

Introduction to Procedures

David Tofovic

Outline

- Ultrasound
- Procedures
- Laboratory orders
- Analysis

The Machine



- On/off
- Depth
- Gain
- Freeze
- Zoom
- M-mode
- Doppler
- Color

The Probes



- Liner
- Curvilinear
- Superficial
- Cardiac
- Abdominal

The Probes

Continued

- Higher frequency, higher resolution
- Higher frequency, higher attenuation
 - Greater drop-off in quality with depth.

Artifacts

Attenuation/Shadowing

- Higher frequency, greater attenuation (loss of signal)
- US energy cannot reach areas behind high absorption structures.
- Gas and air reflect almost all US. Thus get large amount of acoustic shadowing.
- Half Value Thickness: distance at which US signal is decreased by 50%.
- Acoustic Impedance: degree to which medium impedes motion of sound waves.



Paracentesis

Paracentesis – When is it needed?

- New onset ascites/new fluid
- Management of tense ascites or ascites resistant to diuretics
- Patient w/ ascites and signs of clinical deterioration
 - fevers, abdominal pain, acidosis, worsening renal function and hepatic encephalopathy.
- Relative contraindications
 - DIC or bleeding from needle sticks
 - Primary fibrinolysis
 - Massive ileus

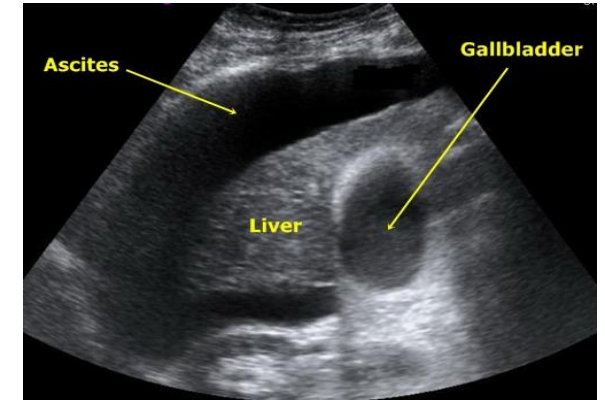
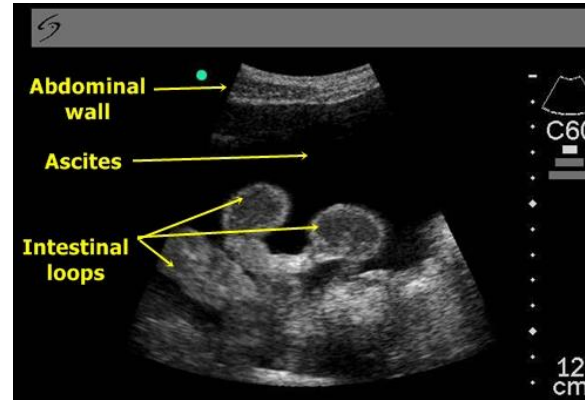
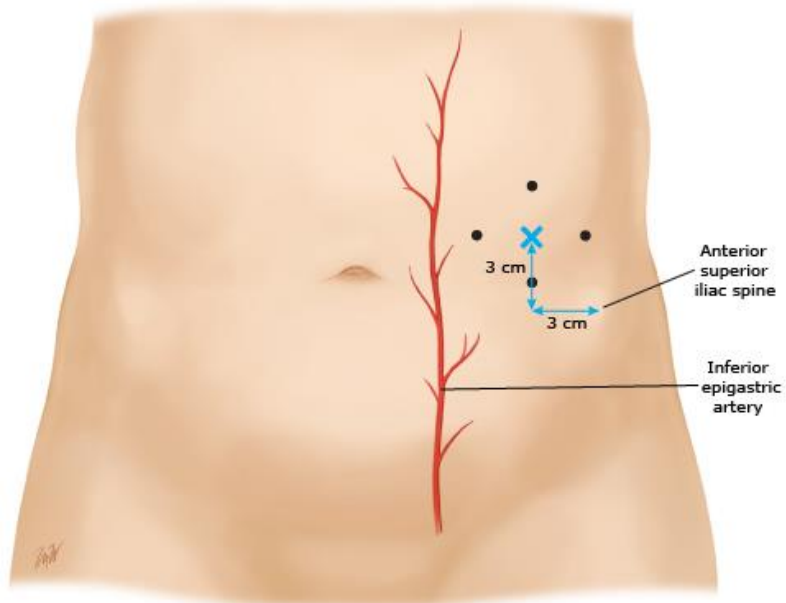
THIS MEANS THAT JUST
BECAUSE THE INR IS 2.1, YOU
CAN STILL DO A
PARACENTESIS.

