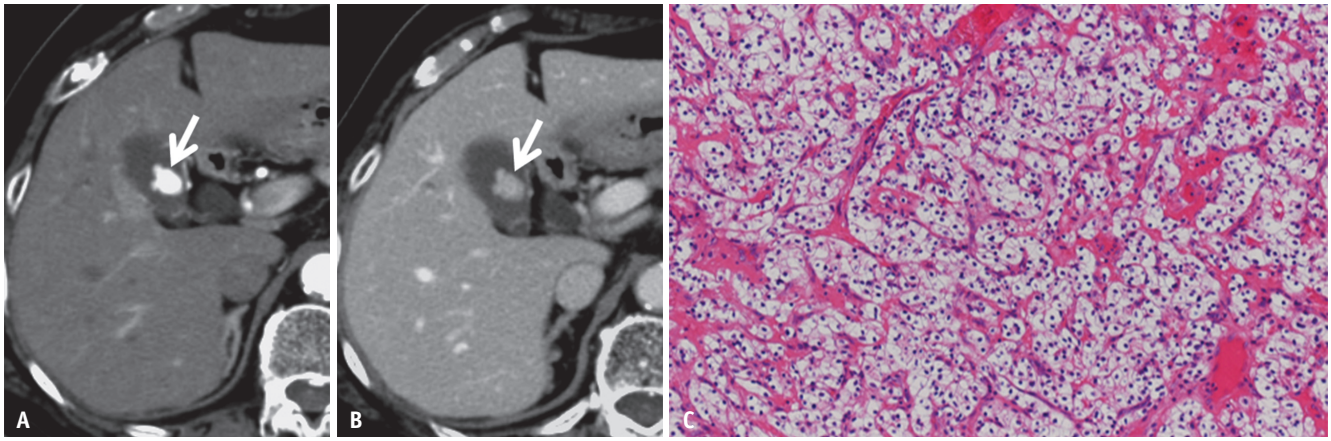

Fig. 10. Gallbladder metastasis from RCC in an asymptomatic 74-year-old female. A mass lesion in the gallbladder was found on ultrasonography during an annual medical checkup. Laboratory test results, including tumor markers, were negative. The female had undergone right radical nephrectomy for RCC (clear cell, pT3b, 45 x 38 mm, G1 > 2, v(+)) 6 years prior.
A, B. Arterial phase **(A)** and portal venous phase **(B)** contrast-enhanced computed tomography showing a polypoid lesion measuring 15 mm in diameter in the body of the gallbladder (arrows). The mass shows marked contrast enhancement in the arterial phase and iso-attenuation to the liver in the portal venous phase. **C.** Microscopic pathology (hematoxylin and eosin stain, x 200) revealed that the mass was composed of large nests and sheets of moderately sized polygonal cells with abundant clear nonpapillary cytoplasm, typical of clear cell carcinomas. RCC = renal cell carcinoma

Lymphoma

Lymphoma of the gallbladder accounts for only 0.2% of all malignant gallbladder neoplasms [9,17]. Most patients present with nonspecific symptoms, including abdominal pain, fever, or weight loss; however, they can be asymptomatic [23]. Imaging findings depend on the pathologic classification. Low-grade lymphomas show mild wall thickening, whereas high-grade lymphomas show a solid mass within the gallbladder (Fig. 9) or diffuse irregular wall thickening [9,17]. Typically, the mucosa is intact, and the submucosal layer infiltrates [9,17]. Para-aortic or retroperitoneal lesions were commonly observed (Fig. 11).

