Iatrogenic complications after abdomino-pelvic interventions

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Content organization

1) Introduction
2) Common procedures where iatrogenic complications happen
3) Appropriate imaging for suspected complications
4) Mechanisms of injury, characteristic imaging findings and management strategies
Iatrogenesis- Greek term, meaning "brought forth by the healer" is any consequence of medical treatment.

Unlike an adverse event, an iatrogenic effect is not always harmful, however it usually implies undesired consequences.

In the US iatrogenic causes account for approx. 225,000 deaths/year and is third most common cause after heart disease and cancer.
Commonly done Abdomino-Pelvic Interventions

- Drainage catheter placement
- Ostomies *(Gastric/gallbladder/renal/colon)*
- Biopsies *(FNA/core; CT/US guided)*
- Ablations *(RF/MW/Cryo)*
- Open surgical resections
- Screening procedures *(colonoscopy, D&C)*
- Embolization *(glue/bland/coil/chemo/UFE)*
- Diagnostic fluoroscopy procedures *(UGI +/- SB, BE, HSG, VCUG, RU, PTC)*
- Laparoscopic/Minimally-invasive procedures
- Organ transplant
- Endovascular procedures *(TIPS/IVC filter/stent)*
Content organization

• **Gastrointestinal**
  – Pancreas
  – Hepatobiliary
  – GI tract

• **Genitourinary**
  – Renal
  – Reproductive System
Gastrointestinal Complications

**Hepatobiliary**
- **Biliary System**
  - Hepatic parenchymal injury
  - Hepatic vascular injury
    - AVF, thrombosis, occlusion/stenosis, pseudoneurysm, bleeding
  - Liver abscess
  - Biliary System
    - Biliary tree injury +/- leak
    - Bilioma
    - Cholangitis
    - Hemobilia
    - Occlusion/Stricture

**Pancreas**
- Pancreatic abscess
- Sequela of pancreatic collection drainages

**Liver**
- Hepatic parenchymal injury
- Hepatic vascular injury
  - AVF, thrombosis, occlusion/stenosis, pseudoaneurysm, bleeding
  - Liver abscess

**GI Tract**
- Perforation
- Enteric fistulas
- Vascular injury
Appropriate Imaging modalities to evaluate complications

- CECT, MRI +Gd
- Biliary: PTC, ERCP & MRCP
- Vascular: CTA/MRA, DSA, conventional angiography
Retroperitoneal-colonic fistula after pancreatectomy with diverting ileostomy and partial colectomy

CECT images (A & C) demonstrate multiple retroperitoneal fluid collections (asterisk) that are fistualized with proximal descending colon stump (circle) status post partial colectomy.

(B) changes of pancreatic necrosectomy (arrow).

DC = Descending colon
Intraop axial NECT abdomen images (A & B) demonstrate (A) an obliquely-oriented transabdominal 18G needle traversing a mesenteric vessel (arrow) anterior to the target US-guided aspiration confirmed peripancreatic abscess (asterisk) which occurred after distal pancreatectomy.

(B) Dislodged 14G Pigtail catheter (arrow) with surrounding new intraperitoneal hematoma (circle). (C) Postoperative CECT abdomen images demonstrate interval increase in size of a perigastric/mesenteric hematoma (circle) and new perihepatic fluid collection (arrow).
Acute pancreatitis after non-selective TACE for unresectable HCC

MR T2W Axial images (A) demonstrate high signal intensity lesion (circle) on hepatic segment V; (B) T1W post-Gd axial with early arterial enhancement; (C) delayed portal venous washout and persistent rim enhancement on postcontrast delayed FST1W images; and DWI image (D) demonstrating restricted diffusion. DSA spot image (E) demonstrating a hypervascular hepatic dome lesion (circle) with subsequent TACE. 2 days after the procedure patient presented with epigastric pain and uptrending pancreatic enzymes. (F) axial CECT image demonstrates decreased pancreatic body enhancement and peripancreatic stranding (circle) suggesting acute pancreatitis.
Hepatic laceration, subcapsular hematoma & hemoperitoneum after liver biopsy

US image (A) of RUQ and CECT images (B & C) demonstrate hepatic laceration (arrow) with intrahepatic focus of active extravasation (asterisk), subcapsular hematoma (circle) and hemoperitoneum (arrow).