I'm looking at you, interventional radiology.

Things you will need.

- Paracentesis kit
- Gloves
- Ultrasound
- Face masks
- Alcohol pads
- Culture vials (same ones for Bcx)
- Chlorhexadine
- Vacuum Bottles (if large volume)
- Labels
- Marker
- Patient Consent
- Your senior

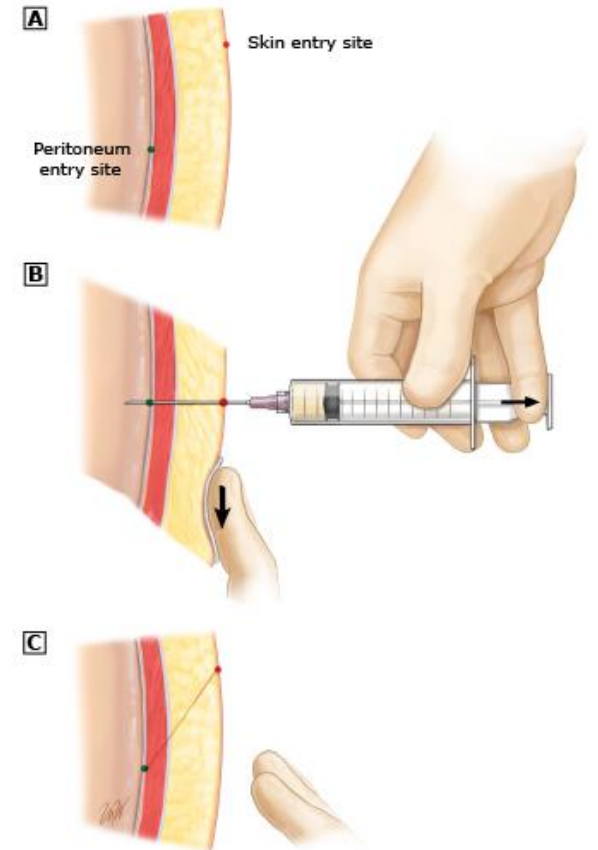
Paracentesis - Technique



Paracentesis - Technique



Z-technique



Paracentesis – Large Volume

- Removal of > 5 L of fluid at once.
- Upper limit is usually 12-15 L as long as you aggressively replete Albumin.
 - 6-8 grams/L removal
 - Prevents hypotension
 - Midodrine can be used instead (small study)




So you need labs huh?

- **Cell count w/ differential**
- **Total Protein**
- **Albumin**
- Gram stain/culture
- LDH
- Amylase
- Glucose
- Cytology
 - Also get CEA, CA 19-9, AFP
- Extended smears/cultures
 - Adenosine Deaminase Activity (ADA)
- TGs
- Billirubin
- Serum pro-BNP
- Alkaline Phosphate

Paracentesis - Ascitic Fluid Orders

Session
Type: Standard Reason: Immediate Activation

Manual Entry Searching for ...

fluid	Order	Cost
	 Fluid Culture (Culture, Body Fluid, includes smear)	
	Cost: \$\$	
	 Fluid Lab Orders (Lab Fluid Orders)	
	 Fluid Replacement Therapy.	

Immediate Activation

[Add...](#)
[View...](#)
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[Drug Info](#)
[i](#)

Lab Fluid Orders [3 orders of 16 are selected]

Relevant Results

Combined Measurements
 Height (cm) Weight (kg) BSA

Collection Date:

Collection Time/Priority:

Laboratory

Order	Collection Date	Collection Priority	Fluid	Clinician Instructions
<input checked="" type="checkbox"/> Albumin, Fluid	25-Jul-2015	STAT	(FLDS4) PERITONEAL	
<input type="checkbox"/> Amylase, Body Fluid				
<input type="checkbox"/> Cell Count, Fluid				
<input checked="" type="checkbox"/> Cell Count + Differential, Body Fluid	25-Jul-2015	STAT	(FLDSR) ASCITES	
<input type="checkbox"/> Cholesterol, Fluid				
<input type="checkbox"/> Crystal Exam				
<input type="checkbox"/> Glucose, Fluid				
<input type="checkbox"/> Lactate Dehydrogenase, Fluid				
<input type="checkbox"/> Potassium, Fluid				
<input type="checkbox"/> Sodium, Fluid				
<input type="checkbox"/> Total Bilirubin, Fluid				
<input type="checkbox"/> Protein, Total Body Fluid				
<input type="checkbox"/> Urea Nitrogen, Fluid				

UHFormLists

Please Pick One from the List

▼

- AMNIOTIC
- ASCITES**
- PERICARDIAL
- PERITONEAL
- PLEURAL
- SYNOVIAL
- THORACENTESIS

Or please type in your own value:

Close

Microbiology




Order	Collection Date	Clinician Instructions	Source	Site	Antibiotic Therapy	Special Instructions
<input checked="" type="checkbox"/> Culture, Body Fluid, includes smear	25-Jul-2015	STAT	Fluid (FLU)			
<input type="checkbox"/> Culture, Acid Fast Bacilli, Misc.+ smear			Fluid (FLU)			
<input type="checkbox"/> Culture, Fungus +smear			Fluid (FLU)			


Paracentesis – IR Procedure Order

Session
Type: Reason:

Manual Entry

paracentesis

Order	Cost
  Paracentesis	
 Paracentesis Ultrasound Dept (Ultrasound Paracentesis)	

[Add...](#)
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[Item Info](#)
[Add to Favorites](#)
[Message](#)
[Drug Info](#) ▾


Immediate Activation

Order: Order ID:

Requested By: Template Name:

Messages:

ConditionalOrder

Max # of activations:

Clear

Height (cm)	Weight (kg)	BSA
<input type="text" value="158.7"/>	<input type="text" value="121.9"/>	<input type="text" value="2.32"/>

Relevant Results

Health Issues

Relevant Medications

Priority

Requesting Physician Contact #

Transport Method

Current Signs and Symptoms

Special Instructions

Radiologist to Determine Optimal Study

ScheduledDtm

Additional Information

Serum Ascites-Albumin Gradient

SAAG = serum albumin – albumin level of ascitic fluid

Cut off is 1.1

Serum Ascites-Albumin Gradient

High SAAG

- Cirrhosis
- Budd-Chiari syndrome
- Port Vein Thrombosis
- Heart Failure

Low SAAG

- Infectious
 - Tuberculosis
- Pancreatitis
- Pancreatic Cancer
- Serositis
- Nephrotic Syndrome

Serum Ascites-Albumin Gradient

		SAAG	
		<1.1	>1.1
Total Protein	<2.5	Nephrotic Syndrome	Cirrhosis, Budd-Chiari (late)
	>2.5	Cancer, TB	HF, Budd-Chiari (early), portal vein thrombosis

Spontaneous Bacterial Peritonitis

- Signs/Symptoms
 - Fever (~70%)
 - Abdominal pain/tenderness (~50-60%)
 - Encephalopathy (~45%)
 - No symptoms (~10%)
- Risk Factors
 - Worse cirrhosis
 - Child Pugh C and worse
 - Prior SBP
 - Low fluid protein
 - < 1 g/dL
 - GI Bleed
 - UTI
 - Lines/catheters
- ≥ 250 PMNs/mm³
- Positive Fluid Culture
 - 60% Gram negative
 - 25% Gram Positive
- Other labs
 - Glucose
 - Generally remains > 50 mg/dL
 - Near 0 mg/dL in secondary peritonitis
 - LDH
 - increased in SBP from PMN lysis
 - even higher in secondary peritonitis
 - Amylase
 - increased with pancreatitis or gut perforation

Secondary Bacterial Peritonitis

- ≥ 250 PMNs/mm³
- Positive Fluid Culture
- **Caused by surgically treatable intraabdominal source**
- Mortality of secondary bacterial peritonitis ~100% w/o surgical intervention.
- Mortality of spontaneous bacterial peritonitis ~80% w/ surgical intervention
- Runyon's Criteria
 - Need ≥ 2 of below
 - $T_p < 1$ g/DL,
 - glucose < 50 mg/dL
 - LDH $>$ than upper limit of normal serum
- Polymicrobial growth suggests gut perforation
- Early imaging

Thoracentesis

Thoracentesis – When is it needed?

