

Altered Mental Status: But why?

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Diagnostic radiology – RAD 4001

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Clinical History

- Pt is a 69 y/o F who presented to the ED by EMS for altered mental status. Pt's roommate called 911 when she noticed the patient was "not acting like herself" and reported that she had back pain. In the ED, the pt repeatedly stated her name but was otherwise confused and unable to respond to questions.
- PMH: cirrhosis, HTN, and T2DM

Clinical History

- Unable to provide rest of HPI, ROS
- Social Hx (from info provided 3 months ago during prior hospitalization): Never used alcohol, tobacco, or illicit drugs

Physical Exam

- VS: T: **100.6** HR: **106** RR: **24** BP: **96/50-129/60** SpO2: **100%** RA
- General: **Pt drowsy and disoriented**, repeated name multiple times on exam
- Neuro: **A&Ox1 (self)**, CN 2-12 intact, not responding to questions
- HEENT: Normocephalic, atraumatic, EOMI, **+scleral icterus**
- CV: Normal S1, S2 without M/G/R
- Lungs: Clear to auscultation bilaterally in anterior and posterior fields. No wheezing, rales, or rhonchi.

Physical Exam

- Abd: Soft, non-distended. **Diffusely tender to palpation with guarding, R>L. Foley insertion yielded dark red urine.**
- Extremities/MSK: **1+ pitting of BLE.** No strength testing done.
- Back: No CVA tenderness
- Skin: **+jaundice**

Previous Workup

Cirrhosis:

- First noted 6 mo ago with CT scan evidence with portal hypertension
- 2 hospitalizations of hepatic encephalopathy: 3 and 6 mo ago

Initial Workup

Labs:

- CMP: hyperbilirubinemia 17.3 (↑), ammonia 87 (↑), lactic acid 6.3 (↑), CK 945 (↑), ALT 35 (normal), AST 82 (↑), glucose 310 (↑), HbA1c 6.5
- EKG normal
- CBC: Hgb 13.6, plt 51 (↓), WBC 7.2
- Coag: INR 3.70 (↑), aPTT 50.7 (↑)
- UA: moderate bacteria, (+) LE and nitrites, large blood, trace ketones
- BC: (+) for MSSA
- UC: (+) for MSSA

