Expanse of Ultrasonography-Guided Intervention

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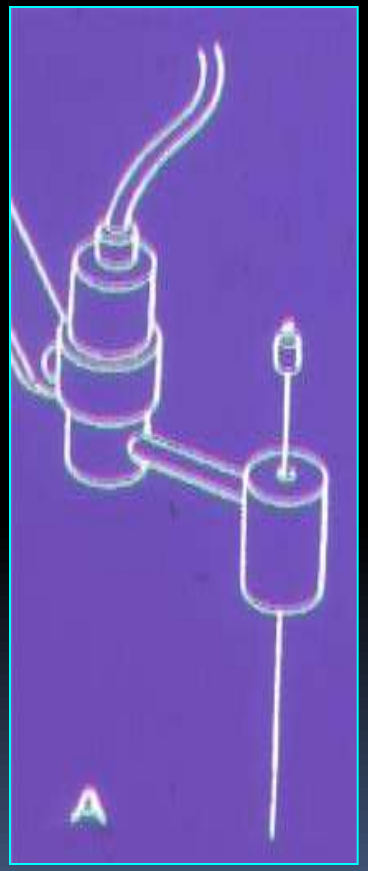
Imaging Guidance for Intervention

- Ultrasonography (US)
- Computed tomography, or

- US and fluoroscopy combined

Ultrasonography(US) Guidance

- **Seldinger, 1953:**
  wire-guided catheterization
- **Kratochwil, 1969:**
  A-mode-guided puncture
- **Goldberg & Pollack, 1972:**
  Puncture of abdominal cyst
- **Holm, 1972:**
  Static B-mode-guided puncture
- **Late 1970s:**
  Real-time US-guided procedures
  (percutaneous, transluminal)



Purposes of US-guided Intervention

- Diagnostic.
- Therapeutic.
- Pre-surgical Localization.

Patient Preparation

- **Lab data – PT** Prothrombin Time **(INR < 1.6)**
  - **PTT** Partial Throboplastin Time
  - **PL** Platelet **> 50,000**
- **Grugs: Aspirin, NSAID: none x 7 days**
- **Diet: NPO > 6hrs**
- **I.V. access with normal saline in certain cases**
- **Oxygen or conscious sedation if necessary**
- *avoidance of body heat loss in neonate*
- *minimization of radiation doses*

US-Guidance / Advantages

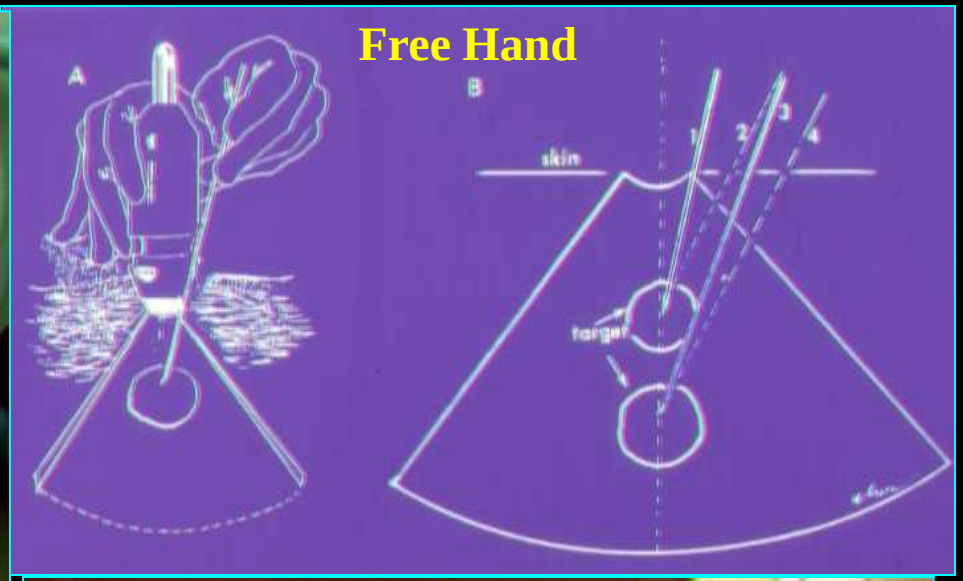
- Expedient
- Real-time
- Less expensive
- Portable
- No ionizing radiation
- Safer with CDU

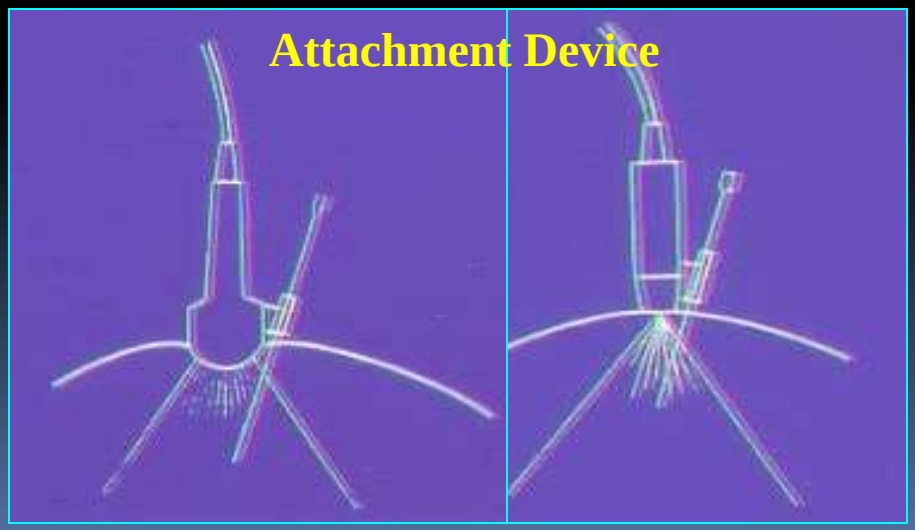
US-Guidance / Disadvantage

- Interposition of bowel gas, lung, bone
- More difficult in larger patient
- Retroperitoneal approach: difficult
- Less global view compared with CT.

US-Guided Needling Procdures

- Free hand
- Attached needle guidance
- Electromagnetic

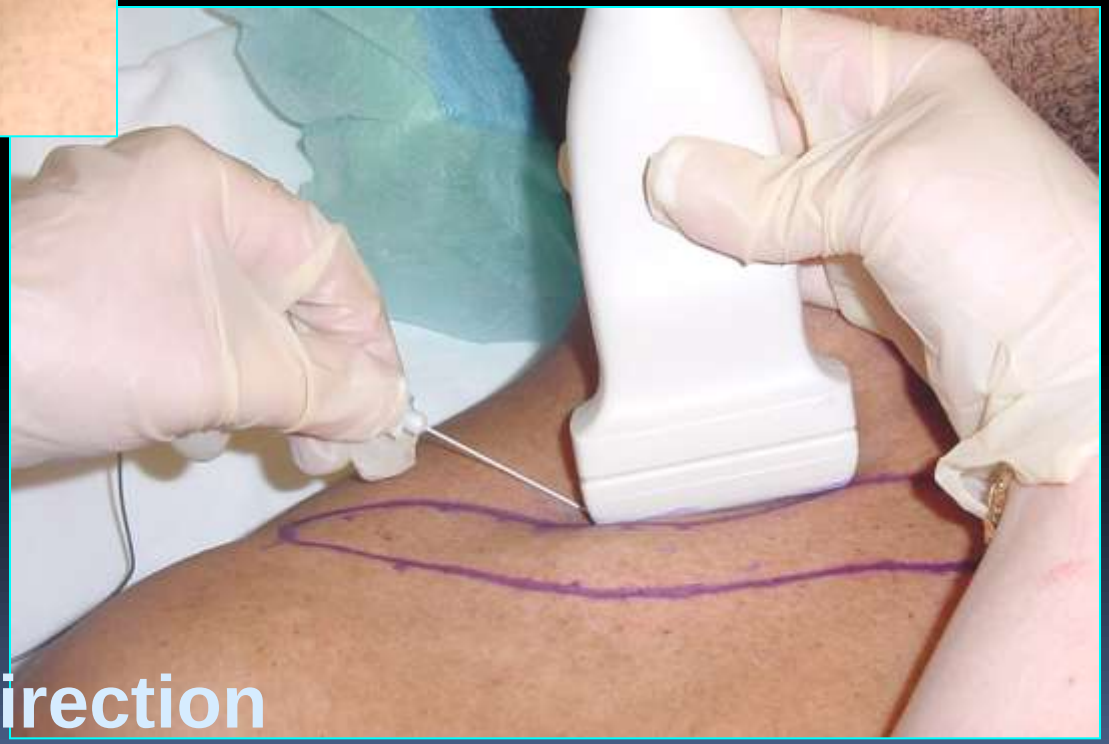




Advantages / Free Hand

- **Better specular reflection:**
  - ***better visualization of needle***
- **Good for near-field lesion**
- **Good for multiple passes at FNAC**
- **Good for small lesions**

Transverse Direction

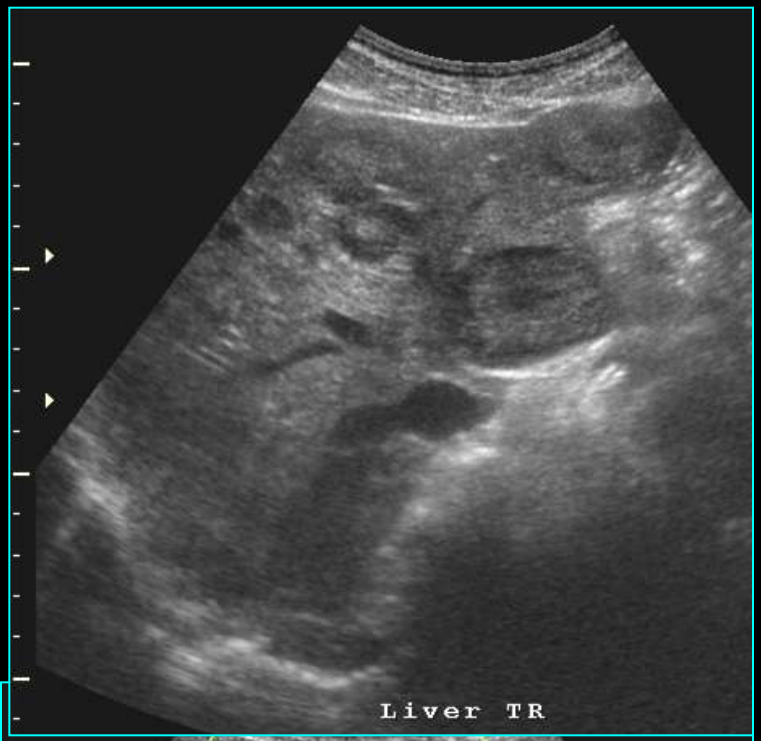


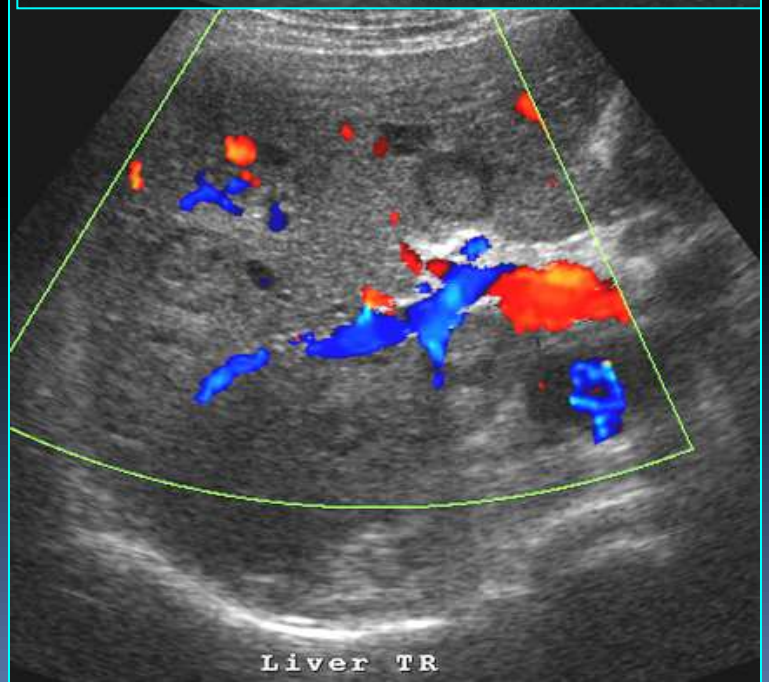
Longitudinal Direction

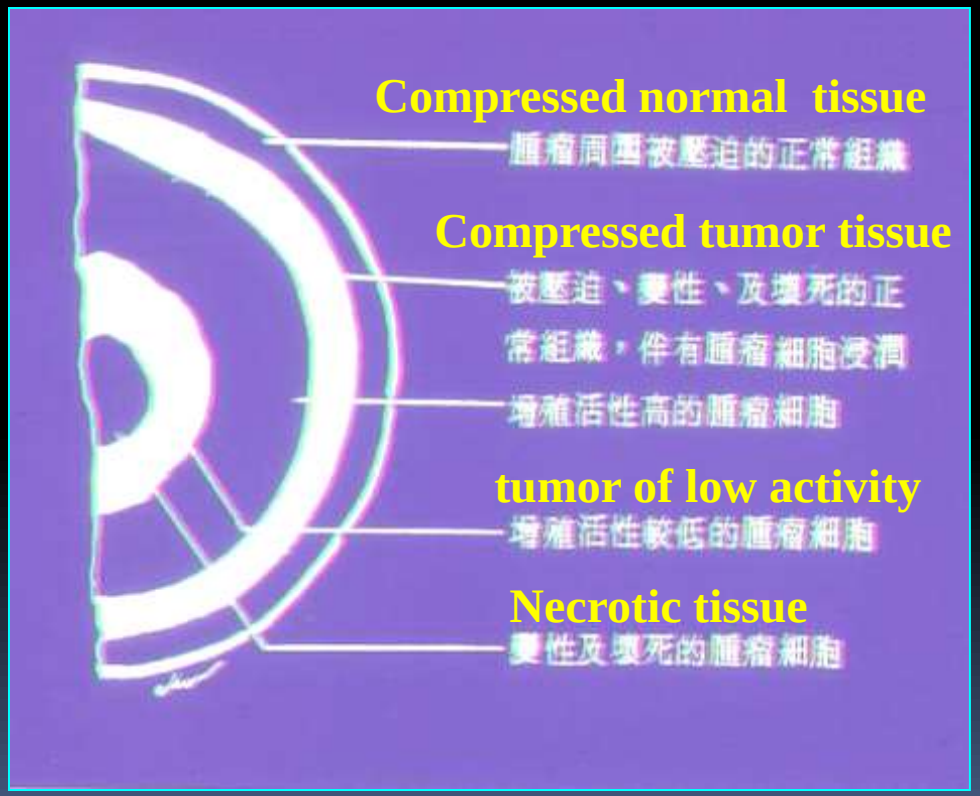
Courtesy: Vincent Chan, MD

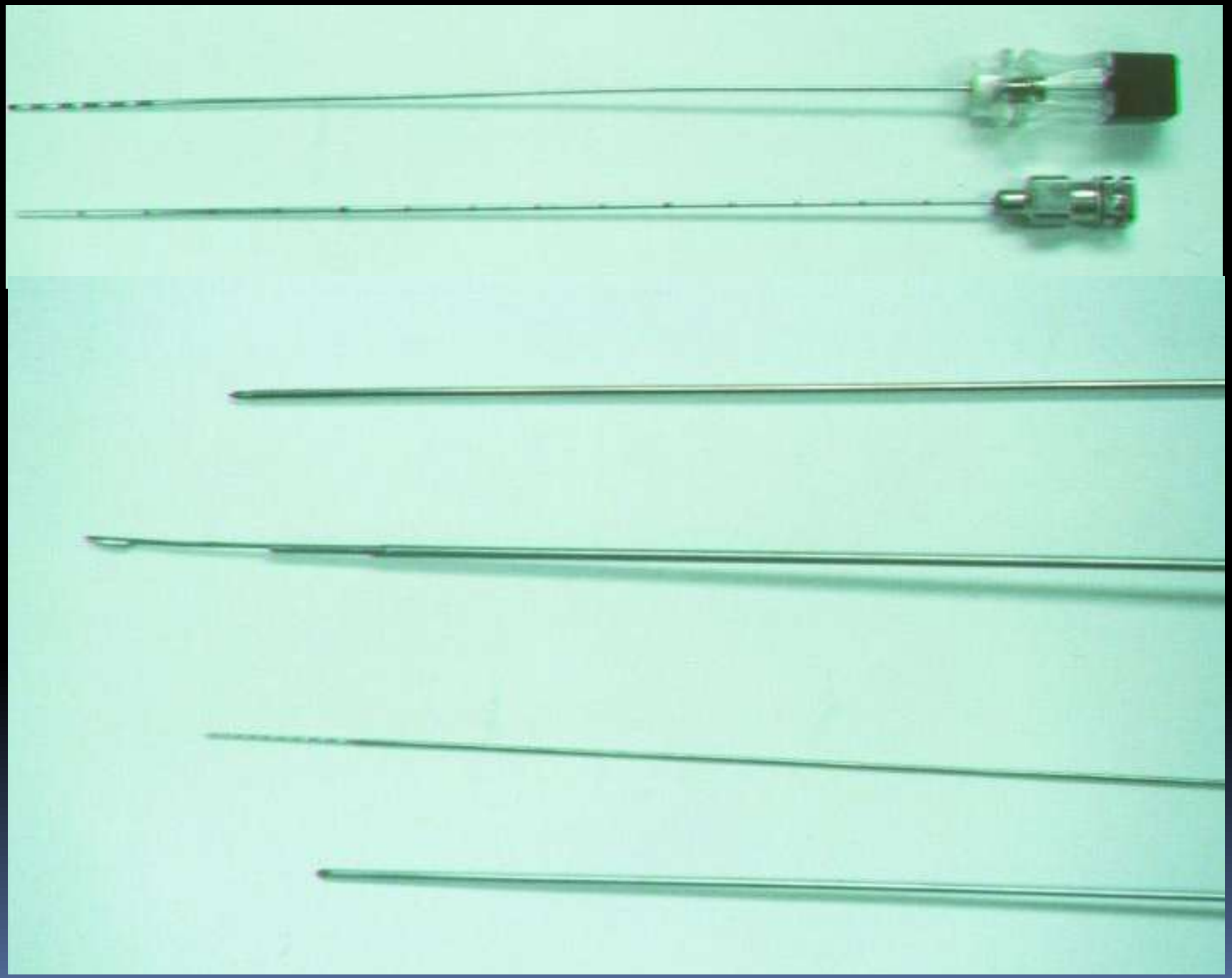
Aspiration Cytology / Biopsy

- **Aspration cytology**
  - 21-23 G fine needle, air-dried or fixation.
  - Liu's stain; papanicoloau, Giemsa, PAS stain.
- **Aspiration biopsy**
  - Surecut, E-Z-EM-Cut, etc.
  - 14-21 G needle
- **Core or large-bore needle cut biopsy**
  - 14-20 G needle
- **Vacuum-assisted biopsy**
  - 8-12 G needle


Liver TR


Liver TR


Compressed normal tissue
腫瘤周圍被壓迫的正常組織
Compressed tumor tissue
被壓迫、變性、及壞死的正
常組織，伴有腫瘤細胞浸潤
增殖活性高的腫瘤細胞
tumor of low activity
增殖活性較低的腫瘤細胞
Necrotic tissue
變性及壞死的腫瘤細胞



“Patent Track” Sign

-- 5 minutes after the biopsies, this sign was persistently seen in 4 and disappeared in the remaining 39. Patients with a persistent patent track sign more frequently bled than those without it ($p < 0.0001$).
Sensitivity, specificity, positive predictive value, and negative predictive value were 60%, 100%, 75%, and 99%, respectively.