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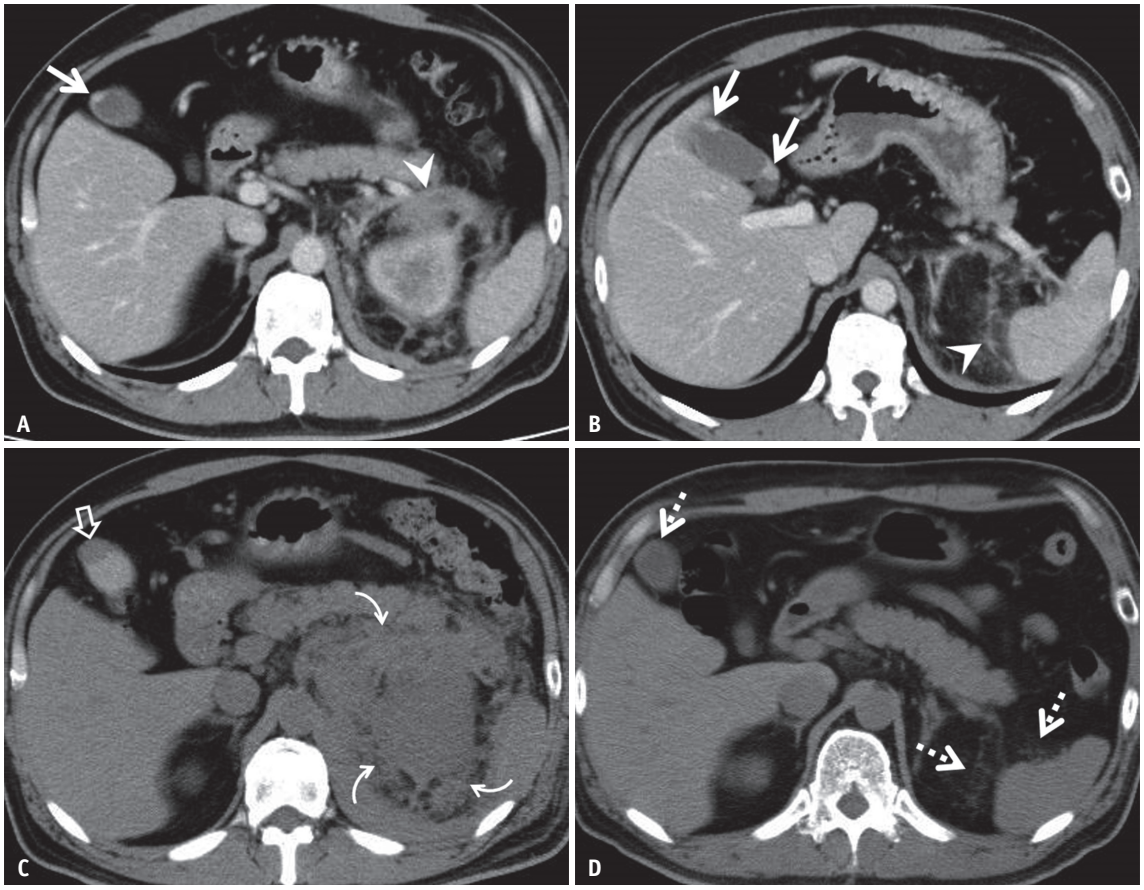

Fig. 11. Lymphoma in a 46-year-old male with left back pain. Serum interleukin-2 receptor 2540 U/mL, lactate dehydrogenase 328 U/L, and C reactive protein 50.5 mg/L were elevated.
A, B. Contrast-enhanced CT shows several nodules in the gallbladder (arrows). Retroperitoneal mass is also noted (arrowheads). **C.** Non-contrast CT after four weeks of **(A)** and **(B)** shows the rapid growth of the polypoid lesions (open arrow) and the large retroperitoneal mass (curved arrows). CT-guided biopsy of the retroperitoneal mass was performed, and the diagnosis of diffuse large B-cell lymphoma was made. **D.** Non-contrast CT after chemotherapy shows that the polypoid lesions in the gallbladder and retroperitoneal mass have almost disappeared (dotted arrows). CT = computed tomography

Cystic Duct

Cystic Duct Carcinoma

Cystic duct carcinoma is a rare type of biliary cancer that arises in conjunction with the gallbladder and extrahepatic bile duct. The incidence of cystic duct carcinoma in autopsy studies ranges from 0.03% to 0.05% [24]. It is defined as a cancer confined to the cystic duct that does not spread to the gallbladder or common bile duct [25]. Its clinical presentation is similar to that of biliary calculus [25]. The main symptoms, including abdominal pain and jaundice, may develop earlier than the symptoms of gallbladder cancer; therefore, patients with cystic duct carcinoma tend to have a better prognosis than those with gallbladder carcinoma [25]. Cystic duct carcinoma can be identified as thickening of the cystic duct wall on CT or MRI (Fig. 12), but preoperative diagnosis is often difficult.

