Article published online: 2023-10-10

Spectrum of Multidetector Computed Tomography Imaging Findings in Iatrogenic Abdominopelvic Injuries: A Comprehensive Pictorial Review

Pavithra Subramanian[1,*] Arun Sharma[1,*] Raghuraman Soundararajan[1] Manphool Singhal[1]

[1] Department of Radiodiagnosis and Imaging, Postgraduate Institute of Medical Education and Research, Chandigarh, India

Indian J Radiol Imaging 2024;34:139–149.

Address for correspondence Arun Sharma, MD, DM, Department of Radiodiagnosis and Imaging, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India (e-mail: drarungautam@gmail.com).

Abstract

Iatrogenic injuries are unavoidable complications of surgeries and minimally invasive procedures. They are generally classified into vascular and nonvascular injuries and based on the time of injury into early and late injuries. Iatrogenic injuries, particularly vascular injuries, increase the mortality and morbidity, with prolongation of hospital-stay. Multidetector computed tomography (MDCT) is a highly sensitive, and often the first imaging modality in suspected iatrogenic injuries. This pictorial review elucidates the imaging considerations and appearances of iatrogenic injuries of the abdominopelvic organs on MDCT.

Keywords
- abdomen
- iatrogenic injuries
- multidetector computed tomography
- pseudoaneurysm
- vascular injuries

Introduction

Iatrogenic injuries may be caused by surgical or minimally invasive percutaneous procedures. They may be vascular or nonvascular.[1] Iatrogenic injuries may also be classified as early and late, depending on the time of presentation; early injuries are identified intraoperatively, while late injuries present in the postoperative period.[2,3] Often under-reported the overall prevalence of iatrogenic injuries due to abdominal surgeries is unknown. The widespread availability of ultrasound and fluoroscopy has led to radiologically guided procedures replacing "blind" procedures. Percutaneous intervention procedures are relatively safe, with an estimated iatrogenic complication of less than 1%, most of which are vascular.[4] However, despite meticulous technique, iatrogenic injuries remain inevitable. Computed tomography is the primary modality for the diagnosis of such iatrogenic vascular and nonvascular injuries. The management of iatrogenic injuries depends on the type and severity of the injury. This is a review of multidetector computed tomography (MDCT) findings in iatrogenic complications associated with commonly performed intra-abdominal procedures/surgeries.

Imaging Considerations

The protocol is tailored according to the suspected site and nature of injury (vascular/nonvascular). For suspected vascular injuries, a noncontrast scan of the region of interest (ROI) is initially obtained to look for hematoma/hemoperitoneum. This is followed by an arterial phase (~35 seconds) scan covering the ROI (CT angiography [CTA]). Subsequently, a scan of the whole abdomen is acquired in the portal venous phase (65–70 seconds). This phase suffices when nonvascular injuries are suspected. For suspected injuries of the pelvicalyceal system/ ureter, a delayed scan is obtained at 15 minutes postcontrast injection, to look for urinoma.

* *Contributed equally and share first authorship.*

article published online
October 10, 2023

DOI https://doi.org/10.1055/s-0043-1775736.
ISSN 0971-3026.

Urinary bladder injuries can be diagnosed by CT cystography,[5] which is a noncontrast scan after retrograde instillation of positive contrast into the urinary bladder through the Foley's catheter. Nonionic positive oral/rectal contrast is given in suspected bowel perforation.

Imaging Spectrum

Liver

Procedures commonly causing hepatic injury include liver biopsy (percutaneous and trans-jugular), percutaneous transhepatic biliary drainage, cholecystectomy, and hepatectomy. The prevalence of major vascular injury following percutaneous procedures of the liver is around 0.16%.[6] Vascular injuries include hematoma, pseudoaneurysm (PA), arterioportal or arteriohepatic fistula, arterial laceration, and vascular thrombosis. PAs are well-defined contrast-filled outpouchings arising from the injured artery, which may be narrow or wide-necked. Active extravasation is suggested by increase in the size or density of hematoma on venous/delayed phase scan.[7] In arterioportal fistula, there is shunting of hepatic arterial blood into the portal venous system leading to abnormal opacification of the portal vein/its branches in the arterial phase scan (►**Fig. 1**).

Biliary System

The incidence of iatrogenic biliary injuries ranges from 0.1 to 0.6%.[8] Common causative procedures include cholecystectomy, liver transplantation, endoscopic retrograde cholangiopancreatography (ERCP), hepatic resection, and hepaticojejunostomy. Nonvascular injuries of the biliary tract include extra-biliary bile collection (biloma) and biliary strictures. Magnetic resonance cholangiopancreatography is sensitive for biliary injuries. In laparoscopic cholecystectomy, the common bile duct can be mistaken for the cystic duct due to anomalous insertion of the cystic duct.[8] This leads to inadvertent ligation of the common bile duct, with resultant biliary injury and stricture. Injury to the peribiliary vascular plexus, particularly during liver transplantation, leads to ischemia and development of nonanastomotic biliary strictures.[9] Iatrogenic strictures are short-segment, symmetrical, with smooth outline, whereas malignant strictures are long-segment (> 12 mm) with irregular outline, and may be associated with metastatic lymphadenopathy.[10] CT is a useful imaging modality in cases of biloma, which is commonly found in perihepatic locations, with/without obvious communication with the biliary tree[11] (►**Fig. 2**). Vascular injuries include PAs of the right hepatic artery (►**Fig. 3**), cystic artery, and common hepatic artery.

Spleen

Iatrogenic splenic injuries are extremely rare, with an estimated incidence of 0.00005 to 0.017%.[12,13] Most commonly seen as a complication of colonoscopy and colonic surgeries, these may also be caused by left nephrectomy, left adrenalectomy, percutaneous nephrolithotomy, left lung biopsy, etc. Lacerations

