Pictorial Essay

J Korean Soc Radiol 2024;85(1):109-123
https://doi.org/10.3348/jksr.2023.0026
eISSN 2951-0805

JOURNAL of THE KOREAN SOCIETY of RADIOLOGY

Imaging and Clinical Findings of Xanthogranulomatous Inflammatory Disease of Various Abdominal and Pelvic Organs: A Pictorial Essay

복부와 골반의 다양한 장기에서 발생한 황색육아종성 염증 질환의 영상 및 임상 소견: 임상화보

Se Jin Lee, MD[1], Dal Mo Yang, MD[1]*, Hyun Cheol Kim, MD[1], Sang Won Kim, MD[1], Kyu Yeoun Won, MD[2], So Hyun Park, MD[3], Woo Kyoung Jeong, MD[4]

DeDepartments of [1]Radiology and [2]Pathology, Kyung Hee University College of Medicine, Kyung Hee University Hospital at Gangdong, Seoul, Korea
[3]Department of Radiology, Gil Medical Center, Gachon University College of Medicine, Incheon, Korea
[4]Department of Radiology and Center for Imaging Sciences, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea

ORCID iDs
Se Jin Lee https://orcid.org/0000-0002-1050-5657
Dal Mo Yang https://orcid.org/0000-0001-7766-5826
Hyun Cheol Kim https://orcid.org/0000-0002-3121-092X
Sang Won Kim https://orcid.org/0000-0002-1999-9163
Kyu Yeoun Won https://orcid.org/0000-0002-9520-9952
So Hyun Park https://orcid.org/0000-0001-9935-2863
Woo Kyoung Jeong https://orcid.org/0000-0002-0676-2116

Received March 21, 2023
Revised May 22, 2023
Accepted June 11, 2023

***Corresponding author**
Dal Mo Yang, MD
Department of Radiology,
Kyung Hee University
College of Medicine,
Kyung Hee University Hospital
at Gangdong, 892 Dongnam-ro,
Gangdong-gu, Seoul 05278, Korea.

Tel 82-2-440-6183
Fax 82-2-440-6932
E-mail dmy2988@daum.net

Xanthogranulomatous (XG) inflammatory disease is a rare benign disease involving various organs, including the gallbladder, bile duct, pancreas, spleen, stomach, small bowel, colon, appendix, kidney, adrenal gland, urachus, urinary bladder, retroperitoneum, and female genital organs. The imaging features of XG inflammatory disease are nonspecific, usually presenting as a heterogeneous solid or cystic mass. The disease may also extend to adjacent structures. Due to its aggressive nature, it is occasionally misdiagnosed as a malignant neoplasm. Herein, we review the radiological features and clinical manifestations of XG inflammatory diseases in various organs of the abdomen and pelvis.

Index terms Abdomen; Pelvis; Xanthogranulomatous Cholecystitis; Xanthogranulomatous Pyelonephritis; Ultrasonography; Computed Tomography, X-Ray; Magnetic Resonance Imaging

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INTRODUCTION

Xanthogranulomatous (XG) inflammatory disease is a rare and aggressive form of chronic inflammation. It is pathologically characterized by soft yellow nodules composed of lipid-laden foamy macrophages, histiocytes, and plasma cells, with a variable number of foreign body giant cells (1). In XG inflammation, the organ tissue is eventually replaced by abundant xanthoma cells, granuloma formation, and dense proliferation of fibrin and collagen deposition, resulting in tissue destruction that extends into the adjacent structures (2).

Although various mechanisms have been proposed, including defective lipid transport, immunological disorders, infection caused by low-virulence organisms, reactions to specific infectious agents, and lymphatic obstruction (3), the precise pathogenesis of XG inflammation has not been elucidated.

XG inflammation is commonly seen in cholecystitis and pyelonephritis; however, it can also occur in other organs, including the bile duct, pancreas, spleen, stomach, small bowel, colon, appendix, adrenal gland, urachus, urinary bladder, retroperitoneum, and female genital organs (4). Owing to their aggressive nature, the clinical and radiologic findings of XG inflammatory diseases are often misdiagnosed as malignant neoplasms. Therefore, accurate diagnosis is essential for proper patient management and surgical planning. Imaging plays a substantial role in the diagnosis and assessment of disease progression and its associated complications (4).

Herein, we review the radiological features and clinical manifestations of XG inflammatory disease in various abdominal and pelvic organs.

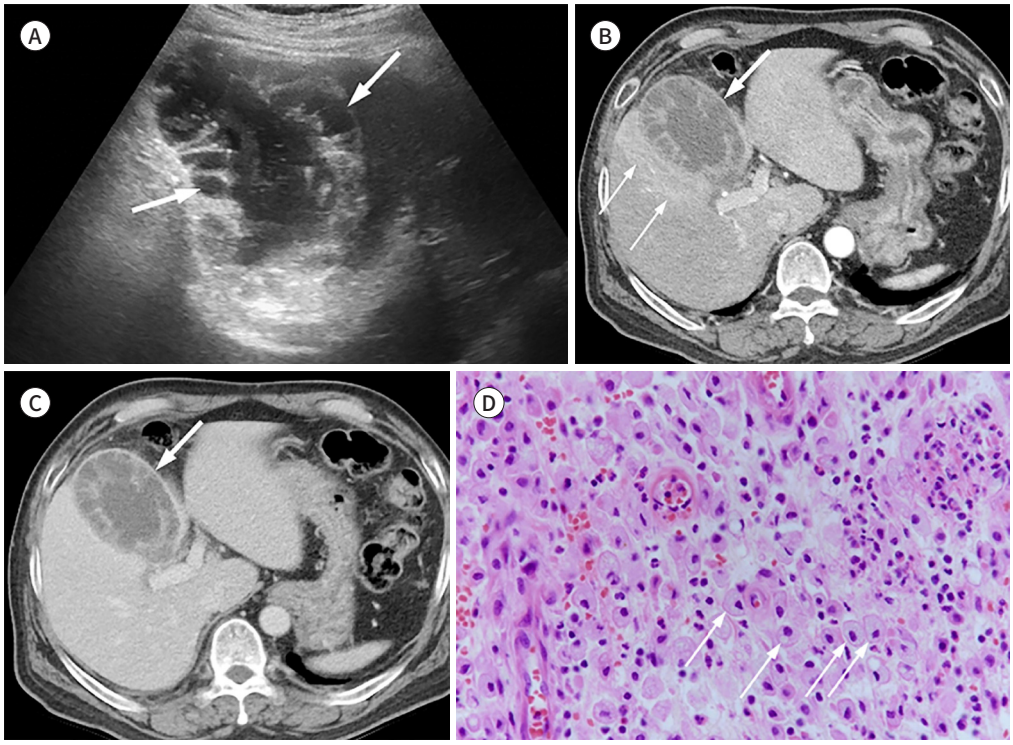
XANTHOGRANULOMATOUS CHOLECYSTITIS

XG cholecystitis is a rare chronic inflammatory disease characterized by grayish-yellow nodules or streaks in the gallbladder wall (5). It commonly occurs in women aged 60–70 years. Patients with XG cholecystitis present with various signs and symptoms of cholecystitis, including right upper quadrant pain, vomiting, jaundice, leukocytosis, and a positive Murphy's sign (5). The pathogenesis of XG cholecystitis is unclear; however, one theory suggests that it may occur due to extravasation of bile into the gallbladder wall (with the involvement of the Rokitansky–Aschoff sinuses), or through a small ulceration in the mucosa (5, 6).