Granular Cell Tumor

Granular cell tumors generally arise in the oral cavity, subcutaneous tissues, and skin, with less than 1% occurring in the biliary system. They are most often found in the common bile duct and common hepatic duct and less commonly in the cystic duct [26]. Granular cell tumors are uncommon soft tissue tumors thought to be derived from Schwann cells because they are typically S100 positive [26]. Most cases are benign, and less than 2% of cases are malignant [26]. They typically present with symptoms of biliary obstruction but can be found incidentally on imaging. Preoperative diagnosis is challenging because it may mimic cholangiocarcinoma or cystic duct carcinoma (Fig. 13).

Amputation Neuroma

Amputation neuroma is a reactive hyperplasia of nerve

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tissue at the ends of severed or injured nerves [27]. It can occur in the cystic duct stump after cholecystectomy because the common bile duct is surrounded by a delicate nerve fiber net [27]. The patient may present with jaundice late after surgery, but amputation neuroma can also be found incidentally on imaging. Amputation neuroma should always be considered in the differential diagnosis of patients with a mass in the cystic duct stump who have a history of previous cholecystectomy, and it can be followed up in the absence of symptoms. CT and MRI showed a well-defined mass with contrast enhancement adjacent to the common bile duct (Fig. 14). However, in patients with enhancing soft tissue at the stump of the cystic duct that developed after cholecystectomy for a tumorous condition, it is difficult to distinguish amputation neuroma from local recurrence.

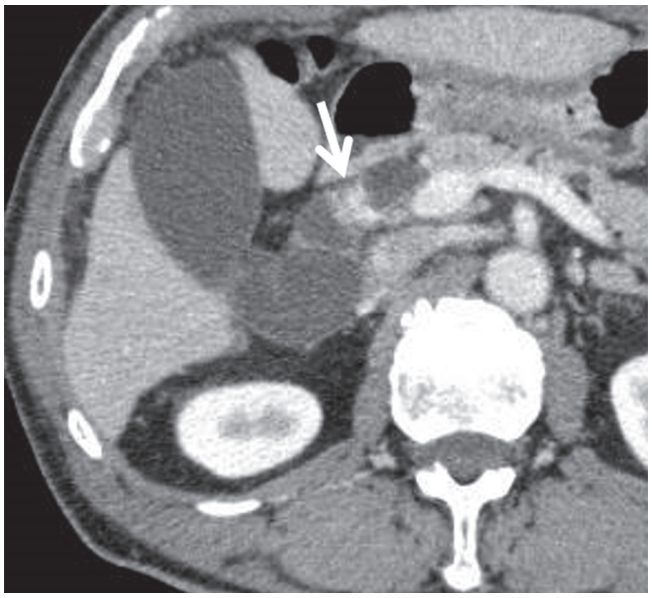

Fig. 12. Cystic duct carcinoma in a 67-year-old male with abdominal pain. A mass lesion near the gallbladder was found on ultrasonography during an annual medical checkup. Laboratory test results, including tumor markers, were negative. Contrast-enhanced computed tomography demonstrates enhanced circumferential wall thickening in the cystic duct (arrow) with gallbladder enlargement. Open cholecystectomy was performed, and the lesion was diagnosed as cystic duct adenocarcinoma.

DISCUSSION

There are various diseases of the gallbladder and cystic duct, and imaging diagnosis is challenging for the rare among them. However, familiarity with these cases may improve diagnostic accuracy and patient management. Various differential diagnoses should be considered in gallbladder adenocarcinoma. It is challenging to differentiate some of these diseases from gallbladder adenocarcinoma using preoperative imaging; however, the following findings can aid in determining the correct diagnosis:

- Multiseptate gallbladder: multiple linear structures crossing the gallbladder lumen, which produces a

