

Imaging of Iatrogenic Bile Duct Injuries: A Radiologist's Guide to Characterization, Outcome, and Management Issues

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Learning Objectives

- Outline advantages and disadvantages of different imaging modalities with regard to detection and characterization of bile duct injuries
- Identify and characterize bile duct injuries on imaging
- Describe key findings with regards to treatment and outcome

Imaging Examples

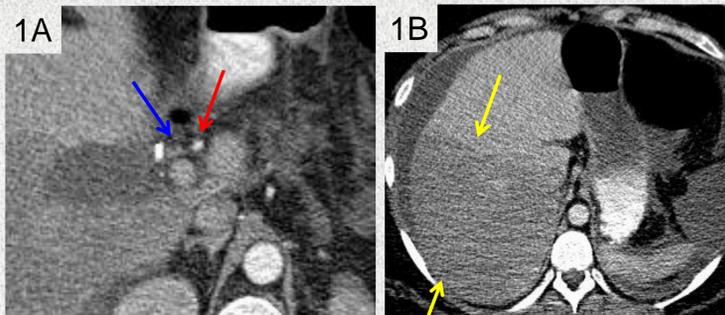


Figure 1: Right hepatic artery injury in association with bile duct injury. Non-opacified right hepatic artery (1A, blue arrow) and corresponding perfusional alteration (1B, yellow arrows). Note the normally opacified left hepatic artery (1A, red arrow).



Figure 2: Ligated aberrant low right posterior duct. A finding that is easily overlooked on ERCP is the absence of contrast within the right posterior segmental ducts (*). At MRCP, the ligated dilated right posterior segmental branches are well visualized (white arrows).

References

- Wu YV, Linehan DC. Bile duct injuries in the era of laparoscopic cholecystectomies. The Surgical Clinics of North America. 2010;90(4):787-802.
- Kim JY, Kim KW, Ahn CS, Hwang S, Lee YJ, Shin YM, et al. Spectrum of biliary and nonbiliary complications after laparoscopic cholecystectomy: radiologic findings. AJR American journal of roentgenology. 2008;191(3):783-9.
- Desai NS, Khandelwal A, Virmani V, Kwatra NS, Riccio JA, Saboo SS. Imaging in laparoscopic cholecystectomy--what a radiologist needs to know. European journal of radiology. 2014;83(6):867-79.

Imaging Modalities

Modality	Advantages	Disadvantages
Hepatobiliary Scan	<ul style="list-style-type: none"> Sensitive for leak detection 	<ul style="list-style-type: none"> Poor spatial resolution limits ability to localize (improved with SPECT) Ionizing radiation
Ultrasound and CT	<ul style="list-style-type: none"> Identify fluid collections and vascular injury Fast and readily available US – No ionizing radiation 	<ul style="list-style-type: none"> Cannot distinguish biloma from other types of fluid collections CT – Ionizing radiation
MRI/MRCP	<ul style="list-style-type: none"> Can identify bile leak (hepatocellular agent) May identify leak site, including peripheral sites of leakage not filled with retrograde injection Can identify vascular injury Characterization of fluid collections No ionizing radiation 	<ul style="list-style-type: none"> Variable duct filling with reduced hepatic function (hepatocellular agent) Limitations of MRI in general: contraindications and artifacts (motion, surgical clips) Potential for interference with T2WI given T2 shortening effects of contrast material in bile ducts with hepatocyte agents (need to perform MRCP sequences prior to contrast administration)
ERCP	<ul style="list-style-type: none"> Can detect and localize leaks Allows intervention 	<ul style="list-style-type: none"> May miss peripheral injuries in ducts not filled with retrograde injection Invasive with complications Cannot detect vascular injury Ionizing radiation
PTC	<ul style="list-style-type: none"> Can detect and localize leaks Superior to ERCP to detect proximal duct injuries Allows intervention 	<ul style="list-style-type: none"> Limited in defining biliary anatomy distal to injury Invasive with complications May require multiple sites of access depending on site of injury Cannot detect vascular injury Ionizing radiation

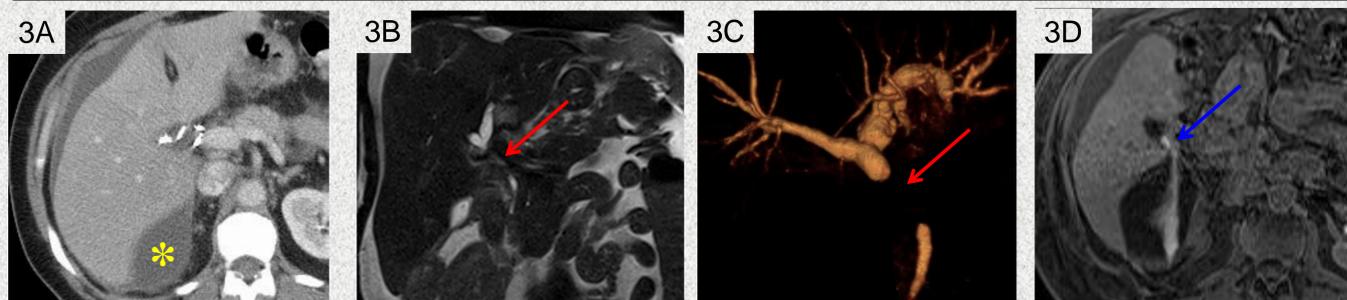


Figure 3: (A) CT, (B) Coronal T2-W MRI, (C) 3D-MRCP, (D) postcontrast MRI with gadopetate disodium in the hepatocyte phase. Perihepatic fluid collection (3A,*) which is nonspecific in etiology on CT. This was confirmed to represent biloma on MRI as evidenced by extravasated contrast material (3D, blue arrow) on hepatocyte phase images. There is segmental non-visualization of the common duct (3B-C, red arrows).