--A patent track sign, immediately after percutaneous liver biopsy, provides excellent screening for postbiopsy bleeding.
--This sign strongly predicts postbiopsy bleeding when persistently seen for 5 minutes.

Value of “Patent Track” Sign on Doppler Sonography After Percutaneous Liver Biopsy in Detection of Postbiopsy Bleeding: A Prospective Study in 352 Patients

Kyoung Won Kim, Min-Jeong Kim, Hyo-Cheol Kim, Seong Ho Park, So Yeon Kim, Mi-Suk Park, Tae Kyoung Kim

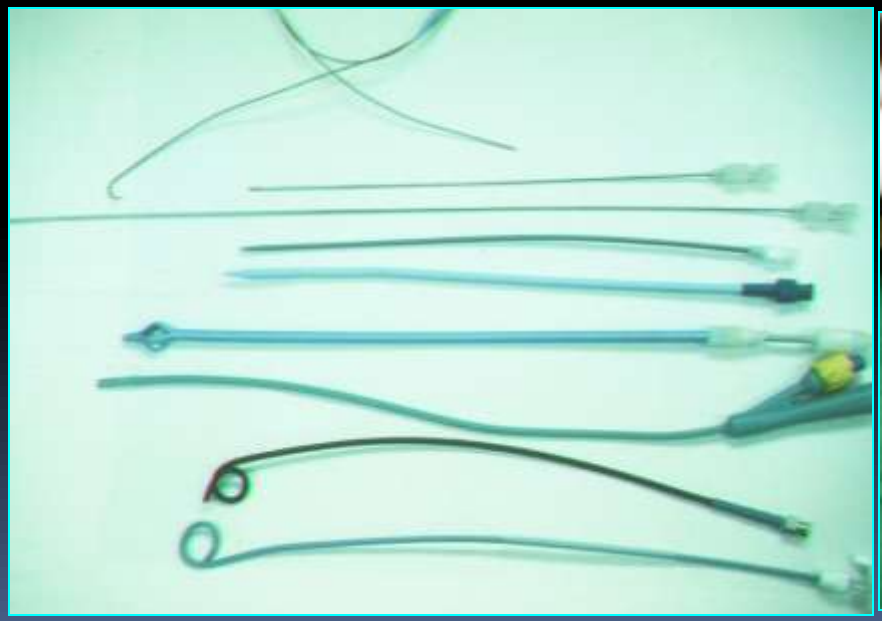
AJR 2007; 189:109–116

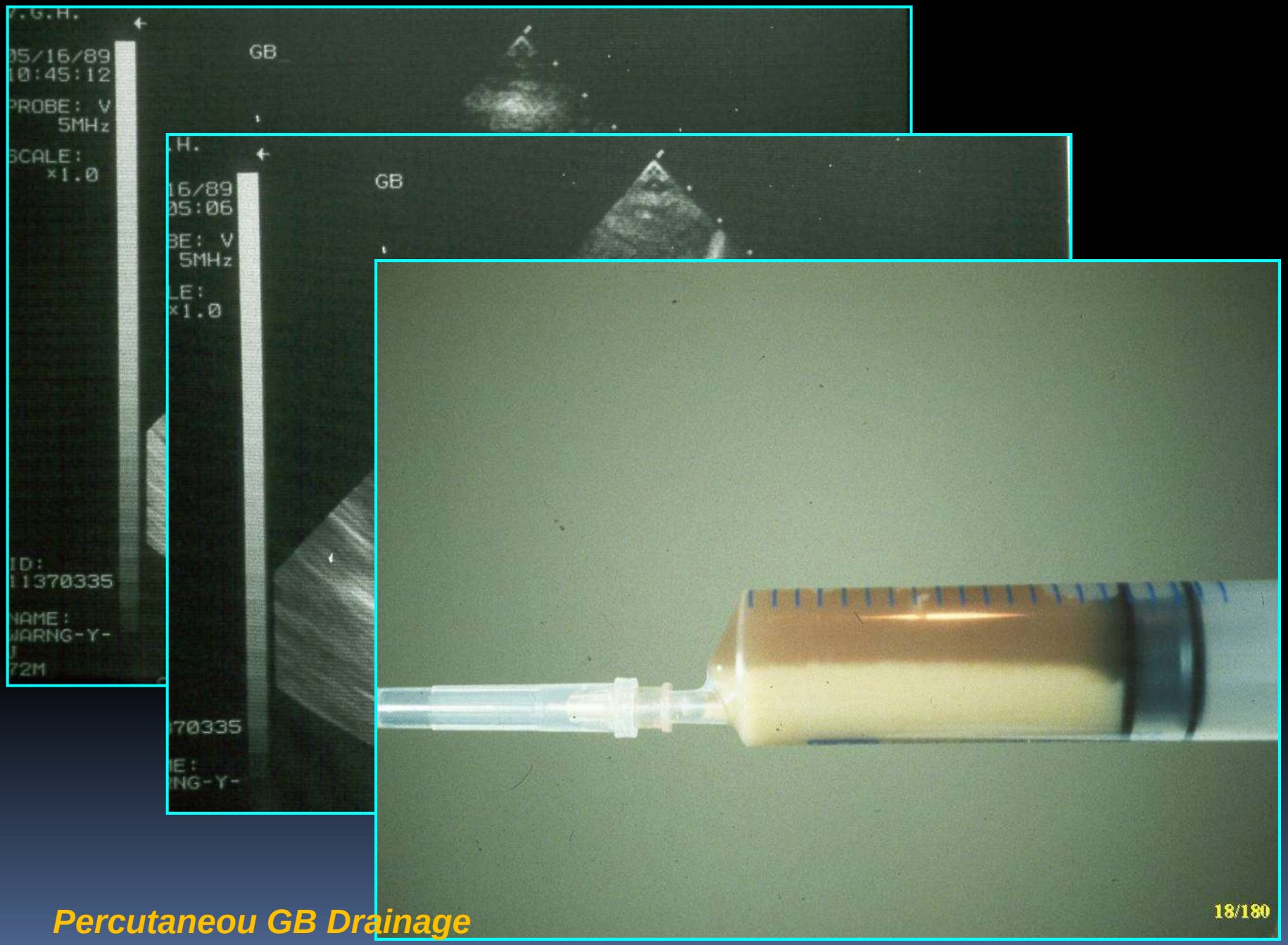
Percutaneous imaging-guided drainage

- first-line treatment for infected or symptomatic fluid collections in the abdomen and pelvis, in the absence of indications for immediate surgery
- obviate surgery

Catheter insertion procedures

- **Trocar**
- Seldinger techniques





Percutaneou GB Drainage

Locations that are Difficult to Access

- **Pelvis**,

  subphrenic regions, or epigastric region

- **Alternative access routes:**

  - transrectal, transgluteal, transvaginal, intercostal, or transhepatic

Gervais D, Brown D, Connolly SA, Brec SL, Harisinghani MG, Mueller PR Radiographics. 2004;24 :737-54

Imaging Guidance- Ultrasonography vs CT

- **Deep-seated:** drainage is performed under CT guidance
  . CT has certain advantages
  - better spatial resolution
  - allowing more accurate depiction of the abscess, adjacent organs, and organs along the proposed access route

  - reduces the likelihood of mistaking fluid-filled bowel loops for fluid collections
- **US is a real-time imaging modality**
  - allows the course of needles and catheters to be monitored as they traverse tissue planes along the path to the abscess

  - angulation from the axial plane can frequently be more easily achieved and monitored with US than with CT
- **combined with US, fluoroscopy** can be useful for performing drainage with the Seldinger technique
  - avoiding loss of access or guide wire kinking during tract dilatation

Aspiration versus Catheter Placement

- **Catheter placement is generally favored over needle aspiration for definitive treatment**
  - the catheter is usually secured in position for several days (2)
- **Simple aspiration** of collections that communicate with bowel is invariably ineffective because immediate reaccumulation of the collection usually occurs once the needle or temporary catheter is removed

Aspiration of abscess inaccessible for percutaneous catheter placement:

- most commonly seen in the pelvis, particularly in patients with Crohn's disease who have a propensity for developing interloop abscesses
- prior to surgery to make the surgical field clean, facilitating primary bowel anastomosis
- the patient is undergoing immunosuppression therapy
- transgressing intervening bowel with a 20-gauge needle and aspirating the collection dry

Traversal of Organs (I)

- **Collects sometimes cannot be accessed without traversing an intervening organ:**
  - *(a)* **unsuitable** for percutaneous abscess drainage and the case referred back to the surgeon
  - *(b)* the intervening organ can be traversed with a catheter***: stomach*** and ***liver*** are examples of organs that we consider safe to traverse in most circumstances to allow treatment of an epigastric collection when no other option exists

Traversal of Organs (II)

- Ensure that **coagulation parameters** are normal
- The chosen catheter course through the liver be as short as possible, away from major **blood vessels or dilated biliary ducts** and away from other organs such as the gallbladder
- The catheter **side holes** should be completely contained within the abscess to avoid contamination of the adjacent liver or biliary tract
- The stomach is most commonly traversed for percutaneous drainage of pancreatic abscesses or pseudocysts

Transgastric Approach

- **To promote the formation of a tract between the pancreatic collection and the stomach**
  - A catheter with multiple side holes is deployed with side holes in both the **pancreatic collection** and the stomach
  - usually left in place for 6 weeks to promote the formation of a cystogastrostomy tract
  - when a communication exists between a pseudocyst and the pancreatic duct, the duct contents will theoretically empty into the stomach
  - there is no proved benefit to transgastric drainage of pancreatic pseudocysts (the lifetime of such tracts is very short)

Traversing the vagina and rectum

- **using transcavitary routes for imaging-guided abscess drainage**
  - Most interventional radiologists choose not to traverse the bladder or small bowel when performing percutaneous *abscess* drainage
  - some authors have attested to the safety of using these routes in extreme circumstances,

    i.e., Afferent loop syndrome

Intervening vascular structures

- **should always be avoided** during percutaneous abscess drainage

- **Color Doppler US** is very useful in avoiding damage to intervening vascular structures

Organs should be avoided being traversed in Drainage Procedure

- pancreas, spleen, gallbladder, small and large bowels, urinary bladder, uterus and ovaries, prostate gland, and most blood vessels

Serious incidents of hemorrhage

- **Injury to the superior and inferior epigastric arteries as well as the internal mammary and intercostal arteries** (3)
  - placement of catheters through the skin in the midline ensures that the linea alba (an avascular plane) but may be unsafe in patients with portal hypertension
  - **CDU** or review of a preprocedure contrast-enhanced **CT scan** is advised to demonstrate the course of the superior and inferior epigastric arteries

Abscesses in Difficult Locations-Deep Pelvis

- a **transvaginal** US-guided approach, a **transrectal** US- or CT-guided approach, and a **transgluteal** CT- or US-guided approach
  - Transvaginal and transrectal US-guided pelvic abscess drainage is now much easier to perform
- **CT of the upper abdomen and pelvis** before undergoing transrectal or transvaginal US-guided abscess drainage
  - *(a)* many pelvic abscesses are associated with collections in the upper abdomen that may be missed if only transrectal or transabdominal US is performed
  - *(b)* CT allows assessment for organs that may inadvertently be injured by the needle or catheter
  - all of our patients receive antibiotics immediately before undergoing transvaginal or transrectal drainage

Transvaginal US-guided drainage of pelvic abscesses

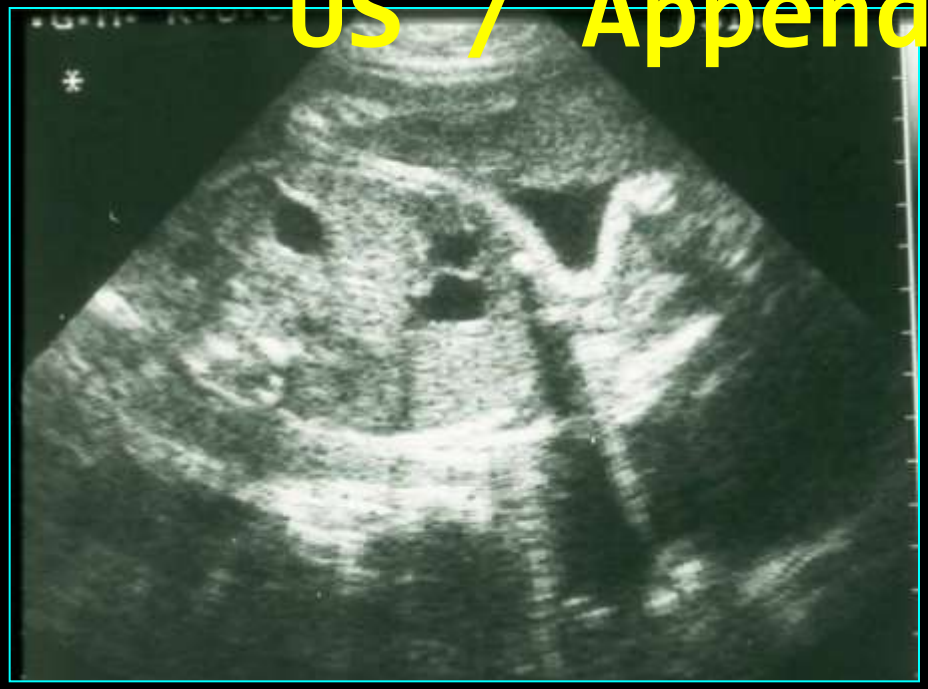
- useful for deep-seated abscesses located close to the vagina
- **no attempt** should be made to drain **presacral** abscesses via the transvaginal route (4)
- **not traverse UB** during the procedure
- other intervening structures such as the small bowel or colon
- **not be used to drain** abscesses that are located too **high** in the pelvis
  - may increase the risk of bladder or bowel transgression or vascular injury

Pelvis

- **in the iliac fossa or pelvic floor extending upward to the lower abdomen**

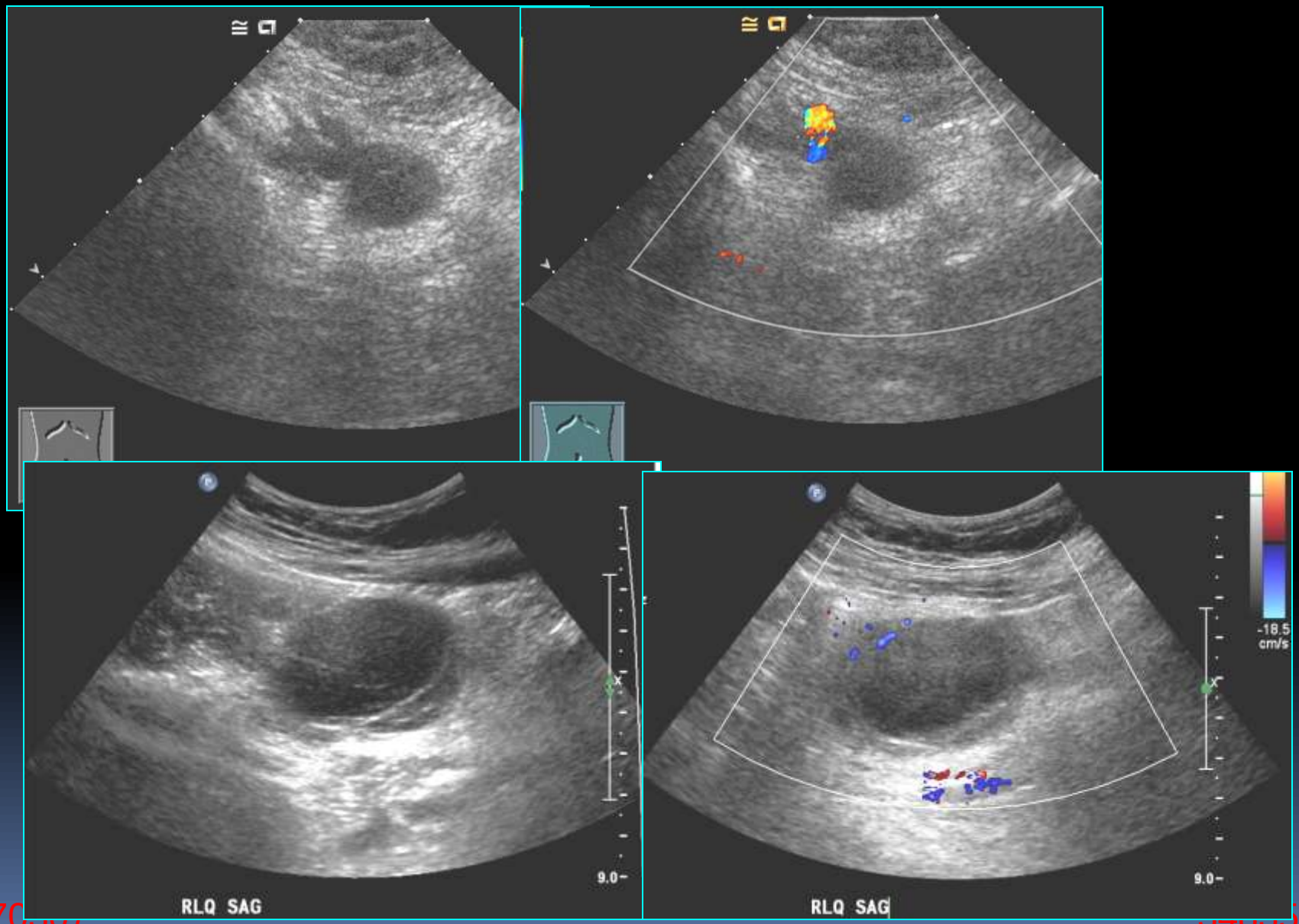
- *(a)* US guidance , and
- *(b)* CT guidance