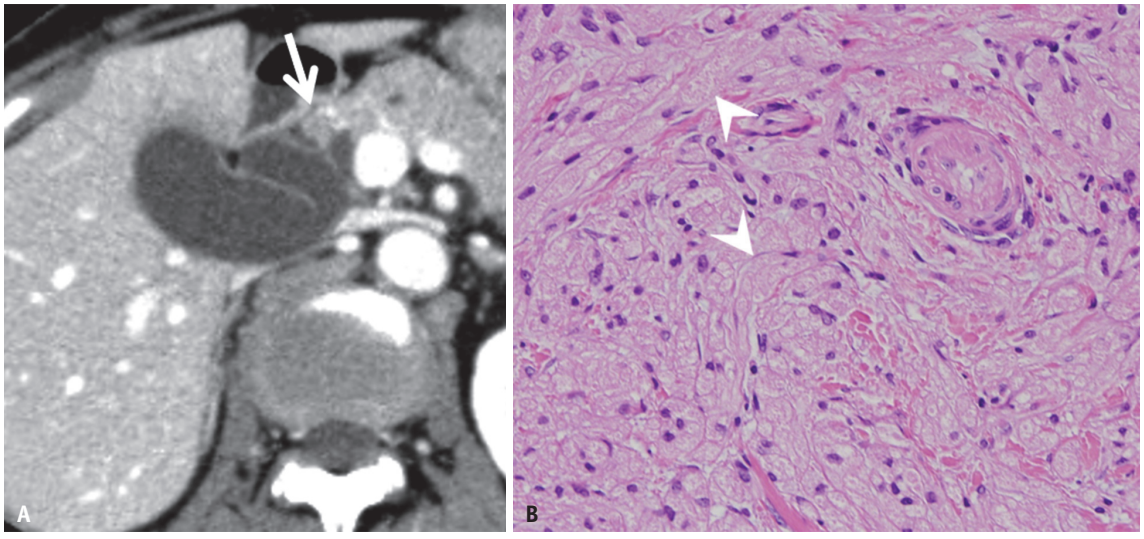

Fig. 13. Granular cell tumor in an asymptomatic 58-year-old female. A mass lesion in the cystic duct was found on ultrasonography during an annual medical checkup. Laboratory test results, including tumor markers, were negative.
A. Portal venous phase computed tomography shows a thickened cystic duct wall with prolonged enhancement (arrow). **B.** Open cholecystectomy was performed, and microscopic pathology (hematoxylin and eosin stain, x 200) reveals that the mass contains dense proliferation of polygonal atypical cells with eosinophilic granules (arrowheads). These cells are weakly positive for the Periodic acid–Schiff stain and broadly positive for the S100 stain (not shown).

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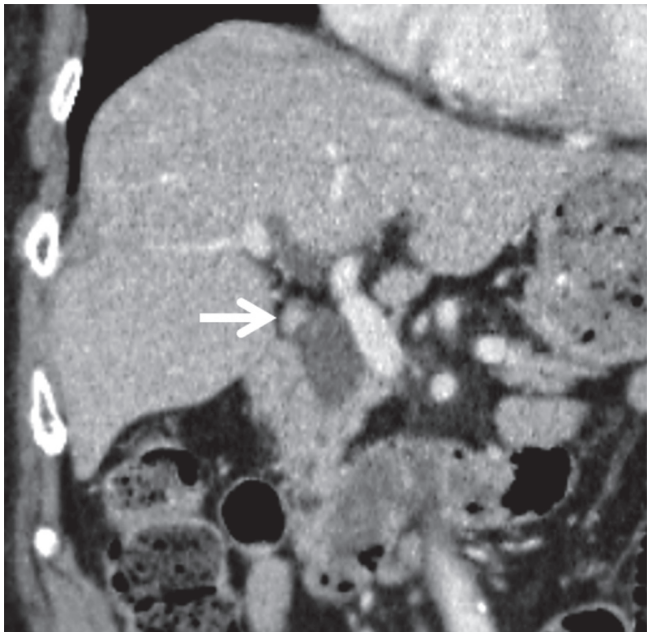

Fig. 14. Amputation neuroma in an asymptomatic 84-year-old female with a history of cholecystectomy. Enhancing soft tissue at the cystic stump was incidentally found on contrast-enhanced computed tomography. Laboratory test results, including tumor markers, were negative. Contrast-enhanced coronal computed tomography reveals an enhanced mass in the cystic duct stump (arrow). This lesion did not change in size for more than four years during follow-up.

honeycomb appearance on imaging and grape-like clusters of the gallbladder on MRCP.