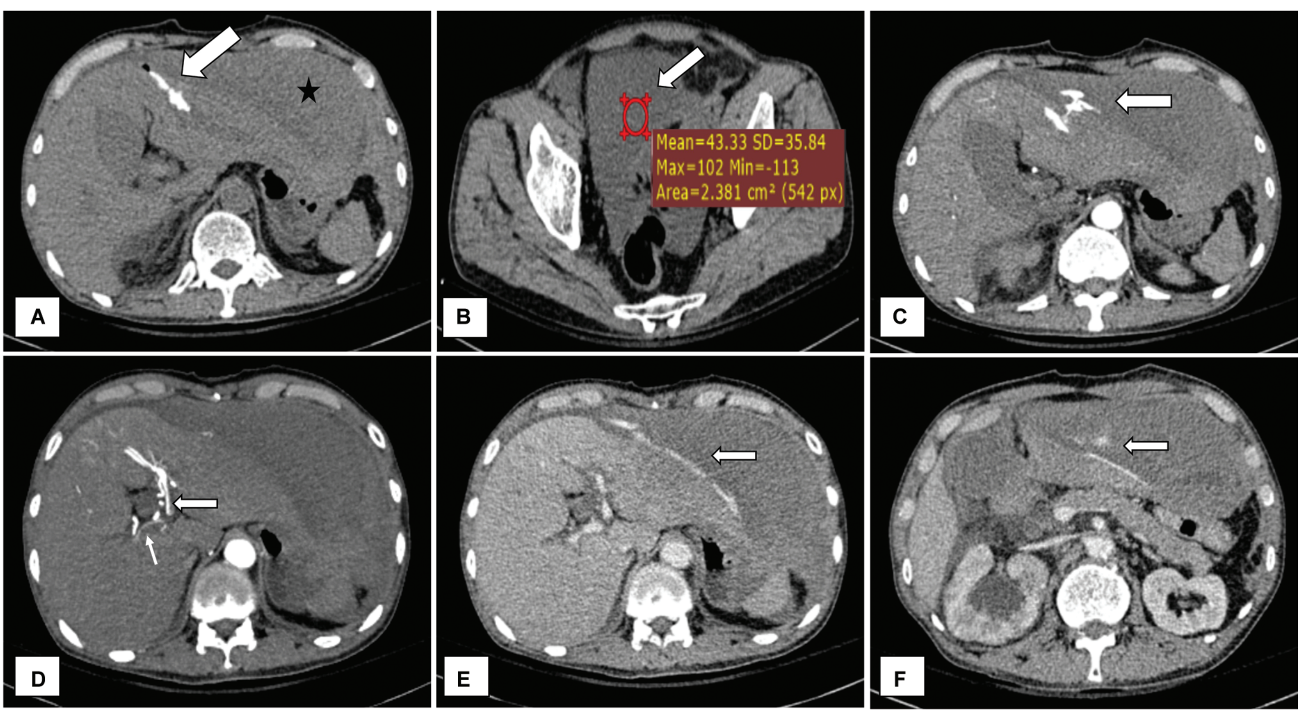

Fig. 1 A 61-year-old male patient with biliary obstruction complained of unbearable abdominal pain while undergoing percutaneous transhepatic biliary drainage (PTBD). Multiphasic computed tomography done in view of suspected iatrogenic injury. (**A**) Noncontrast scan shows hyperdense perihepatic collection (black star). Positive contrast from PTBD is noted in the left ductal system (arrow). (**B**) Hyperdense intraperitoneal free fluid is seen (arrow) on noncontrast scan. (**C**) On arterial-phase scan, there is extravasation of intravenous contrast into the left perihepatic collection (arrow). (**D**) There is opacification of the left branch of portal vein (thick arrow) on arterial phase. Subtle opacification is also noted in the right branch of portal vein (thin arrow). On portal-venous phase (**E** and **F**), there is active extravasation of contrast with layering in the perihepatic collection (arrows).

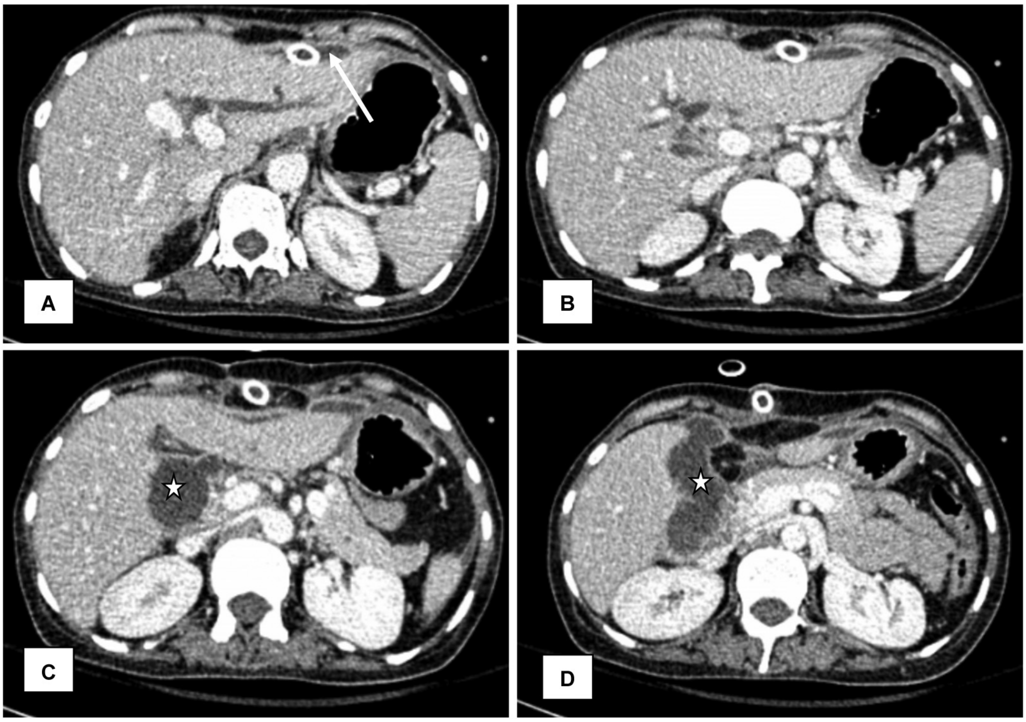

Fig. 2 A 57-year-old female patient presented with vomiting, fever, and upper abdominal pain on postoperative day 4 following open cholecystectomy and perihepatic drain placement. Contrast-enhanced computed tomography was done to rule out intra-abdominal collections. (**A**) Axial portal-venous phase image showing mild perihepatic collection with surgical drain (arrow). There is mild intrahepatic biliary radicle dilatation (**A** and **B**). (**C**) and (**D**) Peripherally enhancing collection (star) is seen in the gallbladder fossa, which is suggestive of biloma.

are the most common injuries, resulting from capsular tear or traction on the splenocolic ligament. These present as linear hypodensities in the splenic parenchyma. More severe injury leads to hematoma and hemoperitoneum.

Pancreas

Iatrogenic pancreatic injuries are mostly nonvascular, with ERCP being the commonest cause of iatrogenic pancreatitis.[14] This is characterized by bulky, heterogenous pancreas

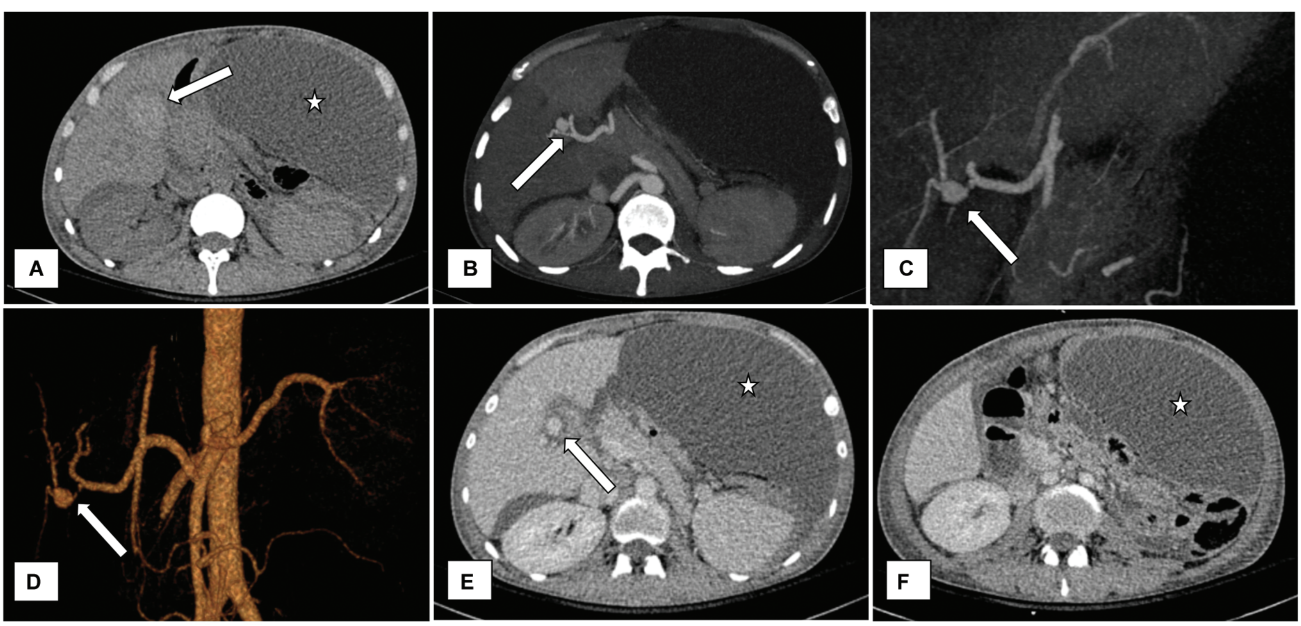

Fig. 3 A 35-year-old gentleman presented with hemorrhagic output from subhepatic drain on day 5 of laparoscopic cholecystectomy for cholelithiasis. Multiphasic computed tomography was done to localize the source of bleed. (**A**) Noncontrast scan of upper abdomen shows a hyperdense collection in the gallbladder fossa (arrow). (**B**)–**D**) Arterial phase images with volume rendering showing a pseudoaneurysm arising from the right hepatic artery (arrows). However, there was no evidence of active extravasation, as shown in the venous phase image (arrow in **E**). This patient also had a biloma (denoted by star in **A–F**).