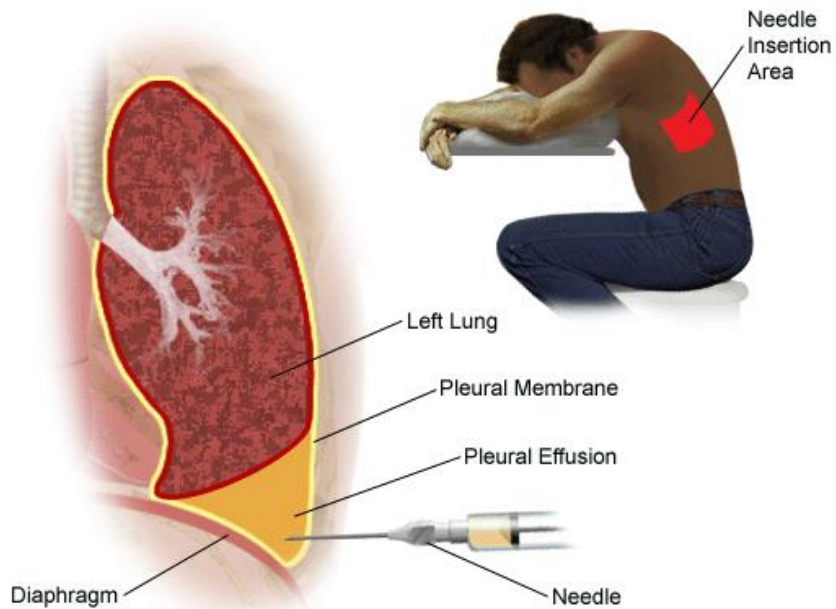
- Evaluation of new pleural effusion
- Symptoms management
 - 1500-1600 cc fluid removal max.
 - reduce the risk of pulmonary re-expansion edema
 - Removal fluid until coughing
- Assistance with extubation
- Relative Contraindications
 - Small effusion (< 1cm)
 - Overlying infection
 - Positive pressure ventilation
 - Small increase in risk

Things you will need

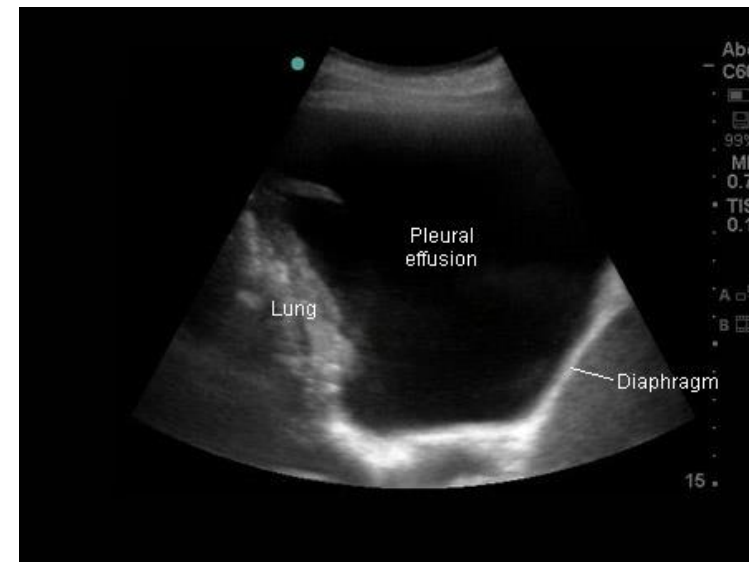
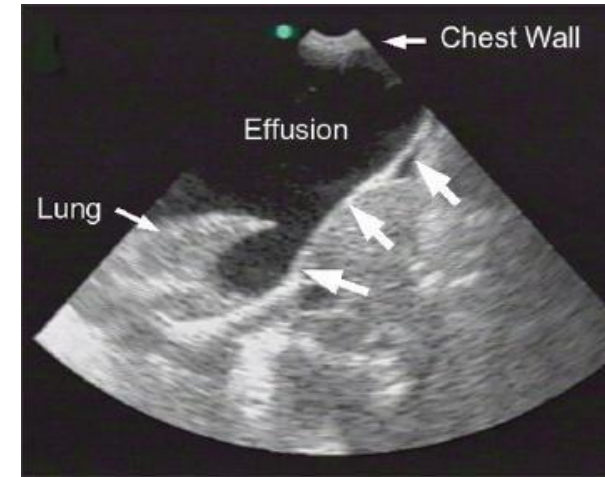
- Thoracentesis kit
- Gloves
- Ultrasound
- Face masks
- Alcohol pads
- Culture vials (same ones for Bcx)
- Chlorhexadine
- Labels
- Patient Consent
- Your senior
- Pulmonary Fellow