US / Appendical abscess



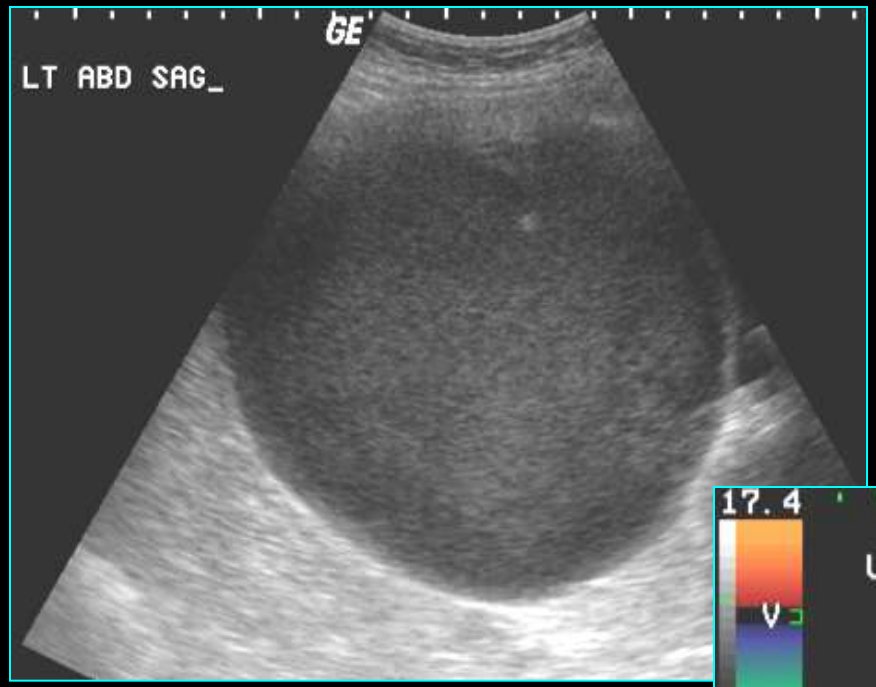
Acute RLQ Abdomen Pain, F31

Appendiceal Abscess

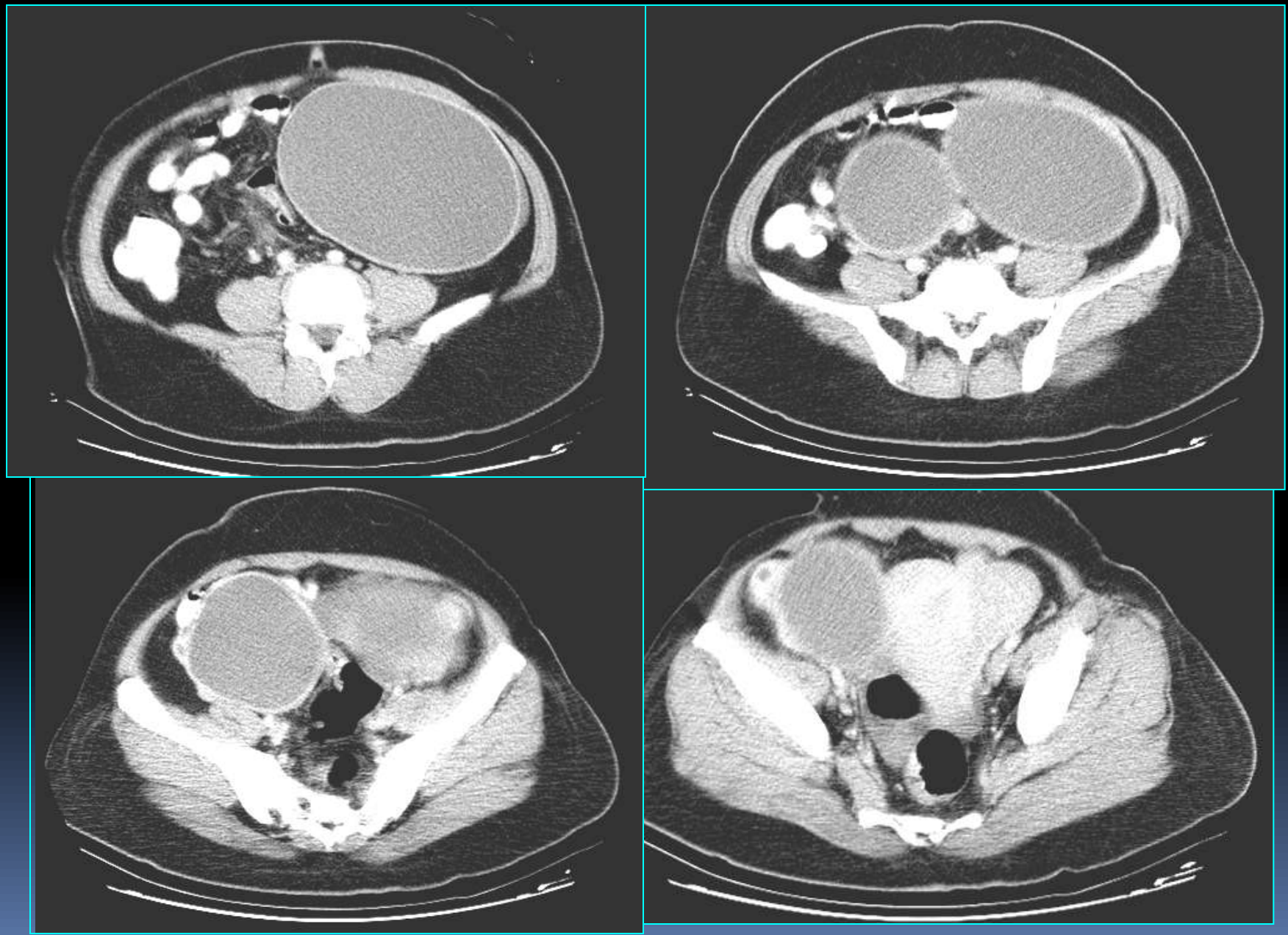


Pelvic/ TOA (I)

Pelvic/ TOA (II)



Gyn-Pelvic/ TOA (IV)



Low Pelvis

- **low in the presacral space or in the perirectal space or perineum**

- *(a)* **US** guidance , and
- *(b)* **CT** guidance with
- angulation of the gantry

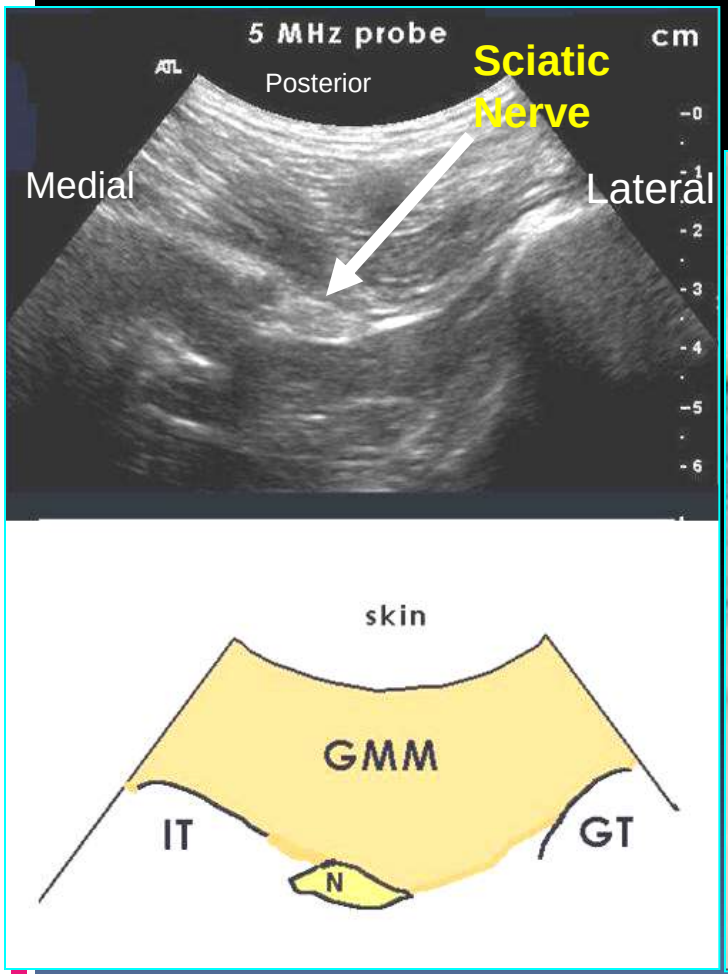
Transrectal US-guided Abscess Aspiration or Drainage

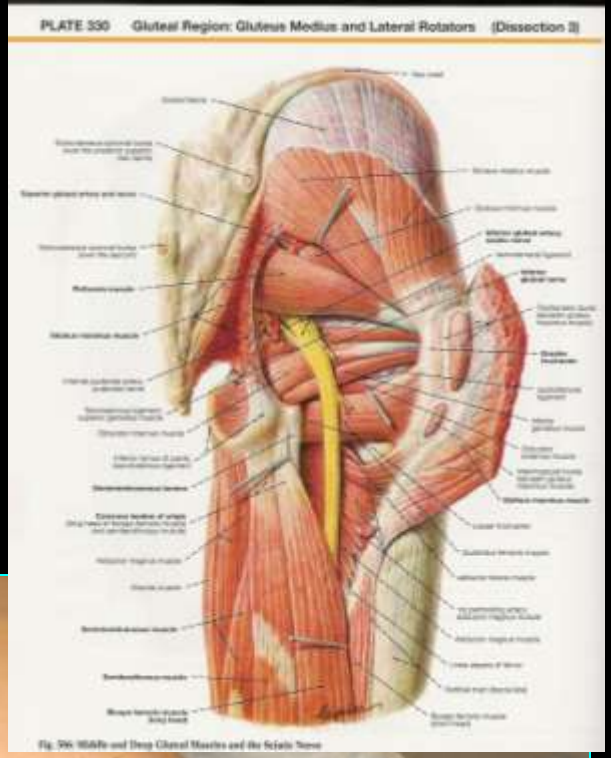
- used in female patients with presacral abscesses, and for abscesses that are anterior and posterior to the rectum in male, particularly useful in male patients with prostatic abscesses
- using the trocar technique, usually performed with the patient in the left lateral decubitus position

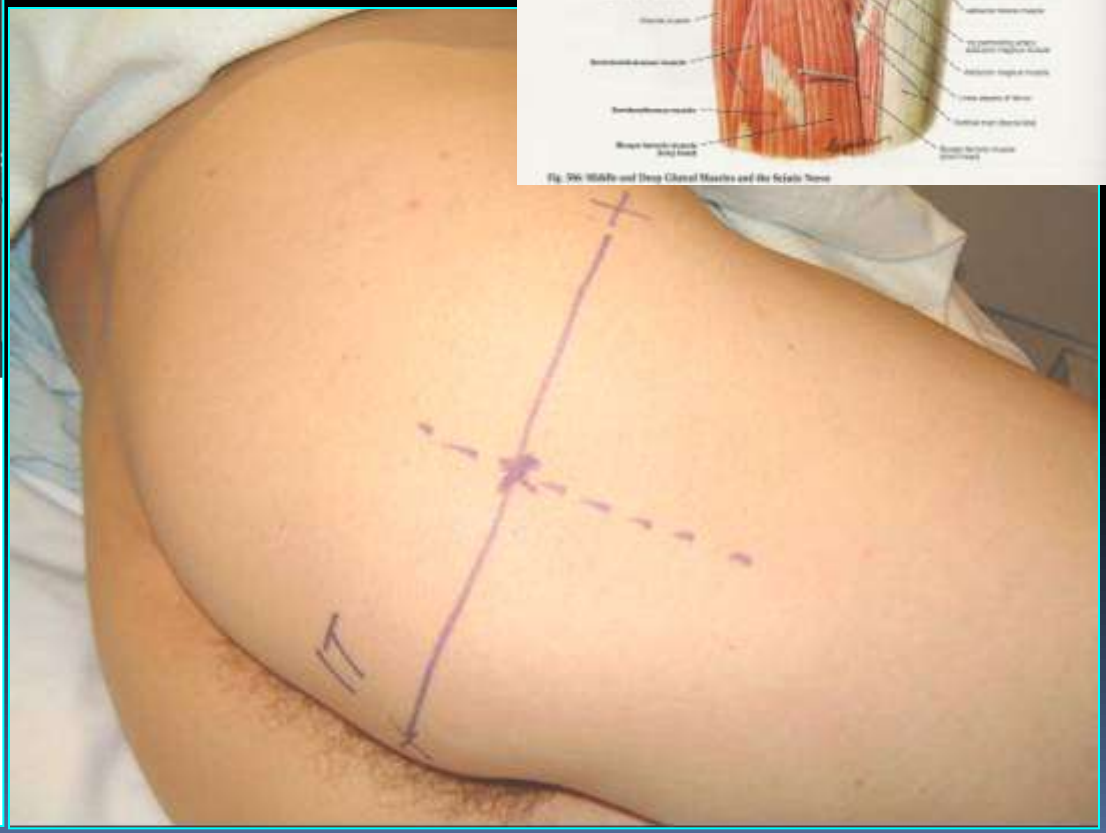
US or CT guidance for transgluteal percutaneous drainage of a pelvic abscess

- **transgluteal percutaneous drainage of a pelvic abscess** (2)
  - if a skin site close to the sacrum is chosen, the sciatic nerve and adjacent vessels can be avoided and large catheters can be placed (6)

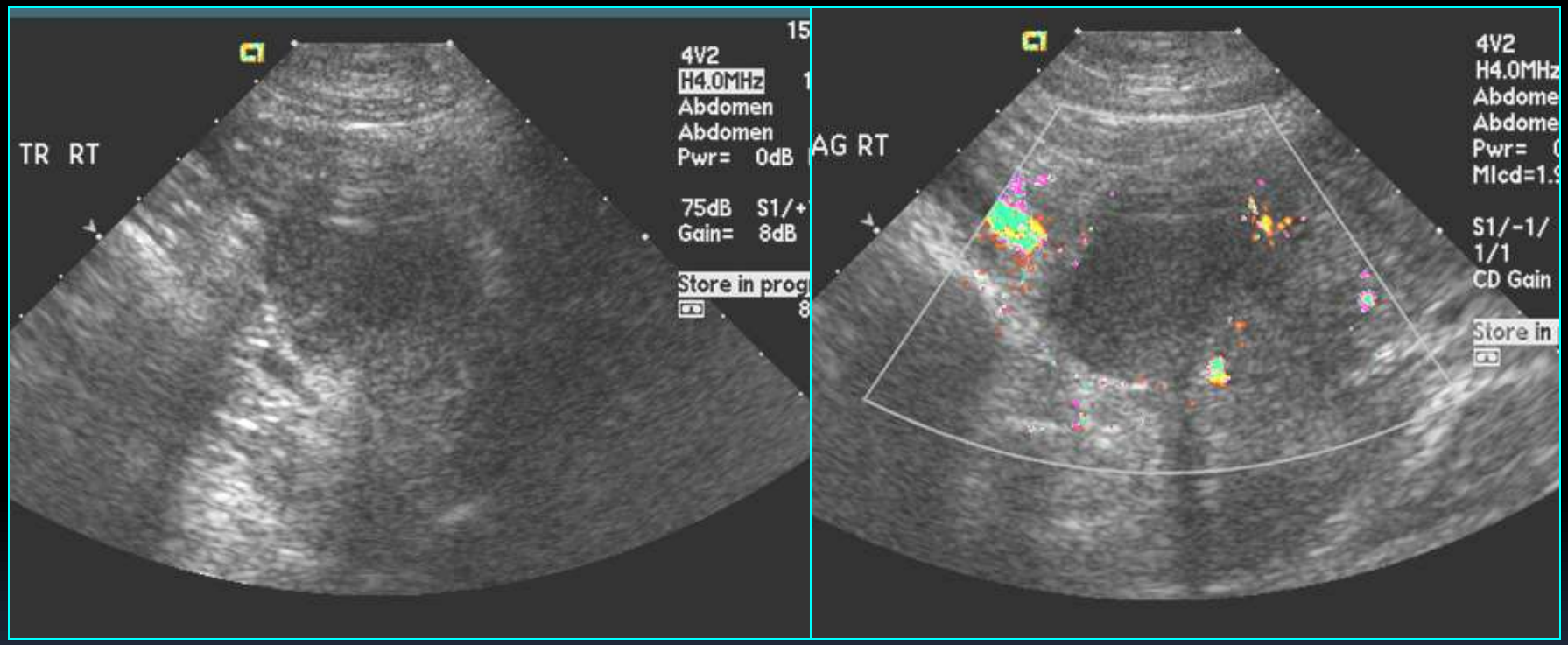
Avoid Sciatic Nerve: Subgluteal Approach





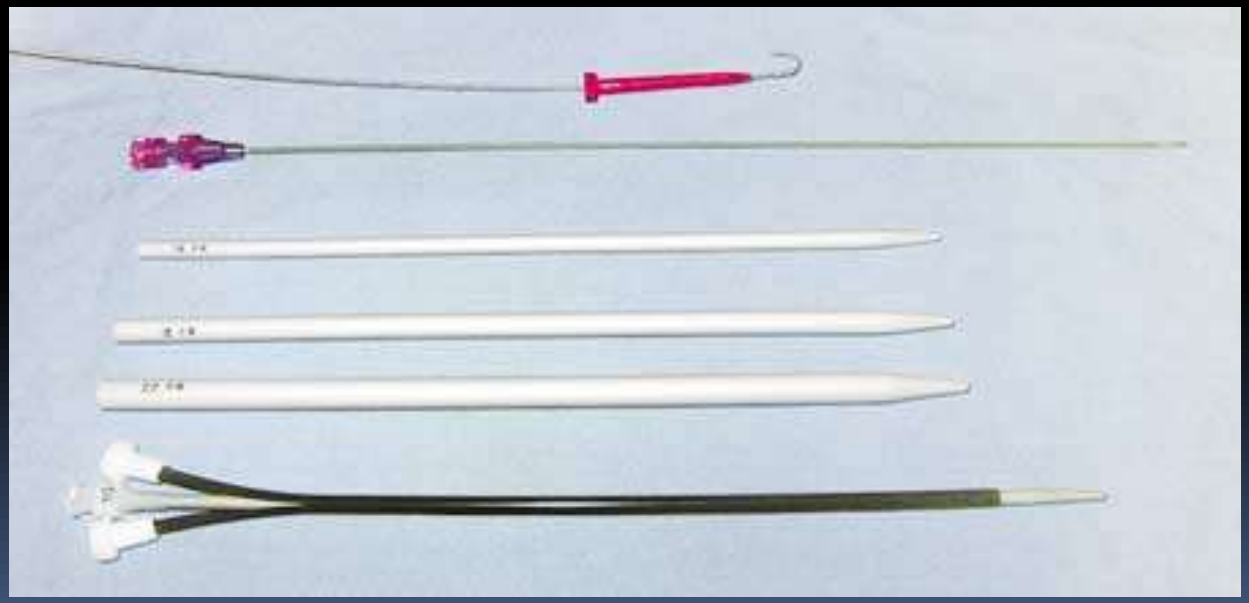


Deep Pelvic Abscess



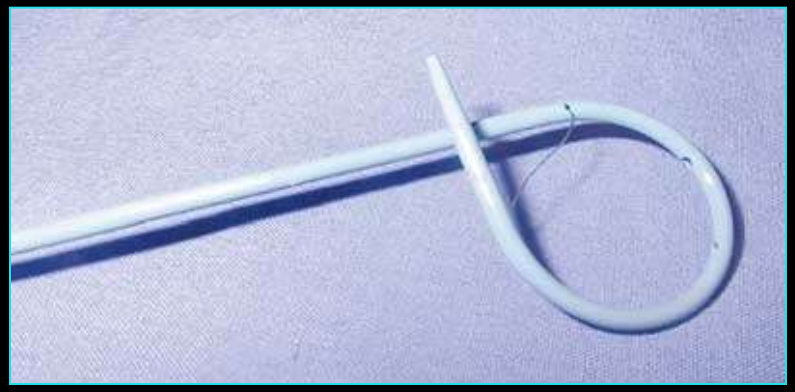
Transgluteal Approach: **Sector Transducer** Preferred

