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# Cholangiocarcinoma: Radiologic evaluation and interventions

Colin Nevins, Harvard Medical School Year III  
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# Agenda

- Initial course and work-up
- Endoscopic retrograde cholangiopancreatography (ERCP)
- Initial intervention
- Cholangiocarcinoma
- Post-operative course and imaging
- Magnetic resonance cholangiopancreatography (MRCP)
- ACR appropriateness criteria
- Percutaneous transhepatic cholangiography (PTC)
- Cholangiocarcinoma prognosis
- Outcome
- Recap



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## Our patient: Initial presentation

- 84 year old Asian male presenting to his PCP
- CC/HPI: fatigue, fever, and weight loss for several weeks



## Our patient: Initial presentation

- 84 year old Asian male presenting to his PCP
- CC/HPI: fatigue, fever, and weight loss for several weeks
- ROS: negative for RUQ pain
- PMH: HTN, BPH, GERD
- PSH: remote cholecystectomy
- Medications: hydrochlorothiazide, omeprazole
- Allergies: none
- Family Hx: none
- Social Hx: rare EtOH, no tobacco, no illicit substances



## Our patient: Physical Exam

- Vitals: T 100.4, HR 60, BP 132/72, RR 16, SaO<sub>2</sub> 98% RA
- Gen: elderly male, appears tired
- HEENT: mild scleral icterus
- CV: RRR, no murmurs/rubs/gallops
- RESP: CTAB, no rales, rhonchi, or wheezes
- ABD: soft, NT, ND, + bowel sounds, no hepatomegaly or splenomegaly, no caput medusae
- EXT: WWP, no palmar erythema
- NEURO: A&O x3, moving all extremities, no asterixis
- SKIN: no generalized jaundice, no spider angioma



## Our patient: Selected Labs

- Basic labs including CBC and chem-10 were within normal limits
- However, the liver panel was suggestive of biliary obstruction due to the combination of:
  - Elevated transaminases
    - AST: 142, ALT: 172
  - Elevated alkaline phosphatase: 458
  - Direct hyperbilirubinemia
    - total bilirubin: 2.9, direct bilirubin: 2.2
- A radiologic work-up was then begun for biliary obstruction



# Our patient: Radiologic work-up for biliary obstruction





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## 1. RUQ U/S



# Our patient: Radiologic work-up for biliary obstruction

## 1. RUQ U/S

- Renal cysts and s/p cholecystectomy
- otherwise unremarkable



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RUQ U/S and follow-up abdominal CT were unrevealing

An ERCP was then recommended



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## Indications

1. **Evaluation of biliary obstruction** in patients with persistent jaundice
2. Evaluation of recurrent pancreatitis
3. Suspected pancreatic cancer, when other studies, e.g. CT, are equivocal
4. Evaluation of pancreatic and biliary anatomy prior to surgery
5. **Bile duct stent placement to relieve obstruction**
6. **Biopsy of identified lesions**
7. Stone removal

## Contraindications

1. Fluoroscopy utilizes x-rays, i.e. ionizing radiation and should not be performed in pregnant women unless absolutely necessary.
2. Coagulopathy is a relative contraindication.
3. There is a low risk of allergic reaction to contrast material, so the exam is not contraindicated in patients with a history of contrast allergy.



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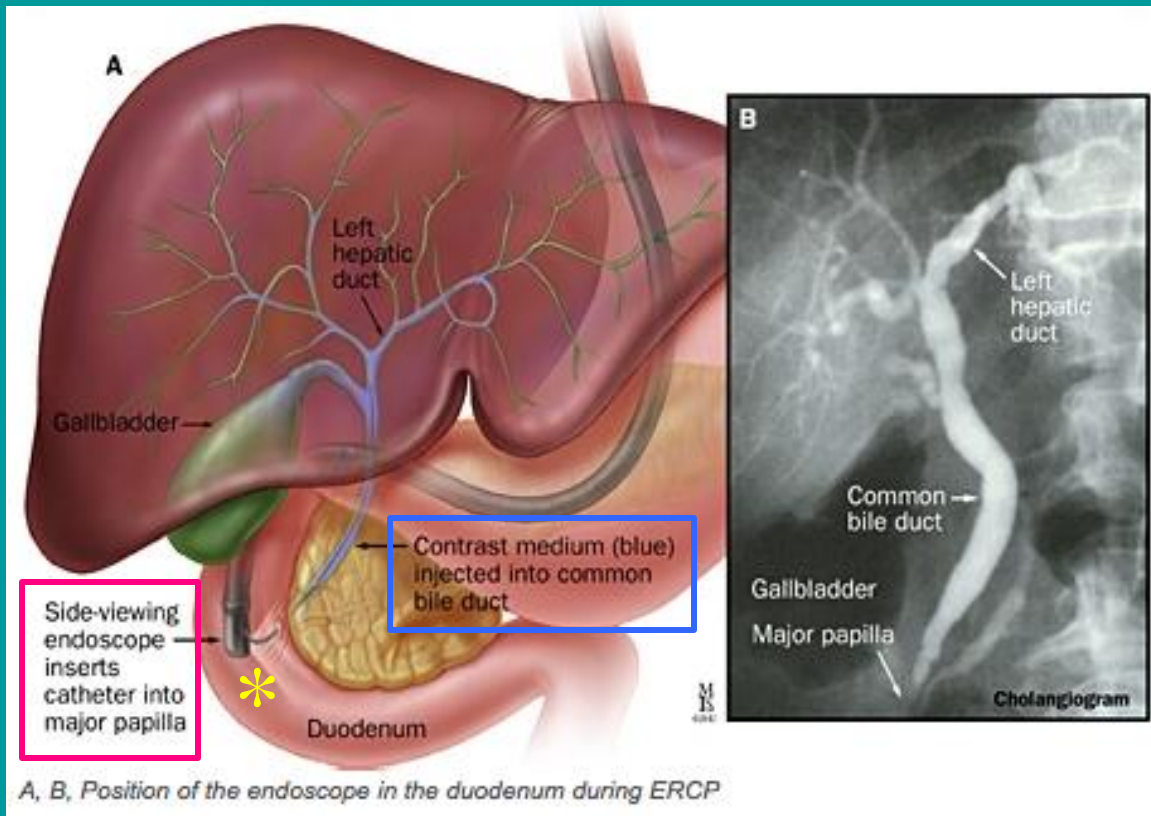
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## Limitations

1. **Invasive procedure with attendant risks.**
2. **There are many less expensive, noninvasive procedures that visualize the pancreaticobiliary systems, such as ultrasound, CT, and MRCP. ERCP should only be used when results of other imaging modalities are equivocal or intervention is anticipated**

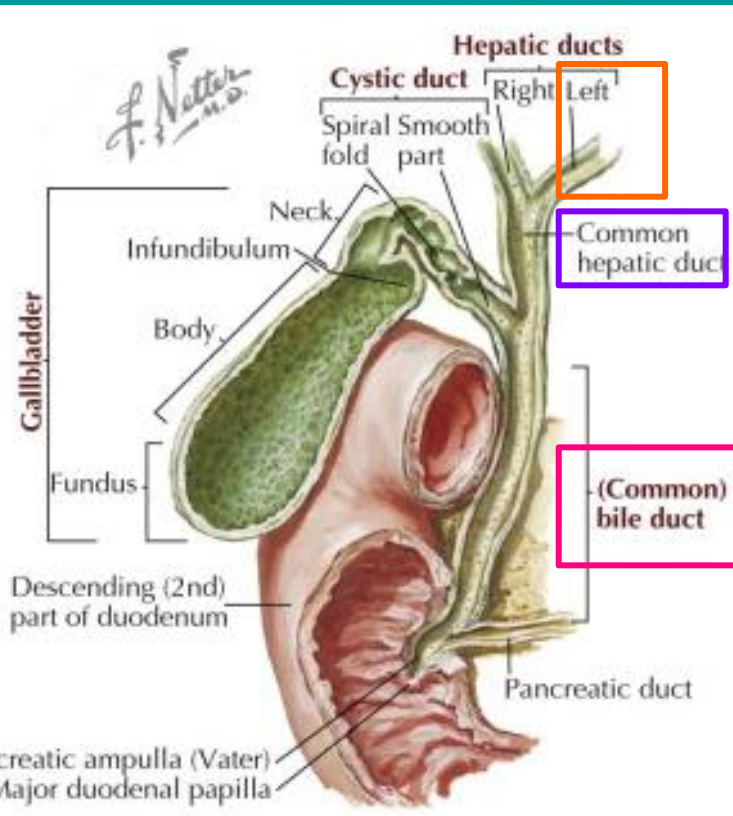
# ERCP: technique



1. Endoscope positioned in the second portion of the duodenum
2. Cannulation of the Ampulla of Vater
3. Fluoroscopic imaging with contrast medium



## Our patient: ERCP findings



- The **left intrahepatic ducts** were not filled with contrast.
- 1.5 cm stricture in the proximal **CBD**.
- The **CBD** was 7mm in maximum diameter. No filling defects identified.
- No evidence of Primary Sclerosing Cholangitis (PSC).
- Sphincterotomy with brushings was performed and a biliary stent was placed into the right main hepatic duct.