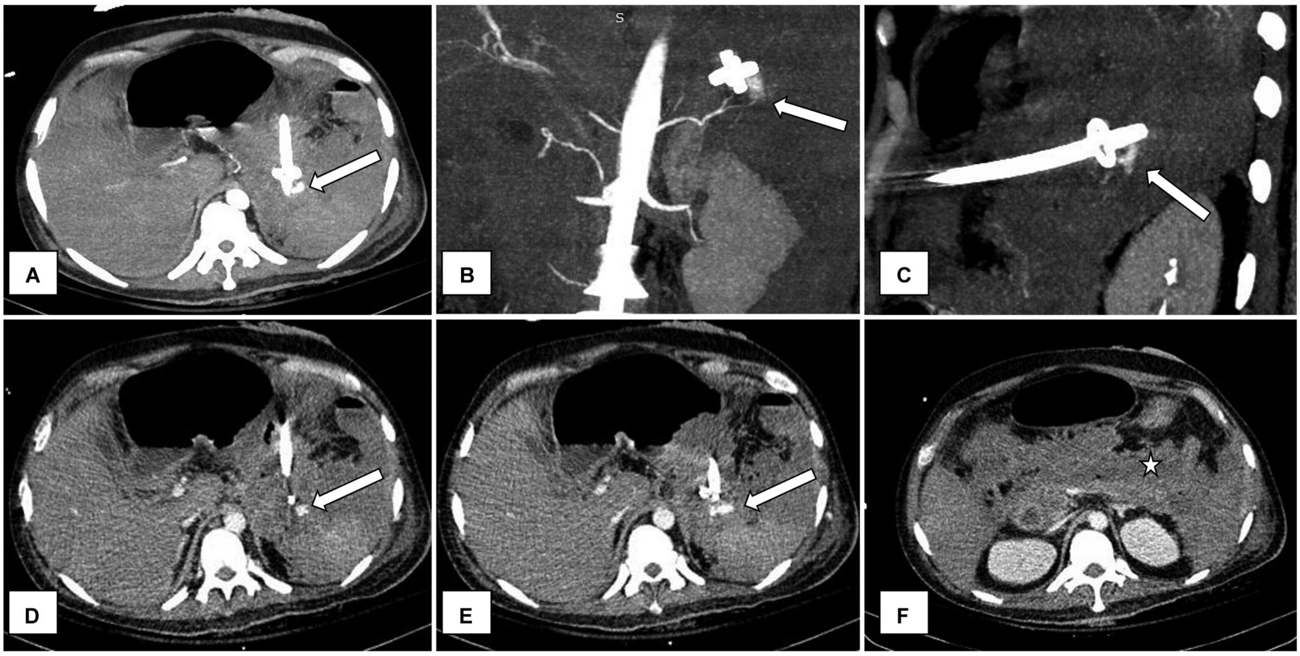

Fig. 4 A 29-year-old male patient underwent Malecot catheter insertion for peripancreatic collection, after which he presented with bleeding through the catheter. (**A**) Axial, (**B**) coronal reconstructed maximum intensity projection (MIP), (**C**) sagittal reconstructed MIP images on arterial phase showing pseudoaneurysm (arrows) arising from the splenic artery, adjacent to the tip of Malecot catheter. On venous phase, there was increase in the size of the pseudoaneurysm, suggestive of active extravasation (**D** and **E**). The peripancreatic collection is denoted by the star in (**F**).

with/without intra/peripancreatic collections. Vascular injuries may result from pancreatectomy, Whipple procedure, and drainage catheter insertion (►**Fig. 4**). Iatrogenic vascular injuries of pancreas have an estimated prevalence of around 3.9%, with pancreatectomy being the most common cause.[15] The gastroduodenal artery stump is the most common site of bleeding, followed by common hepatic artery, left hepatic artery, dorsal pancreatic artery, and splenic artery.[15] Early postpancreatectomy hemorrhage (presentation within 24 hours) is due to technical failure, while delayed postpancreatectomy hemorrhage (presentation after 24 hours) is due to anastomotic leakage.[16]

Kidneys

Iatrogenic renal injuries are mostly vascular, with a prevalence of 0.9 to 3%.[17] Various causative procedures include but are not limited to percutaneous nephrostomy, percutaneous nephrolithotomy, renal biopsy, partial nephrectomy, and antegrade ureteral stenting.[18] Vascular injuries lead to renal arterial PAs (►**Figs. 5**, **6**), arteriovenous fistula (AVF), calyceal hemorrhage (►**Fig. 7**), etc.

Pelvicalyceal System and Ureters

Ureters have a long course extending from the pelvicalyceal system up to the urinary bladder. They cross major vessels and lie in close proximity to the uterus, which make them prone to injuries, particularly during gynecologic surgeries.[19] The incidence of iatrogenic ureteric injuries ranges from 0.5 to 10%[20–22] with the distal third being the most common site, accounting for up to 75% of cases.[23] In the early phase, these present as urinomas, which appear as hyperattenuating collections on urography, owing to leakage of excreted contrast (►**Fig. 8**). Over time, there is development of fibrosis resulting in strictures, which is often the presentation when detected late. These can also be well visualized on CT urography as segmental smooth narrowing of the ureter. Ureterovaginal fistula is a late complication of ureteric injury, especially after pelvic surgeries.

Urinary Bladder

Iatrogenic urinary bladder injuries may be caused by catheterization, cystoscopy, transurethral resection of bladder tumor, etc. and procedures performed on other pelvic organs in relation to the bladder, such as hysterectomy and cesarean section.[24] In an institutional study, iatrogenic bladder injuries resulted from gynecologic/obstetric, general and urologic surgeries in 65%, 22%, and 13% of cases.[25] In intraperitoneal injury, there is leakage of contrast into the peritoneal spaces such as the paracolic gutters, rectouterine pouch, and retrovesical space, with contrast outlining the bowel (►**Fig. 9**). This usually happens with injury to the dome of a distended bladder. In extraperitoneal injuries, there is leakage of contrast into the prevesical space (►**Fig. 10**), perineum, scrotum, and thighs.[26]

Uterus and Genital Tract

Iatrogenic uterine injuries are usually vascular and include uterine artery PAs (►**Fig. 11**) and AVF. These have a prevalence of 0.1 to 0.2%.[27,28] On CTA, AVFs appear as lesions that opacify in the arterial phase, with subsequent early opacification of the gonadal and/or internal iliac veins. Nonvascular injuries include uterine perforation, rupture, and adhesions.

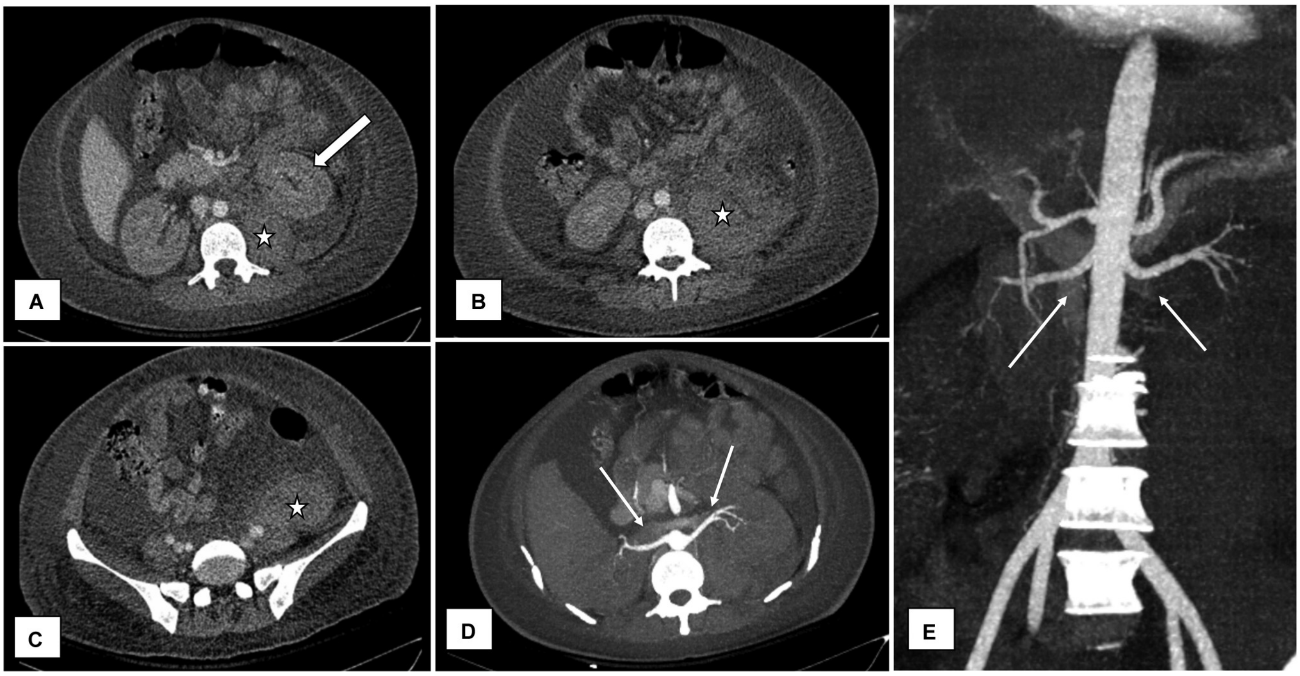

Fig. 5 A 35-year-old female patient presented with abdominal distension and hemoglobin drop following biopsy from the left kidney. Axial images in portal-venous phase (**A–C**) show hyperdense collection in the left perinephric region with layering (star). The left kidney is displaced anteriorly by the collection (block arrow in **A**). However, bilateral renal arteries were unremarkable and no bleeding source was identified. Axial (**D**) and coronal maximum intensity projection (**E**) images depicting the renal arteries, denoted by line arrows.