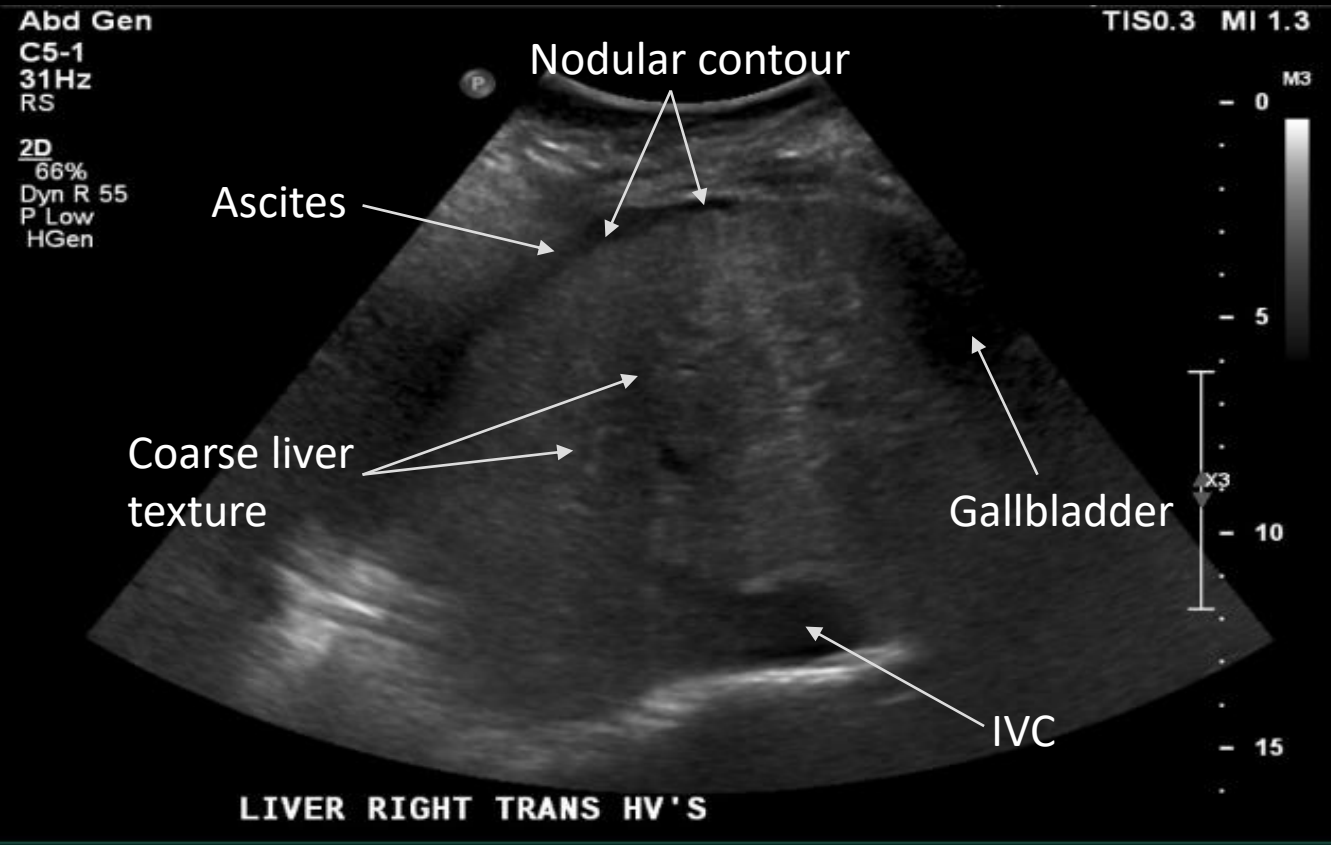
Initial Workup

Imaging:

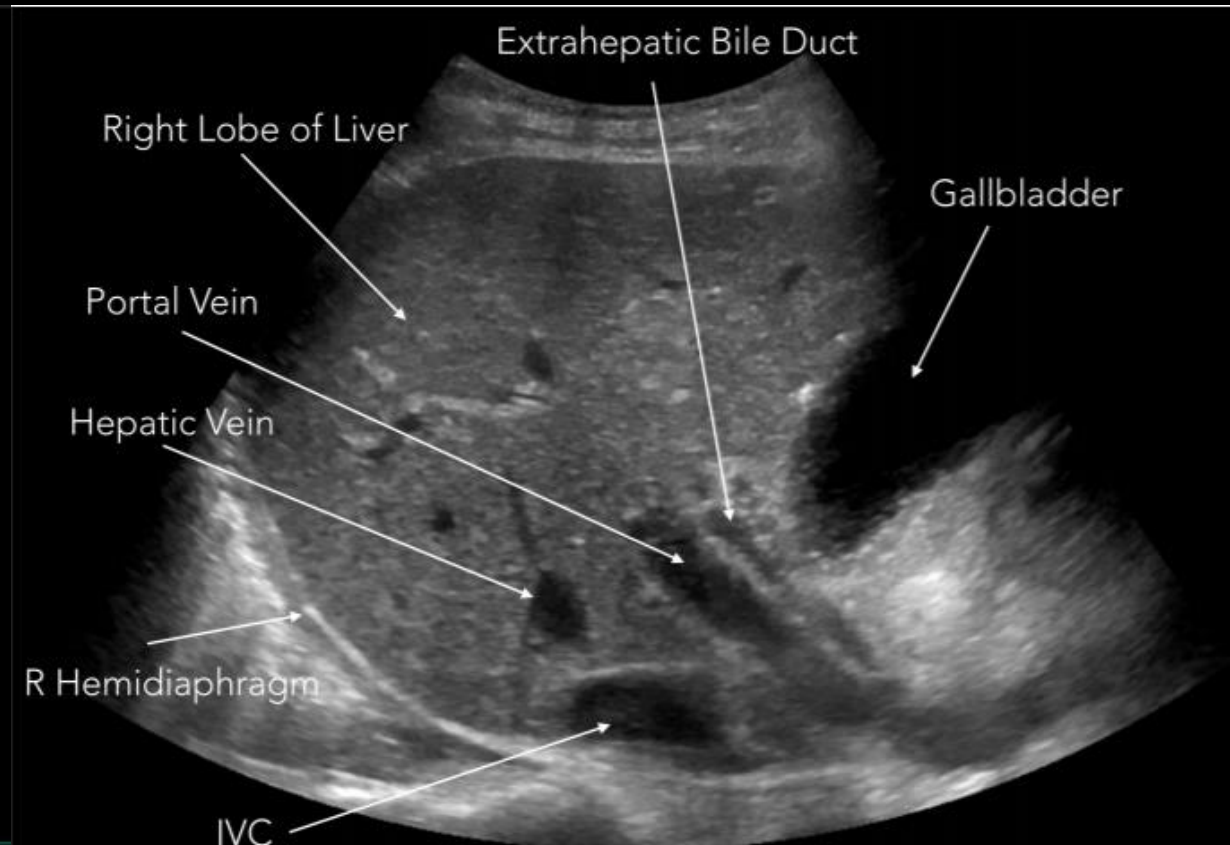
- CT head w/o contrast normal
- TTE neg
- Liver Doppler US ordered for further evaluation
- CT Abd/Pelvis showed cirrhotic changes