## Our patient: pathology and decision making

- Common bile duct stricture, brushings:
  - “Highly atypical but degenerated glandular cells are present; cannot rule out reactive atypia.”



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- Patient also had mildly elevated CA-19-9
- High concern for cholangiocarcinoma, warranting surgical intervention





# Agenda

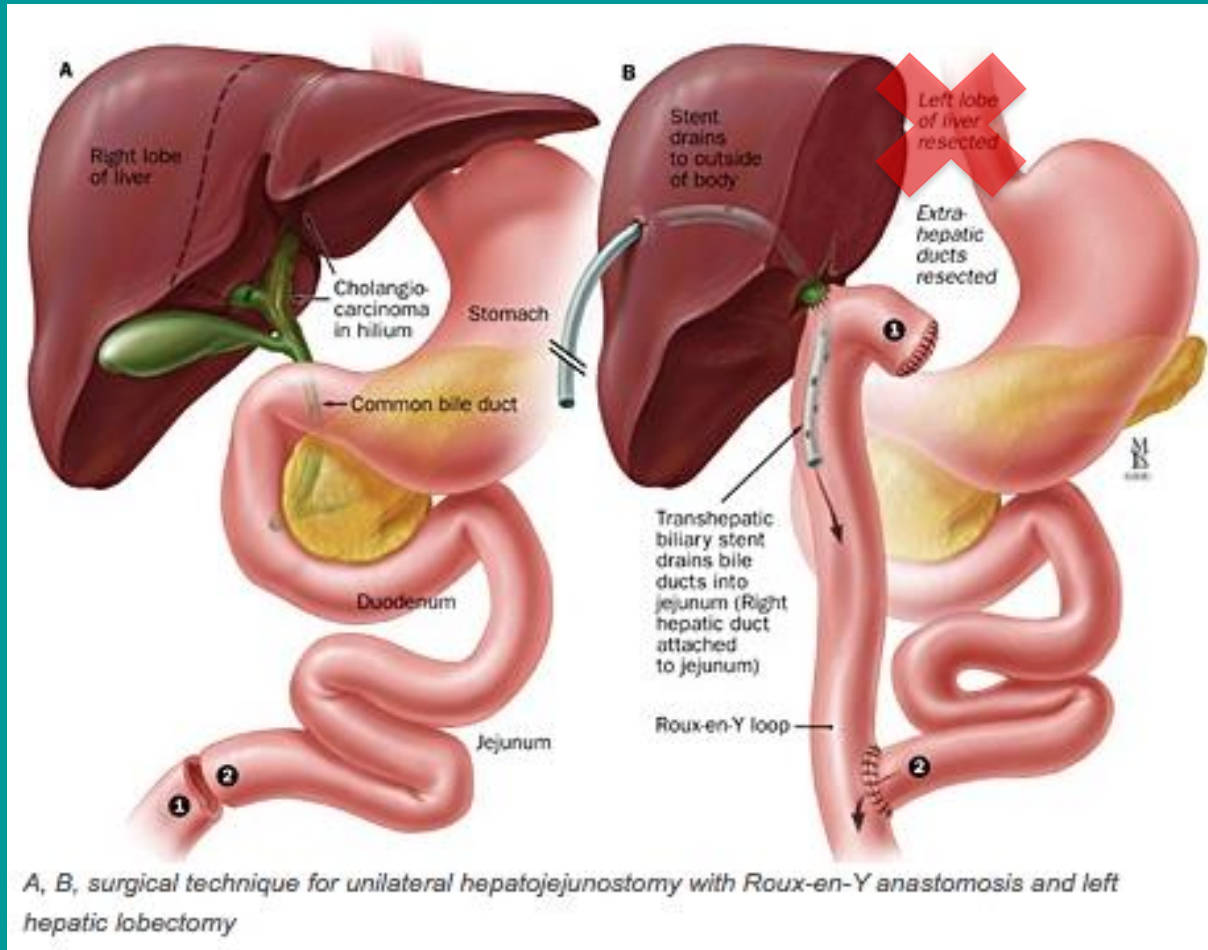
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## Our patient: surgical plan

- High concern for cholangiocarcinoma, warranting surgical intervention
  - Underwent a Roux-en-Y hepatojejunostomy to the extrahepatic common hepatic duct (resected the extrahepatic biliary tree and performed a biliary bypass)
  - Family and surgeon opted not to perform an extensive liver or pancreatic resection

# Roux-en-Y hepatojejunostomy to the extrahepatic common hepatic duct



(note: this patient did not undergo a hepatic lobectomy)



## Our patient: post-operative course

- The resected tissue was sent to pathology for diagnosis



## Our patient: post-operative course

- The resected tissue was sent to pathology for diagnosis
- Post- operative diagnosis: invasive cholangiocarcinoma



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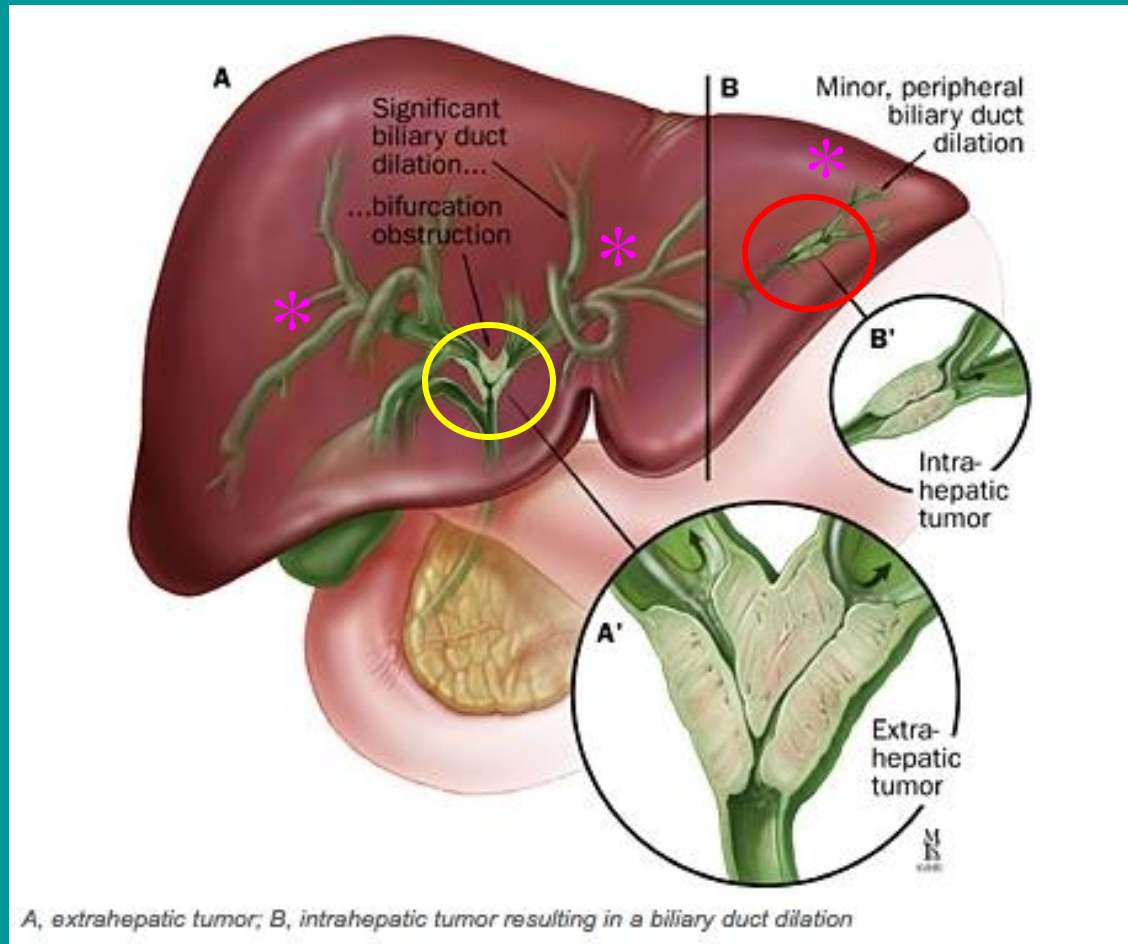
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  - Two-thirds involve the bifurcation of the common hepatic duct