Sonographic features of XG cholecystitis includes diffuse wall thickening with hypoechoic intramural nodules or a hypoechoic band surrounding the gallbladder (Fig. 1) (5, 7). Hypoechoic nodules indicate abscesses and xanthogranulomas, alone or in combination (8). Similarly, CT and MRI can reveal intramural nodules, thickened gallbladder walls, gallstones, and ductal dilatation (Fig. 2) (5-7). Intramural nodules are hypoattenuated on CT and show T2 hyperintensity and signal drops on opposed phase MRI (5-7). Complications of XG cholecystitis include gallbladder perforation, abscess formation, fistulous tract formation to the duodenum or skin, liver or colon invasion, and Mirizzi syndrome (4).

Clinical and radiological findings of XG cholecystitis often resemble those of gallbladder cancer. Several studies have attempted to determine the characteristic imaging features that distinguish XG cholecystitis from gallbladder cancer. The following features significantly in-

Fig. 1. A 64-year-old male with xanthogranulomatous cholecystitis.
A. Transverse sonography shows diffuse wall thickening of gallbladder with hypoechoic intramural nodules (arrows) and sludges in gallbladder lumen.
B, C. Arterial (B) and portal (C) phases CT reveal diffuse wall thickening of gallbladder with multiple intramural hypodense nodules (arrows) along with transient arterial enhancement of liver parenchyma adjacent to the gallbladder (thin arrows in B).
D. Photomicrography shows diffuse sheets of foamy lipid-laden macrophages (arrows) and lymphocytes (hematoxylin and eosin, × 400).



dicate XG cholecystitis over malignancy: diffuse gallbladder wall thickening, continuous mucosal line, intramural nodules, gallstones, pericholecystic fat stranding, transient hepatic attenuation differences, absence of intrahepatic bile duct dilatation, and absence of hepatic invasion (6, 7). Intramural nodules corresponding to xanthoma deposition are key features for differentiating XG cholecystitis from malignancies (5).

XANTHOGRANULOMATOUS CHOLANGITIS

XG cholangitis is a rare disease, with only 14 reported cases (9). Although it usually develops because of the extension of inflammatory lesions from XG cholecystitis into the bile ducts (10), cases of isolated XG cholangitis have been reported (9). The most common symptoms of XG cholangitis include abdominal pain and jaundice. However, its pathogenesis remains unclear. It occurs secondary to recurrent cholangitis and leads to chronic bile duct inflammation, scarring, and XG reaction (9).

Although there are few reports of XG cholangitis imaging features, bile duct stricture with associated wall thickening is a known finding (11, 12). In our case, XG cholecystitis was diagnosed concurrent with XG cholangitis. CT and MRI revealed a stone in the dilated extrahe-

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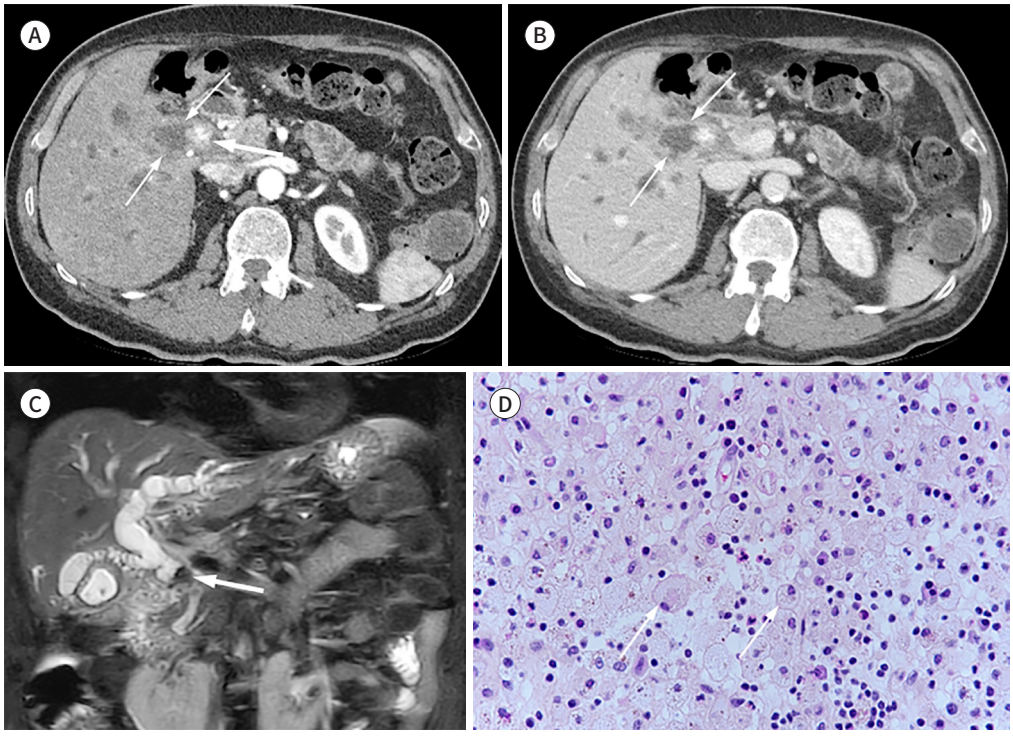
Fig. 2. A 70-year-old male with xanthogranulomatous cholangitis.
A, B. Arterial (A) and portal (B) phases CT show wall thickening of dilated extrahepatic bile duct (thin arrows) with a stone (arrow). Intrahepatic bile ducts are dilated.
C. Coronal T2-weighted image shows a hypointense stone in dilated extrahepatic bile duct (arrow). Diffuse wall thickening of gallbladder with tiny stones is seen. Intrahepatic bile ducts are dilated.
D. Photomicrography shows numerous foamy lipid-laden macrophages (arrows), lymphocytes, and plasma cells (hematoxylin and eosin, × 400).



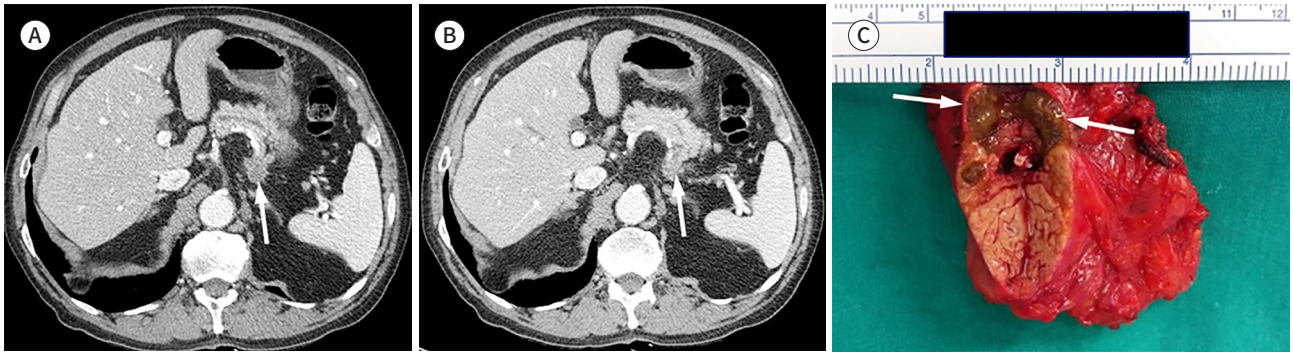
patic bile duct, bile duct wall thickening, and intrahepatic bile duct dilatation (Fig. 2). XG cholangitis can mimic cholangiocarcinoma, primary sclerosing cholangitis, recurrent pyogenic cholangitis, inflammatory pseudotumors, and Mirizzi syndrome (12).

XANTHOGRANULOMATOUS PNCREATITIS

XG pancreatitis is a rare form of chronic pancreatitis. The exact pathophysiology of XG pancreatitis remains unclear; however, it typically results from a combination of duct obstruction, infection, and repeated hemorrhages. Moreover, it is occasionally associated with pancreatic neoplasms (13, 14). XG pancreatitis commonly occurs in middle-aged men and presents with abdominal pain (15). Laboratory findings, including WBC count, serum C-reactive protein, amylase, lipase, and CA19-9 are mostly within the normal range or clinically insignificant (14).