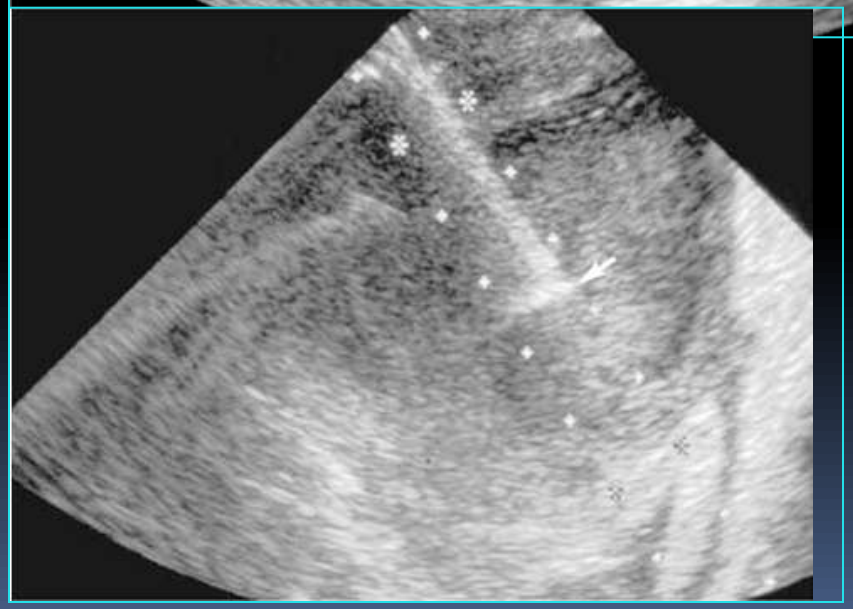
Interventional US of Female Pelvis

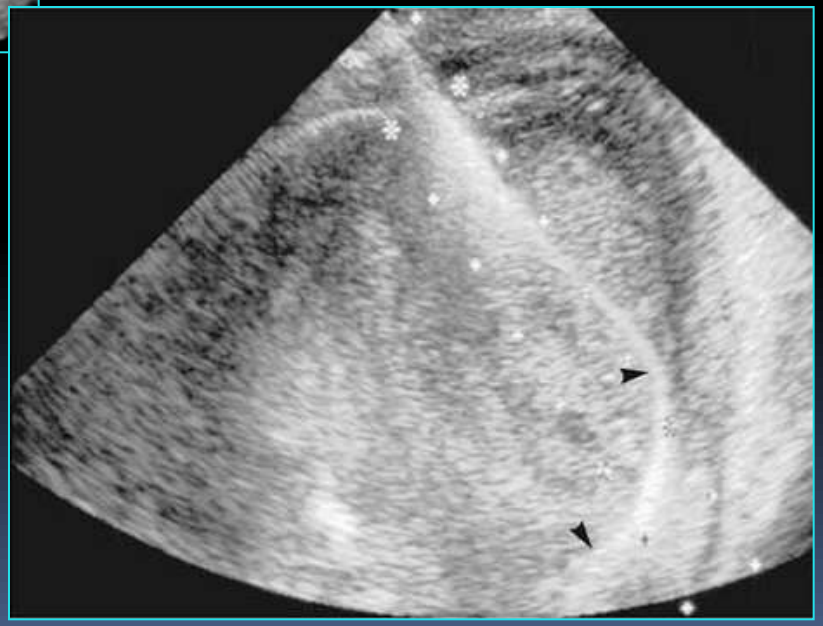


Devices for interventional Procedure

Drainage







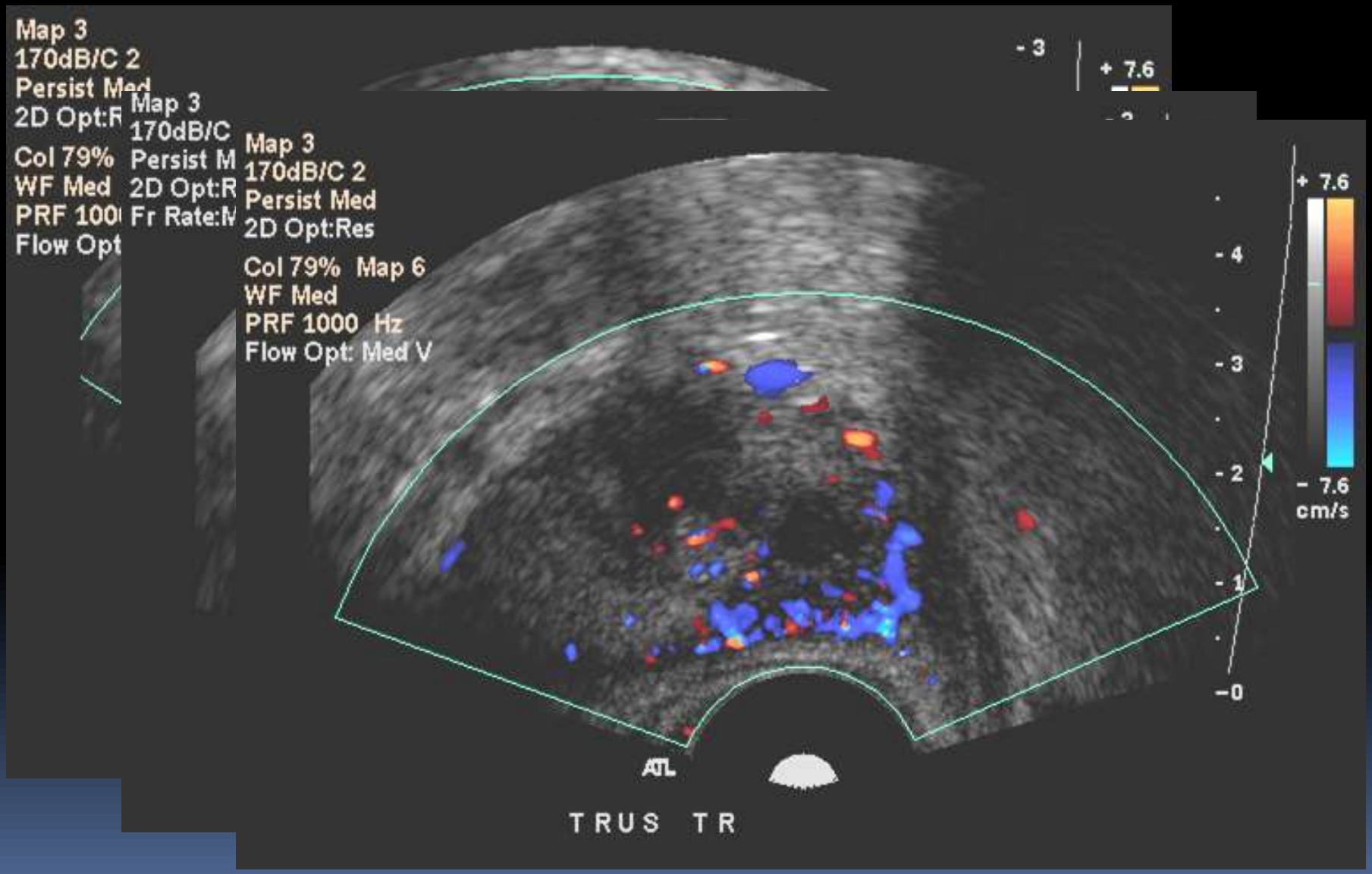
Drainage of pelvic abscesses in a young woman with fever, pelvic pain.

The major drawbacks of transvaginal pelvic abscess drainage

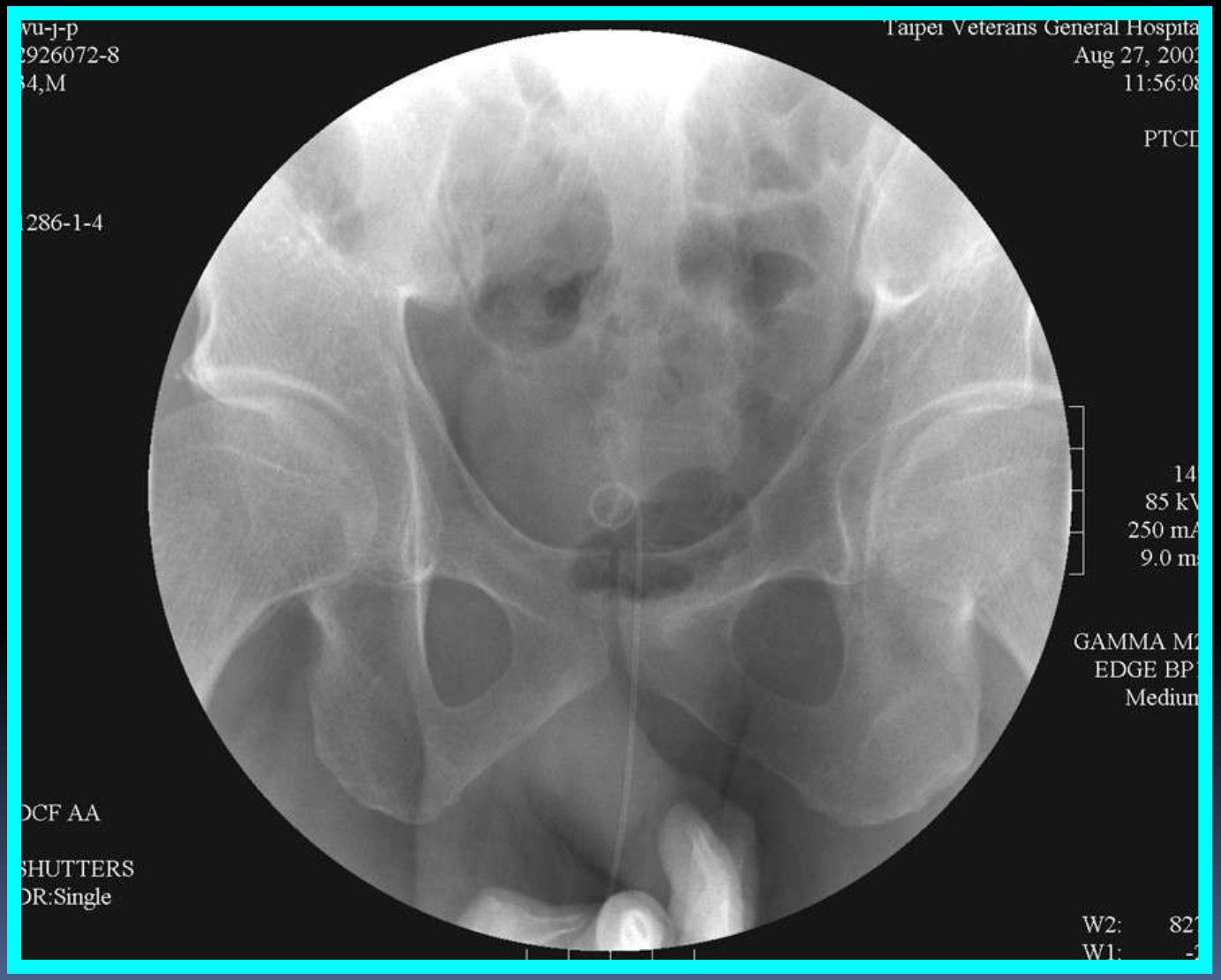
- **The risk of patient discomfort** (4)
  - adequate conscious sedation and the administration of lidocaine at the site of vaginal puncture usually help reduce discomfort
- Complications: low, no major bleeding complications

- **Catheter drainage** is generally favored over needle aspiration in patients with tubo-ovarian abscesses
  - trocar method with a hydrophilic catheter (e.g., 7-8-F) rather than the Seldinger technique (much more time consuming and painful) (more difficult to monitor the position of the guide wire)

Prostatic Abscess - asp.



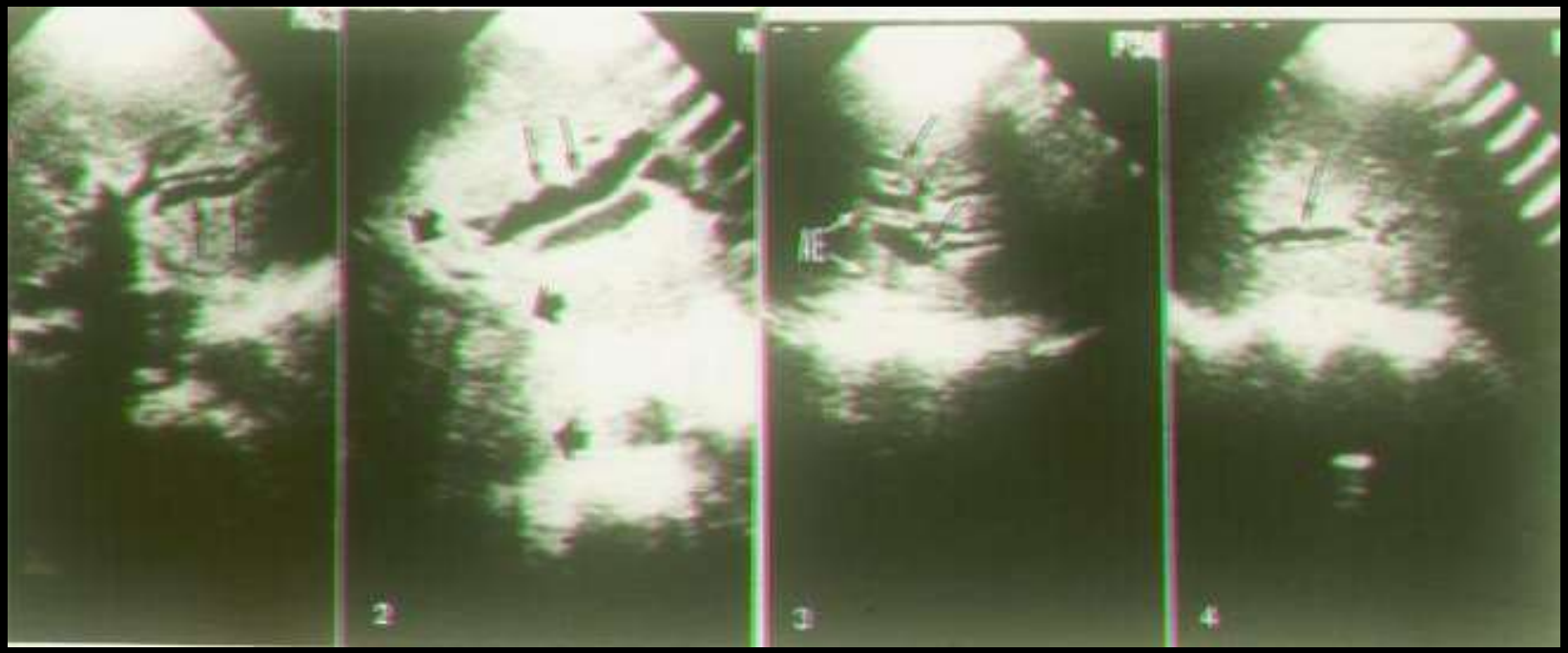
Prostatic Abscess : Drainage



Subphrenic collections

- in many cases parietal pleural transgression cannot be avoided while accessing subphrenic collections
- Postsplenectomy subphrenic collections
- the splenectomy bed is filled by loops of bowel
- the risk of pleural transgression: pneumothorax, pleural effusion, or empyema
- Left-sided subphrenic collections:
  - the operator should be aware that associated pancreatic tail injury, all fluid aspirated from this area should be analyzed for amylase content, and the catheter should be injected prior to removal to assess for communication with the pancreatic duct
- Right-sided subphrenic collections:
  - US-fluoroscopic guidance has advantages over CT guidance in gaining access to achieve optimal catheter position

Percutaneous Transhepatic Cholangial (or Biliary) Drainage (PTCD, PTBD)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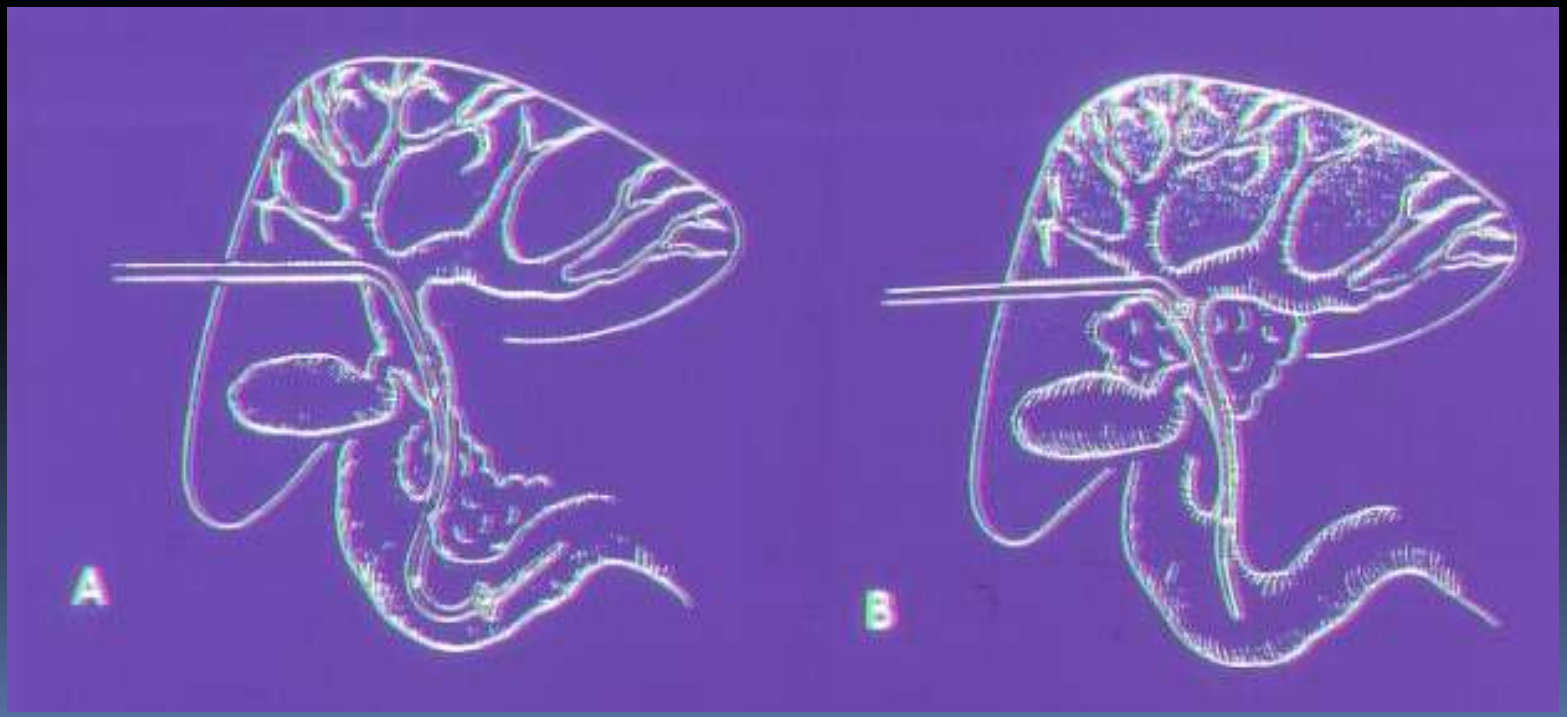
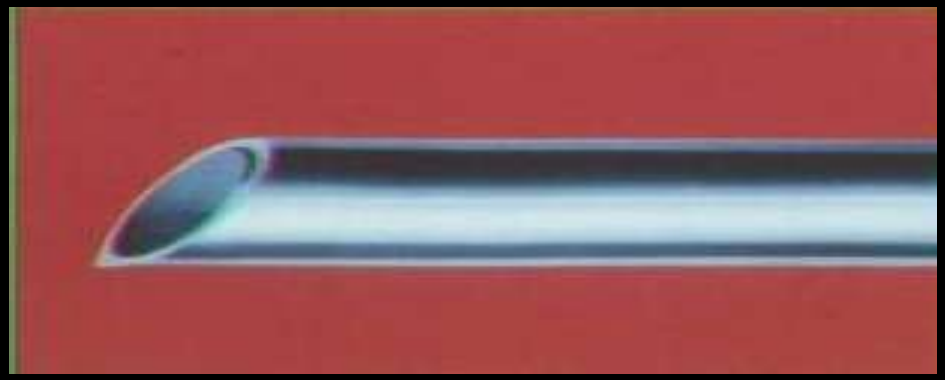
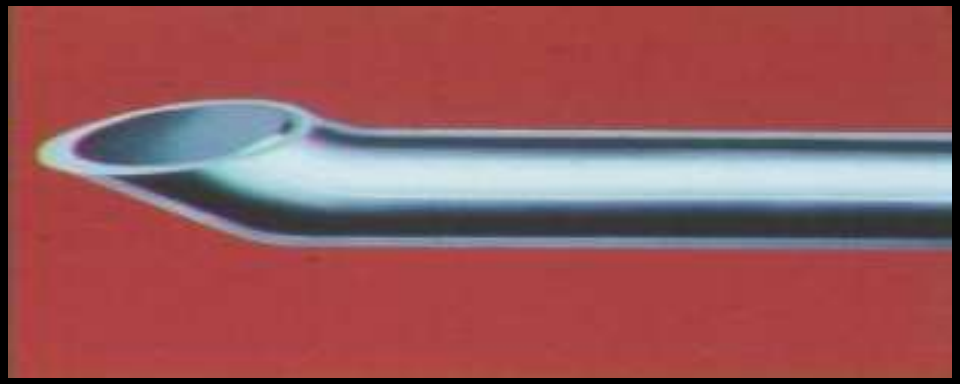
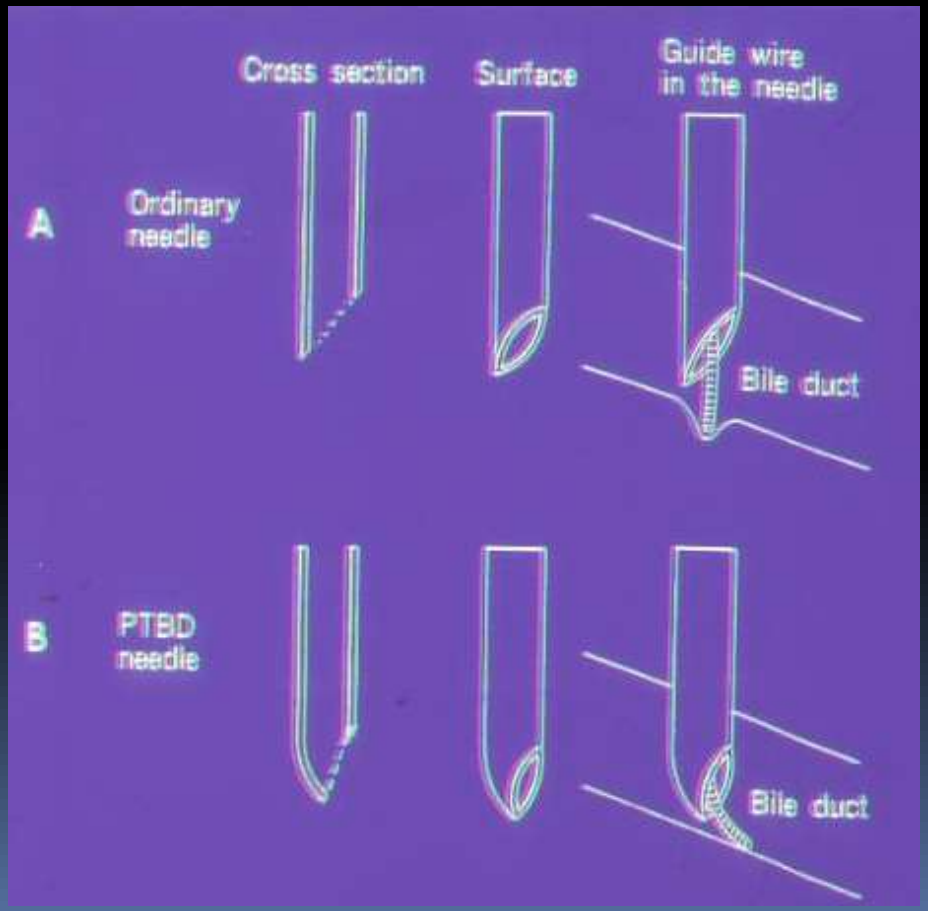
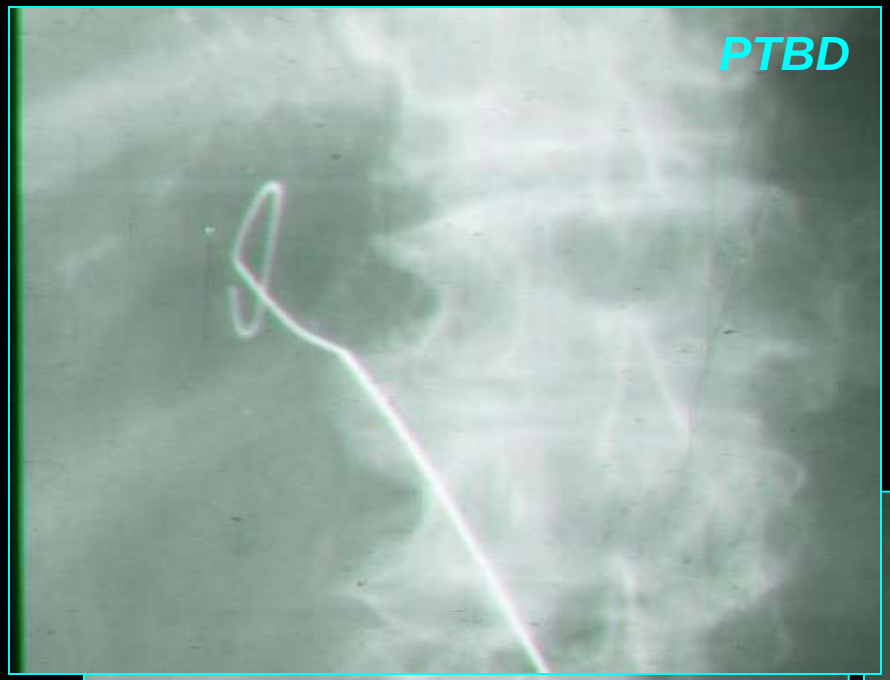