## Cholangiocarcinoma: locations



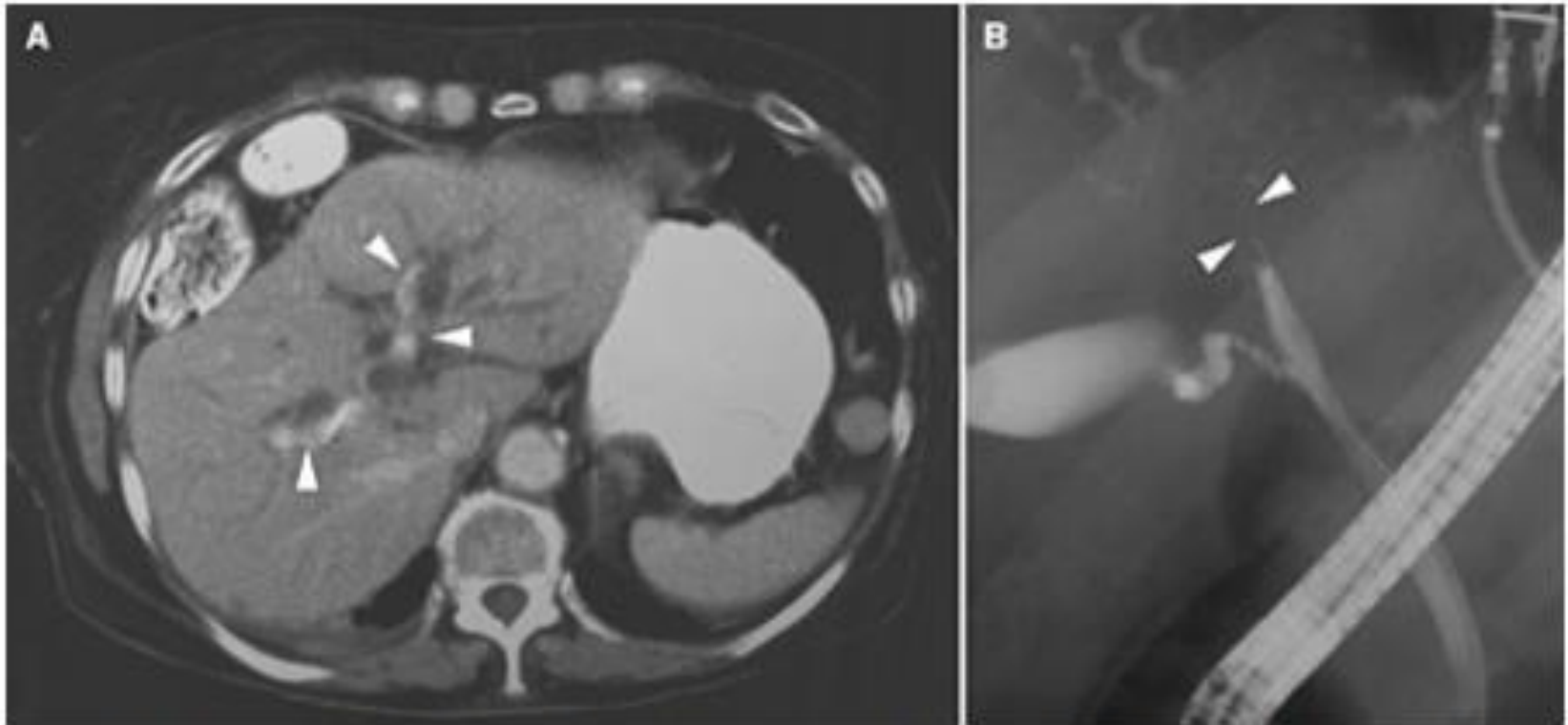
2/3 involve the  
**bifurcation of the  
common hepatic duct**  
("Klatskin tumors")

May also involve  
**peripheral ducts**

**Ductal dilation** may  
occur proximally to an  
obstruction



# Comparison patients #1 and #2: examples of the radiologic manifestations of cholangiocarcinoma



*Comparison of radiographic images showing cholangiocarcinoma; A, computed tomography (CT) image; B, cholangiogram (ERCP) image. Arrows designate the tumor.*



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- Histology:



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- Grading:
  - well, moderately, or poorly differentiated



## Our patient: post-op pathology report

- Macroscopic:
  - Specimen type: **extrahepatic biliary tree**
  - Procedure: excision of extrahepatic biliary tree
  - Tumor site: **common hepatic duct**
  - Tumor size: cannot be determined
- Microscopic:
  - Histologic type: **Adenocarcinoma** (not otherwise characterized)
  - Histologic Grade: **Well differentiated**
  - Microscopic tumor extension: **tumor invades beyond the wall of the bile duct into surrounding connective tissue**
- Margins
  - Segmental resection specimen: **margins positive for invasive carcinoma: proximal bile duct margin**
  - Lymphatic/vascular invasion: present
  - Perineural invasion: present



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## Our patient: POD-5 gravity cholangiogram

Routine study to evaluate patency of Roux-En-Y hepatojejunostomy for biliary stricture



Pause to evaluate the images, then continue to reveal the findings



## Our patient: POD-5 gravity cholangiogram

Routine study to evaluate patency of Roux-En-Y hepatojejunostomy for biliary stricture



### FINDINGS:

1. Abdominal surgical drain.
2. Right upper quadrant surgical clips and T-tube
3. Dilated left hepatic ducts **centrally** with no peripheral dilation.
4. **Right hepatic ducts were not seen.**
5. No evidence of leak.
6. No evidence of anastomotic stricture.

### IMPRESSION:

**No evidence of anastomotic stricture or leak.**



## Our patient: post-operative course

POD-10: elevated transaminases were found on standard follow-up labs. Patient mildly febrile and team was concerned about a possible liver abscess



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### IMPRESSION:

1. **Stable intrahepatic biliary dilatation involving the right and the left lobes**
2. Ill-defined hypodense area in the left lobe of the liver which may be postsurgical in nature. Recommend attention on follow up.
3. Postsurgical changes including a small amount of fluid in the abdomen and in the postsurgical bed without other evidence of complication.





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### IMPRESSION:

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2. Ill-defined hypodense area in the left lobe of the liver which may be postsurgical in nature. Recommend attention on follow up.
3. Postsurgical changes including a small amount of fluid in the abdomen and in the postsurgical bed without other evidence of complication.

Five days later, LFT's were still rising.

MRCP then obtained to asses biliary system for obstructions or leaks



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# MR Cholangiopancreatogram (MRCP): some facts

**Non-invasive** imaging of the bile and pancreatic ducts **without the need for contrast.**



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Non-invasive imaging of the bile and pancreatic ducts without the need for contrast.