There are various CT and MRI indications for XG pancreatitis, ranging from a cystic mass to a solid mass which can mimic pancreatic neoplasms (14). The solid type of XG pancreatitis presents a lobulated heterogeneous mass with hypovascular and progressive enhancement (Fig. 3) (14). Differentiating XG pancreatitis from a malignant tumor is difficult; however, in patients with XG pancreatitis, upstream pancreatic duct dilatation is generally absent, and

Fig. 3. A 68-year-old female with xanthogranulomatous pancreatitis.
A, B. Axial enhanced CT reveal a heterogeneously hypodense lesion with irregular contour (arrows), which is protruded from the pancreatic tail.
C. Gross specimen of distal pancreas shows a capsular lesion filled with mud-like contents (arrows).



CA19-9 levels are within the normal range (14). The cystic type of XG pancreatitis presents as a lobulated cystic mass with an irregular thick wall, similar to intraductal papillary mucinous neoplasms or other pancreatic cystic tumors (13, 14). MRI findings can help distinguish the cystic type from other cystic tumors. In XG pancreatitis, T2-weighted imaging usually demonstrates a low signal intensity relative to the fluid as well as obvious diffusion restriction (13, 14).

XANTHOGRANULOMATOUS INFLAMMATION OF THE GASTROINTESTINAL TRACT

The involvement of the gastrointestinal tract in XG inflammation is rare, with only 14 cases reportedly affecting the stomach (16, 17), 2 affecting the terminal ileum (18, 19), and 5 affecting the colon (20, 21). Of the five cases with colonic involvement, two involved the sigmoid colon, two involved the ascending colon, and one involved the cecum (20, 21).

Most gastric lesions present as mass-forming lesions, with submucosal involvement or wall thickening (16). Cases of XG gastritis may be misdiagnosed preoperatively as submucosal tumors or advanced gastric cancer (16). XG inflammation of the terminal ileum presents with mucosal ulceration, wall thickening (18), or mass formation (19), whereas XG colitis presents as a submucosal (21) or ulceroinfiltrative (20) mass. Symptoms of XG colitis are abdominal pain, constipation, and diarrhea (20, 21). XG inflammation of the gastrointestinal tract is difficult to distinguish from other malignancies. Therefore, intraoperative pathological diagnosis using frozen sections may be required to plan the surgical extent (20).

XANTHOGRANULOMATOUS APPENDICITIS

XG appendicitis is a rare chronic inflammatory disease of the appendix and is associated with long-standing or recurrent inflammation (22). XG appendicitis occurs in patients who undergo interval appendectomy after perforation of acute appendicitis (23). Although several studies have been published in pathology journals, imaging findings have rarely been described (24-26). All imaging findings reported were obtained using CT (24-26). Previously reported CT findings of XG appendicitis have only been described as secondary findings of ap-

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pendicitis, such as diffuse bowel wall thickening of the terminal ileum and cecum (24), pericecal abscesses (25), or large ileocecal phlegmon (26). In addition, these reports did not provide CT findings of XG appendicitis in the appendix itself.

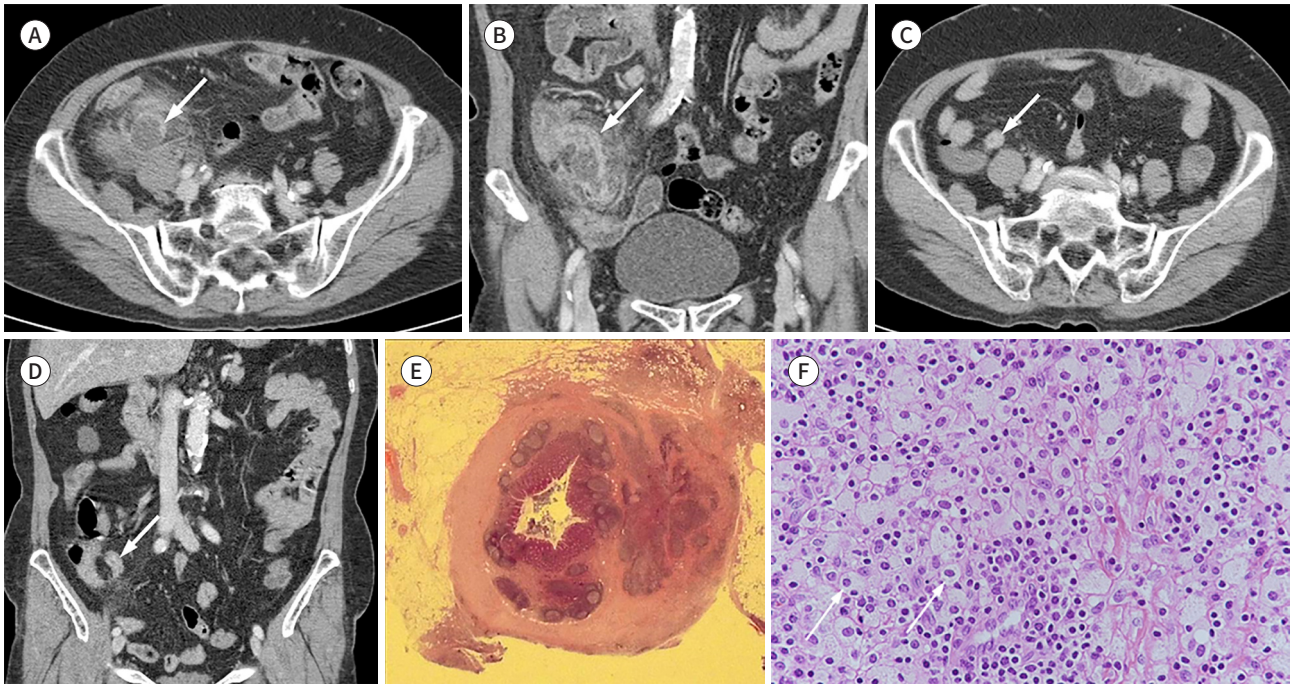
In our case, the CT findings of XG appendicitis demonstrated severe asymmetric appendiceal wall thickening and scant intraluminal fluid (Fig. 4). This result correlates with the pathology of mural fibrosis, chronic transmural inflammation with lymphoid aggregates, and subserosal spread.

XANTHOGRANULOMATOUS INFLAMMATION OF THE PERITONEUM

To the best of our knowledge, XG inflammation of the peritoneum is rare, and only one case has been reported (27), with CT findings of an approximately 1.7 cm-sized omental nodule and multiple peritoneal nodules. Bile leakage after laparoscopic cholecystectomy is considered a cause of XG inflammation of the peritoneum (27).

In our case, a 1.2 cm-sized heterogeneous enhancing soft tissue mass in the peritoneal cavity of the epigastric portion was observed on CT of a 77-year-old man with a history of cholecystectomy for gallbladder cancer (Fig. 5). The mass was located near the surgical incision

Fig. 4. A 69-year-old male with xanthogranulomatous appendicitis.
A, B. Axial (A) and coronal (B) enhanced CT show perforated appendicitis with periappendiceal abscess formation (arrows). Periappediceal fat infiltration is noted.
C, D. Follow-up enhanced CT after 40 days shows diffuse wall thickening of appendix (arrows). Periappendiceal abscess and periappendiceal fat infiltration are disappeared.
E. Low-power photography reveals diffuse mural fibrosis and thickening and transmural chronic inflammation with lymphoid aggregates of appendix.
F. Photomicrography shows numerous foamy lipid-laden macrophages (arrows), lymphocytes, and plasma cells (hematoxylin and eosin, × 400).



site on the abdominal wall. We believe that the XG inflammation of the peritoneum in our case may have been related to surgery. XG inflammation in the peritoneum was confirmed by surgical resection.