Thoracentesis – technique

Example of Thoracentesis



- Between 8th and 9th rib
- At least 10cm lateral to spin
- Go above lower rib



Thoracentesis – technique

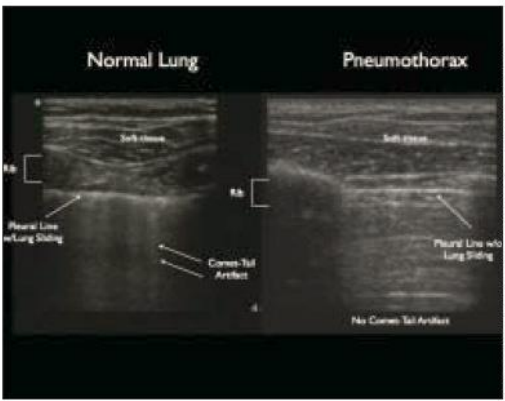
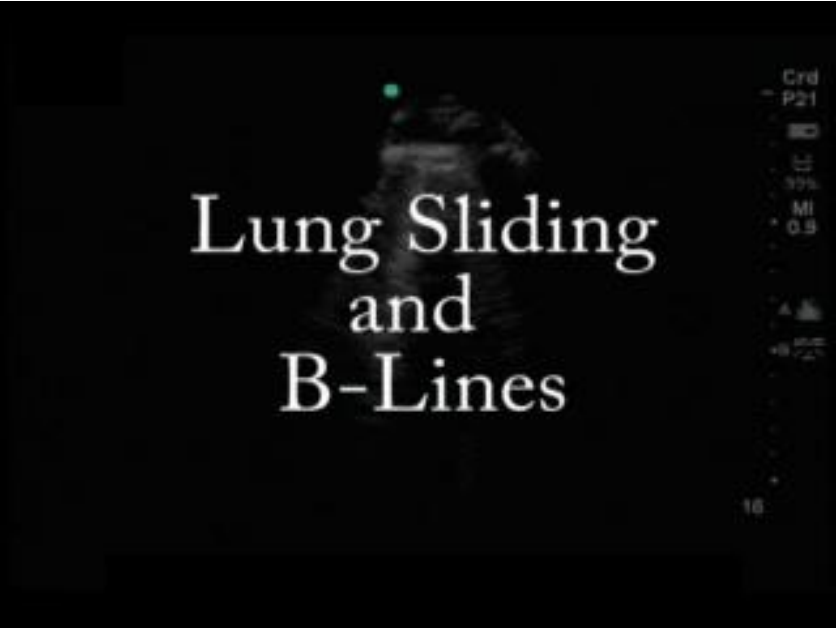


Image 4

More labs for everybody!

- **Serum & pleural LDH**
- **Serum & pleural T_p**
- Cell count with differential
- Gram stain and culture
- Cytology
- pH
- Glucose
- Cytology
 - Also get CEA, CA 19-9, AFP
- Extended smears/cultures
 - Adenosine Deaminase Activity (ADA)
- TGs
- Cholesterol
- Serum pro-BNP

Relevant Results

Combined Measurements
 Height (cm) 158.7 Weight (kg) 121.9 BSA 2.32

Collection Date: 25-Jul-2015
 Collection Time/Priority: STAT

Laboratory

Order	Collection Date	Collection Priority	Fluid	Clinician Instructions
<input type="checkbox"/> Albumin, Fluid				
<input type="checkbox"/> Amylase, Body Fluid				
<input type="checkbox"/> Cell Count, Fluid				
<input checked="" type="checkbox"/> Cell Count + Differential, Body Fluid	25-Jul-2015	STAT	(FLDSR) PLEURAL	
<input type="checkbox"/> Cholesterol, Fluid				
<input type="checkbox"/> Crystal Exam				
<input checked="" type="checkbox"/> Glucose, Fluid	25-Jul-2015	STAT	(FLDS7) PLEURAL	
<input checked="" type="checkbox"/> Lactate Dehydrogenase, Fluid	25-Jul-2015	STAT	(FLDS4) PLEURAL	
<input type="checkbox"/> Potassium, Fluid				
<input type="checkbox"/> Sodium, Fluid				
<input type="checkbox"/> Total Bilirubin, Fluid				
<input checked="" type="checkbox"/> Protein, Total Body Fluid	25-Jul-2015	STAT	(FLDS4) PLEURAL	
<input type="checkbox"/> Urea Nitrogen, Fluid				

UHFormLists

Please Pick One from the List

- AMNIOTIC
- ASCITES
- PERICARDIAL
- PERITONEAL
- PLEURAL**
- SYNOVIAL
- THORACENTESIS

Or please type in your own value:

Close

Microbiology







Order	Collection Date	Clinician Instructions	Source	Site	Antibiotic Therapy	Special Instructions
<input checked="" type="checkbox"/> Culture, Body Fluid, includes smear	25-Jul-2015	STAT	Fluid (FLU)			
<input type="checkbox"/> Culture, Acid Fast Bacilli, Misc.+ smear			Fluid (FLU)			
<input type="checkbox"/> Culture, Fungus +smear			Fluid (FLU)			

Thoracentesis – IR Procedure Order

Session
Type: Standard Reason: Immediate Activation

Manual Entry Searching for ...