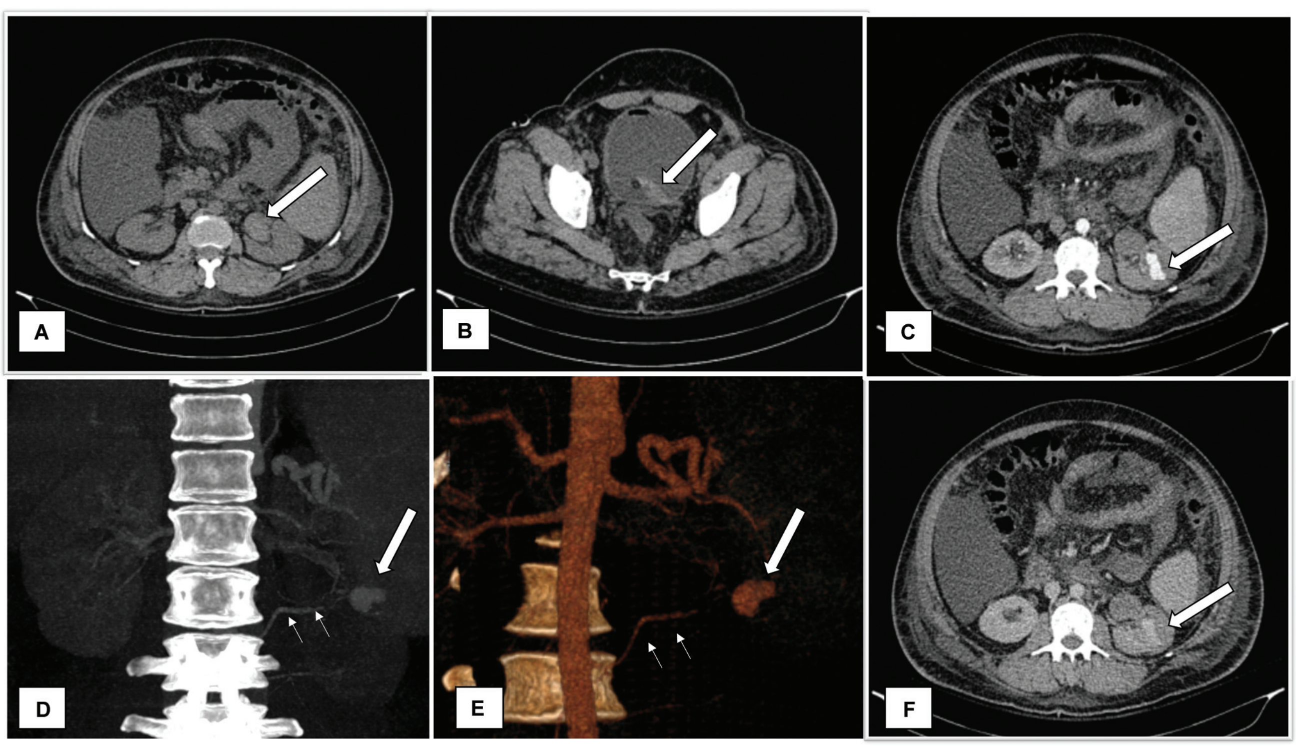

Fig. 6 A 47-year-old male patient presented with abdominal pain and gross hematuria following left percutaneous nephrolithotomy. Noncontrast computed tomographic images showed hyperdense contents in the left renal pelvis (**A**) and in the urinary bladder (**B**). Arterial phase image (**C**) showed a pseudoaneurysm in the mid-pole of left kidney (block arrow), arising from the branches of accessory left renal artery, marked by thin arrows in **D** and **E**). There was no active extravasation in the venous phase (**F**).

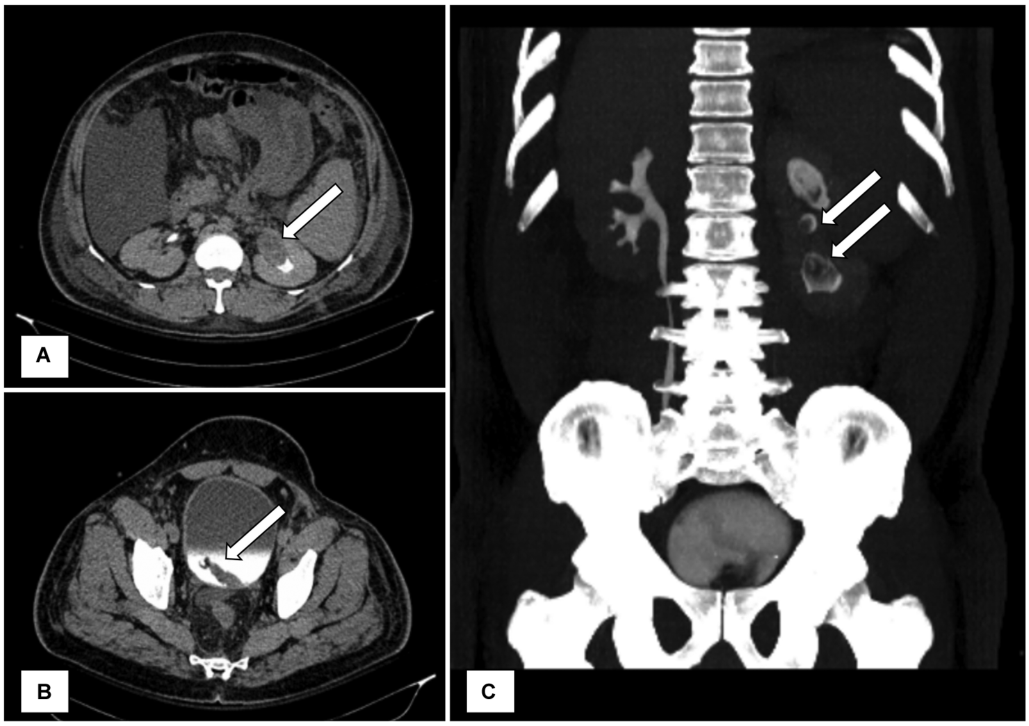

Fig. 7 Computed tomography urography images of the same patient as in ►**Fig. 6** showed filling defects in the left pelvicalyceal system and urinary bladder, suggestive of hematoma, indicated by block arrows in (**A**) and (**B**). (**C**) Coronal maximum intensity projection of urography showing filling defects in the left pelvicalyceal system (block arrows). The right pelvicalyceal system and ureter were normal.