(D) Fluoro spot images demonstrating successful superselective coil embolization (circle) of right hepatic arterial branches.
ArterioVenous fistula after liver RFA

Arterial phase images of CT demonstrates an AV fistula within a RFA thermal defect connecting the posterior right hepatic artery (arrow) to right hepatic vein (arrow). DSA images demonstrate right hepatic arterial pooling (C; arrow), and early draining right hepatic vein (D & E; arrow). Subsequent coil embolization (F; arrow) demonstrates closure of AV fistula.
Hepatic abscess after Liver RFA and after cholecystectomy

Axial CECT (A) and NECT (B) images obtained 2 months after RFA reveal a large heterogeneous fluid collection (arrow) containing foci of air (arrow). The presence of air 2 months post-procedure raised concern for abscess formation. US guided percutaneous pigtail drain placement was done and frank pus was aspirated. Different patient- (C & D) Axial CECT images 1 month post open cholecystectomy (dashed line) demonstrates a high density fluid collection (arrow) adjacent to the gallbladder fossa, which drained pus after drainage.
Hepatic artery pseudoaneurysm after liver biopsy. Axial arterial phase CECT (A & C), DSA (B), coronal MIP (D) and volume rendered images (C) demonstrate a small pseudoaneurysm (arrows) arising from the left hepatic artery in this young male patient who presented with severe abdominal pain and hypotension following liver biopsy. The patient was successfully treated with emergent angioembolization.
Portal vein stenosis and hepatic artery thrombosis after liver transplant

Color Doppler images of a liver transplant with portal vein stenosis. Doppler images of PV at post-anastomotic site demonstrates 5 times increased velocity in post-anastomotic portion of portal vein (A) with turbulent waveform, compared to pre-anastomotic velocity (B). Angioplasty with stent placement was subsequently performed to manage this PV stenosis.

Different patient – post liver transplant with partial Hepatic artery thrombosis. Doppler US of the hepatic artery demonstrating turbulent flow (C), and (D) parvus tardus spectral waveform distal to thrombotic portion. Patient underwent successful thrombectomy with restoration of laminar unidirectional flow (E) and normal arterial waveform (not shown here).
Hepatic ischemia with subsequent biloma and bilio-cutaneous fistula after TIPS

(A) Successful fluoroscopy guided TIPS from the right hepatic vein (arrow) to the inferior branch of the right portal vein (arrow). (B) Large wedge shaped area of hypoattenuation (circle) in hepatic segment V/VIII visualized 10 days after. Evolving hepatic infarction is suspected. (C) Unknown high density fluid collection (asterisk) develops on follow up imaging. Successful CT-guided drainage catheter placement was performed and (E) abscessogram through catheter demonstrated cavity with multiple fistulous communications (circle) to the right intrahepatic bile ducts. (E) Successful coil embolization (arrow) of a fistulous tract between the right biliary system and the bilioma. (F) Bilio-cutaneous fistula was noted and depicted here on axial NECT after glue embolization.
Biloma, bile leak & hemobilia after ERCP, cholecystectomy and RFA

(A) HIDA scan images demonstrating extrahepatic bile collection (circle), (B) Ultrasound images with Doppler demonstrating anechoic perihepatic fluid collection without flow (asterisk) after cholecystectomy (C) Coronal MIP MRCP images demonstrate a bile leak (asterisk) after RFA (dashed line), (D) Axial CECT image demonstrated a high density fluid collection (arrow) with layering contrast (arrow) – bilioma with hemobilia - after RFA.
Hemorrhage into gallbladder & peritoneum following percutaneous cholecystostomy

US image (A) shows GB wall thickening, sludge (arrow) and calculi (arrow) from acute cholecystitis. Patient underwent percutaneous cholecystostomy. Few hours after procedure frank bleed was noticed through the tube. Ultrasound two days post-procedure (B) shows extensive echogenic material (arrow) consistent with blood clots in the GB. Pt developed low hematocrit and hypotension. Axial NECT images (C & D) show the tube in an appropriate position (arrow). High density fluid in the peritoneal space (asterisk) with layering (arrow) represents a mixture of injected contrast and blood. Small perihepatic air (arrow) is likely post-procedural.
CBD occlusion after cholecystectomy

Axial CECT images post laparoscopic cholecystectomy with intrahepatic dilation (arrow) and (C) surgical clip at porta hepatis (arrowhead). Cholangiogram images (C & D) demonstrate occluded CBD at ligation site from surgical clip (arrow). (D) Subsequent balloon dilation with stent placement was successfully carried out to manage this complication.
Small bowel perforation and 8 days ileus from Suprapubic catheter placement