Liver Ultrasound with Doppler (9/29)

Patient



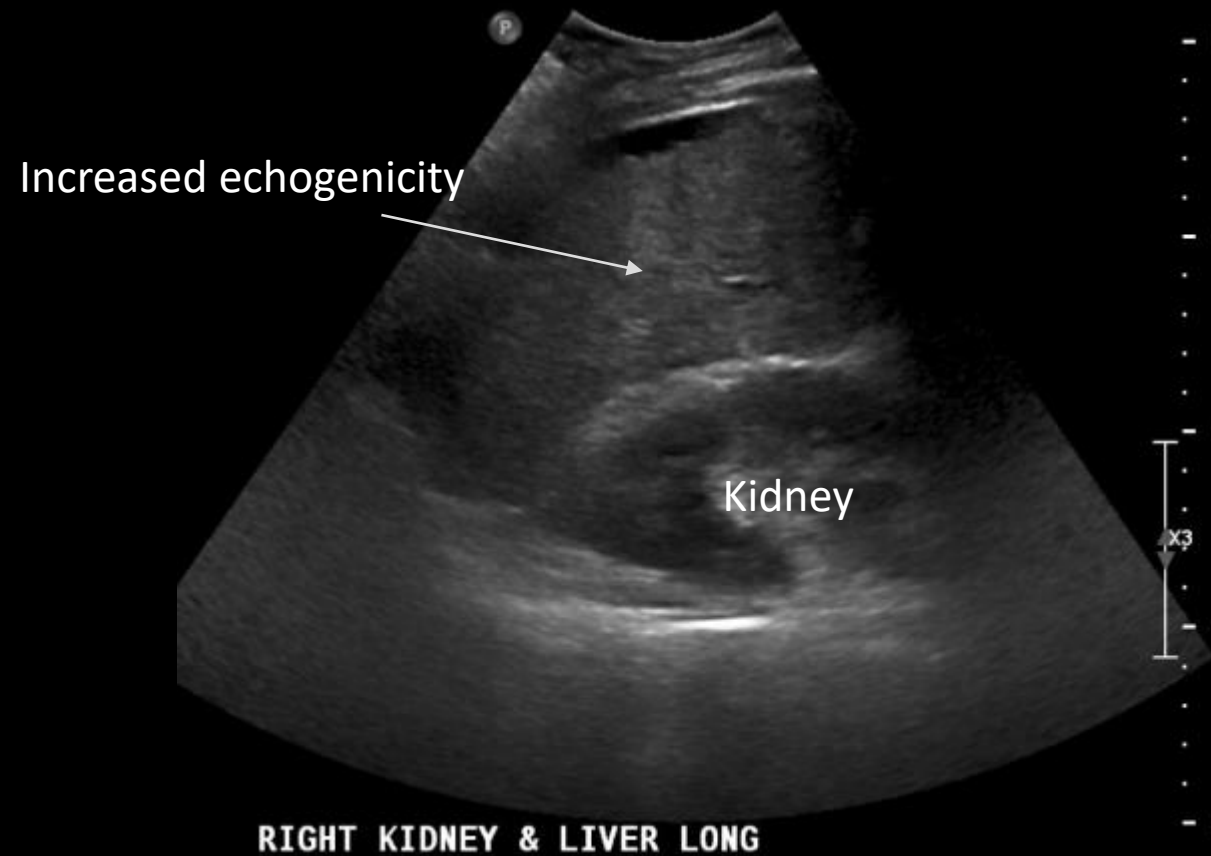
Normal



Liver Ultrasound with Doppler (9/29)