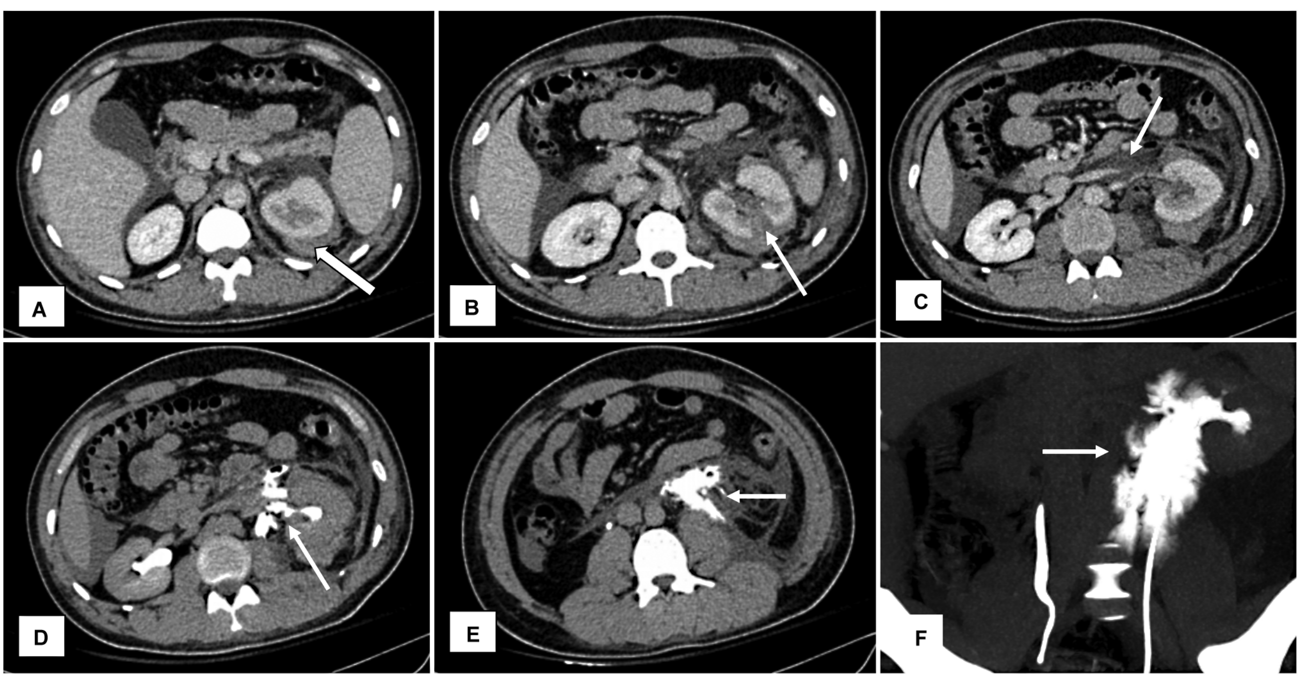

Fig. 8 A 40-year-old male patient with left nephrolithiasis underwent percutaneous nephrolithotomy following which he presented with abdominal pain and distension. Axial contrast-enhanced computed tomography (CT) shows left perinephric hematoma (arrow in **A**), with a parenchymal discontinuity in the left kidney (arrow in **B**) and a collection near the left renal hilum (arrow in **C**) with perinephric fat stranding. CT urography showed leakage of excreted contrast from the ruptured pelvicalyceal system (PCS) into this collection (arrows in **D–F**), suggestive of PCS injury with urinoma.

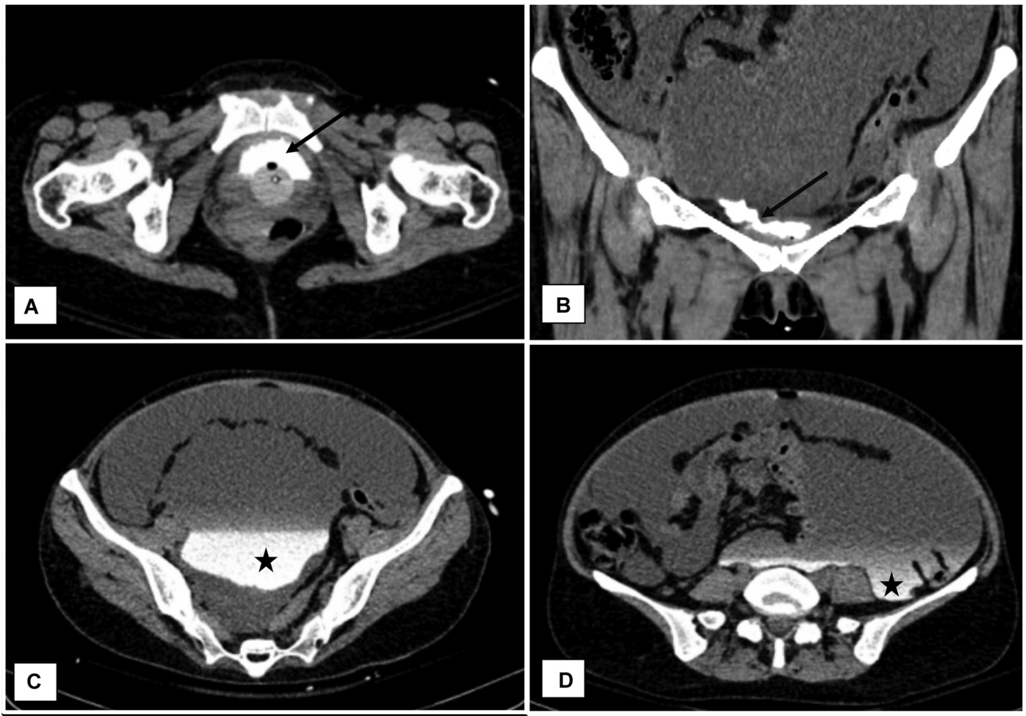

Fig. 9 A 33-year-old female patient presented with abdominal pain, distension, and inability to void following diagnostic hysteroscopy. Urinary bladder injury was suspected and computed tomography cystography was done. (**A**) Extravesical contrast in the pelvis (black arrow). The urinary bladder was undistended and bulb of Foley's catheter was noted. (**B**) Coronal reformatted image showing a rent in the right superolateral aspect of urinary bladder wall (black arrow) with leakage of contrast across it. (**C**) There was gross ascites with fluid-contrast level (indicated by star). (**D**) The leaked contrast was extending up to the left paracolic gutter (indicated by star). These findings are suggestive of intraperitoneal bladder injury.

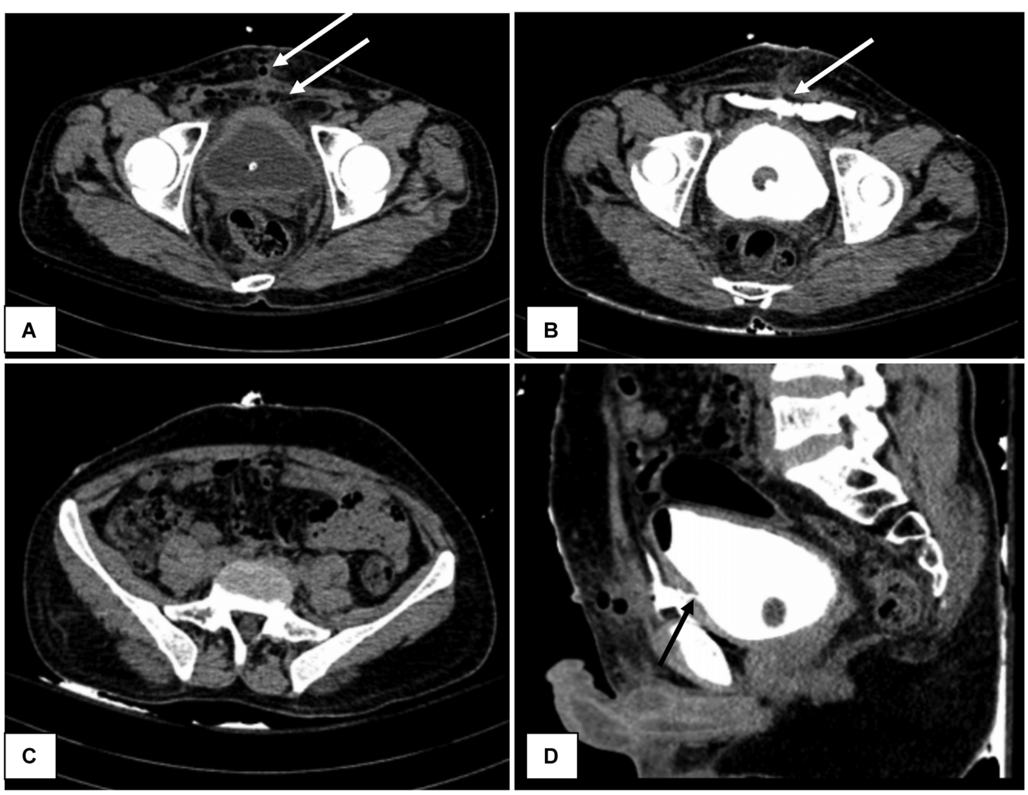

Fig. 10 A 27-year-old male patient presented with abdominal pain and distension following failure of attempted suprapubic cystostomy. (**A**) Noncontrast computed tomography (CT) section showing air foci and fat stranding in the anterior abdominal wall and prevesical space (arrows). (**B**) CT cystogram showed leakage of contrast into the prevesical space (arrow). There was no intraperitoneal fluid or contrast leak (**C**). (**D**) Sagittal reformatted image showing a rent in the anterior wall of urinary bladder with contrast leak across it (arrow). These findings are suggestive of extraperitoneal bladder injury.