## Indications

1. **Imaging of bile and pancreatic ducts.**
2. Detection of ductal stenosis or calculi, including choledocholithiasis.
3. **Road-mapping pancreatobiliary anatomy in patients who fail conventional ERCP or in patients who are not good candidates for ERCP, e.g. medically unsuited for ERCP or s/p hepatojejunostomy.**
4. Identifying anomalous biliary anatomy (e.g. low-lying cystic duct) in patients being considered for laparoscopic cholecystectomy.
5. **Depiction of ducts as well as surrounding anatomy.**

## Contraindications

1. Ferromagnetic metallic devices within the body



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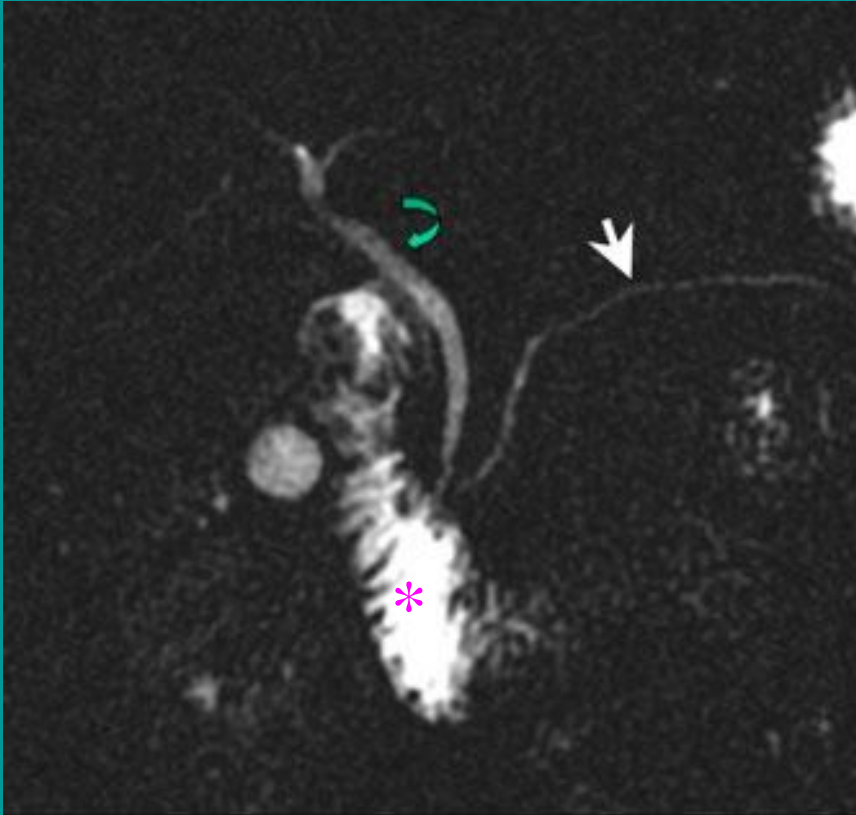
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## Limitations/ Disadvantages

1. **Image resolution is currently inferior to ERCP and PTC**
2. Surgical clips or air within bile ducts can give rise to artifacts.
3. **Because it is not an invasive procedure, MRCP does not provide therapeutic options such as drainage or stent placement that can be provided with ERCP or PTC.**
4. There is limited availability of MRI scanners.
5. Open scanners must be used in morbidly obese patients.
6. Sensitivity to motion limits ability to image uncooperative patients.
7. Imaging is difficult for claustrophobic patients
8. MRI is insensitive to subtle calcifications or small bony fragments, limiting accuracy for these findings.



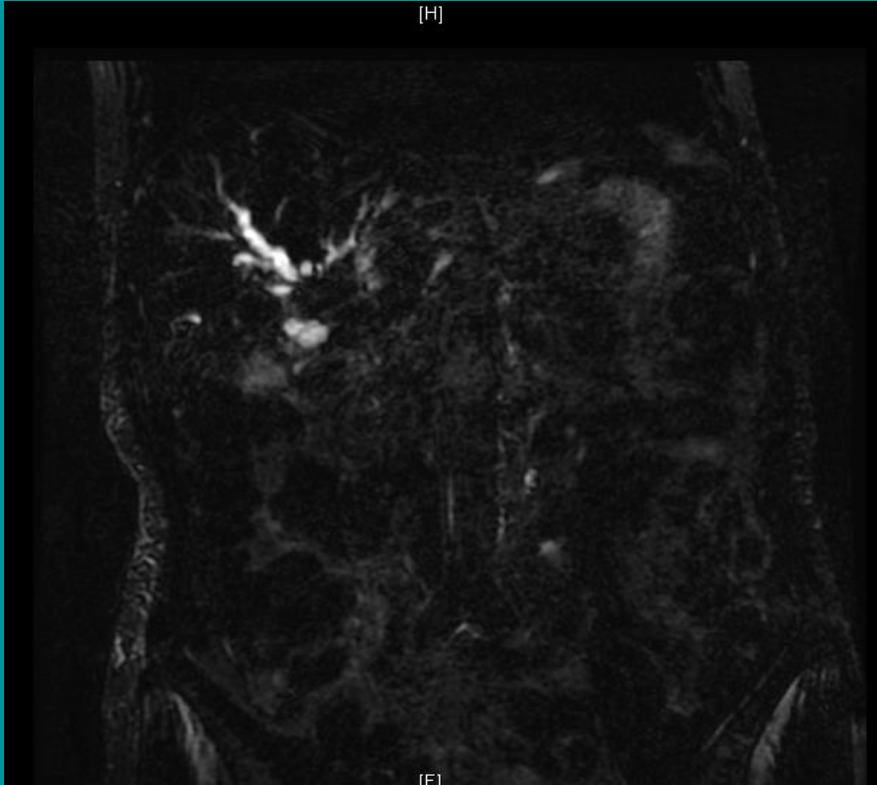
## Comparison patient #3: normal MRCP



Normal MRCP image showing the common bile duct (curved arrow) and the pancreatic duct (arrow). Note the fluid filled duodenum (\*)



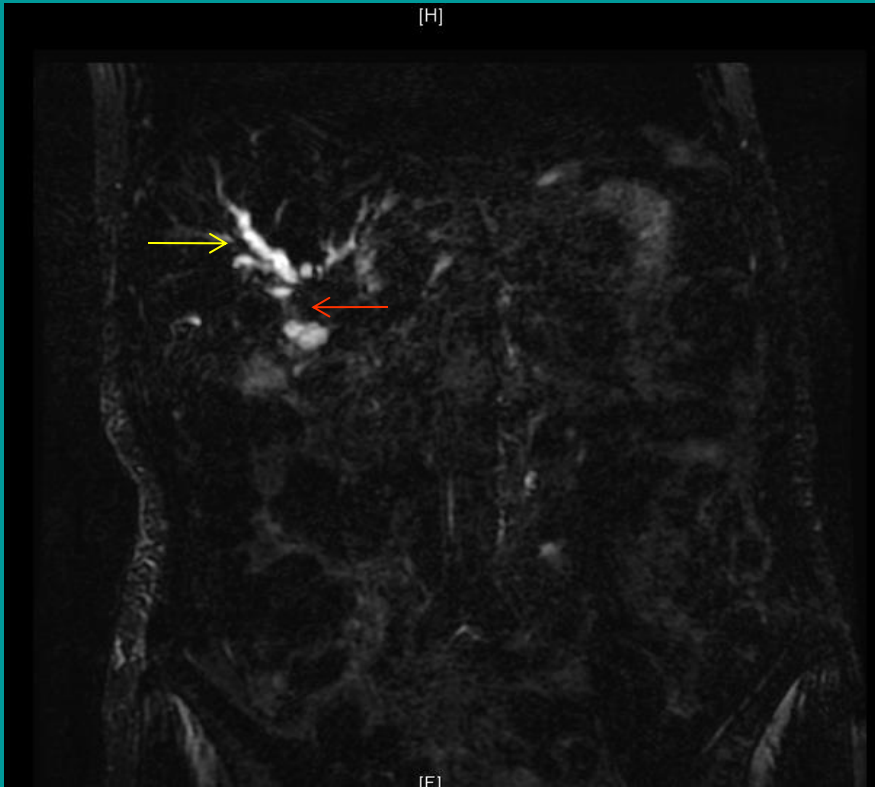
## Our patient: post-operative MRCP



Pause to evaluate the image, then continue to reveal the findings



## Our patient: post-operative MRCP



Persistent  
**intrahepatic biliary tree dilatation** with  
**discontinuation and  
amputation at the  
level of biliary confluence at the hilum.**

The findings are  
concerning for residual Klatskin tumor in  
volving the secondary biliary  
confluences bilaterally (Bismuth Corlette  
type IV).