A
B

PTBD Puncture Needle

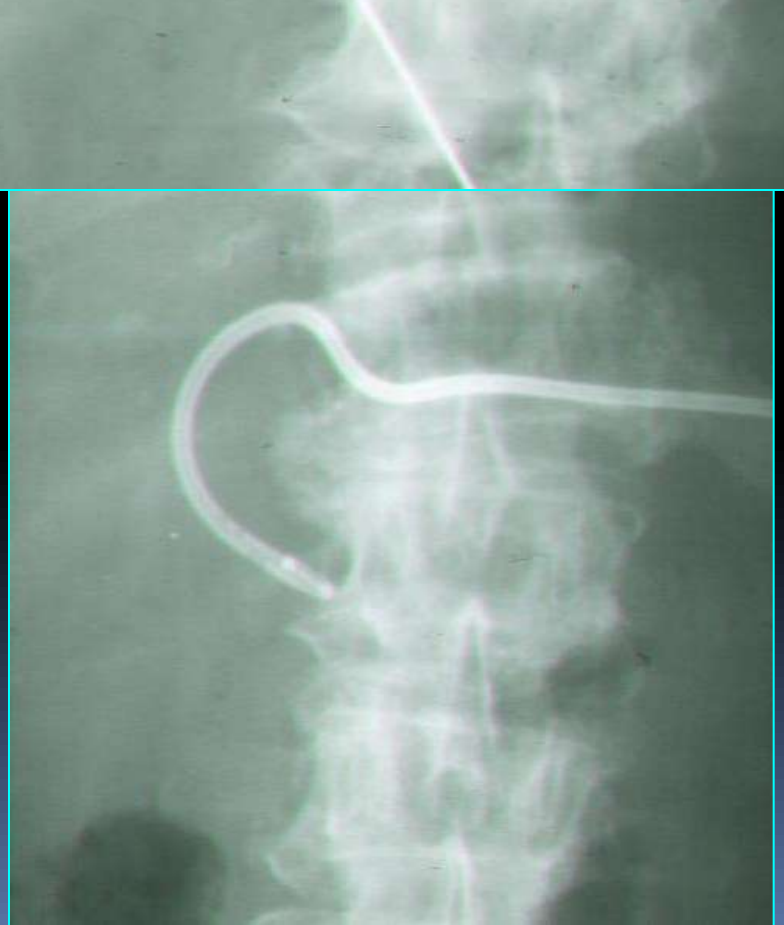


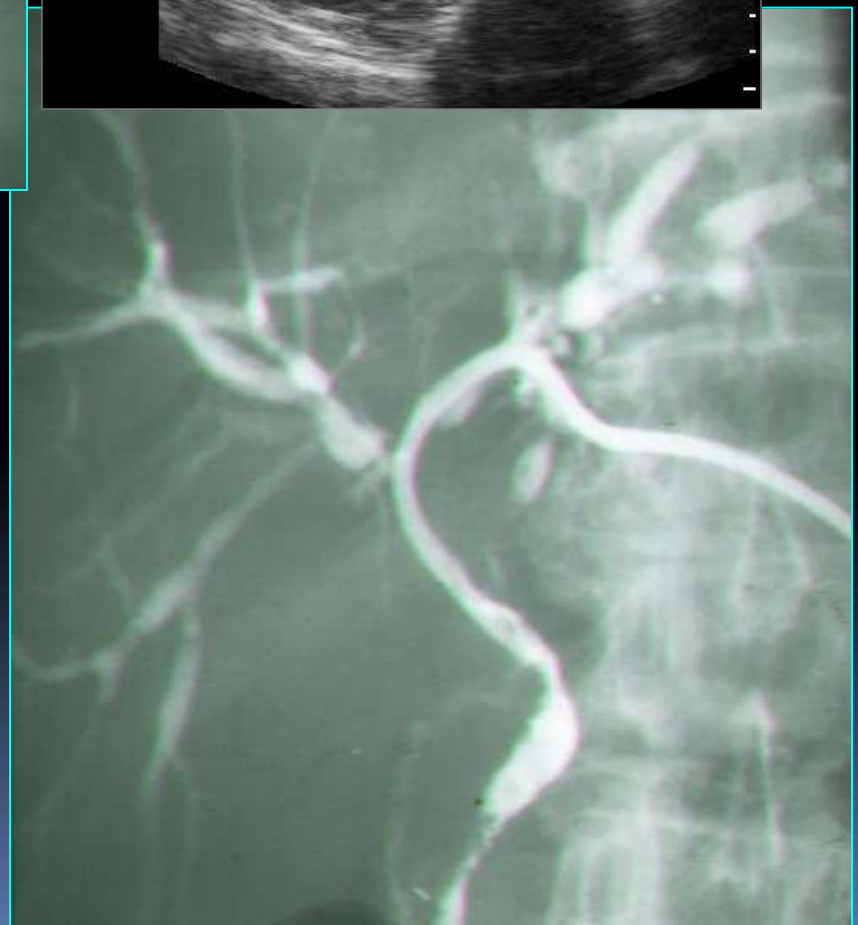





PTBD


LIVER

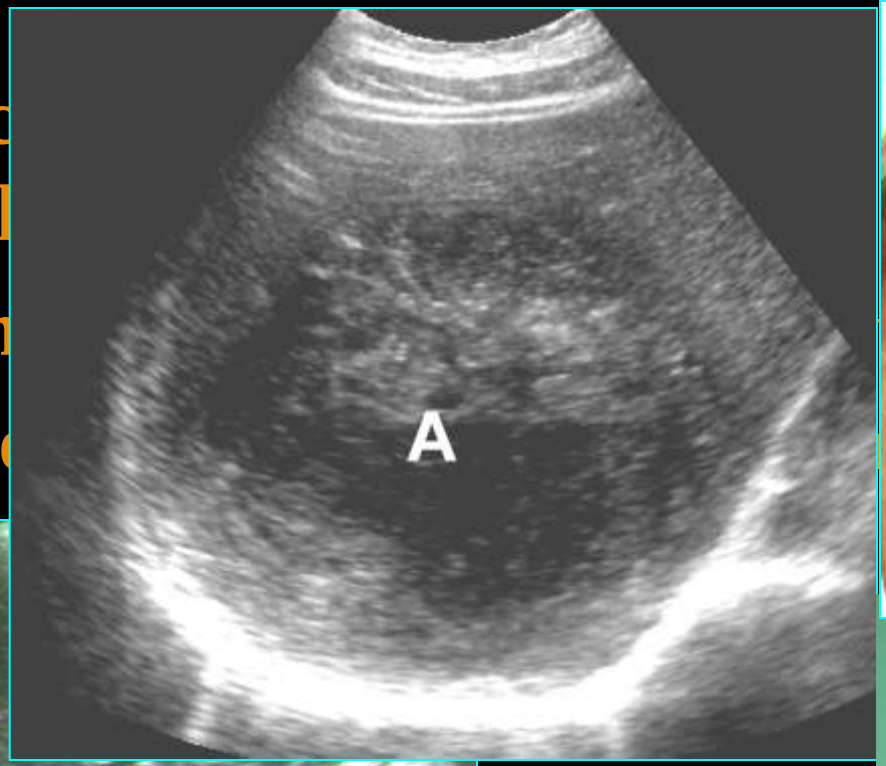


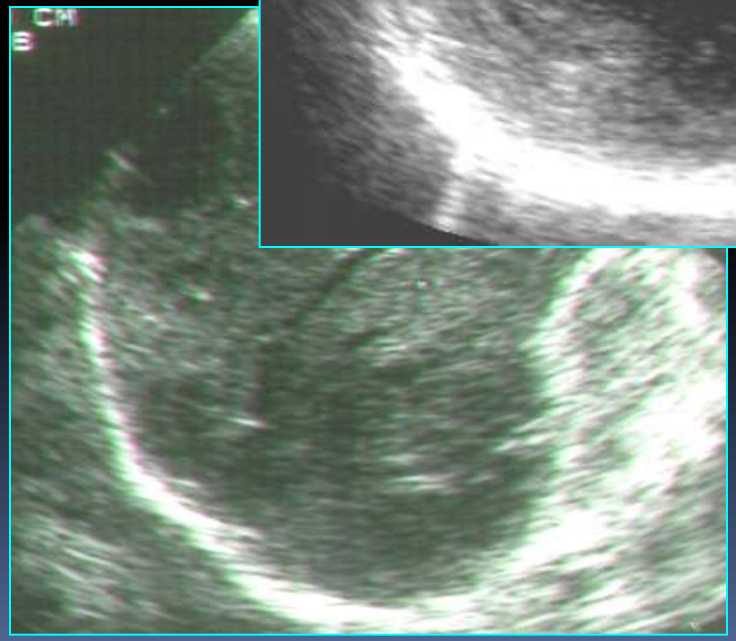


Percutaneous Abscess Drainage

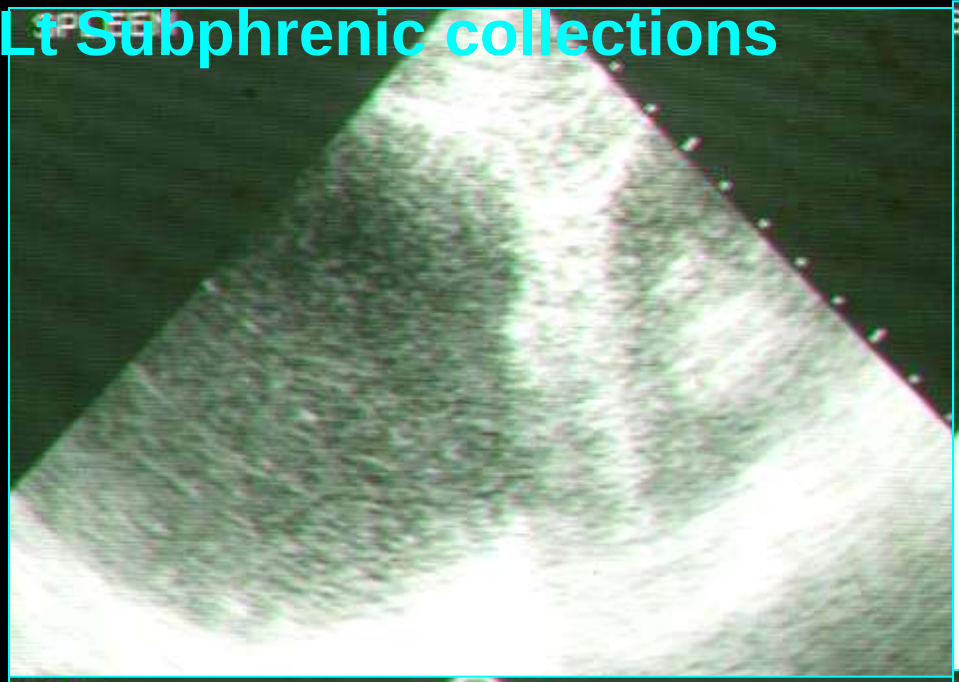
Liver Abscess

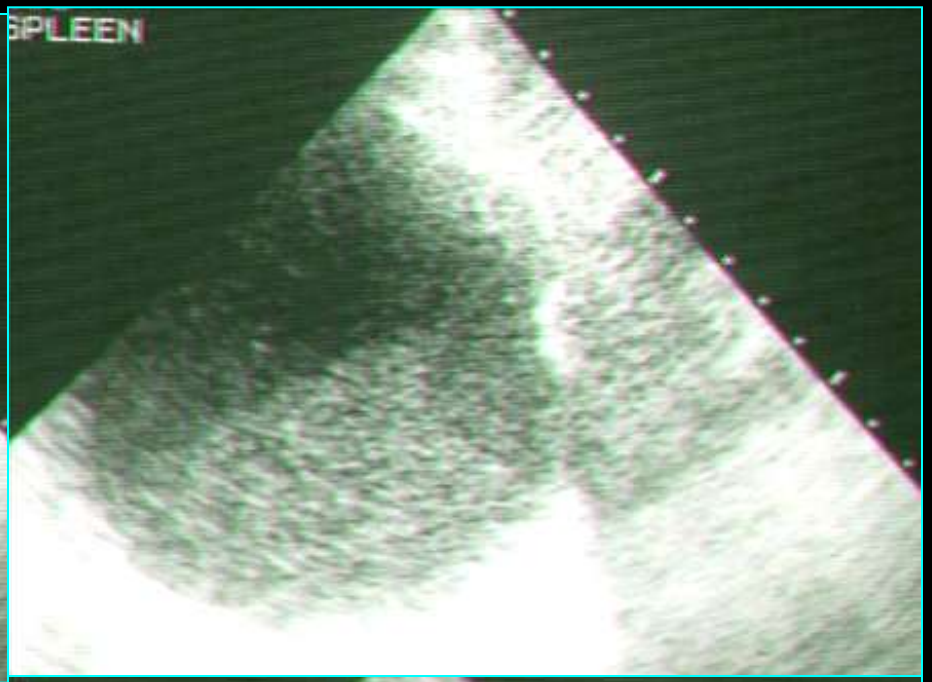
- Cystic
  to high
- Intern
- CT: b

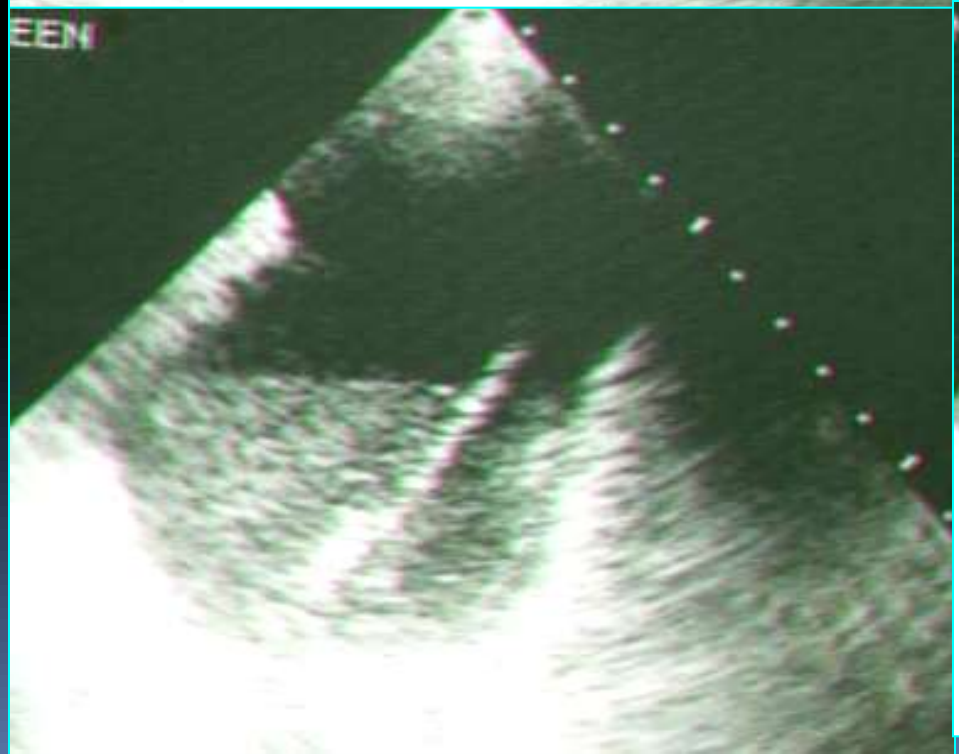




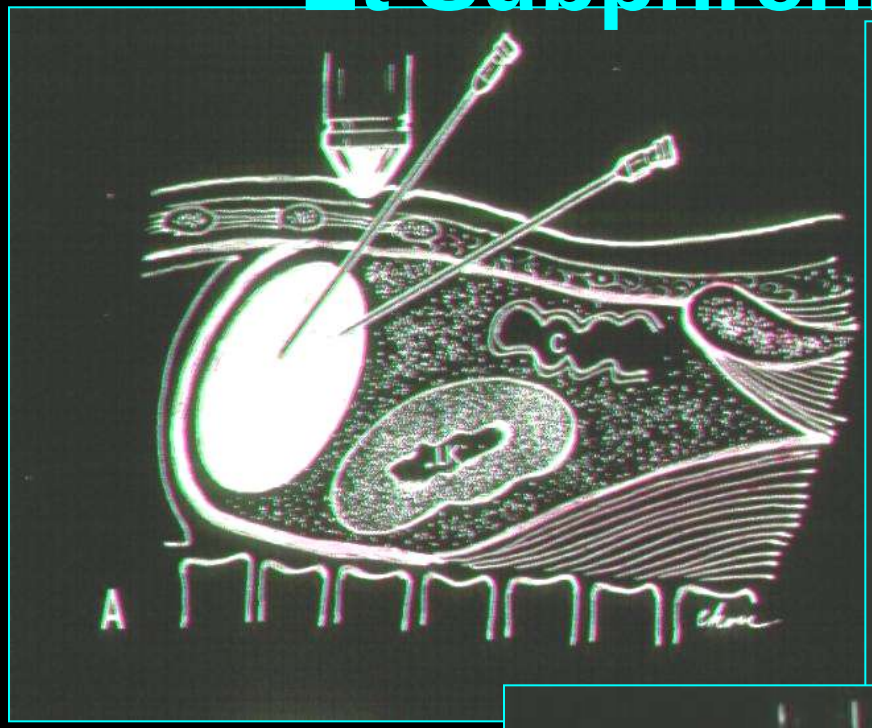
Lt Subphrenic collections

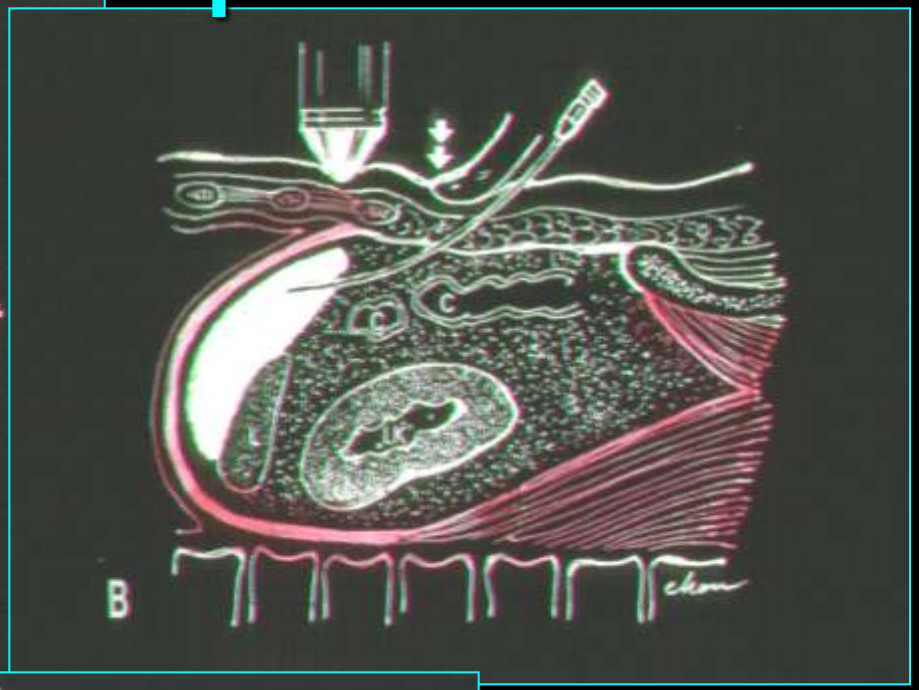


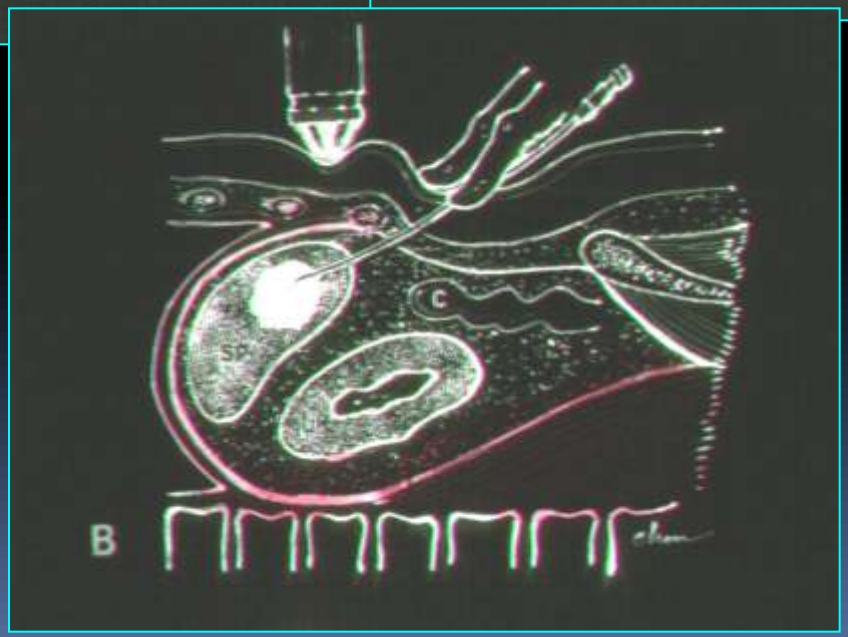




Lt Subphrenic /Spleen



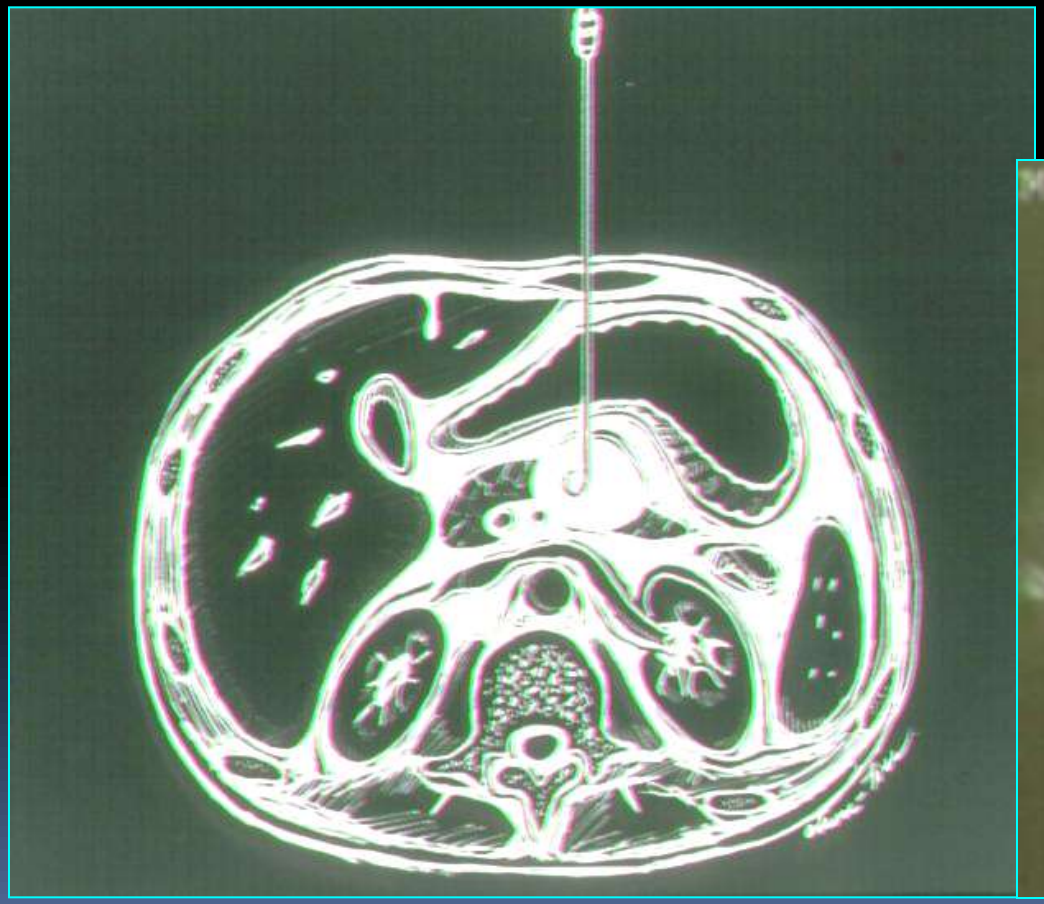




Epigastrium and Peripancreatic Area

- **The major consideration**: to avoid crossing small or large bowel or major mesenteric, peripancreatic, or retroperitoneal vessels (9)
- **collections in or near the pancreatic fossa**
  - a safe access route between the stomach and transverse colon (gastrocolic ligament)
  - a transhepatic approach, to avoid the gallbladder, and the porta hepatis
- **Collections in the region of the pancreatic tail**
  - through the left anterior pararenal space
- **the pancreatic body and tail:**
  - through the gastrosplenic ligament
- **transgastric approach for pancreatic and peripancreatic** collections: controversy
  - colon or small bowel should never be transgressed

Drainage of Pancreatic Pseudocyst or Abscess



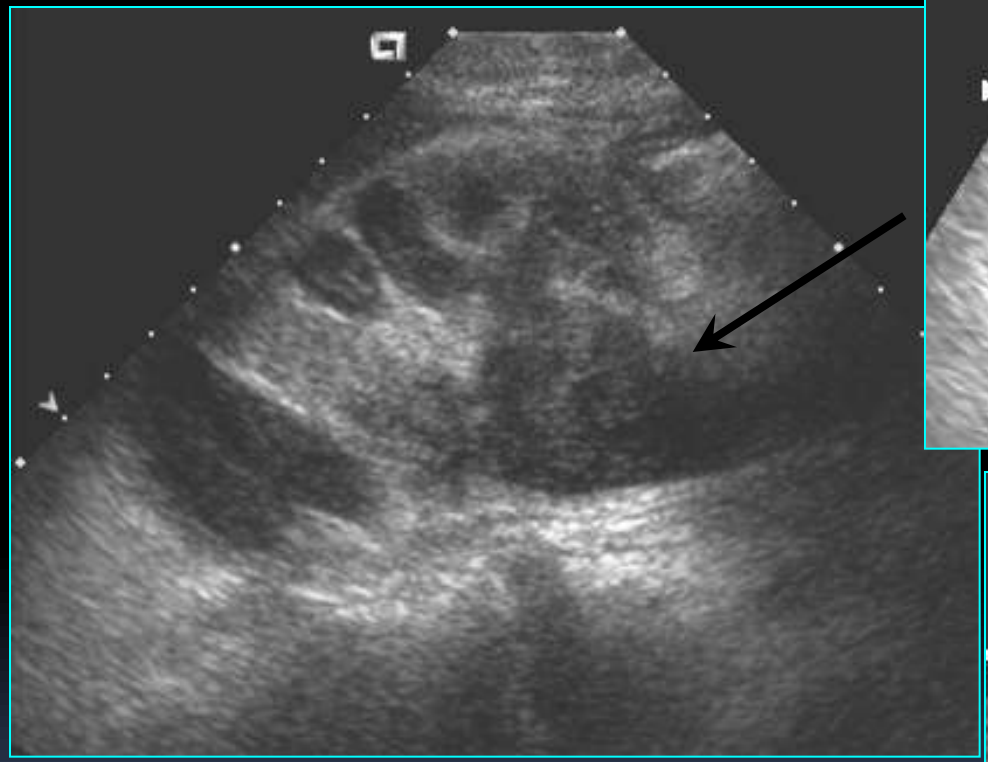
Retroperitonium

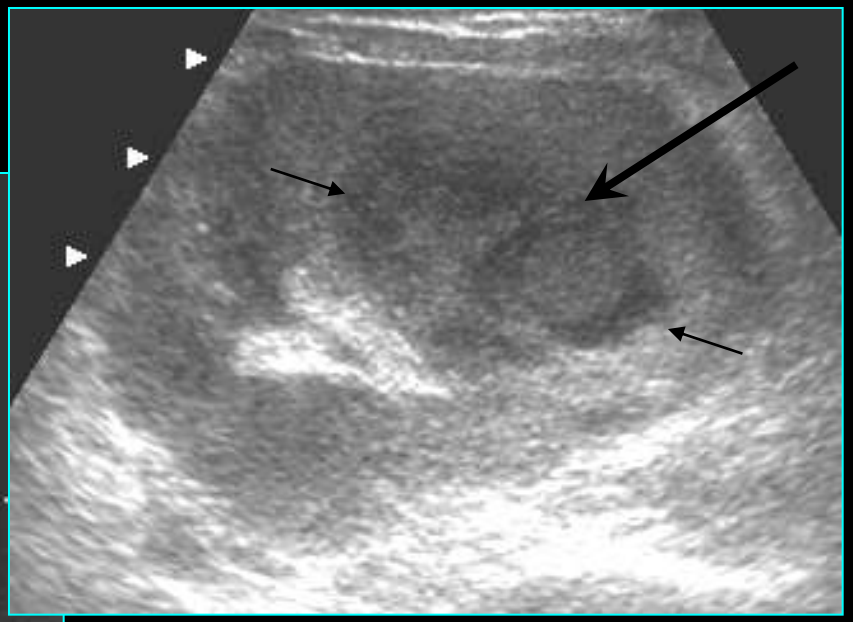
Urinary Tract Obstruction

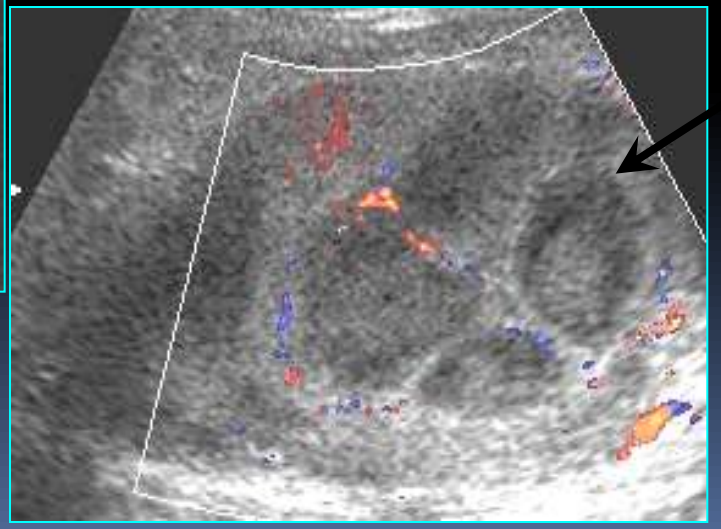
- Can occur at any site
- The most common site: ureteropelvic junction (UPJ).
- Distal ureteral obstruction
- Ectopic ureterocele associated with the duplicated system
- **Hydro- or Pyonephrosis**

Pyonephrosis

Renal Carbuncle:
Aspiration or Drainage







Percutaneous Nephrostomy
(PCN)

Difficulties Due to Thickened Contents

- Fibrinous products are often found in abscesses and hematomas
- the introduction of adjunctive thrombolytics into the abscess through a catheter has proved effective in many cases

Situations in Which Imaging-guided Drainage Is Inappropriate