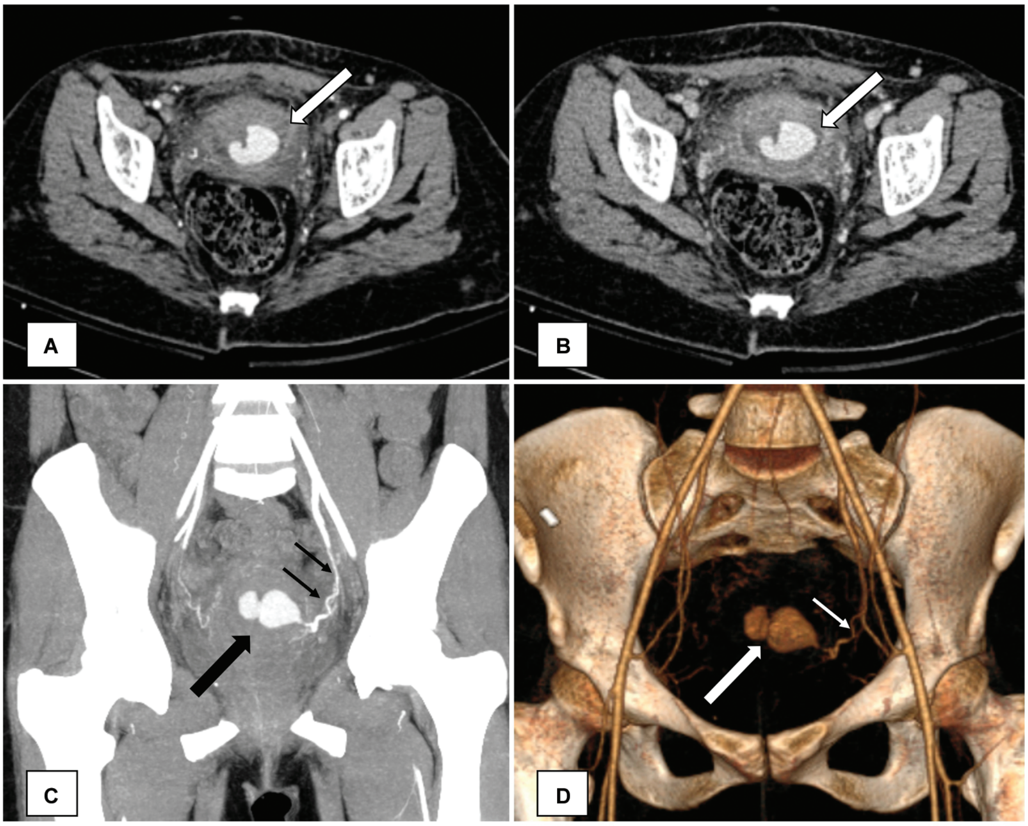

Fig. 11 A 31-year-old female patient presented with excessive vaginal bleeding 7 days after a lower-segment cesarean section. Ultrasonography was suggestive of uterine artery pseudoaneurysm and a biphasic contrast-enhanced computed tomography was done to confirm the same. (**A**) Arterial phase image showing a bilobed contrast-filled outpouching in the uterine wall. There was no enlargement on the venous phase (**B**). This pseudoaneurysm was seen arising from the left uterine artery (thin arrows), as shown on the coronal maximum intensity projection (**C**) and virtually reconstructed three-dimensional image (**D**). There was no active contrast extravasation.

The prevalence of uterine rupture ranges from 0.6/10,000 births in an unscarred uterus to 5.3/10,000 births after cesarean section.[29] Procedures with high risk of uterine injury include cesarean section, hysterotomy, dilatation and curettage, evacuation of retained products of conception, and hysteroscopy. Postpartum vulval hematoma (►**Fig. 12**) is a complication of episiotomy, with an incidence of 1 per 300 to 1,000 deliveries.[30,31]

Bowel

Iatrogenic causes of bowel perforation and mesenteric injury are not very common. Perforation rate in diagnostic gastroscopy is reported to be 0.01 to 0.03% and iatrogenic perforation during colonoscopy is reported to be 0.016 to 0.2%.[32,33] Gastroduodenal perforation is a rare complication of ERCP. Inadvertent gastric perforation can be caused by nasogastric tube insertion, intercostal drainage tube insertion,[34] etc. Iatrogenic rectosigmoid injury is commonly caused by gynecologic surgeries.[35] Free intraperitoneal air outlines the liver, and tracks along the ligamentum teres (*ligamentum teres sign*), portal vein (*periportal free gas sign*), and falciform ligament (*falciform ligament sign*). In the postoperative scenario, it is important to differentiate free intraperitoneal air following laparotomy/ laparoscopy from bowel perforation. Postoperative pneumoperitoneum resolves within 3 days in 81% of patients and is unlikely to persist thereafter; such patients are asymptomatic and clinically stable. In contrast, patients with bowel perforation present with worsening clinical status.[36,37] Extraluminal oral/rectal contrast is the most sensitive finding in bowel perforation.[35,38] Perforation of retroperitoneal hollow viscus (duodenum, ascending and descending colon) leads to pneumoretroperitoneum, wherein air outlines the kidneys and perinephric spaces (►**Fig. 13**).

Abdominal Wall

Iatrogenic complications involving the abdominal wall can be caused by surgical procedures and percutaneous intervention procedures, particularly ascitic tap. Nonvascular complications include but are not limited to incisional hernia, parastomal hernia, collections, wound dehiscence, etc. The reported incidence of iatrogenic hernia is 7.5 to 12%.[39,40] Vascular complications include inferior epigastric artery PA and rectus sheath hematoma that can extend into the preperitoneal space (►**Fig. 14**).

Conclusion

Although iatrogenic injuries are unavoidable, some of the ways to limit their occurrence include performing guided procedures to avoid vital structures and vessels, identification of

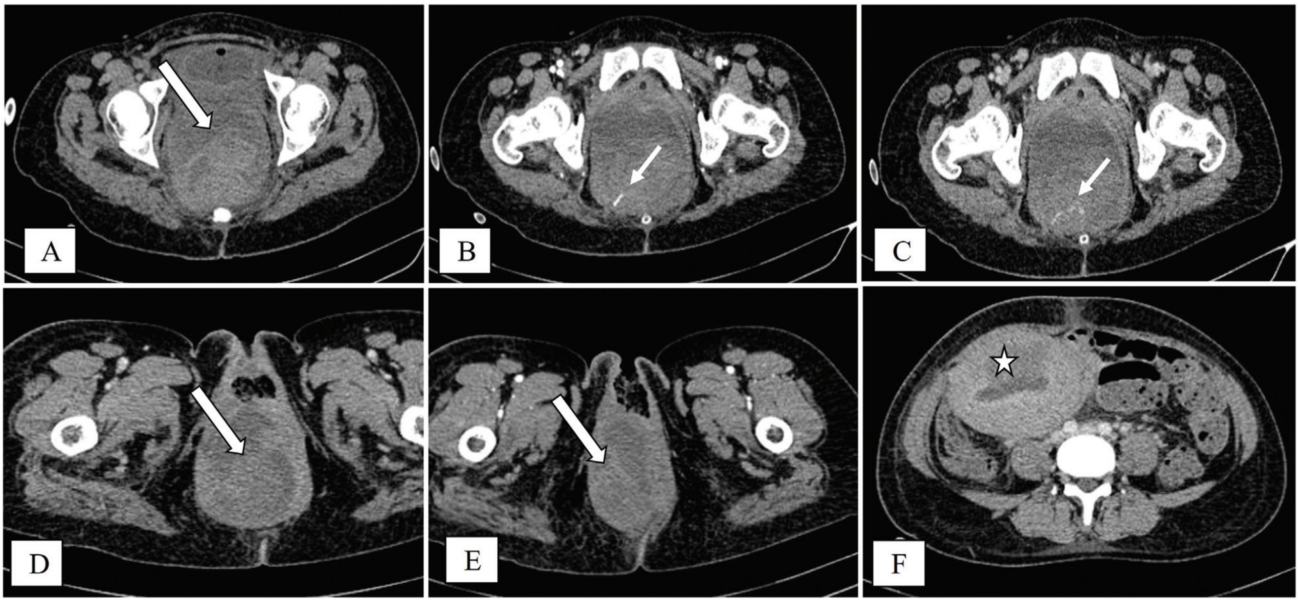

Fig. 12 A 25-year-old female patient presented with persistent vaginal bleeding and vulval swelling 10 days after vaginal delivery, which was complicated by atonic postpartum hemorrhage. (**A**) Non-contrast computed tomography shows a hyperdense hematoma in the pelvis displacing the rectum. (**B**) Curvilinear hyperenhancement was seen within the hematoma on the arterial phase (line arrow) which showed progressive increase in size on the venous phase (line arrow in **C**). The hematoma was seen extending into the vulva (arrows in **D, E**). The uterus was bulky with heterogenous attenuation (star in **F**).