No concerning lymph nodes.

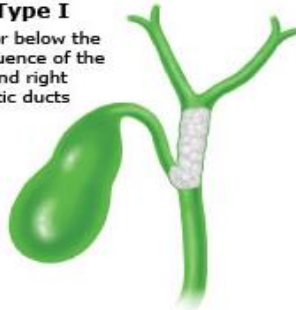




## Bismuth-Corlette classification of biliary tract cancers

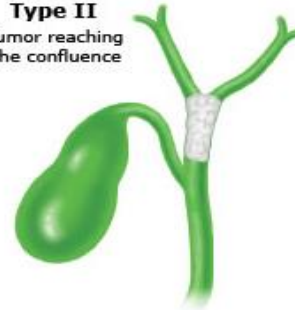
### Type I

Tumor below the confluence of the left and right hepatic ducts



### Type II

Tumor reaching the confluence



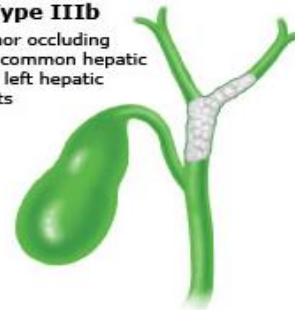
### Type IIIa

Tumor occluding the common hepatic and right hepatic ducts



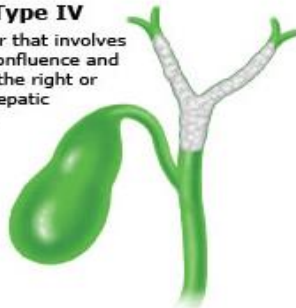
### Type IIIb

Tumor occluding the common hepatic and left hepatic ducts



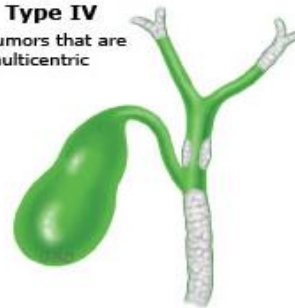
### Type IV

Tumor that involves the confluence and both the right or left hepatic duct



### Type IV

Tumors that are multicentric





## Our patient: medical decision making

Due to residual tumor, our patient was recommended to undergo stenting to relieve the obstruction

The ACR Appropriateness Criteria was used to aid in the decision of how to insert a stent to treat this obstruction



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# ACR Appropriateness Criteria

**Clinical Condition:** Radiologic Management of Benign and Malignant Biliary Obstruction

**Variant 4:** Initial therapeutic procedure for a patient with hilar biliary obstruction from malignant etiology (eg, Klatskin tumor).

Treatment/Procedure	Rating	Comments
Endoscopic internal biliary catheter	6	
Percutaneous internal/external biliary catheter	8	
Surgery (transplant or hepaticojejunostomy)	5	May be appropriate in some cases; however, must be individualized based on patient's comorbidities and likelihood of cure.
Medical management only	2	
Permanent biliary metallic stent	6	
Removable biliary covered stent	5	
Endosonography-guided biliary drainage (ESBD)	3	

**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate



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## Our patient: medical decision making

As our patient was s/p an operation that complicated his GI anatomy (Roux-en-Y hepatojejunostomy), Percutaneous Transhepatic Cholangiography (PTC) with permanent stent placement was deemed to be preferable to an ERCP which would require navigating an endoscope through the roux-en-y.

PTC has an appropriateness rating of 8 in this clinical setting and permanent stent placement has a rating of 6, so these were chosen as the next steps in our patient's care.



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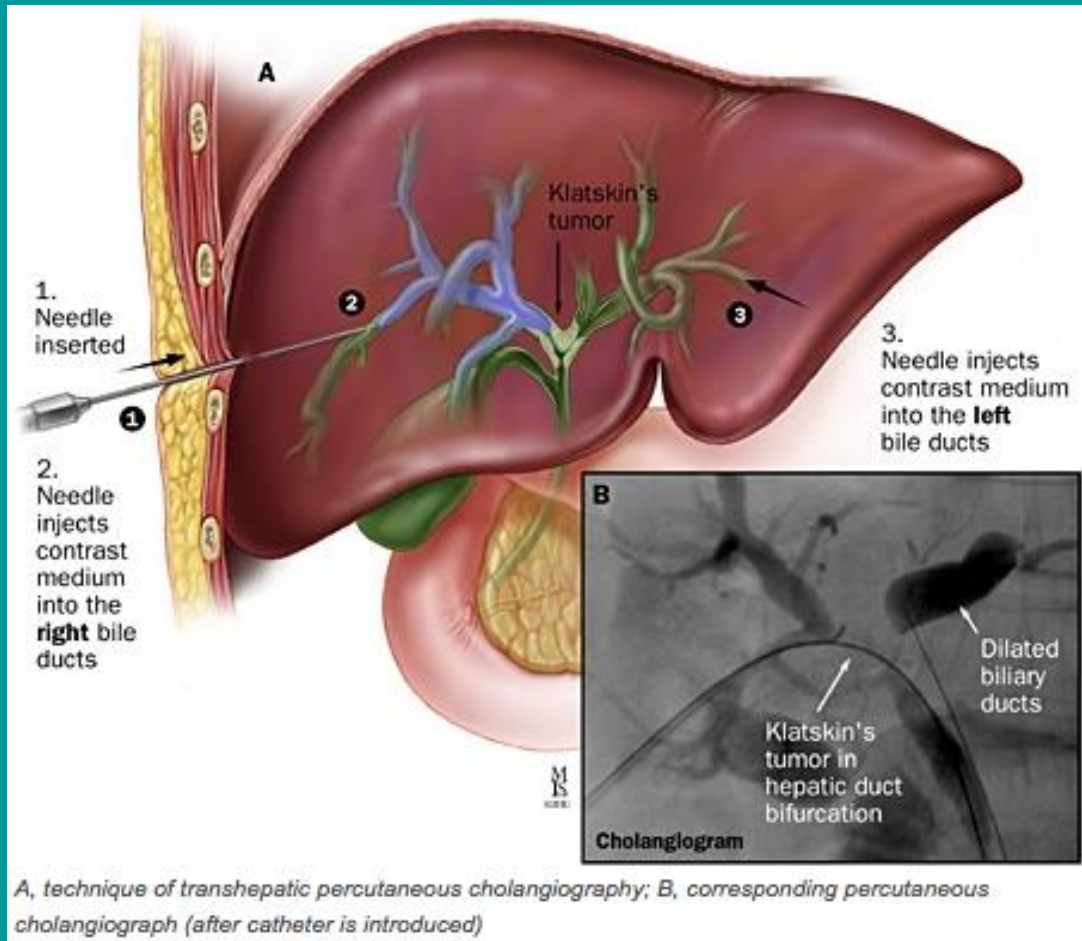
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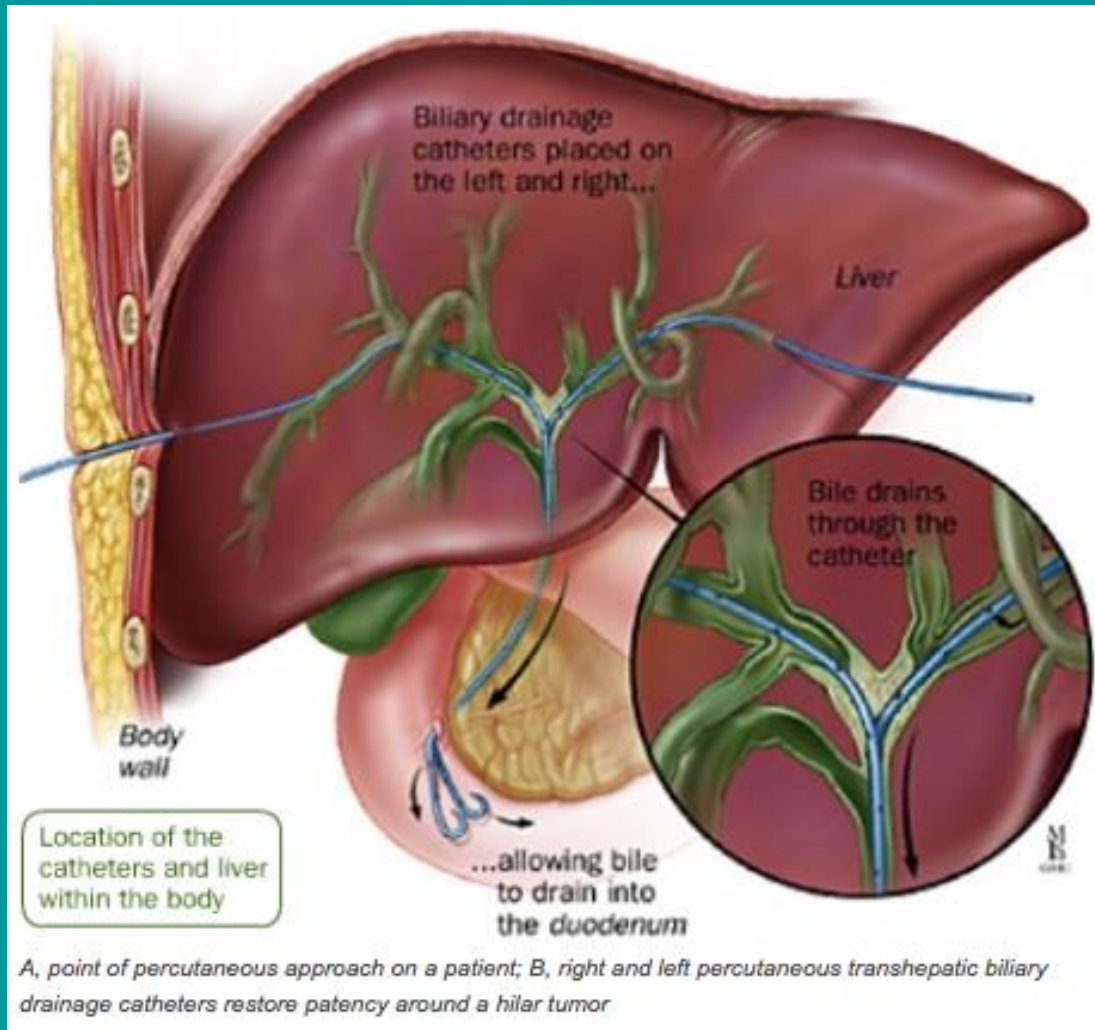