• XGC: diffuse gallbladder wall thickening, continuous mucosal line, intramural hypoattenuating nodules, absence of macroscopic hepatic invasion, and absence of intrahepatic bile duct dilatation on CT; signal loss at the thickened wall during phase-shift MRI imaging.

• PGA: multiple small cystic spots as large as 2 mm in diameter within the polyps on endoscopic ultrasonography. They appeared as hyperintense spots on T2WI images.

• Mucinous carcinoma: delayed enhanced papillary lesions in the enlarged gallbladder; the abundance of mucus accounts for the heterogeneous signal by the gallbladder contents on T2WI.

• Adenosquamous carcinoma: a large mass in the gallbladder fossa with aggressive liver invasion. It may appear as a hepatic mass.

• Metastases from RCC: polypoid lesions with marked early enhancement and washout. Intratumoral hemorrhage and fat were also observed.

• Lymphoma: solid mass or gallbladder wall thickening without mucosal invasion. Para-aortic or retroperitoneal lesions are commonly observed.

Even with a good understanding of these features, the rarity of these conditions makes imaging diagnosis of cystic duct lesions difficult.

CONCLUSION

Some rare gallbladder diseases present with characteristic imaging findings; therefore, clinicians should be familiar with these diseases and their findings. Cystic duct lesions are difficult to differentiate on imaging; however, patient history may provide clues for diagnosis. Familiarity with the characteristic imaging findings of these rare diseases can facilitate early and accurate diagnosis and improve the treatment outcomes of patients.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

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REFERENCES

1. Whittle C, Skoknic V, Maldonado I, Schiappacasse G, Pose G. Multimodality imaging of congenital variants in the gallbladder: pictorial essay. *Ultrasound Q* 2019;35:195-199
2. Nakazawa T, Ohara H, Sano H, Kobayashi S, Nomura T, Joh T, et al. Multiseptate gallbladder: diagnostic value of MR cholangiography and ultrasonography. *Abdom Imaging* 2004;29:691-693
3. Singh VP, Rajesh S, Bihari C, Desai SN, Pargewar SS, Arora A. Xanthogranulomatous cholecystitis: what every radiologist