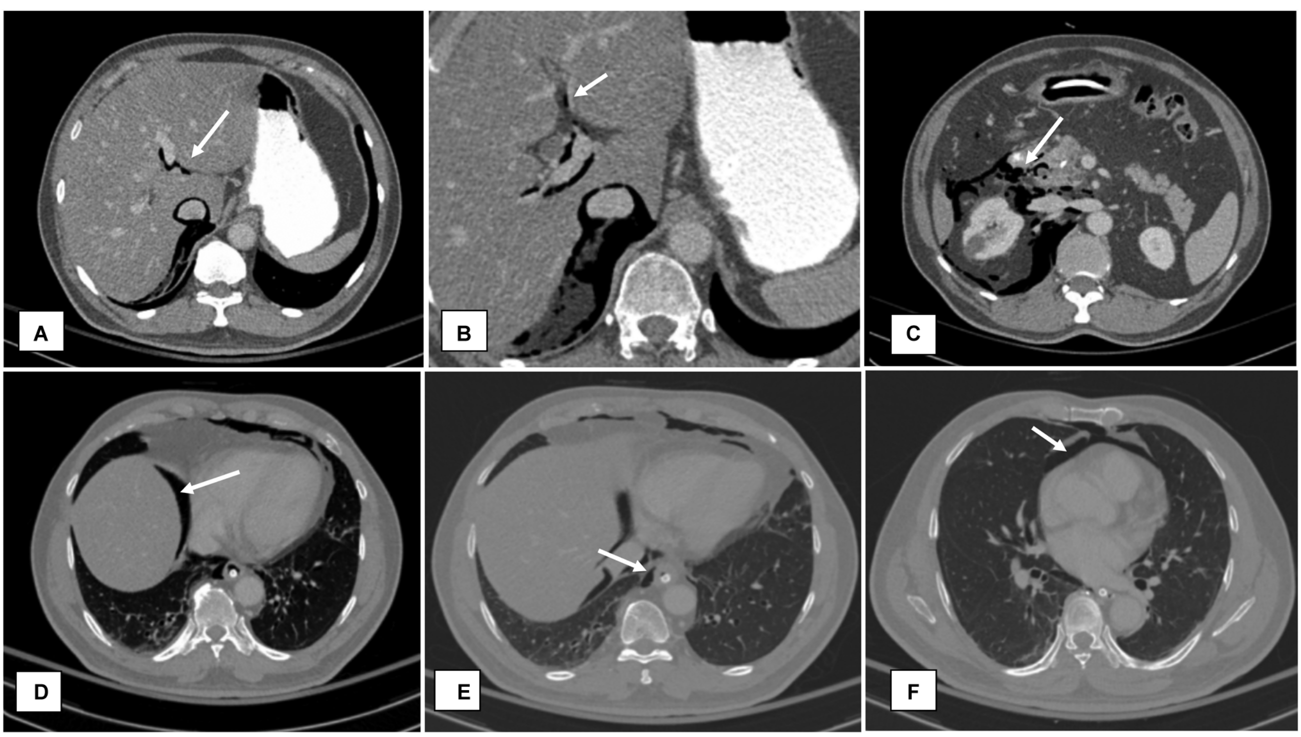

Fig. 13 A 63-year-old male patient presented with severe abdominal pain and vomiting 4 hours after endoscopic retrograde cholangiopancreaticography for choledocholithiasis. Axial contrast-enhanced computed tomography images showing (**A**) pneumoperitoneum with air along the porta (periportal free gas sign) and intrahepatic inferior vena cava (arrow); (**B**) zoomed image showing air foci along the ligamentum teres (ligamentum teres sign); (**C**) pneumoretroperitoneum with air in the right perinephric space; a suspicious discontinuity was seen in the junction of second and third parts of duodenum (arrow). (**D**) Free intraperitoneal air outlining the liver (arrow). There was tracking of free air along the esophageal hiatus (arrow in **E**) with subsequent pneumomediastinum (arrow in **F**).

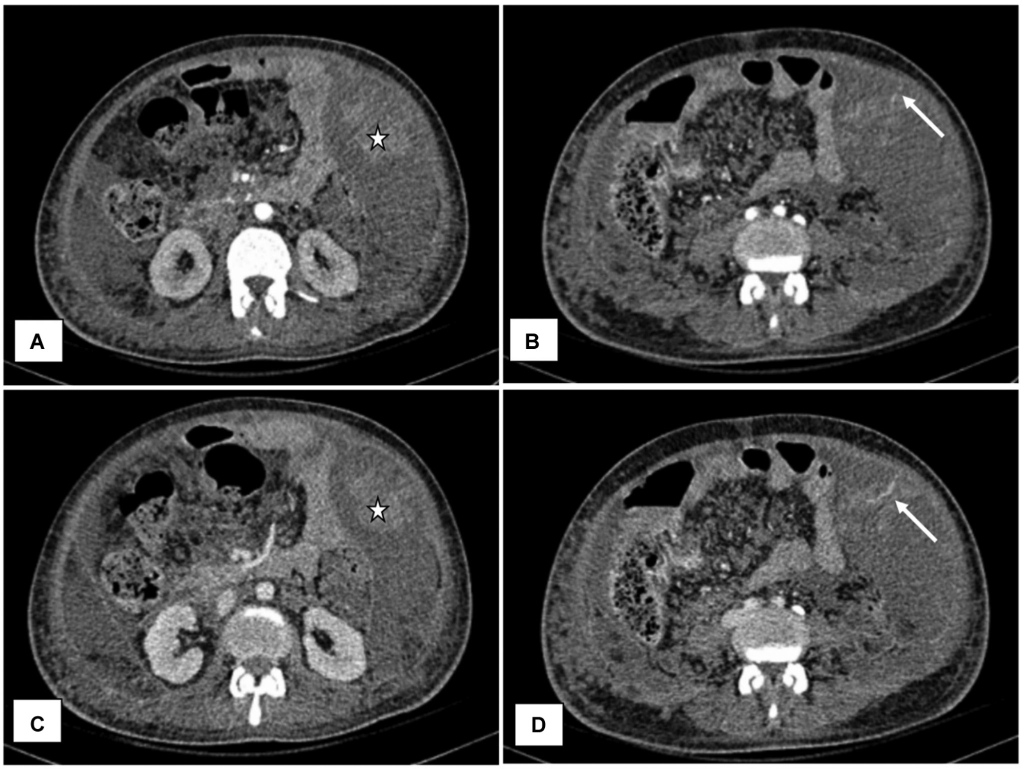

Fig. 14 A 40-year-old female patient with severe abdominal pain and hemoglobin drop after ascitic tap. Biphasic contrast-enhanced computed tomography abdomen was done. (**A**) Arterial phase image showing heterogeneity in the left anterior abdominal wall with a collection in the preperitoneal space with hyperdense contents (star). (**B**) There was suspicious extravasation of contrast seen as ill-defined curvilinear hyperdensity within the collection (arrow). (**C**) Portal venous phase image showing abdominal wall collection with hyperdense contents (star) suggestive of hematoma. (**D**) There was increase in the density and size of the curvilinear structure on venous phase, which is suggestive of active extravasation.

variant anatomy, proper exposure of structures, and avoiding blind clamping of vessels. CT is often the most sensitive imaging modality for identifying both vascular and nonvascular injuries and the protocol should be tailored according to the clinical suspicion. Hence, knowledge of possible iatrogenic injuries and their appearances on MDCT is necessary for timely diagnosis and management.