# Comparison patient #4: Percutaneous Transhepatic Cholangiography (PTC) technique





# Percutaneous Transhepatic Biliary Drainage: technique



Note: our patient had a roux-en-Y hepatojejunostomy and therefore had slightly different anatomy



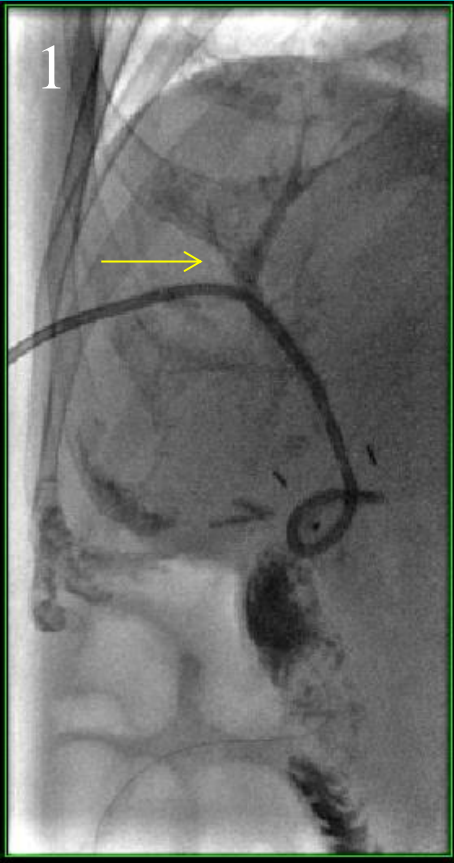
# Our patient: PTC imaging before stent placement



Pause to evaluate the image, then continue to reveal the findings 67



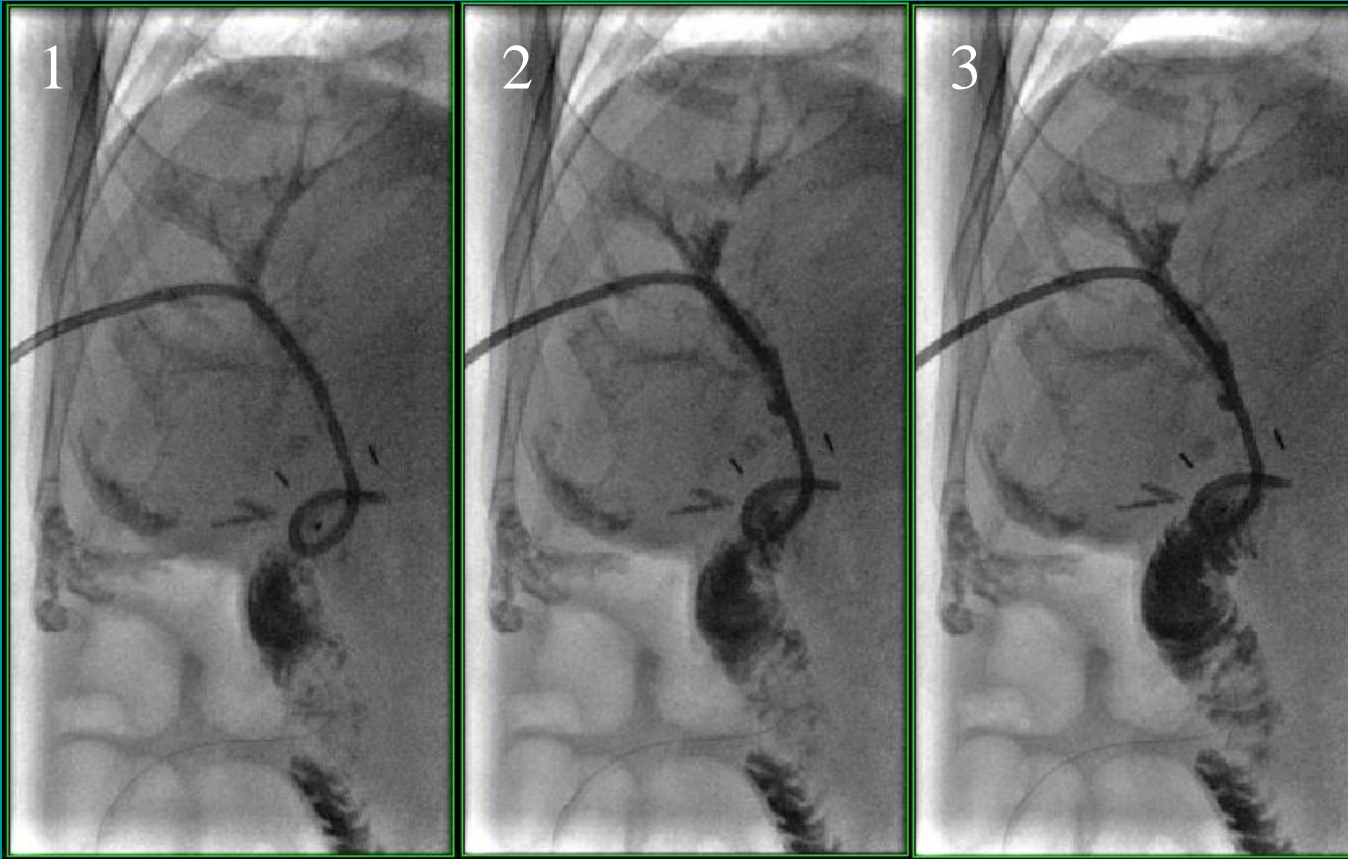
# Our patient: PTC imaging before stent placement