- only a limited role for catheter placement in certain pancreatitis-related collections
- placing a transvaginal drainage catheter for **noninfected collections** is not appropriate
- If clinical evaluation suggests **peritonitis**, the patient should proceed to surgery even if imaging demonstrates drainable collections
  - imaging findings may help in deciding between immediate surgery and percutaneous drainage
- a patient with a similar abscess but with extensive and **massive free air or fluid** remote from the **perforation** site should usually undergo surgery for such an "uncontained" perforation.

Situations in Which Imaging-guided Drainage Is Inappropriate

- drainage in the presence of **free hollow organ perforation** and acute peritonitis
- **diverticular abscesses** secondary to perforated diverticulitis: best treated with imaging-guided percutaneous catheter placement
  - percutaneous treatment combined with administration of systemic antibiotics permits control of acute "flare-up,"
- Symptomatic fluid **collections adjacent to** surgical implants of any type (eg, vascular grafts, mesh used for hernia repair, joint prostheses) should be drained only if infected
  - Infection can be confirmed with needle aspiration and Gram stain and culture.

Conclusion (I)

- Knowing the criteria for assessing the appropriateness of imaging-guided drainage for an abscess or collection
- Knowing the methods of managing seemingly "undrainable" abscesses
- Knowing the the use of alternative access routes (transgluteal, transvaginal, transrectal)
  - facilitate the drainage of deep-seated collections that are inaccessible by more traditional routes

Conclusion (II)

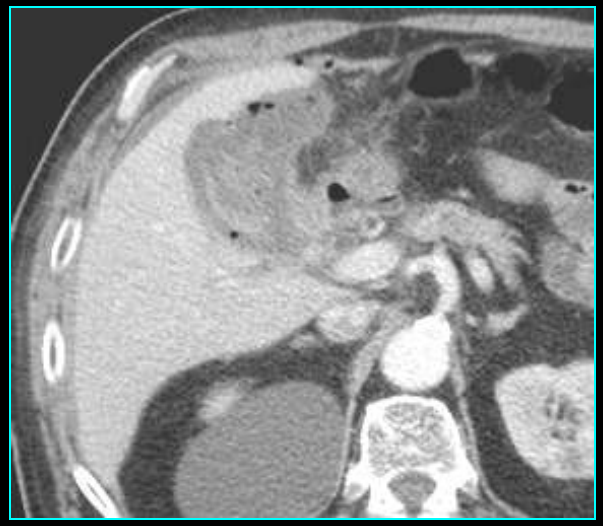
- Familiar with modifications in patient positioning and in the use of imaging hardware (eg, angling the computed tomography [CT] scanner gantry)
- knowing situations in which imaging-guided abscess drainage should not be attempted
- the knowledgeable interventional radiologist will often succeed in draining difficult-to-reach abscesses
- the informed diagnostic radiologist can help obviate surgery