Funding
None.

Conflict of Interest
None declared.

References

1 Oderich GS, Panneton JM, Hofer J, et al. Iatrogenic operative injuries of abdominal and pelvic veins: a potentially lethal complication. J Vasc Surg 2004;39(05):931–936
2 Başaranoğlu S, Deregözü A, Köroğlu N, Kalkan M, Şahin C, Kadanalı S Early and late diagnosis of iatrogenic urinary tract injuries during obstetric and gynecological operations. J Clin Exp Invest 2016;7(03):252–257
3 Leevan E, Carmichael JC. Iatrogenic bowel injury (early vs delayed). Semin Colon Rectal Surg 2019;30(03):100688
4 Ge BH, Copelan A, Scola D, Watts MM. Iatrogenic percutaneous vascular injuries: clinical presentation, imaging, and management. Semin Intervent Radiol 2015;32(02):108–122
5 Fouladi DF, Shayesteh S, Fishman EK, Chu LC. Imaging of urinary bladder injury: the role of CT cystography. Emerg Radiol 2020;27(01):87–95
6 Rockey DC, Caldwell SH, Goodman ZD, Nelson RC, Smith ADAmerican Association for the Study of Liver Diseases. Liver biopsy. Hepatology 2009;49(03):1017–1044
7 Hamilton JD, Kumaravel M, Censullo ML, Cohen AM, Kievlan DS, West OC. Multidetector CT evaluation of active extravasation in blunt abdominal and pelvic trauma patients. Radiographics 2008;28(06):1603–1616
8 Vachhani PG, Copelan A, Remer EM, Kapoor B. Iatrogenic hepatopancreaticobiliary injuries: a review. Semin Intervent Radiol 2015;32(02):182–194
9 op den Dries S, Westerkamp AC, Karimian N, et al. Injury to peribiliary glands and vascular plexus before liver transplantation predicts formation of non-anastomotic biliary strictures. J Hepatol 2014;60(06):1172–1179
10 Kim JY, Lee JM, Han JK, et al. Contrast-enhanced MRI combined with MR cholangiopancreatography for the evaluation of patients with biliary strictures: differentiation of malignant from benign bile duct strictures. J Magn Reson Imaging 2007;26(02):304–312
11 Melamud K, LeBedis CA, Anderson SW, Soto JA. Biliary imaging: multimodality approach to imaging of biliary injuries and their complications. Radiographics 2014;34(03):613–623
12 Zappa MA, Aiolfi A, Antonini I, Musolino CD, Porta A. Splenic rupture following colonoscopy: case report and literature review. Int J Surg Case Rep 2016;21:118–120
13 Ha JF, Minchin D. Splenic injury in colonoscopy: a review. Int J Surg 2009;7(05):424–427

14 Ribeiro IB, do Monte Junior ES, Miranda Neto AA, et al. Pancreatitis after endoscopic retrograde cholangiopancreatography: a narrative review. World J Gastroenterol 2021;27(20):2495–2506
15 Biondetti P, Fumarola EM, Ierardi AM, Carrafiello G. Bleeding complications after pancreatic surgery: interventional radiology management. Gland Surg 2019;8(02):150–163
16 Yekebas EF, Wolfram L, Cataldegirmen G, et al. Postpancreatectomy hemorrhage: diagnosis and treatment: an analysis in 1669 consecutive pancreatic resections. Ann Surg 2007;246(02): 269–280
17 Esparaz AM, Pearl JA, Herts BR, LeBlanc J, Kapoor B. Iatrogenic urinary tract injuries: etiology, diagnosis, and management. Semin Intervent Radiol 2015;32(02):195–208
18 Hausegger KA, Portugaller HR. Percutaneous nephrostomy and antegrade ureteral stenting: technique-indications-complications. Eur Radiol 2006;16(09):2016–2030
19 Jacob G, Vilos G, Al Turki F, et al. Ureteric injury during gynaecological surgery – lessons from 20 cases in Canada. Facts Views Vis Obstet Gynecol 2020;12(01):31–42
20 Al-Awadi K, Kehinde EO, Al-Hunayan A, Al-Khayat A. Iatrogenic ureteric injuries: incidence, aetiological factors and the effect of early management on subsequent outcome. Int Urol Nephrol 2005;37(02):235–241
21 Obarisiagbon EO, Olagbuji BN, Onuora VC, Oguike TC, Ande ABA. Iatrogenic urological injuries complicating obstetric and gynaecological procedures. Singapore Med J 2011;52(10):738–741
22 Vakili B, Chesson RR, Kyle BL, et al. The incidence of urinary tract injury during hysterectomy: a prospective analysis based on universal cystoscopy. Am J Obstet Gynecol 2005;192(05): 1599–1604
23 Chalya PL, Massinde AN, Kihunrwa A, Simbila S. Iatrogenic ureteric injuries following abdomino-pelvic operations: a 10-year tertiary care hospital experience in Tanzania. World J Emerg Surg 2015;10:17
24 Levy BF, De Guara J, Willson PD, Soon Y, Kent A, Rockall TA. Bladder injuries in emergency/expedited laparoscopic surgery in the absence of previous surgery: a case series. Ann R Coll Surg Engl 2012;94(03):e118–e120
25 Cordon BH, Fracchia JA, Armenakas NA. Iatrogenic nonendoscopic bladder injuries over 24 years: 127 cases at a single institution. Urology 2014;84(01):222–226
26 Gross JS, Rotenberg S, Horrow MM. Resident and fellow education feature. Bladder injury: types, mechanisms, and diagnostic imaging. Radiographics 2014;34(03):802–803
27 Rudaitis V, Maldutytė G Uterine arteriovenous malformation treated with selective embolisation of uterine arteries: a case report. Acta Med Litu 2021;28(01):153–158
28 Yazawa H, Soeda S, Hiraiwa T, Takaiwa M, et al. Prospective evaluation of the incidence of uterine vascular malformations developing after abortion or delivery. J Minim Invasive Gynecol [Internet] 2013;20(03):360–367
29 Schwarzman P, Baumfeld Y, Mastrolia SA, Yaniv-Salem S, Leron E, Silberstein T. Obstetric outcomes after perforation of uterine cavity. J Clin Med 2022;11(15):4439
30 Tilahun T, Wakgari A, Legesse A, Oljira R. Postpartum spontaneous vulvar hematoma as a cause of maternal near miss: a case report and review of the literature. J Med Case Rep 2022;16(01):85
31 Egan E, Dundee P, Lawrentschuk N. Vulvar hematoma secondary to spontaneous rupture of the internal iliac artery: clinical review. Am J Obstet Gynecol 2009;200(01):e17–e18
32 Lohsiriwat V. Colonoscopic perforation: incidence, risk factors, management and outcome. World J Gastroenterol 2010;16(04): 425–430
33 Wang K, Shi J, Ye L. Endoscopic management of iatrogenic gastrointestinal perforations. Laparosc Endosc Robot Surg 2019;2(02):41–46
34 Rege SA, Narlawar RS, Deshpande AA, Dalvi AN. Iatrogenic gastric fistula due to inappropriate placement of intercostal drainage tube in a case of traumatic diaphragmatic hernia. J Postgrad Med 2001;47(02):108–110
35 Pouli S, Kozana A, Papakitsou I, Daskalogiannaki M, Raissaki M. Gastrointestinal perforation: clinical and MDCT clues for identification of aetiology. Insights Imaging 2020;11(01):31
36 Gayer G, Hertz M, Zissin R. Postoperative pneumoperitoneum: prevalence, duration, and possible significance. Semin Ultrasound CT MR 2004;25(03):286–289
37 Melemeni A, Tympa Grigoriadou A, Tsaroucha A. Postoperative abdominal free air: How much and when is enough? Report of two cases. SAGE Open Med Case Rep 2021;(09):1–3
38 Hanzelová V Mlyncek M. Iatrogenic bowel injuries during gynaecological surgery: a case report and literature review. Surg Case Rep 2020;(08):1–4
39 Eker HH, Hansson BME, Buunen M, et al. Laparoscopic vs. open incisional hernia repair: a randomized clinical trial. JAMA Surg 2013;148(03):259–263
40 Jg SK, K UK,Manangi M, Kp M, Bj A, Nagaraj N. Incisional hernia: incidence, clinical profile, risk factors and prevention. Int Surg J 2016;3(03):1292–1295