Fig. 5. A 77-year-old female with xanthogranulomatous inflammation of the peritoneum and a history of cholecystectomy for gallbladder carcinoma 4 months ago.
A. Axial enhanced CT shows a small hypodense nodule at peritoneum of the epigastric portion (arrow) and perilesional fat infiltration.
B. After 6 months, the nodule became smaller and more contrast enhanced on enhanced CT (arrow).
C. PET CT shows a focal hypermetabolic lesion in anterior abdominal cavity (arrow).

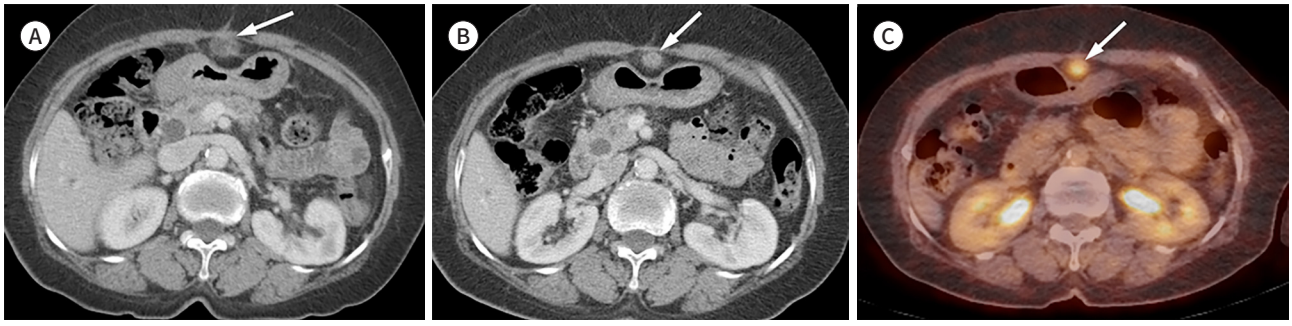
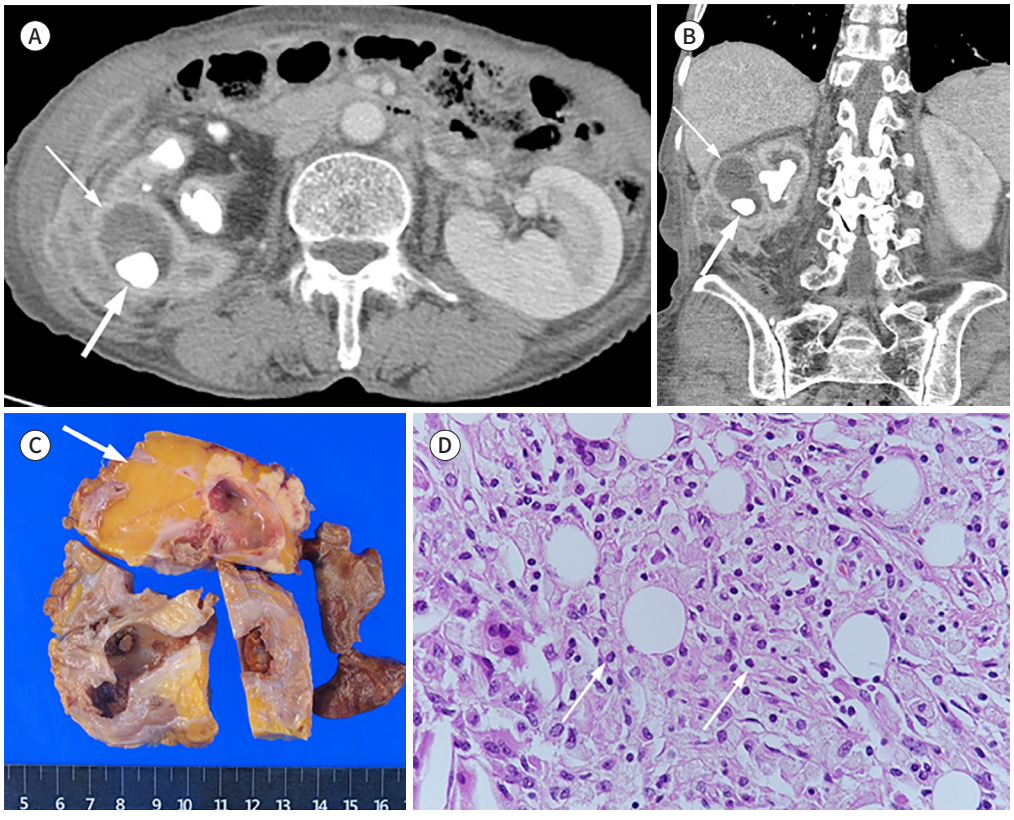


Fig. 6. A 70-year-old female with xanthogranulomatous pyelonephritis.
A, B. Axial (A) and coronal (B) enhanced CT show calyceal dilatation, staghorn calculi (thick arrows), and parenchymal thinning (thin arrows).
C. Excised specimen shows staghorn calculi and xanthogranulomatous inflammation represented by irregular yellow tissue in collecting system (arrow).
D. Photomicrography shows diffuse sheets of foamy lipid-laden macrophages (arrows) and inflammatory cells (hematoxylin and eosin, × 400).



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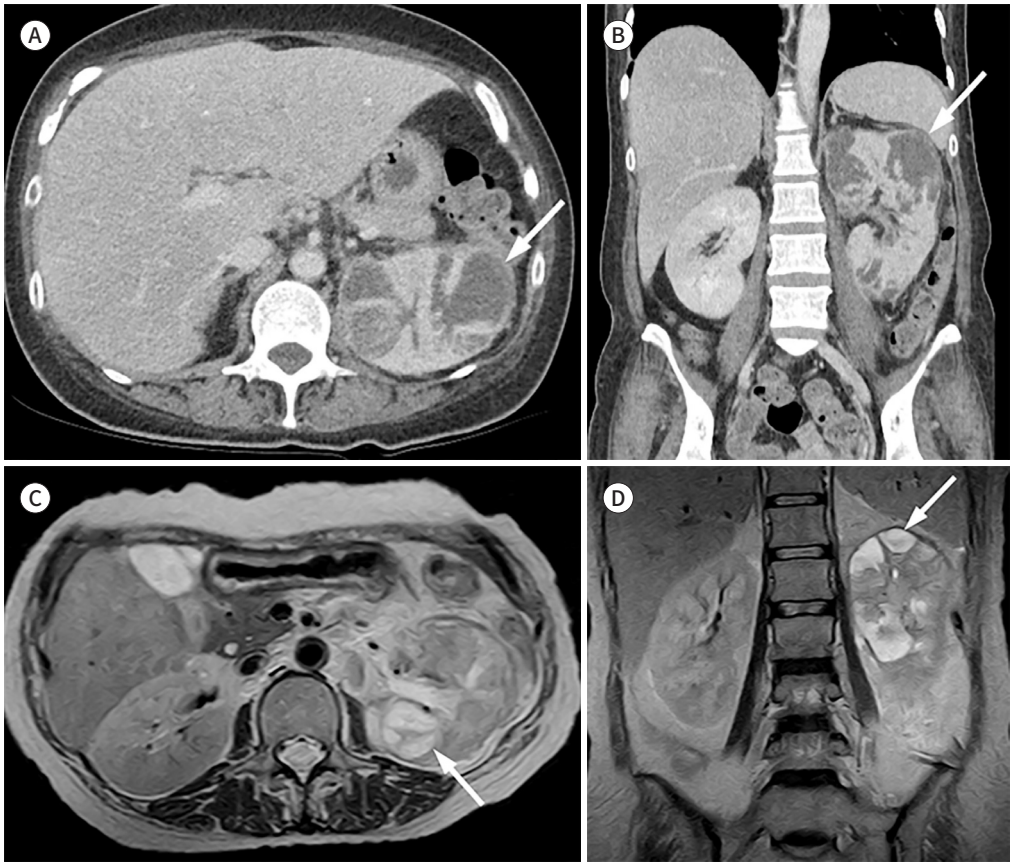
XANTHOGRANULOMATOUS PYELONEPHRITIS

XG pyelonephritis (XGP) is an uncommon but severe form of chronic renal infection. It commonly occurs in middle-aged patients with a history of recurrent urinary tract infections, diabetes, or kidney stones (28). The clinical features are nonspecific, with flank pain and fever being the most common symptoms (29). XGP is a chronic granulomatous disease in which the renal parenchyma is destroyed and ultimately replaced with lipid-laden (foamy) macrophages, often extending beyond the kidneys (2).