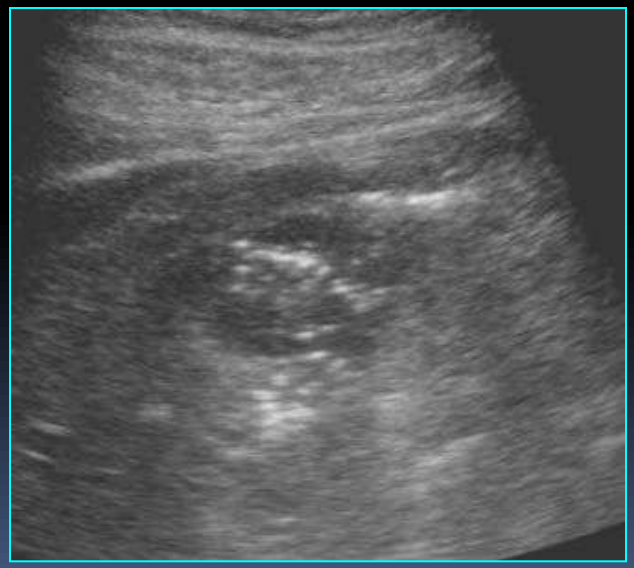
Drainage

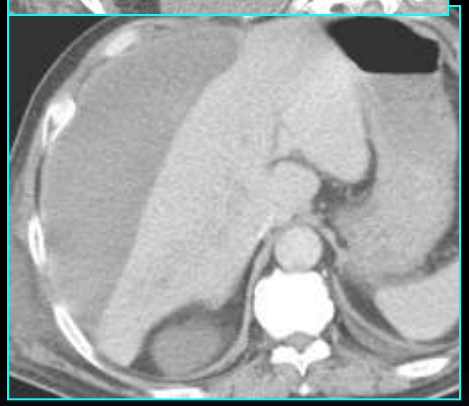
Major Complications

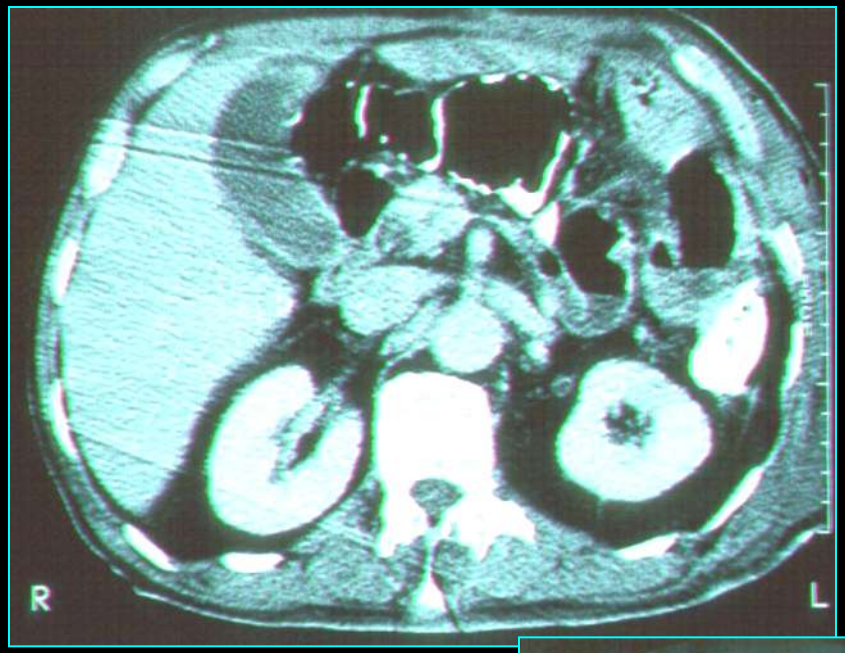
- Hemorrhage
- Hollow organ perforation
- Fistula
- Arteriovenous fistula
- Pneumothorax, pyothorax
- Sepsis
- Death

Emphyseatous Cholecystitis: Drainage





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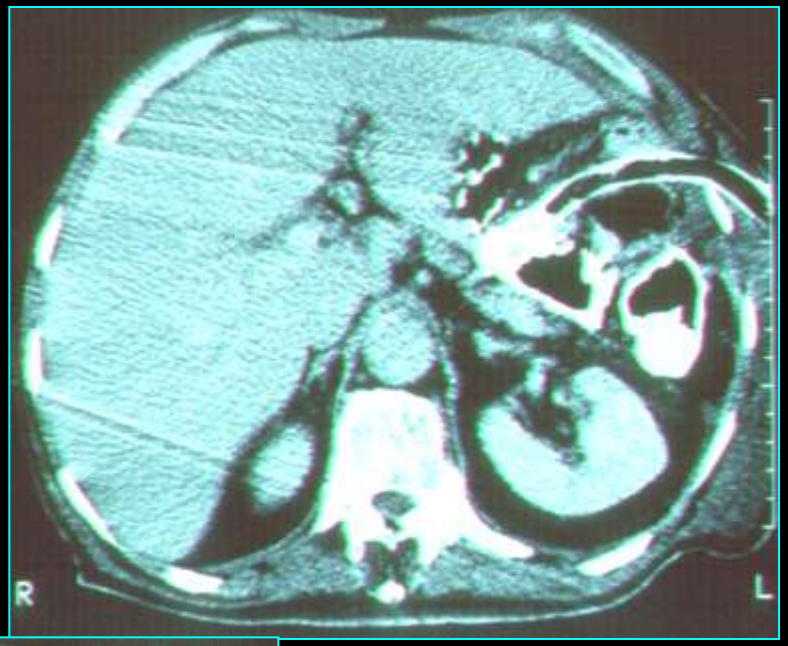
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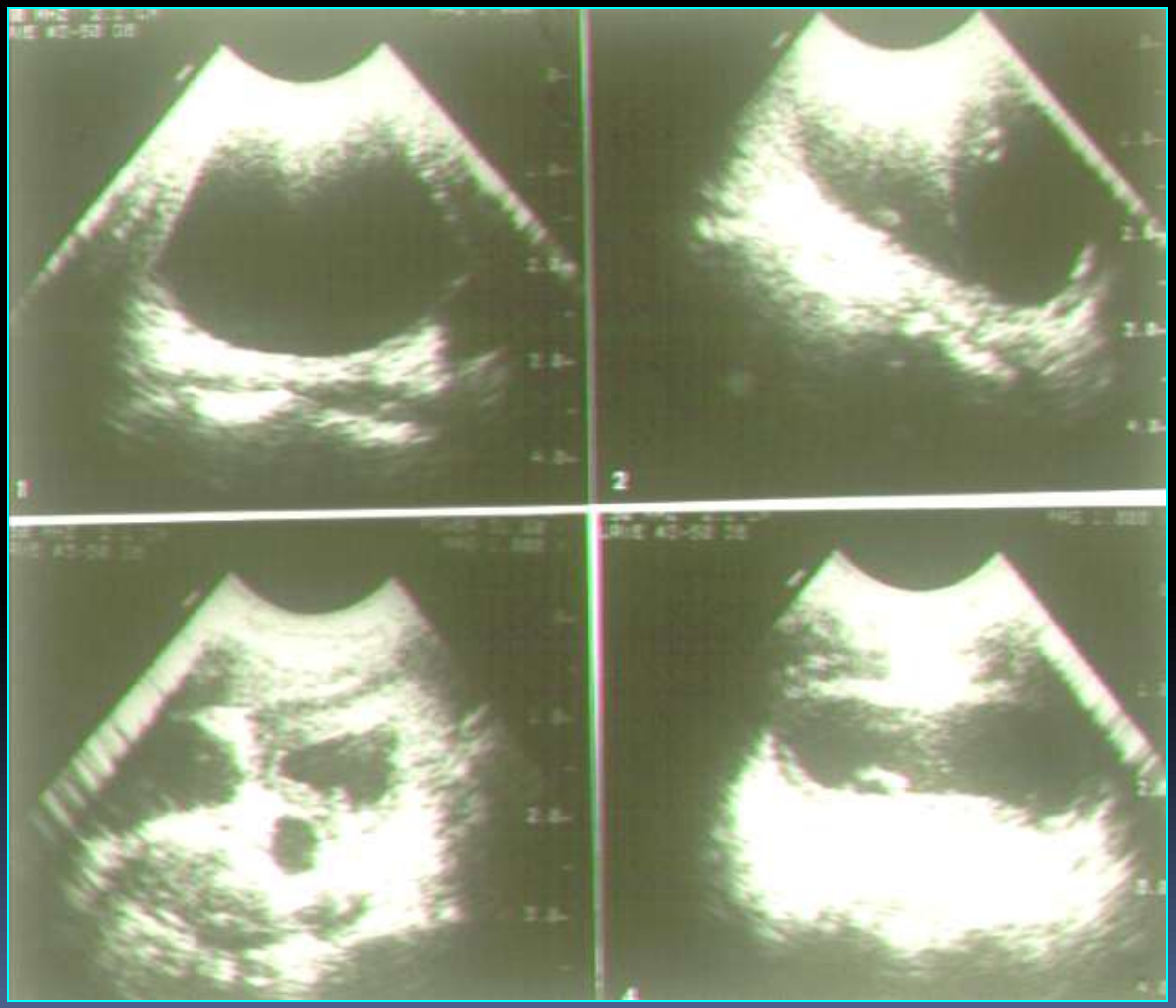
Conclusions

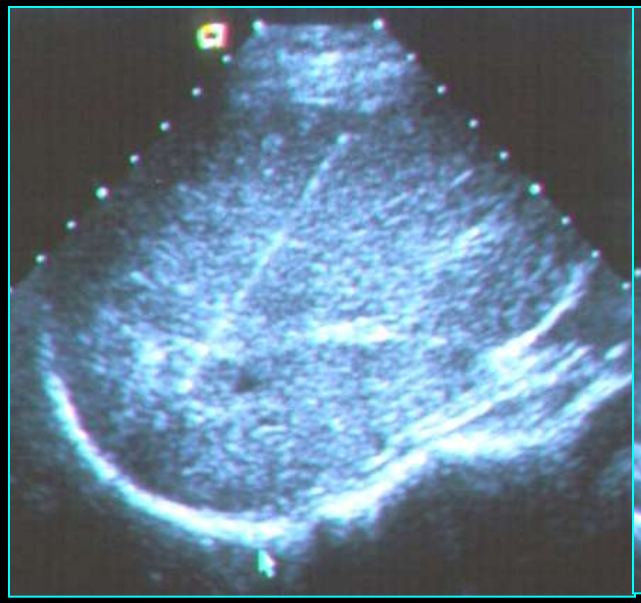
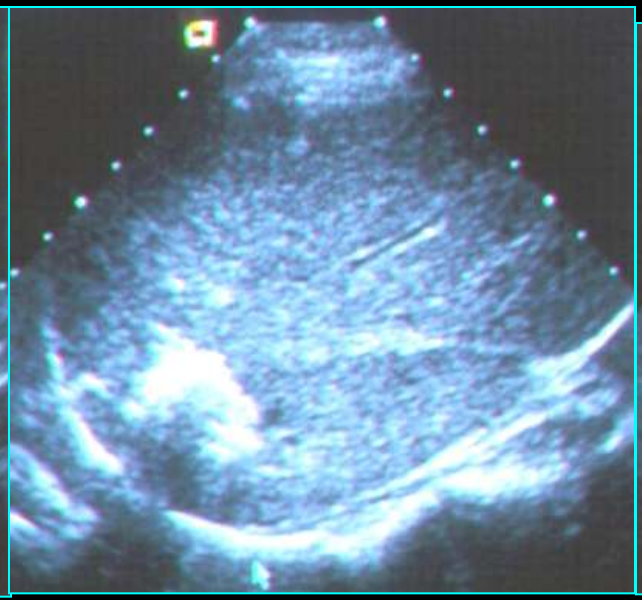
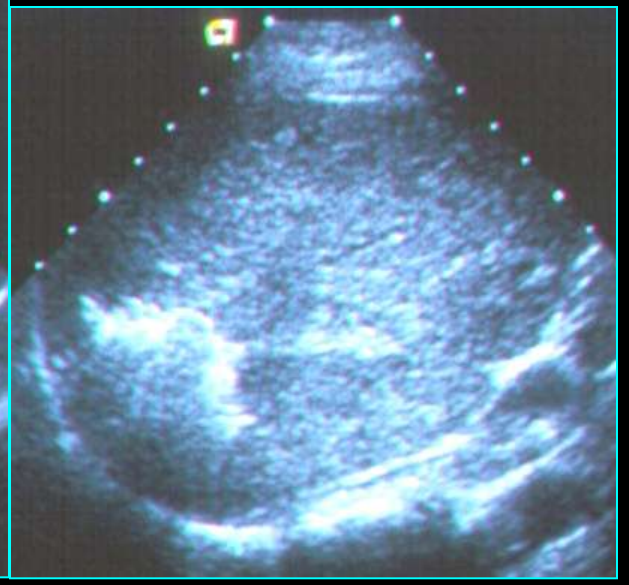
- Percutaneous abscess drainage is a safe, effective, and widely used treatment for patients with abdominal or pelvic sepsis
- Techniques allowing percutaneous drainage of less accessible intraabdominal abscesses, thus eliminating the need for laparotomy

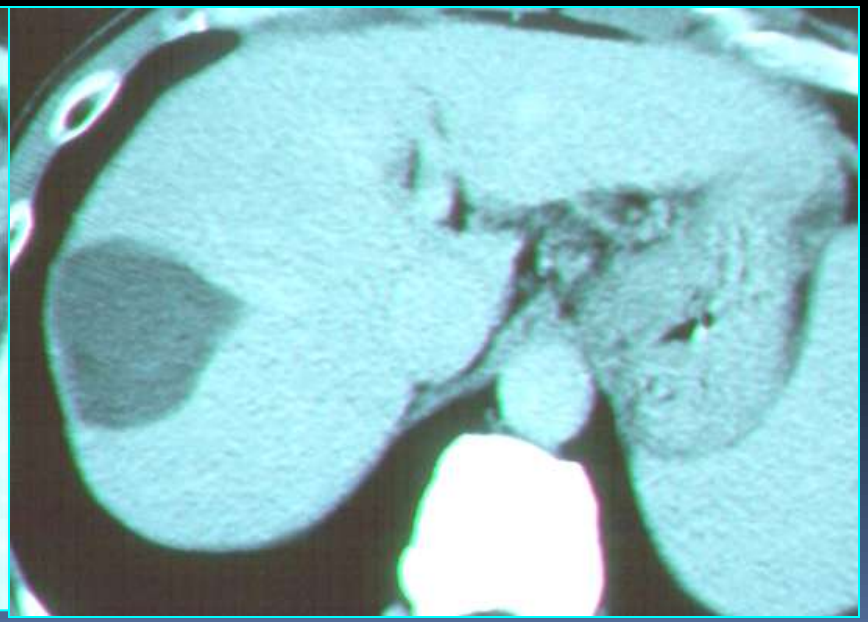
LEARNING OBJECTIVES

- Understand the **feasibility** of abdominal intervetion or abscess drainage in different anatomic locations.
- Identify **US and alternative imaging** methods that may improve access to **deep-seated lesions or collections**.
- Describe situations in which imaging-guided abscess drainage is either unhelpful or contraindicated.