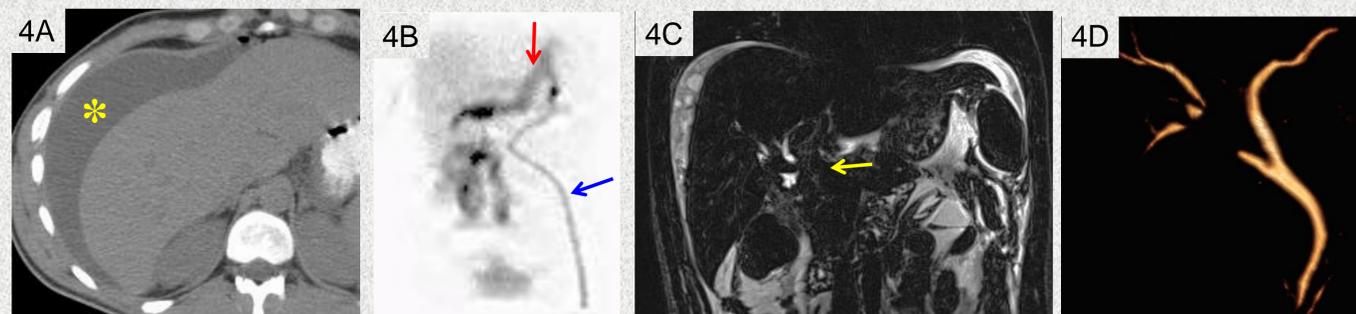
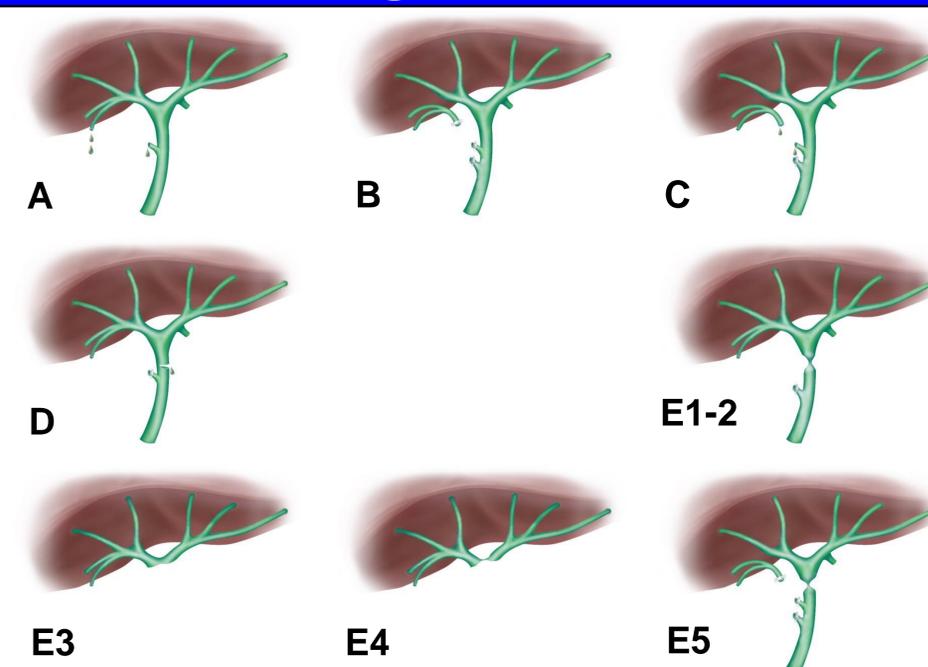


Figure 4: (A) CT, (B) Hepatobiliary scan, (C) Coronal T2-W MRI, (D) 3D-MRCP. A large amount of fluid (4A,*) is present surrounding the liver on CT. Tracer leak is present (4B) in the subhepatic space (red arrow) and within a surgically placed drain (blue arrow). MRCP images (4C-D), localize the injury at the right main hepatic duct. Note the absence of intrahepatic biliary ductal dilatation.

Strasberg Classification



- A: Cystic duct leak or leaks from small ducts in liver bed
- B: Occlusion of part of biliary tree, typically the right hepatic ducts
- C: Transection (but not ligation) of aberrant right hepatic ducts
- D: Lateral injuries to major bile ducts
- E1: Common hepatic duct division, > 2 cm from bifurcation
- E2: Common hepatic duct division, < 2 cm from bifurcation
- E3: Common bile duct division at bifurcation
- E4: Hilal stricture, involvement of confluence and loss of communication between right and left hepatic duct
- E5: Involvement of aberrant right hepatic duct alone or with concomitant stricture of the CHD

Key Surgical Information

- Location and extent of injury:** proximal (peripheral) extent of injury is of particular importance as this will determine type/number of anastomoses
- Presence of aberrant biliary anatomy**
- Presence of vascular injury:** Associated with worse prognosis; may affect anastomotic healing
- Status of segment I ducts:** Evaluate duct size and for presence of injury; if injury present, size will determine if ducts can be incorporated into the anastomosis or if they will need to be ligated; if missed, leaks from these ducts can give false positives for anastomotic leak