Sonography typically shows diffuse enlargement of the kidney, with renal parenchymal thinning or loss of normal corticomedullary differentiation (29). Multiple anechoic or hypoechoic masses similar to the "bear paw sign" on CT can be observed (30). Central echogenicity with posterior acoustic shadowing indicates pelvic staghorn calculus (30). XGP is focal in 10% of cases and can mimic renal tumors (2).

CT demonstrates renal enlargement and replacement of the renal parenchyma by multiple low-attenuation blown-out calyces with cortical thinning, representing a "bear paw sign" (Fig. 6) (30, 31). Low-attenuation calyces show either dilated calyces or renal parenchyma filled with

Fig. 7. A 48-year-old female with xanthogranulomatous pyelonephritis.
A, B. Axial (A) and coronal (B) enhanced CT reveal multiple ill-defined hypodense lesions in left kidney (arrows).
C, D. Axial (C) and coronal (D) T2-weighted images show multiple hyperintense masses with cortical thinning of left kidney (arrows).



pus, debris, or hemorrhage (31). A large staghorn calculus with contraction of the renal pelvis can also be seen (29).

The MRI findings are nonspecific and overlap with those of tuberculosis and malignancy. Lipid-laden foamy macrophages are hyperintense on T1-weighted images (28). Cavities and abscesses are hypointense on T1-weighted images and hyperintense on T2-weighted images (Fig. 7) (30).

Complications associated with XGP include perforation with an abscess and/or fistula formation involving the spleen, paraspinal muscles, or psoas muscle (2, 28).

XANTHOGRANULOMATOUS INFLAMMATION OF THE URACHUS AND URINARY BLADDER

The urachus is an embryonic fibrous remnant of the allantois that extends from the apex of the bladder to the umbilicus. Involution of the urachus is usually complete at birth; however, incomplete involution results in urachal abnormalities such as patent urachus, umbilical-urachal sinus, vesicourachal diverticulum, and urachal cysts (32). Few cases of XG inflammation in the urachus have been reported (33-35). The main symptoms include lower abdominal mass, abdominal pain, and dysuria (35).

Sonography and CT reveal a midline supravesical soft tissue mass with adjacent organ involvement. On sonography, it usually appears as a mixed echogenic mass in the anterosuperior portion of the bladder (Fig. 8) (33). CT demonstrates heterogeneous attenuation with variable contrast enhancement (33) or peripheral rim enhancement (Figs. 8, 9) (34). The differential diagnosis of urachal carcinoma based on imaging is difficult; however, a supravesical mass with calcification would significantly favor urachal carcinoma over inflammation (32).

XG cystitis is a rare, benign, chronic inflammatory disease; to date, 30 cases have been reported in the literature (in English) (36). However, a majority of the reported cases were associated with urachal cysts or remnants, and the location of XG cystitis in these cases was at the dome of the bladder (Fig. 9) (37).

XG cystitis without a relationship with the urachus is very rare, with only four cases demonstrating this condition (36, 38). Common symptoms of XG cystitis without a relationship with the urachus include lower abdominal pain and dysuria; it may also be asymptomatic (36, 38). Imaging findings of XG cystitis without a relationship to the urachus include a polypoid mass (36) and wall thickening of the urinary bladder (38). XG cystitis is difficult to distinguish from actinomycosis, which is another chronic inflammation. However, actinomycosis usually occurs in women and is associated with intrauterine device insertion, which can be helpful in the differential diagnosis (39).

XANTHOGRANULOMATOUS PROSTATITIS

XG prostatitis is a rare form of granulomatous prostatitis that can mimic prostate cancer clinically and radiologically (40-42). Patients with clinical presentation of symptoms are typically in their 60s. It presents with lower urinary tract infections, such as frequency and dysuria (40-42). Prostate-specific antigen levels are typically elevated (41, 42).

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Fig. 8. A 31-year-old female with xanthogranulomatous inflammation of urachus.
A. Sagittal color Doppler sonography shows a tear-drop shaped hypoechoic mass with blood flow within the peripheral portion in supravesical space (arrow).
B, C. On axial (B) and sagittal (C) enhanced CT show an enhancing soft tissue mass with central cystic focus at supravesical space (arrows).
D. On T2-weighted MR image, the mass shows intermediate signal intensity with central cystic focus (arrow).
E. On contrast enhanced T1-weighted image, the mass shows homogeneous enhancement with central cystic lesion (arrow).
F. Photomicrography shows diffuse sheets of foamy lipid laden macrophages (arrows) and lymphocytes (hematoxylin and eosin, × 400).