Patient

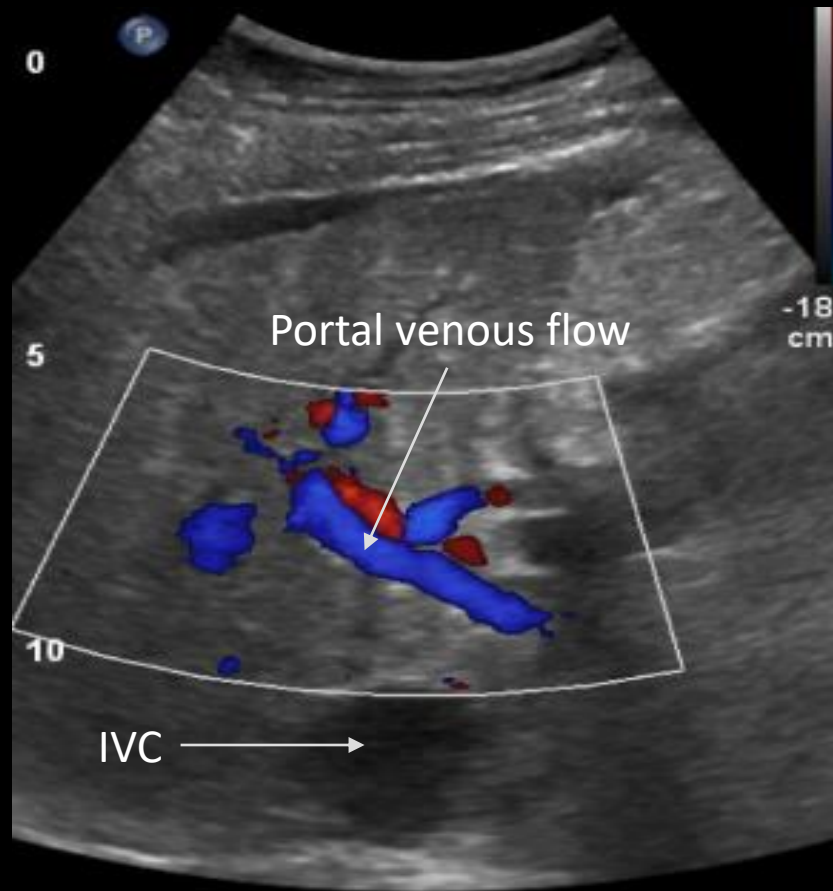
Normal



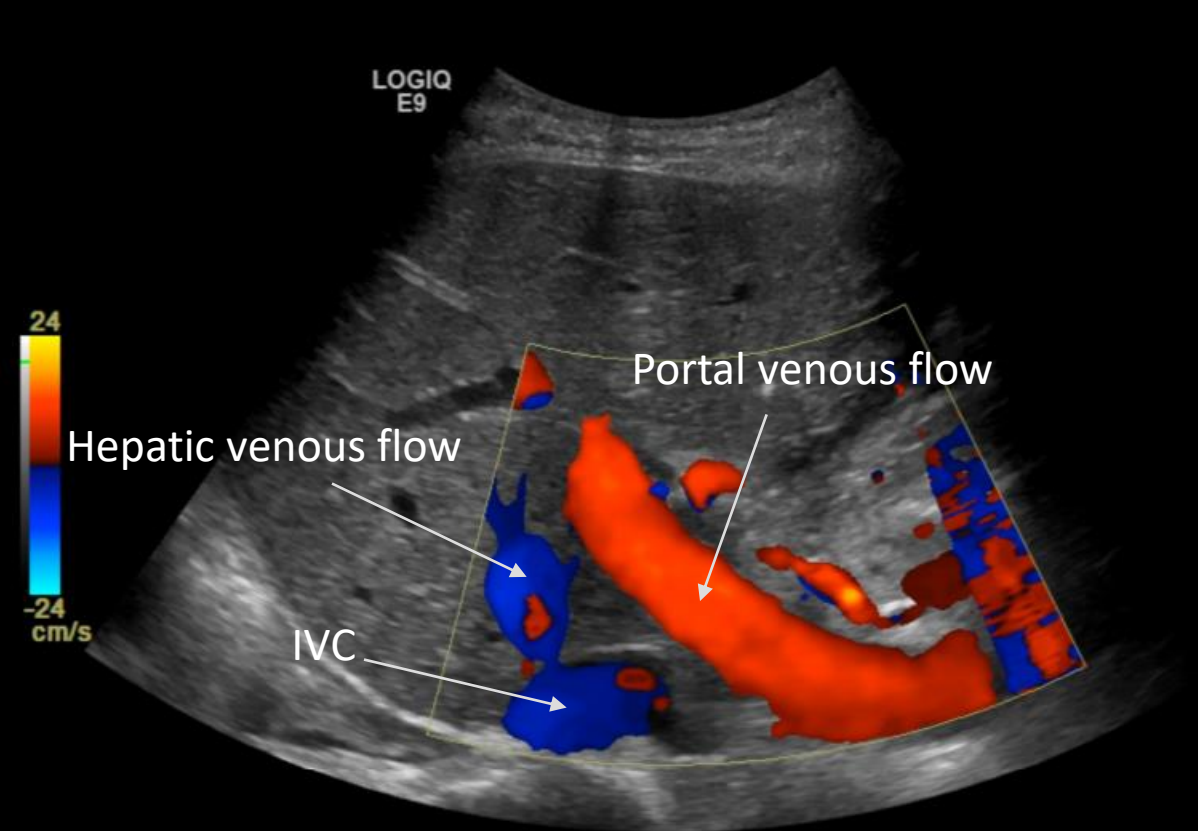
Source: <https://www.renalfellow.org>

Liver Ultrasound with Doppler (9/29)

Patient



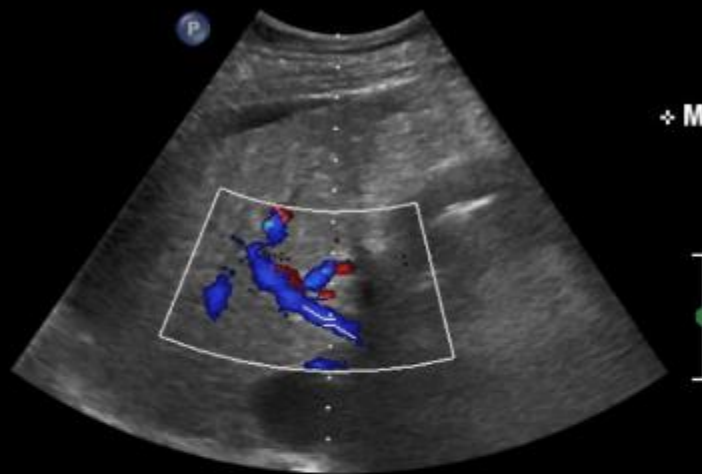
Normal