**1. Intrahepatic biliary stricture at the confluence of the right ducts.**



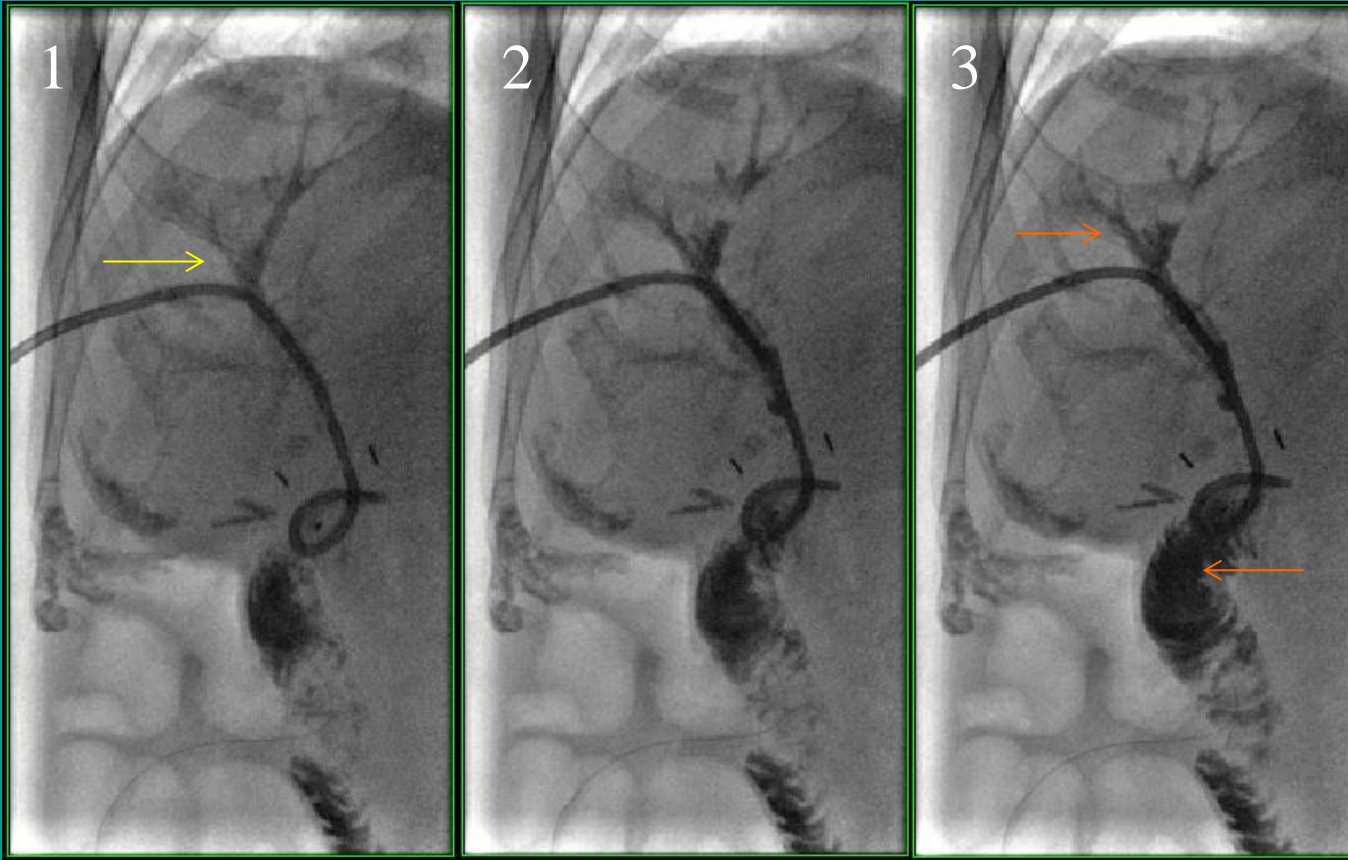
# Our patient: PTC imaging series pre (1) and post (2,3) stent placement



Pause to evaluate the image, then continue to reveal the findings 69



# Our patient: PTC imaging series pre (1) and post (2,3) stent placement



1. **Intrahepatic biliary stricture at the confluence of the right ducts.**
2. Appropriate position and **patency** of the internal external drainage catheter placed into the right anterior biliary system. (contrast is seen passing through the stent)



# Agenda

- Initial course and work-up
- Endoscopic retrograde cholangiopancreatography (ERCP)
- Initial intervention
- Cholangiocarcinoma
- Post-operative course and imaging
- Magnetic resonance cholangiopancreatography (MRCP)
- ACR appropriateness criteria
- Percutaneous transhepatic cholangiography (PTC)
- **Cholangiocarcinoma prognosis**
- Outcome
- Recap



# Cholangiocarcinoma: prognosis

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- Relapse for cholangiocarcinoma can occur even after complete surgical resection



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## Our patient: outcome

- Our patient was discharged one week after his PTC
- His lab abnormalities were improving and he was doing well clinically
- An external drain was in place and capped. The bile was successfully draining internally
- The patient was seen in clinic three weeks after discharge and was recovering well.



# Agenda

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## Recap: Initial Course

- Cholangiocarcinoma may initially present with:
  - Jaundice, clay-colored stools, bilirubinuria, pruritus, weight loss, abdominal pain, fever
- Physical exam may reveal jaundice or hepatomegaly
- Labs may be suggestive of biliary obstruction
  - elevated transaminases
  - elevated alkaline phosphatase
  - direct hyperbilirubinemia

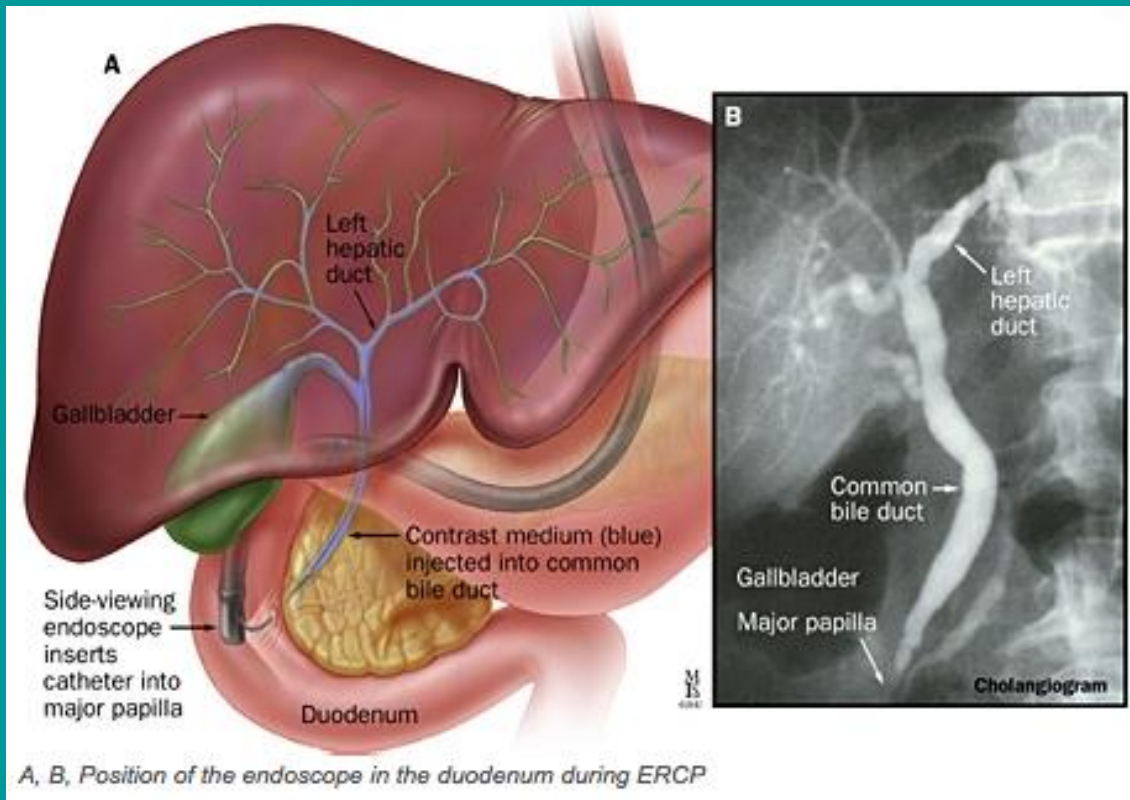




## Recap: Radiologic Workup for biliary obstruction

- Began with a RUQ ultrasound
- This was unrevealing, so an abdominal CT was obtained
- The CT did not reveal a cause of the biliary obstruction, so an ERCP was performed