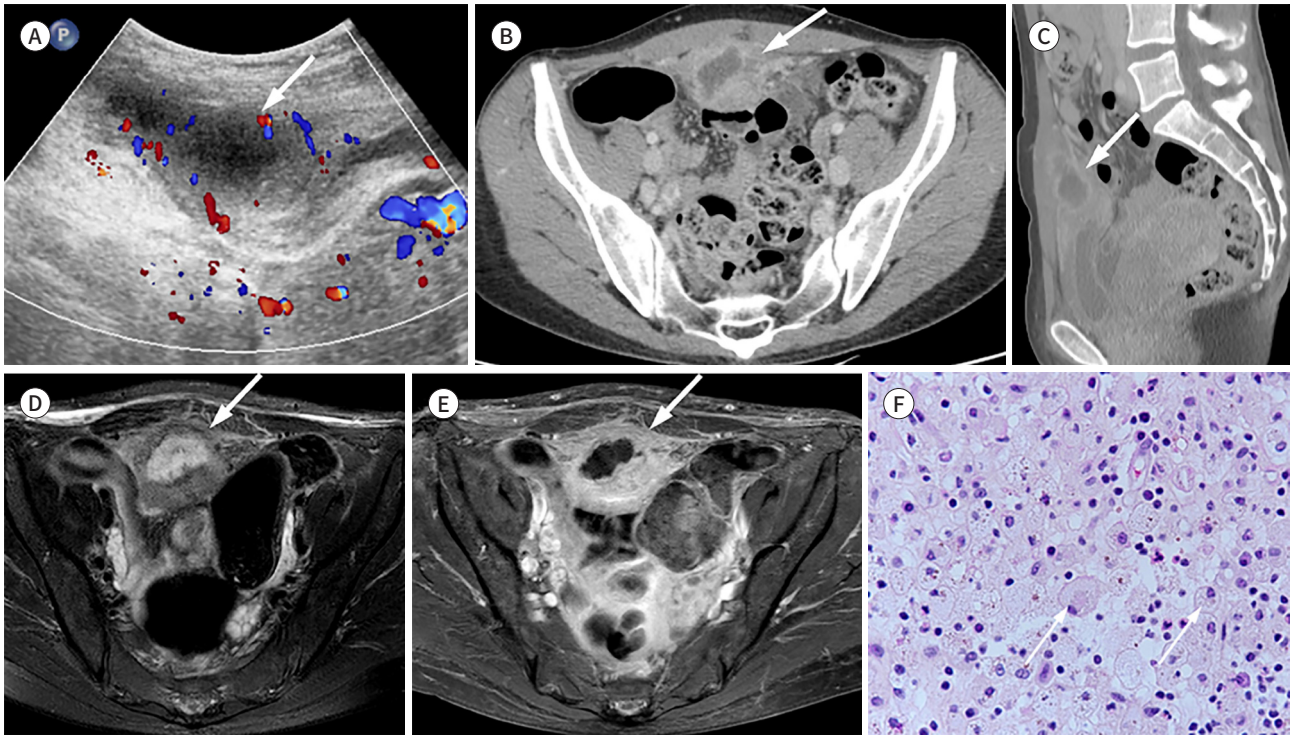
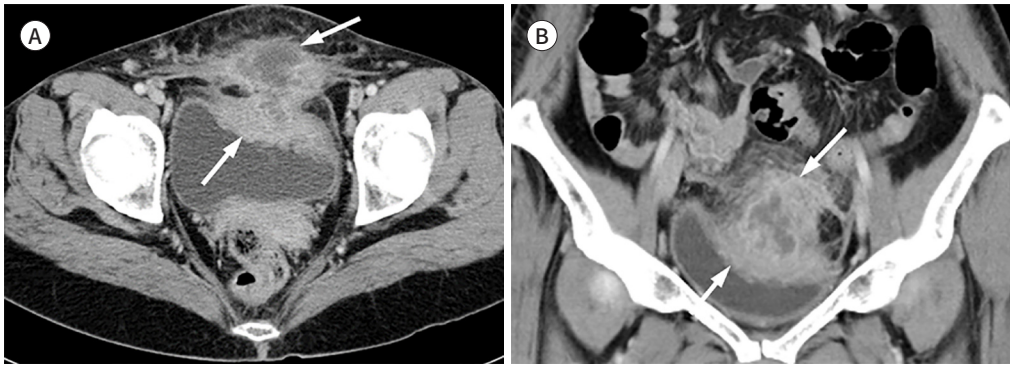
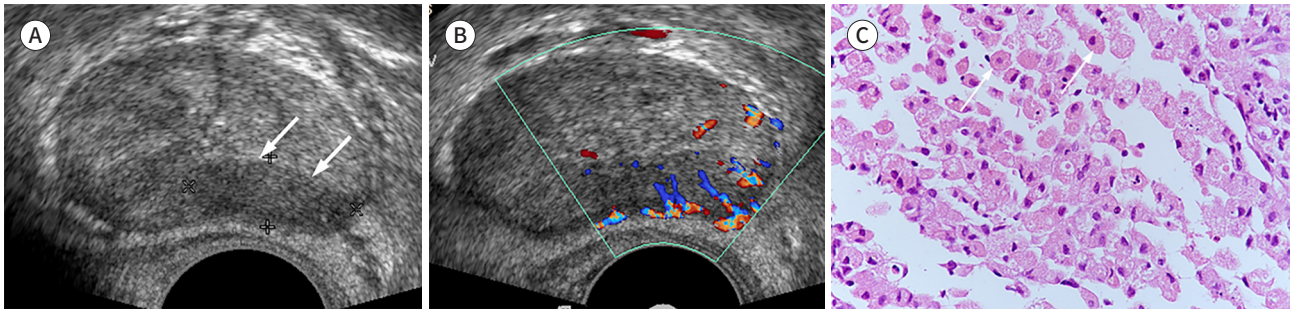


Fig. 9. A 42-year-old female with xanthogranulomatous inflammation of the urinary bladder and urachus.
A, B. Axial (A) and coronal (B) enhanced CT reveal enhancing soft tissue mass with central cystic portion at the urinary bladder dome and supravesical space (arrows).



Endorectal sonography typically shows uniform hypoechoic (43) or multiple hypoechoic lesions (Fig. 10) (40). Few cases concerning MRI features have been reported (41, 44). MRI shows T1 hypointensity and T2 hyperintensity in the bilateral peripheral zones, with peripheral enhancement and diffusion restriction (41). Prostatic abscesses are rare in patients with XG prostatitis (45). On sonography and MRI, differentiation between XG prostatitis and pros-

Fig. 10. A 69-year-old male with xanthogranulomatous prostatitis.
A. Axial sonography shows a hypoechoic lesion in left peripheral zone of the prostate (arrows).
B. The mass shows hypervascularity on color Doppler sonography.
C. Photomicrography shows diffuse sheets of foamy lipid-laden macrophages (arrows) and lymphocytes (hematoxylin and eosin, × 400).



tate cancer may be difficult (40-42). Hence, a transrectal sonography-guided prostate biopsy should be performed for an accurate diagnosis (40). Although XG prostatitis does not require additional treatment, follow-up is necessary (41).

XANTHOGRANULOMATOUS INFLAMMATION OF THE FEMALE GENITAL TRACT

XG inflammation of the female genital tract is an uncommon chronic inflammation that causes destructive masses in the pelvic cavity. It affects the endometrium, fallopian tubes, or ovaries focally or entirely and is most commonly seen in the endometrium (46).

XG endometritis occurs in women aged 59–88 years (average: 72 years) (46). Postmenopausal women with endometrial hyperplasia, endometrial carcinoma, and/or cervical stenosis can develop this condition (47). Clinical manifestations include lower abdominal pain and vaginal discharge. Radiological findings usually include a heterogeneous cystic uterine mass (48) or chronic complex fluid collection in the endometrial canal (47). XG inflammation rarely involves the myometrium and extends to the pelvis with uterine perforation (Fig. 11) (49). Radiological features can easily lead to misdiagnosis of malignant tumors, and XG endometritis may be associated with endometrial cancer. Surgical excision is the standard treatment for XG endometritis (48).

XG salpingitis and oophoritis typically occur in women aged 23–72 years (average: 38.5 years) and mainly affect one side (46). Patients with XG inflammation of the fallopian tube and ovary typically present with a history of pelvic inflammatory diseases that last for months or years. Other clinical presentations include anemia, anorexia, fever, irregular colporrhagia, abdominal pain, and tenderness of the adnexal mass (46).

Sonography, CT, and MRI revealed a thick-walled complex solid cystic tubo-ovarian mass with variably enhanced solid portions (Fig. 12) (50). It usually appears as an invasion of the surrounding tissue and may be difficult to differentiate from actinomycosis (51) or ovarian malignancies (50). On MRI, the presence of non-enhancing nodules in the thickened walls of ovarian cystic masses may be a unique finding to confirm the diagnosis of XG oophoritis (52).

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Fig. 11. A 59-year-old female with xanthogranulomatous inflammation of the uterus, right salpinx, and right ovary.
A-C. Axial (A, B) and coronal (C) enhanced CT show irregular hypodense abscesses in the uterine body (thick arrows), right salpinx, and right ovary (thin arrow). Multiple fat infiltrations are seen adjacent to the inflamed right ovary.