%thoracentesis

Order	Cost
  Thoracentesis	
 Ultrasound Guided Thoracentesis (Ultrasound Thoracentesis)	
 Ultrasound Thoracentesis with Insertion of Tube includes Water Seal when performed	
 US Guided Thoracentesis (Ultrasound Thoracentesis)	
 US Thoracentesis with Insertion of Tube includes Water Seal when performed (Ultrasound Thoracentesis with Insertion of Tube includes Water Seal when performed)	

Add...

View...

Item Info

Add to Favorites

Message

Drug Info



Immediate Activation

Order: Order ID:
Requested By: Template Name:
Messages:

ConditionalOrder

Max # of activations:

Clear

Height (cm)	Weight (kg)	BSA
<input type="text" value="158.7"/>	<input type="text" value="121.9"/>	<input type="text" value="2.32"/>

Relevant Results

Health Issues

Relevant Medications

Priority

Requesting Physician Contact #

Transport Method

Current Signs and Symptoms

Special Instructions

Radiologist to Determine Optimal Study

ScheduledDtm

Additional Information

NOTE: Patient must have a functional Saline Lock

Exudative vs Transudate

- Light's Criteria
 - ≥ 1 = exudate
 - Pleural protein/serum protein >0.5
 - Pleural LDH/serum LDH > 0.6
 - Pleural fluid LDH $>2/3^{\text{rd}}$ upper limit of normal serum LDH
- Two-test Rule
 - ≥ 1 = exudate
 - Pleural cholesterol > 45 mg/dL
 - Pleural LDH >0.45 times upper limit of normal serum LDH
- Three-test Rule
 - ≥ 1 = exudate
 - Pleural protein >2.9 g/dL

Diuresis can affect these numbers!

Effusions in HF

- Most transudates have absolute $T_p < 3.0$ g/dL
- Diuresis will concentrate this, making $T_p > 3.0$ g/dL
- Use serum to pleural fluid albumin
 - > 1.2 g/dL = exudative effusion

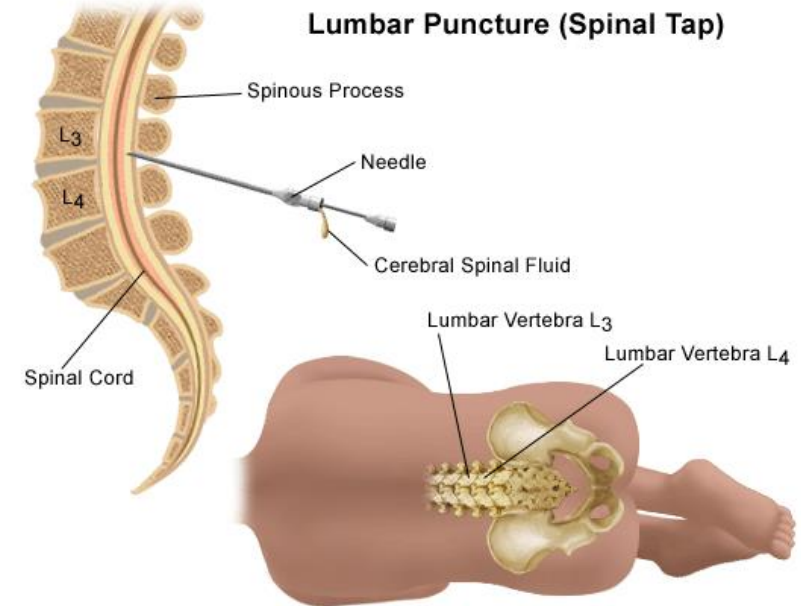
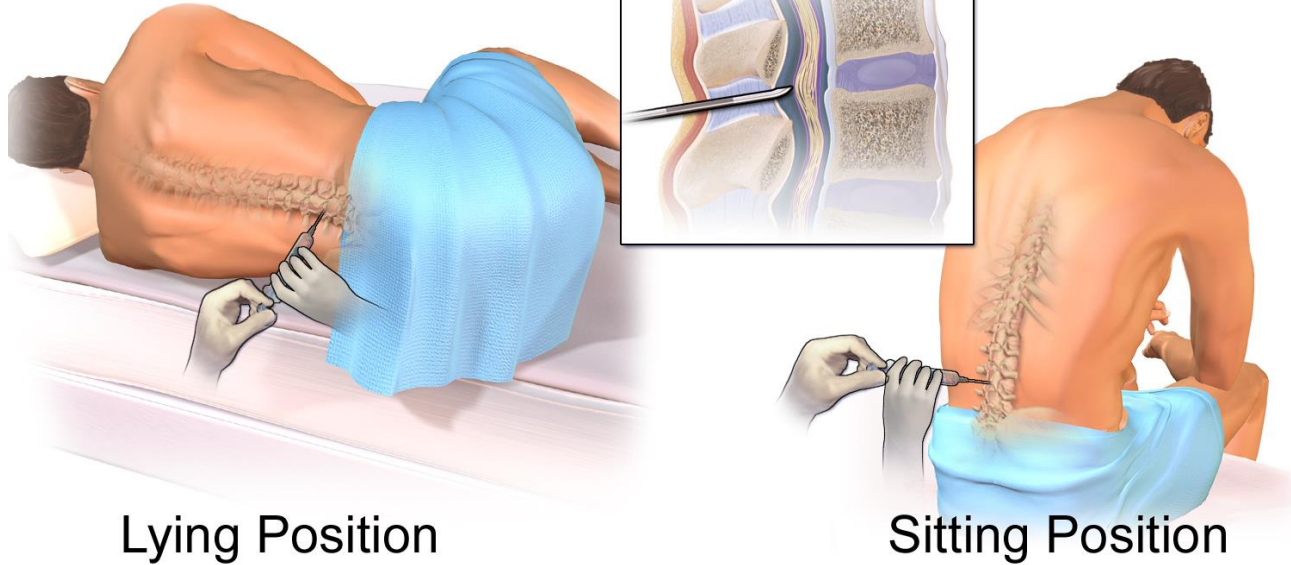
Thoracentesis – Less common findings