Postoperative NECT abdomen/pelvis images status post US-guided suprapubic catheter placement (A & B) demonstrate a transabdominal catheter traversing through a loop of small bowel (asterisk) and into a fluid-filled urinary bladder (asterisk). C) CECT Abdomen/pelvis images (6 days post-op), and D) AP Abdomen radiograph (8 days post-op) demonstrating diffusely distended loops of small bowel with air-fluid-levels (circle). Note no evidence of free air.
Descending colonic perforation after U/S guided drainage catheter placement

(A) Post-procedure operative abdomen topogram after drainage catheter placement (circle) for peripancreatic collection. (B) Postop CECT axial image demonstrates catheter tip (arrow) within air-fluid collection (asterisk) adjacent to descending colon with suspicion of perforation; (C & D) subsequent NECT with PO contrast demonstrate subtle extraluminal contrast extravasation (arrow).
Abscess with fistulous tract to stomach after percutaneous gastrostomy

Axial CECT images (A & B) demonstrate a perihepatic rim enhancing fluid collection (circle), with a focus of air within (arrow), consistent with an abscess. The G-tube tip remains within the stomach (asterisk). Ultrasound (C) done at the time of percutaneous drainage shows an anechoic abscess (yellow). Abscess tube check study (D) done a few days following percutaneous drainage shows a fistula between the small residual collection (arrow) and stomach (arrow).
Genitourinary Complications

• Renal
  – Renal parenchymal injury
  – Renal collecting system injury
  – Renal vascular injury
  – Subcapsular abscess

• Reproductive System
  – Infection: Endometritis/cervicitis/PID/TOA
  – Uterine infarction (UFE)
  – AVM

• Appropriate Imaging:
  – CECT, Renal US, TA/TV Pelvic US, MRI
  – Collecting system: PCN, CT excretory urogram, VCUG, RU, cystogram
  – Vascular: CTA/MRA, DSA, conventional angiography, Renal US + Doppler

SO = Salpingo-oophoritis; PID = Pelvic inflammatory Disease; TOA = Tubo-ovarian abscess
Massive partially thrombosed L Renal Pseudoaneurysm after partial nephrectomy

CECT images (A, B & C) of the abdomen/pelvis demonstrate contrast filling (asterisk) of a partially thrombosed pseudoaneurysm (circle) at the site of previous partial laparoscopic partial nephrectomy (line). Layering mural thrombus (arrow) is noted within the periphery of the pseudoaneurysm.
Bilateral adnexal abscesses after laparoscopic hysterectomy

PO + IV CECT images (A, B & C) of the abdomen/pelvis demonstrate bilateral tortuous tubular structures with rim-enhancement involving the adnexa (circle). Note the surgical absence of a uterus.
Uterine AVM and abnormal uterine bleeding after endometrial curettage

Gray-scale ultrasound image (A) in a young female with abnormal uterine bleeding following endometrial curettage shows an inhomogenous lesion (arrow) with multiple tubular cystic areas showing vascular flow on color Doppler (B). Spectral tracings (C & D) reveal both arterial and venous waveforms. Pelvic angiographic images (E & F) demonstrate a uterine AVM (arrow) supplied by a dilated and tortuous uterine artery (arrow). Note the early draining vein (arrow) which is characteristic of an uterine AVM. The patient was managed with uterine artery embolization (not shown).
Ureteral transection after Ob/Gyn procedure

AP views of the left hemipelvis on percutaneous nephrostogram (A) demonstrating mid-ureteral transection with contrast extravasation (circle) into the abdomen. (B) Retrograde cystoscopic guidewire placement (arrow) and antegrade gooseneck snare (arrow) placed to approximate ureteral segments. (C) Successful antegrade double J ureteral stent (arrows) placed with restoration of collecting system continuity.
Nephrocolic fistula after renal cryoablation

CT-guided axial images of posterior approach left renal cryoablation demonstrates a well-defined hypodense thermal zone around probe (circle). 3 months later patient presents with fecaluria; coronal (B) NECT Abdomen/Pelvis, Renal MR (C) Gd+ and (D) T2W images demonstrate a fistulous connection with the descending colon (circle).
Conclusion

• Iatrogenic complications of various severities arise from different forms of medical and surgical interventions. Most of them occur despite taking proper precautions.
• Imaging and imaging guided interventions play critical role in diagnosis and treatment of such complications.
• The key to diagnose iatrogenic complications familiarity with imaging appearances related to the intervention.
• Delay in recognizing the iatrogenic complications can prevent appropriate management, and at times can prove fatal.
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