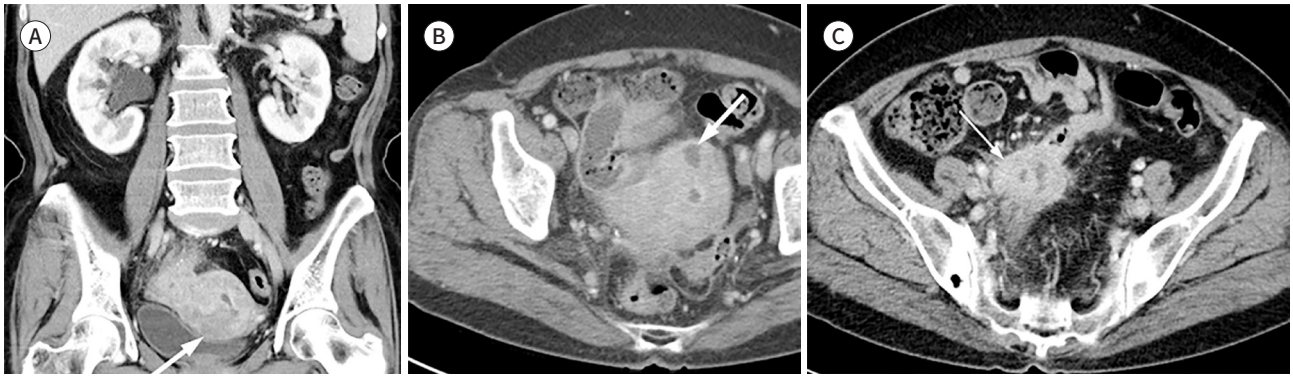
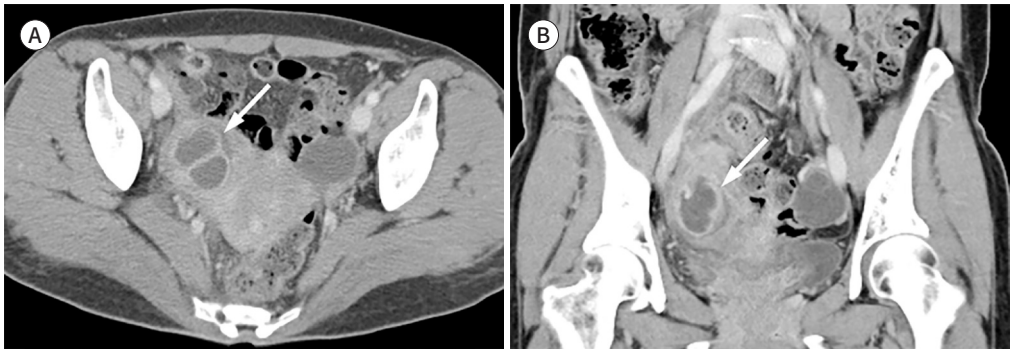


Fig. 12. A 44-year-old female with xanthogranulomatous salpingitis.
A, B. Axial (A) and coronal (B) enhanced CT show a cystic mass with a thick wall and a septum in the right adnexa (arrows). Right salpingectomy, omentectomy, and adhesiolysis were performed. Laparoscopic right salpingectomy was performed. Pathologic diagnosis of xanthogranulomatous salpingitis was made.



CONCLUSION

XG is a rare and benign inflammatory disease involving various organs. The imaging features of XG inflammatory disease are nonspecific and usually present as heterogeneous solid or cystic masses with destruction of the affected organs. Due to its aggressive nature, it is occasionally misdiagnosed as a malignancy. Hence, it is important for radiologists to familiarize themselves with the relevant imaging findings and consider XG inflammatory disease in the differential diagnosis to reduce the rate of unnecessary surgeries.

Author Contributions

Conceptualization, Y.D.M.; data curation, Y.D.M., K.H.C., K.S.W., W.K.Y., P.S.H., J.W.K.; formal analysis, Y.D.M., K.H.C., K.S.W., W.K.Y., P.S.H., J.W.K.; supervision, Y.D.M.; writing—original draft, L.S.J., Y.D.M.; and writing—review & editing, all authors.

Conflicts of Interest

Dal Mo Yang has been a Section Editor of the Journal of the Korean Society of Radiology since 2014; however, he was not involved in the peer reviewer selection, evaluation, or decision process of this article. Otherwise, no other potential conflicts of interest relevant to this article were reported.

Funding

None

REFERENCES

1. Goodman ZD, Ishak KG. Xanthogranulomatous cholecystitis. *Am J Surg Pathol* 1981;5:653-660
2. Craig WD, Wagner BJ, Travis MD. Pyelonephritis: radiologic-pathologic review. *Radiographics* 2008;28:255-277
3. Antonakopoulos GN, Chapple CR, Newman J, Crocker J, Tudway DC, O'Brien JM, et al. Xanthogranulomatous pyelonephritis. A reappraisal and immunohistochemical study. *Arch Pathol Lab Med* 1988;112:275-281
4. Bourm KS, Menias CO, Ali K, Alhalabi K, Elsayes KM. Spectrum of xanthogranulomatous processes in the abdomen and pelvis: a pictorial review of infectious, inflammatory, and proliferative responses. *AJR Am J Roentgenol* 2017;208:475-484
5. 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
6. Zhao F, Lu PX, Yan SX, Wang GF, Yuan J, Zhang SZ, et al. CT and MR features of xanthogranulomatous cholecystitis: an analysis of consecutive 49 cases. *Eur J Radiol* 2013;82:1391-1397
7. Lee ES, Kim JH, Joo I, Lee JY, Han JK, Choi BI. Xanthogranulomatous cholecystitis: diagnostic performance of US, CT, and MRI for differentiation from gallbladder carcinoma. *Abdom Imaging* 2015;40:2281-2292
8. Kim PN, Ha HK, Kim YH, Lee MG, Kim MH, Auh YH. US findings of xanthogranulomatous cholecystitis. *Clin Radiol* 1998;53:290-292
9. Zhang JQ, Truong L, Pan J, Yakirevich E, Hyder SM, Beard RE. Xanthogranulomatous cholangitis mimicking cholangiocarcinoma: case report and review of literature. *Int J Surg Case Rep* 2022;93:106921
10. Bae SK, Abiru S, Kamohara Y, Hashimoto S, Otani M, Saeki A, et al. Hepatic inflammatory pseudotumor associated with xanthogranulomatous cholangitis mimicking cholangiocarcinoma. *Intern Med* 2015;54:771-775
11. Kawate S, Ohwada S, Ikota H, Hamada K, Kashiwabara K, Morishita Y. Xanthogranulomatous cholangitis causing obstructive jaundice: a case report. *World J Gastroenterol* 2006;12:4428-4430
12. Menias CO, Surabhi VR, Prasad SR, Wang HL, Narra VR, Chintapalli KN. Mimics of cholangiocarcinoma: spectrum of disease. *Radiographics* 2008;28:1115-1129
13. Becker-Weidman D, Floré B, Mortelé KJ. Xanthogranulomatous pancreatitis: a review of the imaging characteristics of this rare and often misdiagnosed lesion of the pancreas. *Clin Imaging* 2017;45:12-17
14. Kwon JH, Kim JH, Kim SY, Byun JH, Kim HJ, Hong SM, et al. Imaging and clinical features of xanthogranulomatous pancreatitis: an analysis of 10 cases at a single institution. *Abdom Radiol (NY)* 2018;43:3349-3356
15. Kim HS, Joo M, Chang SH, Song HY, Song TJ, Seo JW, et al. Xanthogranulomatous pancreatitis presents as a solid tumor mass: a case report. *J Korean Med Sci* 2011;26:583-586
16. Tsukada T, Nakano T, Miyata T, Sasaki S, Higashi K. Xanthogranulomatous gastritis mimicking malignant GIST on F-18 FDG PET. *Ann Nucl Med* 2012;26:752-756
17. Tajima S, Waki M, Ohata A, Koda K, Maruyama Y. Xanthogranulomatous gastritis associated with actinomycosis: report of a case presenting as a large submucosal mass. *Int J Clin Exp Pathol* 2015;8:1013-1018
18. Wong KC, Tsui WM, Chang SJ. Xanthogranulomatous inflammation of terminal ileum: report of a case with small bowel involvement. *Hong Kong Med J* 2015;21:69-72
19. Yoon JS, Jeon YC, Kim TY, Han DS, Sohn JH, Nam KW, et al. Xanthogranulomatous inflammation in terminal ileum presenting as an appendiceal mass: case report and review of the literature. *Clin Endosc* 2013;46:193-196
20. Dhawan S, Jain D, Kalhan SK. Xanthogranulomatous inflammation of ascending colon with mucosal involvement: report of a first case. *J Crohns Colitis* 2011;5:245-248
21. Oh YH, Seong SS, Jang KS, Chung YW, Paik CH, Park YW, et al. Xanthogranulomatous inflammation presenting as a submucosal mass of the sigmoid colon. *Pathol Int* 2005;55:440-444
22. McVey RJ, McMahon RF. Xanthogranulomatous appendicitis. *Histopathology* 1994;24:198
23. Guo G, Greenson JK. Histopathology of interval (delayed) appendectomy specimens: strong association with granulomatous and xanthogranulomatous appendicitis. *Am J Surg Pathol* 2003;27:1147-1151