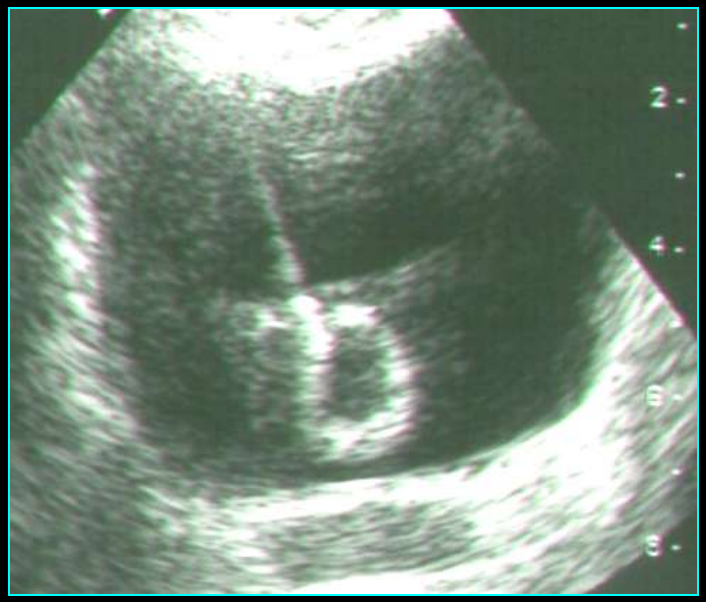
Percutaneous Tumor Ablation

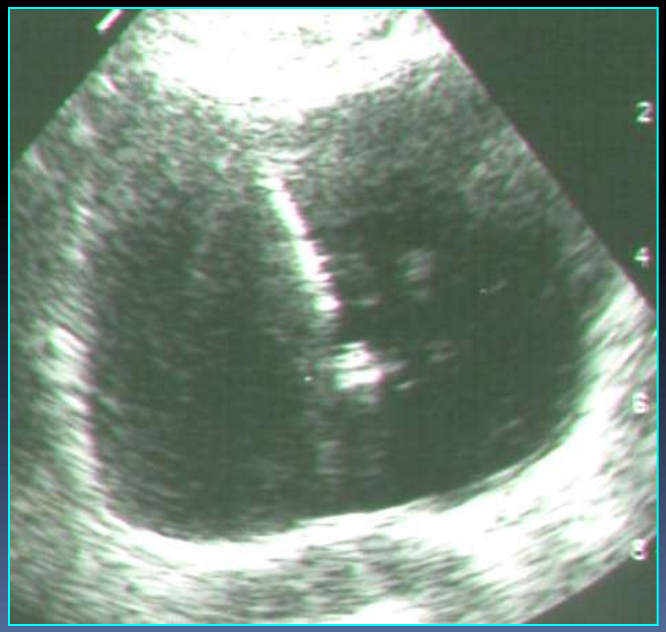




-183.5
32
3


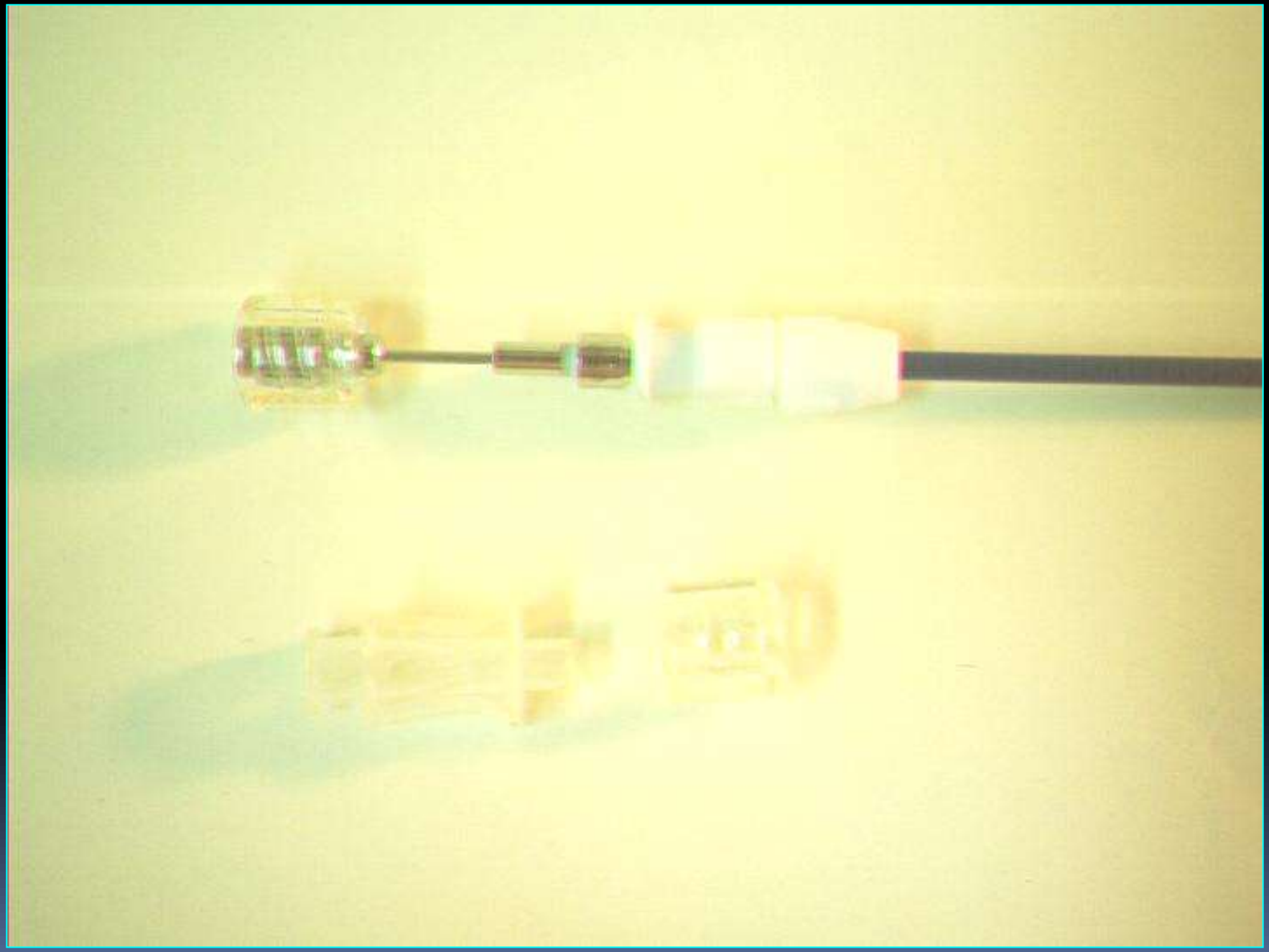
Others

Puncture of **Balloon** *for removal of an entrapped* **Foley Catheter**

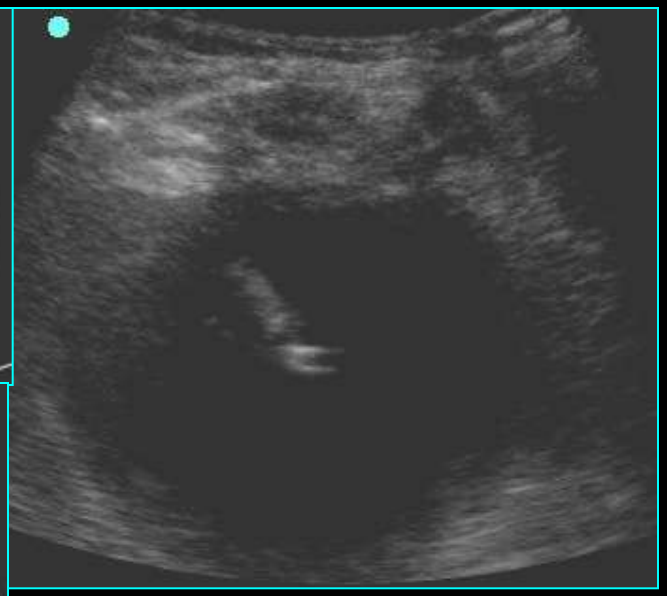


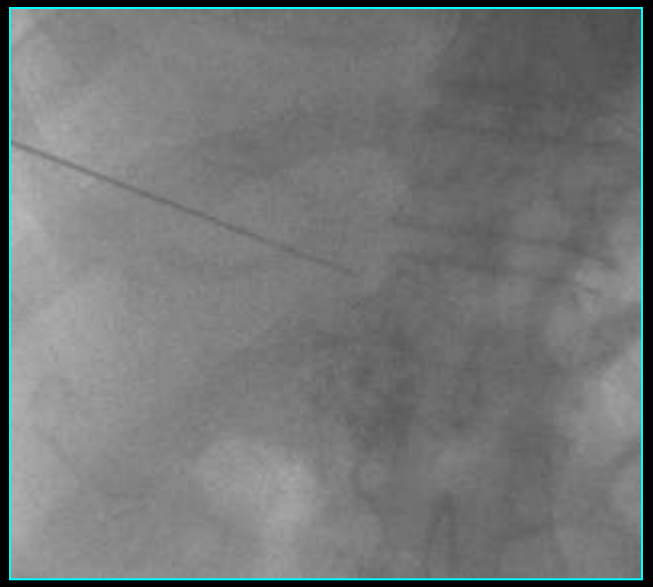


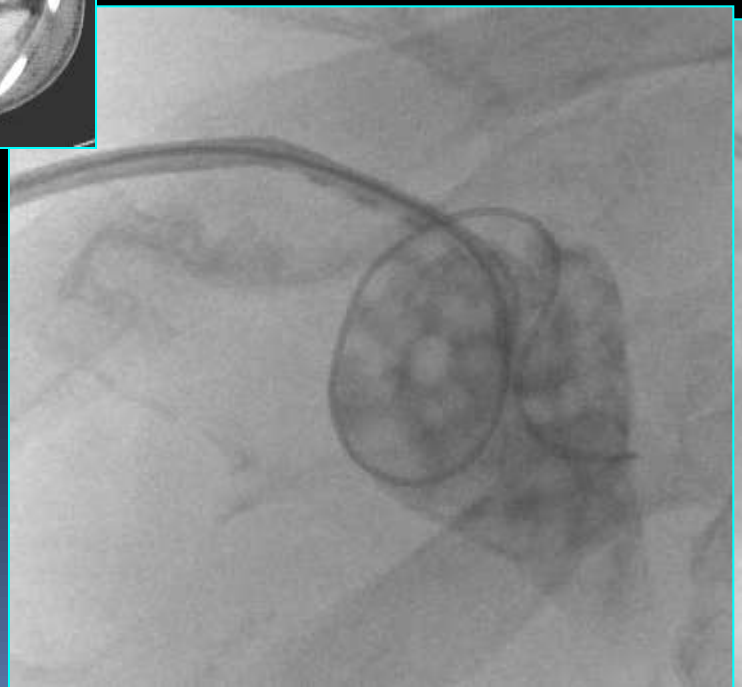
Problems



Ac. Cholecystitis: Gall Bladder Drainage

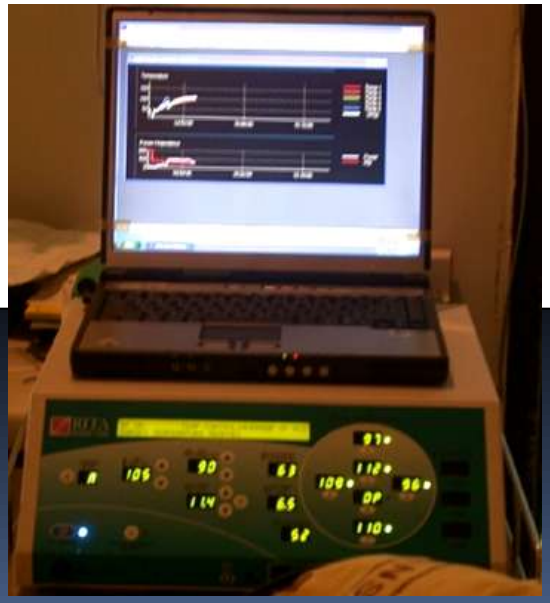


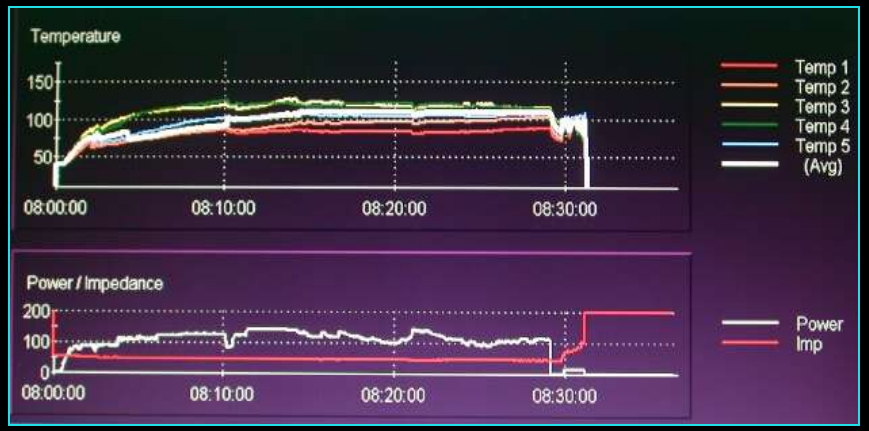




PTCD

Radiofrequecy Ablation RFA





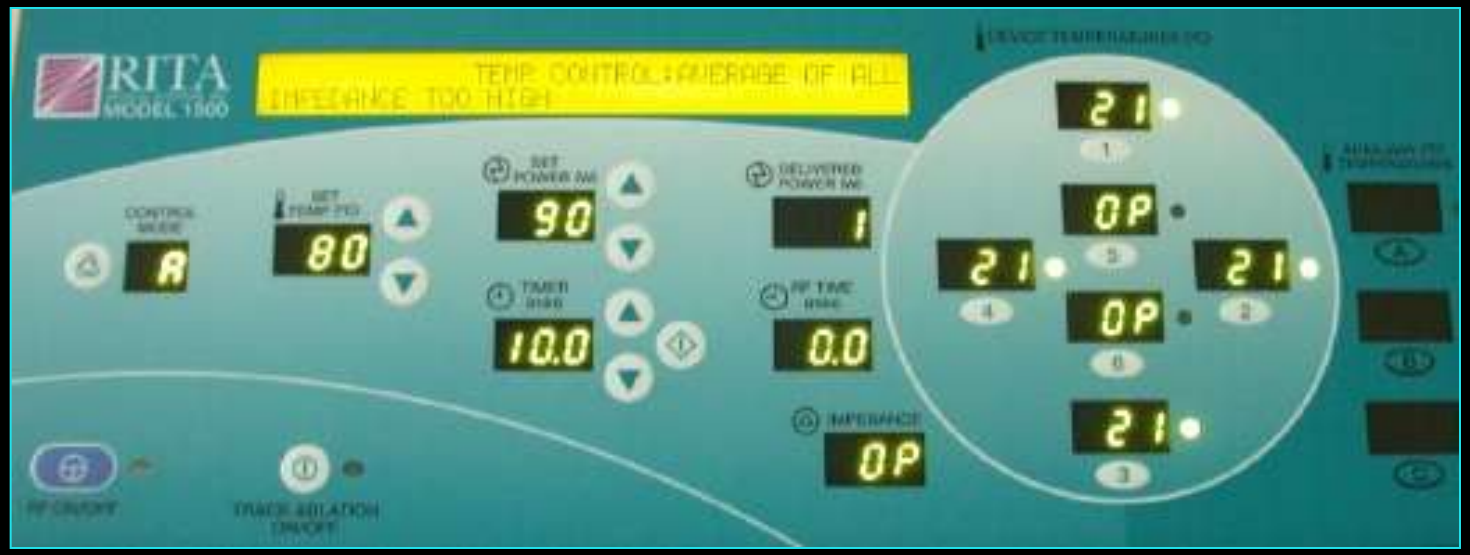
Deployment of Needle Electrode

(2 cm)

(3 cm)

Complete

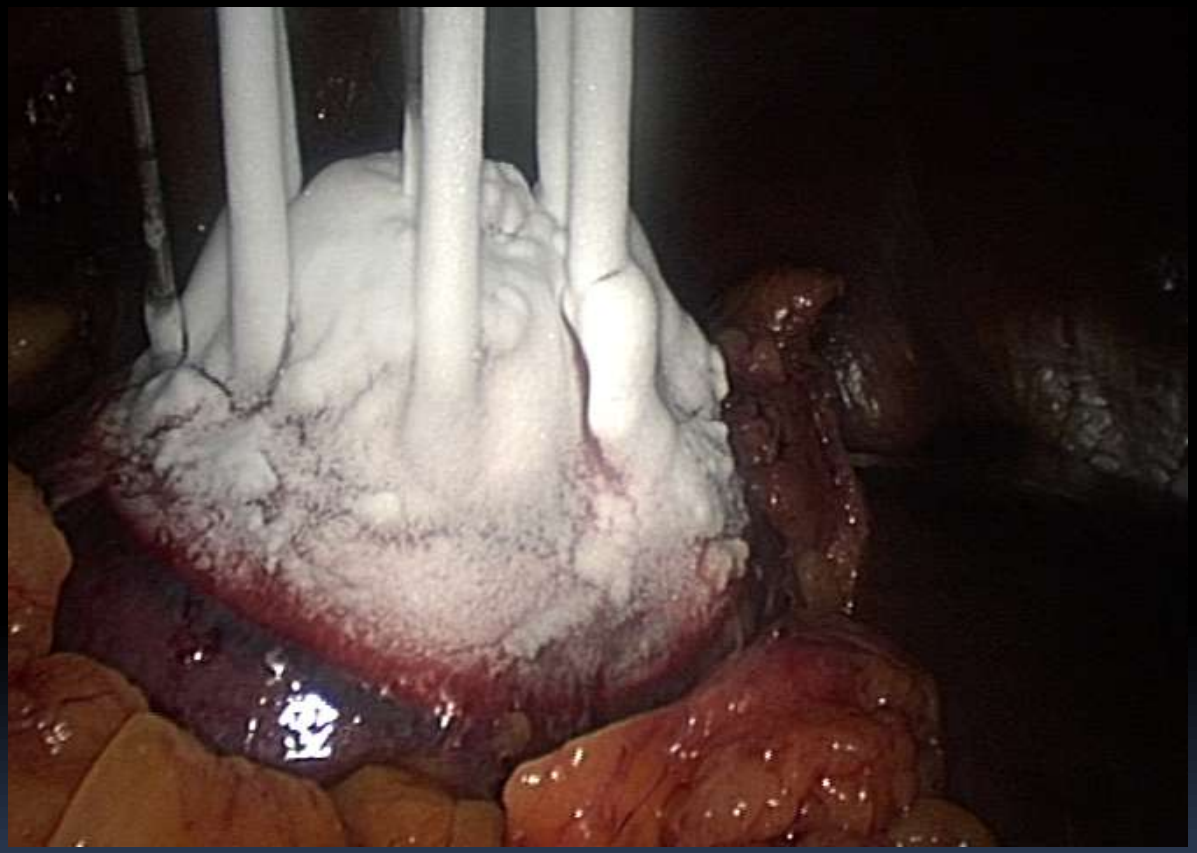
治療中注意病患狀況與RFA治療機之操 作調整

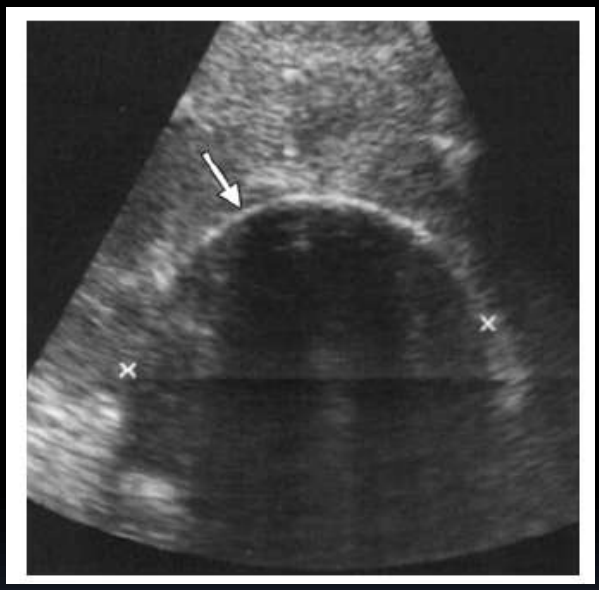


Item / Size	Temp	Power	Time	Temp	Power	Time	Temp	Power	Time	Temp	Power	Time
2 cm	80	90	5.5	80	90	5.5	80	90	8.0	80	90	15
3 cm				105	90	5.0*	105	90	7.5	105	90	14.5
4 cm							110	90	7.0	110	90	14*
5 cm										110	110	7.0**

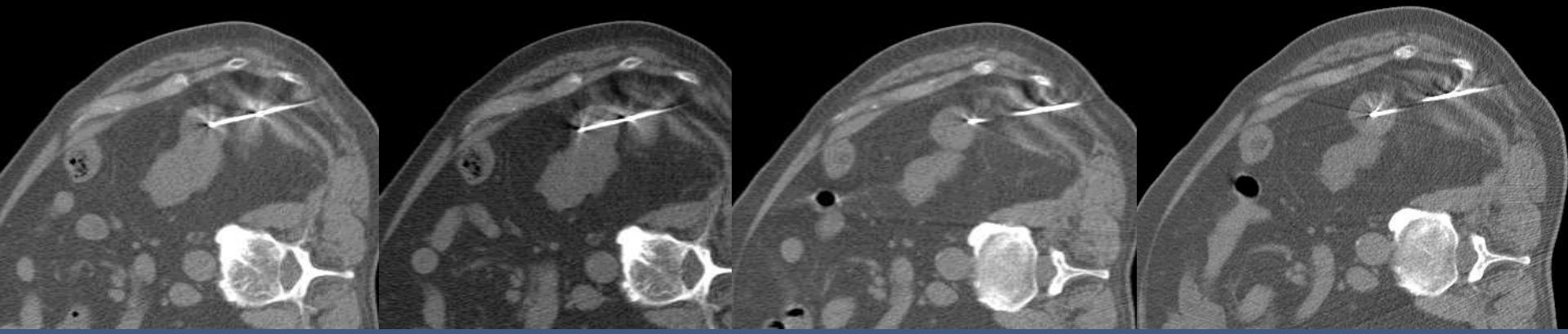
Imaging-Guided Renal Tumor Ablation-

Laparoscopic Renal Cryoablation



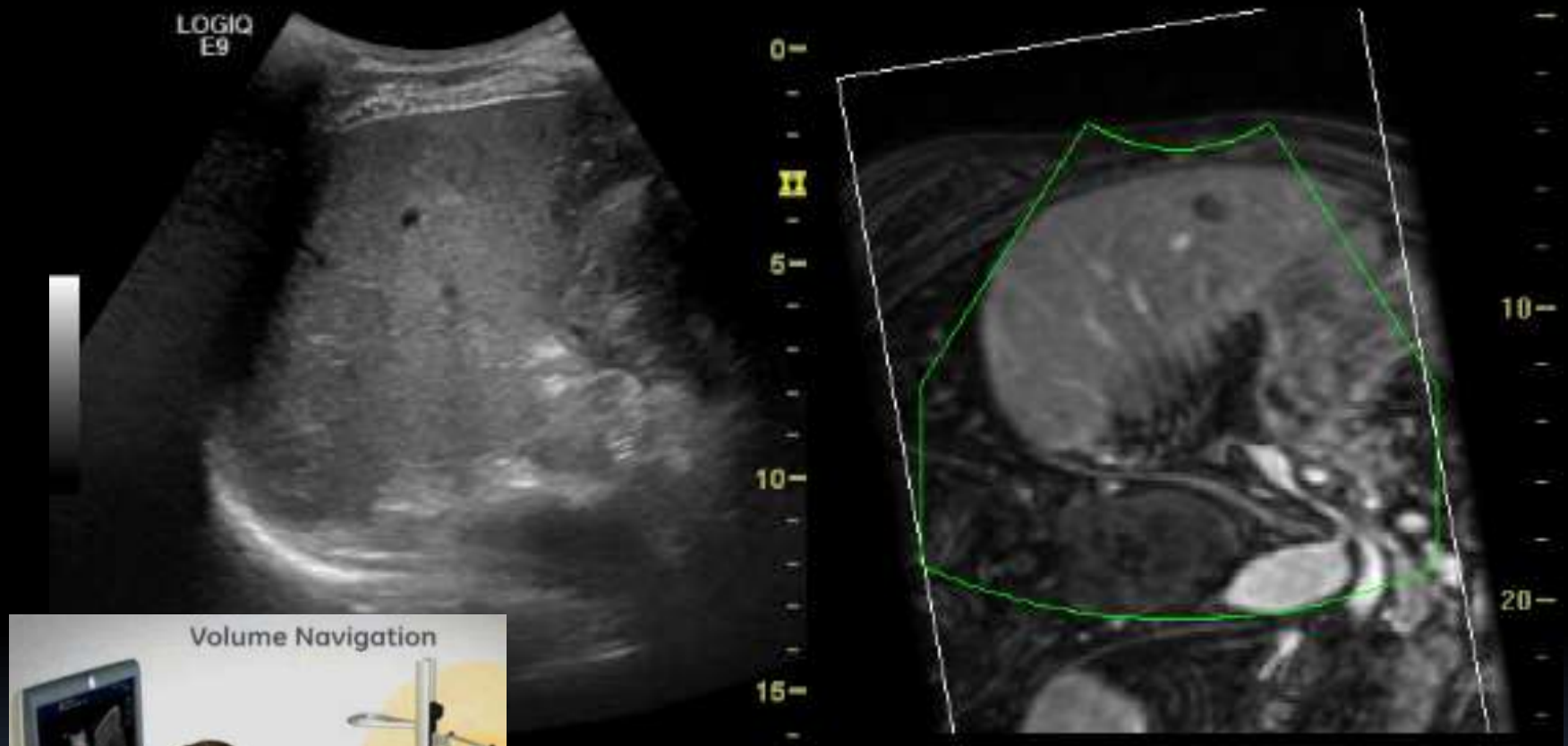


Targeting: US+CT



Planning: decide targeting strategy, explain to the patient

US-CT/MRI Fusion



Identify the spatial location of an US image using GPS information from the magnetic field

2010-
New Vision