- Empyema
 - (+) culture
 - purulence
- Esophageal rupture
 - \uparrow salivary amylase
 - \downarrow pH
- Chylothorax
 - TGs $>$ 110 mg/dL
- Hemothorax
 - ratio of pleural fluid/serum hematocrit $>$ 0.5
- Peritoneal dialysis
 - Pleural $T_p <$ 0.5 mg/dL
 - Pleural/ serum glucose ratio $>$ 1
- Urinothorax
 - Pleural/serum creatinine ratio always $>$ 1
 - diagnostic if $>$ 1.7
- CSF leak
 - beta-2 transferrin

Lumbar Puncture

LP - Technique

Lumbar Puncture



- highest points of iliac crests
- L3/L4 or L4/L5 interspace

LP – So.. can I do this tomorrow?

- Suspected CNS infection
 - except brain abscess
 - or parameningeal process
- Suspected subarachnoid hemorrhage
 - negative CT scan

LP – When is it needed?

- Unexplainable fever, altered mental status, headache, or meningeal signs
- Pseudotumor cerebri, carcinomatous meningitis, TB meningitis, normal pressure hydrocephalus, etc.
- Therapeutic LP
 - Pseudotumor cerebri
 - Spinal anesthesia
 - Intrathecal abx or chemo
- Relative Contraindications
 - Raised intracranial pressure (increased herniation risk)
 - Bleeding disorders
 - Suspected spinal epidural abscess

You get new labs, and you get new labs..






- **Glucose**
- **Protein**
- **Cell count with differential**
- **Bacterial stain/culture**
- **Bacterial antigens**
- **Viral PCR**
- **Fungal stain/culture**
- **Fungal antigens**
- **Lactate**
- **Cytology**


LP – Lab Orders

Session
Type: Reason:


Manual Entry

Order	Cost
 CSF Culture (Culture, CSF, includes smear)	
Cost: \$\$	
 CSF Drain (Neurosurgery CSF Drain/ ICP Monitoring)	
 CSF Lab Orders (Lab CSF Orders)	

Immediate Activation

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- [Drug Info](#)
- 

Combined Measurements
 Height (cm) Weight (kg) BSA

Collection Date: 
 Priority:

Laboratory and Blood Bank

	Order	Collection Date	Priority	Floor to Collect	Source/Site	Clinician Instructions
- Hematology - 2 item(s)						
<input type="checkbox"/>	Cell Count + Differential, CSF			<input checked="" type="checkbox"/>	(TUBE#) TUBE 1	
<input type="checkbox"/>	Cell Count + Differential, CSF			<input checked="" type="checkbox"/>	(TUBE#) TUBE 4	
- Chemistry - 8 item(s)						
<input type="checkbox"/>	Amino Acids, CSF		Routine	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Angiotensin Converting Enzyme, CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Total Protein and Glucose, CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Glucose, CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Lactate, CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	LD, CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Methotrexate, CSF		Routine	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Myelin Basic Protein, CSF		Routine	<input checked="" type="checkbox"/>		
- Immunology - 12 item(s)						
<input type="checkbox"/>	Cryptococcal Ag Qualitative			<input checked="" type="checkbox"/>	(SPEC) CSF	
<input type="checkbox"/>	Fluorescent Treponemal Ab, CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	IgG, CSF		Routine	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Immunoelectrophoresis, CSF		Routine	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Kappa Free CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Listeria Ab IgG, CSF			<input checked="" type="checkbox"/>		
<input checked="" type="checkbox"/>	Lyme IgG + IgM Antibody, CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Protein Electrophoresis, CSF		Routine	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Bacterial Antigen Panel, CSF			<input checked="" type="checkbox"/>	(SPECB) CSF	
<input type="checkbox"/>	Haemophilus Influenzae Antigen, CSF			<input checked="" type="checkbox"/>	(SPECB) CSF	
<input type="checkbox"/>	Neisseria meningitidis Antigen, CSF			<input checked="" type="checkbox"/>	(SPECB) CSF	
<input type="checkbox"/>	Streptococcus pneumoniae Antigen, CSF			<input checked="" type="checkbox"/>	(SPECB) CSF	
- Molecular Dx - 3 item(s)						
<input type="checkbox"/>	HSV By PCR Qual In CSF			<input checked="" type="checkbox"/>		
<input type="checkbox"/>	JC Virus by PCR Qualitative			<input checked="" type="checkbox"/>	(SPEC6) CSF	
<input checked="" type="checkbox"/>	VZV DNA By PCR, Qualitative			<input checked="" type="checkbox"/>	(SITVZ) CSF	

Microbiology

	Order	Collection Date	Collection Priority	Floor to Collect	Source	Site	Antibiotic Therapy	Special Instructions
- Microbiology - 2 item(s)								
<input type="checkbox"/>	Culture, CSF, includes smear			<input checked="" type="checkbox"/>	CSF (CSF)			
<input type="checkbox"/>	Culture, Fungus +smear			<input checked="" type="checkbox"/>	CSF (CSF)			

LP – IR Procedure Order

Session





Type: Standard

Reason: Immediate Activation

Manual Entry

Searching for ...

lumbar

Order	Cost
 Lumbar Drain (Drain Care for Neurosurgery)	
 Lumbar Puncture Diagnostic Xray (Xray Spinal Puncture Lumbar Diagnostic)	
 Lumbar Spine 1 View (Xray Lumbar Spine 1 View)	
 Lumbar Spine AP + Lateral (Xray Lumbar Spine AP + Lateral)	

Add...

View...

Item Info

Add to Favorites

Message

Drug Info



Immediate Activation

Order:

Xray Spinal Puncture Lumbar Diagnostic

Order ID: 001ZNRPHZ

Requested By: Kovach, Cassandra J

Template Name:

Messages:

ConditionalOrder

Max # of activations:

Clear

Height (cm)	Weight (kg)	BSA
158.7	121.9	2.32

Relevant Results

Health Issues

Relevant Medications

Wet Reading

Priority

Level 3 - Routine Today

Requesting Physician Contact #

31742

Transport Method

Current Signs and Symptoms

Special Instructions

Radiologist to Determine Optimal Study

ScheduledDtm

CSF Analysis

- Normal

- Glucose
 - ~40 mg/dL
 - CSF/serum glucose ratio of 0.6
- Protein
 - 23-38 mg/dL
- Cell count
 - ≤ 5 WBCs
 - ≤ 5 RBCs

- Traumatic tap

- True CSF protein
 - Subtract 1g/dL protein for every 1000 RBCmm³
- True WBC count
 - Subtract 1 WBC/mm³ for every 700 RBC/mm³

CSF Analysis

Type of Meningitis	Glucose	Protein	Cells
Acute Bacterial	↓	↑	PMNs, often $>300/\text{mm}^3$
Acute Viral	↔	↔ or ↑	Mononuclear, $<300/\text{mm}^3$
Tuberculosis	↓	↑	Mononuclear & PMNs, $<300/\text{mm}^3$
Fungal	↓	↑	$<300/\text{mm}^3$
Malignant	↓	↑	Usually Mononuclear

CSF Analysis

Glucose (mg/dL)	< 10	10-45	
More common	Bacterial Meningitis	Bacterial Meningitis	
Less common	TB, Fungal Meningitis	Neurosyphilis	

Protein (mg/dL)	> 250	50-250	
More common	Bacterial Meningitis	Viral Meningitis, Lyme's Disease and Neurosyphilis	
Less common	TB Meningitis		

Total WBC #	> 1000	100 - 1000	5 - 100
More common	Bacterial Meningitis	Bacterial, Viral or TB Meningitis	Viral, TB, Neurosyphilis or Early Bacterial
Less common	Some cases of Mumps	Encephalitis	Encephalitis

Acknowledgements

- Dr. Cassandra Kovach
- Dr. Anikat Rali
- Wikipedia
- Uptodate
- Every article on PubMed