24. Chuang YF, Cheng TI, Soong TC, Tsou MH. Xanthogranulomatous appendicitis. *J Formos Med Assoc* 2005;104:752-754
25. Mado K, Mazaki T, Henmi A, Masuda H, Takayama T. Xanthogranulomatous appendicitis. *Indian J Surg* 2013;75:405-406
26. Kochhar G, Saha S, Andley M, Kumar A, Kumar A. Xanthogranulomatous appendicitis with a fulminant course: report of a case. *J Clin Diagn Res* 2014;8:ND01-ND02
27. Gohel TD, Bharadwaj S, McCullough A. Intra-abdominal xanthogranulomatoses secondary to postoperative bile leak. *J Cytol Histol* 2015;6:345
28. Loffroy R, Guiu B, Watfa J, Michel F, Cercueil JP, Krausé D. Xanthogranulomatous pyelonephritis in adults: clinical and radiological findings in diffuse and focal forms. *Clin Radiol* 2007;62:884-890
29. Hayes WS, Hartman DS, Sesterbenn IA. From the archives of the AFIP. Xanthogranulomatous pyelonephritis. *Radiographics* 1991;11:485-498
30. Bolger MP, Hennebry J, Byrne C, Greene L, Stroiescu A, Heneghan J, et al. Xanthogranulomatous pyelonephritis: a narrative review with current perspectives on diagnostic imaging and management, including interventional radiology techniques. *Int J Nephrol Renovasc Dis* 2021;14:359-369
31. Dwivedi US, Goyal NK, Saxena V, Acharya RL, Trivedi S, Singh PB, et al. Xanthogranulomatous pyelonephritis: our experience with review of published reports. *ANZ J Surg* 2006;76:1007-1009
32. Yu JS, Kim KW, Lee HJ, Lee YJ, Yoon CS, Kim MJ. Urachal remnant diseases: spectrum of CT and US findings. *Radiographics* 2001;21:451-461
33. Nimmonrat A, Na-ChiangMai W, Muttarak M. Urachal abnormalities: clinical and imaging features. *Singapore Med J* 2008;49:930-935
34. Kuo TL, Cheng C. Xanthogranulomatous inflammation of urachus mimicking urachal carcinoma. *Urology* 2009;73:443.E13-443.E14
35. Díaz Candamio MJ, Pombo F, Arnal F, Busto L. Xanthogranulomatous urachitis: CT findings. *J Comput Assist Tomogr* 1998;22:93-95
36. Moradi A, Shakiba B, Molanaei S. Xanthogranulomatous cystitis mimicking bladder tumor: a case report. *Urol Case Rep* 2021;38:101684
37. Hayashi N, Wada T, Kiyota H, Ueda M, Oishi Y. Xanthogranulomatous cystitis. *Int J Urol* 2003;10:498-500
38. Yamamoto S, Yoshida K, Tsumura K, Nomiya A, Yoda K, Iida K, et al. Xanthogranulomatous cystitis treated by transurethral resection. *Urol Case Rep* 2015;3:143-145
39. Al-Kadhi S, Venkiteswaran KP, Al-Ansari A, Shamsudini A, Al-Bozom I, Kiliyanni AS. Primary vesical actinomycosis: a case report and literature review. *Int J Urol* 2007;14:969-971
40. Valsangkar RS, Singh DP, Gaur DD. Xanthogranulomatous prostatitis: rare presentation of rare disease. *Indian J Urol* 2012;28:204-205
41. Lee HY, Kuo YT, Tsai SY, Li CC, Wu WJ, Huang CH, et al. Xanthogranulomatous prostatitis: a rare entity resembling prostate adenocarcinoma with magnetic resonance image picture. *Clin Imaging* 2012;36:858-860
42. Mukendi AM, Doherty S, Mohanlal R. Xanthogranulomatous prostatitis: a rare mimicker of prostate adenocarcinoma. *Clin Case Rep* 2020;8:203-205
43. Rafique M, Yaqoob N. Xanthogranulomatous prostatitis: a mimic of carcinoma of prostate. *World J Surg Oncol* 2006;4:30
44. Cheng Y, Zhang X, Ji Q, Shen W. Xanthogranulomatous prostatitis: multiparametric MRI appearances. *Clin Imaging* 2014;38:755-757
45. Belga S, Chen W, Low G, Cervera C. Xanthogranulomatous prostatitis presenting as Pseudomonas aeruginosa prostatic abscesses: an uncommon complication after kidney transplantation. *IDCases* 2019;17:e00559
46. Zhang XS, Dong HY, Zhang LL, Desouki MM, Zhao C. Xanthogranulomatous inflammation of the female genital tract: report of three cases. *J Cancer* 2012;3:100-106
47. Merviel P, James P, Carlier M, Thomas-Kergastel I, Guilloique M, Conan-Charlet V, et al. Xanthogranulomatous endometritis: a case report and literature review. *Clin Case Rep* 2021;9:e04299
48. Du XZ, Lu M, Safneck J, Baker P, Dean E, Mottola J. Xanthogranulomatous endometritis mimicking endometrial carcinoma: a case report and review of literature. *Radiol Case Rep* 2019;14:121-125
49. Liao CY, Chiu CH, Luo FJ. Xanthogranulomatous inflammation of myometrium with uterine perforation. *Taiwan J Obstet Gynecol* 2013;52:428-430

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50. Kim SH, Kim SH, Yang DM, Kim KA. Unusual causes of tubo-ovarian abscess: CT and MR imaging findings. *Radiographics* 2004;24:1575-1589
51. Heo SH, Shin SS, Kim JW, Lim HS, Seon HJ, Jung SI, et al. Imaging of actinomycosis in various organs: a comprehensive review. *Radiographics* 2014;34:19-33
52. Jung SE, Lee JM, Lee KY, Han KT, Hahn ST. Xanthogranulomatous oophoritis: MR imaging findings with pathologic correlation. *AJR Am J Roentgenol* 2002;178:749-751

복부와 골반의 다양한 장기에서 발생한 황색육아종성 염증 질환의 영상 및 임상 소견: 임상화보

이세진[1] · 양달모[1*] · 김현철[1] · 김상원[1] · 원규연[2] · 박소현[3] · 정우경[4]

황색육아종성 염증 질환은 담낭, 담관, 췌장, 비장, 위, 소장, 결장, 충수, 신장, 부신, 요막관, 방광, 후복막, 여성 생식기 등 다양한 장기를 침범하는 드문 양성 질환이다. 황색육아종성 염증 질환의 영상학적 소견은 비특이적이고 대개 비균질한 고형 또는 낭성 종괴로 나타나며 인접한 장기를 침범할 수 있다. 황색육아종성 염증 질환은 공격적인 양상으로 인해 때때로 악성 종양으로 오인될 수 있다. 본 임상화보에서는 복부와 골반의 다양한 장기에서 발생한 황색육아종성 염증 질환의 영상 소견 및 임상양상을 고찰하고자 한다.

경희대학교 의과대학 강동경희대학교병원 [1]영상의학과, [2]병리과,
[3]가천대학교 의과대학 길병원 영상의학과,
[4]성균관대학교 의과대학 삼성서울병원 영상의학과

https://doi.org/10.3348/jksr.2023.0026