## Recap: ERCP



- ERCP allows for a more detailed evaluation of the biliary tree and pancreatic duct than ultrasound or CT.
- It also allows for biopsies to be obtained and therapeutic interventions, such as stent placement
- However, it is an invasive procedure and also requires the use of contrast



## Recap: Cholangiocarcinoma

- Rare, but often highly lethal as it is often locally advanced at presentation
- Main risk factors:
  - Primary Sclerosing Cholangitis (PSC)
  - Fibropolycystic liver disease (e.g., choledochal cysts)
- Classified according to location along the biliary tree
  - Two-thirds involve the bifurcation of the common hepatic duct (termed “Klatskin tumors”)
- Histology:
  - Greater than 90% are adenocarcinomas, most others are squamous cell carcinomas
- Grading:
  - well, moderately, or poorly differentiated

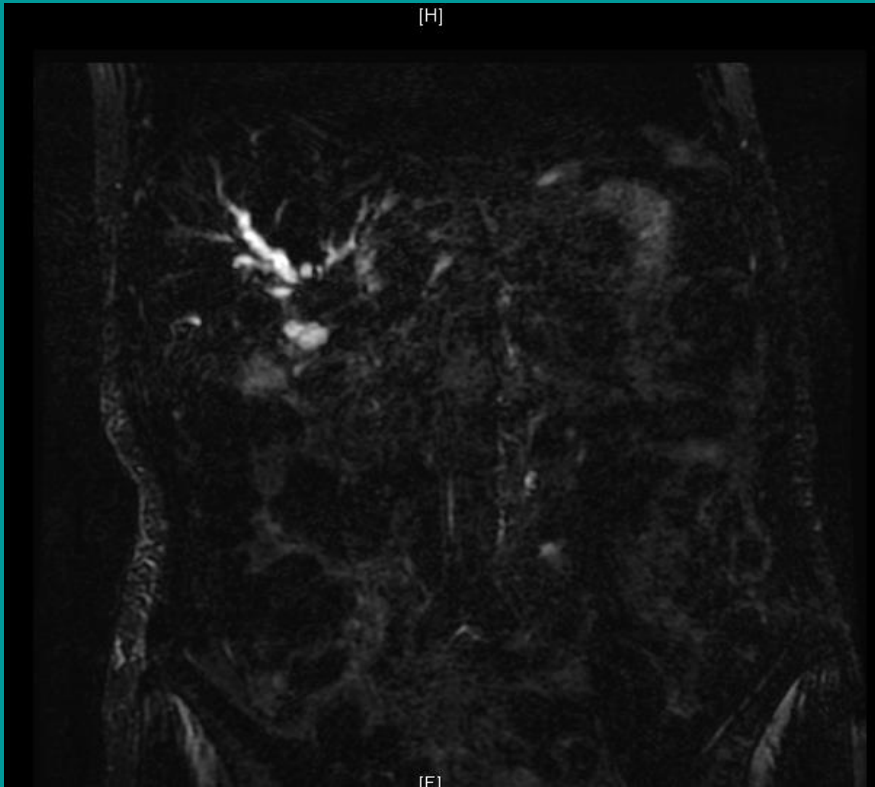
## Recap: Post-operative Complications



- A post-operative cholangiogram is performed routinely to assess for strictures or bile leaks
- After a normal cholangiogram our patient developed elevated transaminases which led to a follow-up CTA
- CTA was then followed by an MRCP



## Recap: MRCP



- MRCP offers non-invasive imaging of the bile and pancreatic ducts without the need for contrast.
- Image resolution is currently inferior to ERCP and PTC
- Because it is not an invasive procedure, MRCP does not provide therapeutic options such as drainage or stenting



# Recap: ACR Appropriateness Criteria

**Clinical Condition:** Radiologic Management of Benign and Malignant Biliary Obstruction

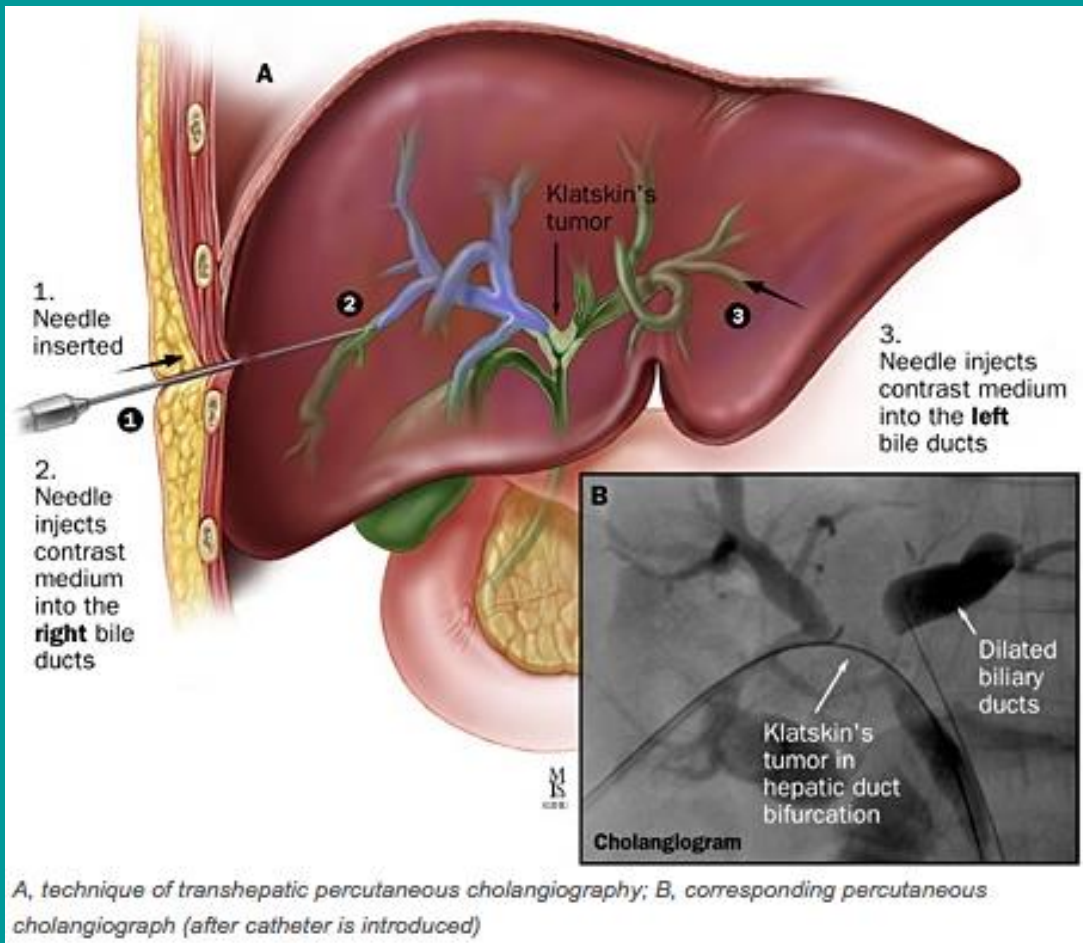
**Variant 4:** Initial therapeutic procedure for a patient with hilar biliary obstruction from malignant etiology (eg, Klatskin tumor).

Treatment/Procedure	Rating	Comments
Endoscopic internal biliary catheter	6	
Percutaneous internal/external biliary catheter	8	
Surgery (transplant or hepaticojejunostomy)	5	May be appropriate in some cases; however, must be individualized based on patient's comorbidities and likelihood of cure.
Medical management only	2	
Permanent biliary metallic stent	6	
Removable biliary covered stent	5	
Endosonography-guided biliary drainage (ESBD)	3	

**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

- ACR criteria provide guidance on the appropriateness of radiologic procedures for specific clinical scenarios

## Recap: PTC



- PTC allows for imaging of and interventional access to the biliary system
- PTC can be helpful when the patient's anatomy makes ERCP difficult or the patient is medically unfit for ERCP



## Recap: Cholangiocarcinoma prognosis

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# References

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