 https://doi.org/10.3348/kjr.2020.1479

should know. *World J Radiol* 2016;8:183-191
4. Goshima S, Chang S, Wang JH, Kanematsu M, Bae KT, Federle MP. Xanthogranulomatous cholecystitis: diagnostic performance of CT to differentiate from gallbladder cancer. *Eur J Radiol* 2010;74:e79-e83
5. Kang TW, Kim SH, Park HJ, Lim S, Jang KM, Choi D, et al. Differentiating xanthogranulomatous cholecystitis from wall-thickening type of gallbladder cancer: added value of diffusion-weighted MRI. *Clin Radiol* 2013;68:992-1001
6. Parra JA, Acinas O, Bueno J, Güezmes A, Fernández MA, Fariñas MC. Xanthogranulomatous cholecystitis: clinical, sonographic, and CT findings in 26 patients. *AJR Am J Roentgenol* 2000;174:979-983
7. Mizobuchi N, Munechika J, Takeyama N, Ohgiya Y, Ohike N, Abe R, et al. Three cases of intracystic papillary neoplasm of gallbladder. *Abdom Radiol (NY)* 2018;43:1535-1539
8. WHO Classification of Tumours Editorial Board. *Digestive System Tumours WHO Classification of Tumours*, 5th ed. Volume 1. Geneva: World Health Organization, 2019
9. Chatterjee A, Lopes Vendrami C, Nikolaidis P, Mittal PK, Bandy AJ, Menias CO, et al. Uncommon intraluminal tumors of the gallbladder and biliary tract: spectrum of imaging appearances. *Radiographics* 2019;39:388-412
10. Valibouze C, El Amrani M, Truant S, Leroy C, Millet G, Pruvot FR, et al. The management of gallbladder polyps. *J Visc Surg* 2020;157:410-417
11. Noda Y, Kaobayashi G, Ito K, Horaguchi J, Iwashita Y, Koshita S, et al. Pyloric-type adenoma and carcinoma in adenoma of the gallbladder, their imaging and histological findings. *Journal of Japan Biliary Association* 2015;29:74-84
12. Hennedige TP, Neo WT, Venkatesh SK. Imaging of malignancies of the biliary tract- an update. *Cancer Imaging* 2014;14:14
13. Dursun N, Escalona OT, Roa JC, Basturk O, Bagci P, Cakir A, et al. Mucinous carcinomas of the gallbladder: clinicopathologic analysis of 15 cases identified in 606 carcinomas. *Arch Pathol Lab Med* 2012;136:1347-1358
14. Ishiguro S, Onaya H, Esaki M, Kosuge T, Hiraoka N, Mizuguchi Y, et al. Mucin-producing carcinoma of the gallbladder: evaluation by magnetic resonance cholangiopancreatography in three cases. *Korean J Radiol* 2012;13:637-642
15. Huang CP, Chiou YY, Chou YH, Chiang JH, Chang CY. Imaging findings in mucin-producing carcinoma of the gallbladder. *J Formos Med Assoc* 2006;105:427-430
16. Murimwa G, Hester C, Mansour JC, Polanco PM, Porembka MR, Wang SC, et al. Comparative outcomes of adenosquamous carcinoma of the gallbladder: an analysis of the National Cancer Database. *J Gastrointest Surg* 2020 Jul [Epub]. https://doi.org/10.1007/s11605-020-04729-w
17. Revzin MV, Scoutt L, Smitaman E, Israel GM. The gallbladder: uncommon gallbladder conditions and unusual presentations of the common gallbladder pathological processes. *Abdom Imaging* 2015;40:385-399
18. Yoon WJ, Yoon YB, Kim YJ, Ryu JK, Kim YT. Metastasis to the gallbladder: a single-center experience of 20 cases in South Korea. *World J Gastroenterol* 2009;15:4806-4809
19. Imaoka K, Satoh D, Oshita K, Yano T, Kubota T, Ishida M, et al. Acute cholecystitis caused by gallbladder metastasis from non-small cell lung cancer: a case report. *Clin J Gastroenterol* 2021;14:351-357
20. Fleres F, Rossitto M, Foti A, Macrì A, Cucinotta E. Metastasis of the gallbladder from the breast cancer. *Ann Ital Chir* 2014;85:S2239253X14023470
21. Barretta ML, Catalano O, Setola SV, Granata V, Marone U, D'Errico Gallipoli A. Gallbladder metastasis: spectrum of imaging findings. *Abdom Imaging* 2011;36:729-734
22. Ueda I, Aoki T, Oki H, Takahashi H, Hayashida Y, Minagawa N, et al. Gallbladder metastasis from renal cell carcinoma: a case report with review of the literature. *Magn Reson Med Sci* 2015;14:133-138
23. Kai K, Hamada T, Hiyoshi M, Imamura N, Yano K, Nagano M, et al. Diffuse large B-cell lymphoma of the gallbladder arised 8 years after malignant lymphoma of the right testis: a case report and literature review. *Int J Surg Case Rep* 2020;76:19-24
24. Phillips SJ, Estrin J. Primary adenocarcinoma in a cystic duct stump. Report of a case and review of the literature. *Arch Surg* 1969;98:225-227
25. Bains L, Kaur D, Kakar AK, Batish A, Rao S. Primary carcinoma of the cystic duct: a case report and review of classifications. *World J Surg Oncol* 2017;15:30
26. Barakat M, Kar AA, Pourshahid S, Ainechi S, Lee HJ, Othman M, et al. Gastrointestinal and biliary granular cell tumor: diagnosis and management. *Ann Gastroenterol* 2018;31:439-447
27. Ueno Y, Ikeda K, Maehara M, Sakaida N, Omura N, Kurokawa H, et al. Traumatic neuroma of the bile duct. *Abdom Imaging* 2008;33:560-562