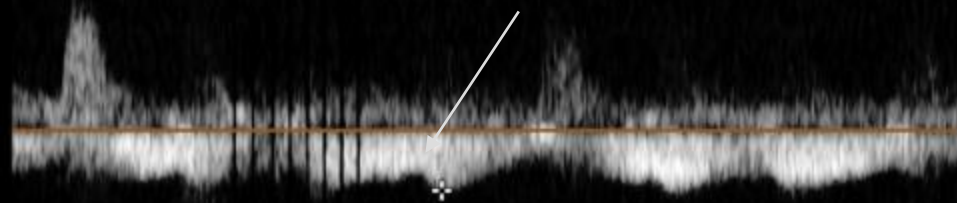
Liver Ultrasound with Doppler (9/29)

Patient

Ada Gen
C5-1
10Hz 60°
2D
63%
Dyn R 55
P Med
HGen
CF
51%
1320Hz
WF 65Hz
2.8MHz
PW
40%
WF 50Hz
SV 2.0mm
2.2MHz
9.2cm

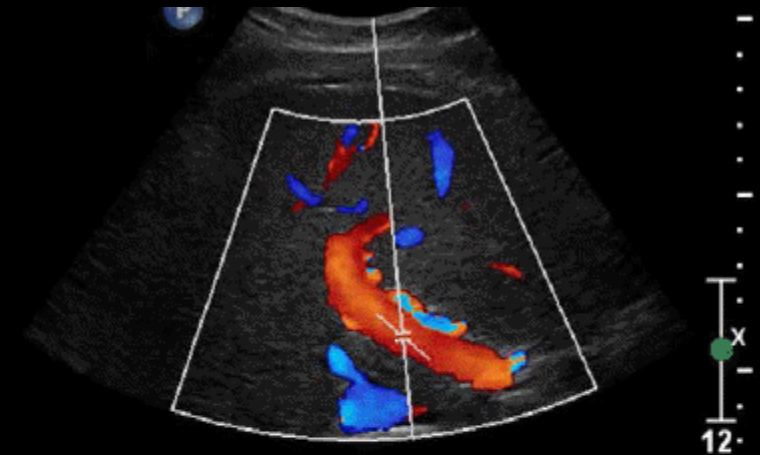


Predominantly negative flow

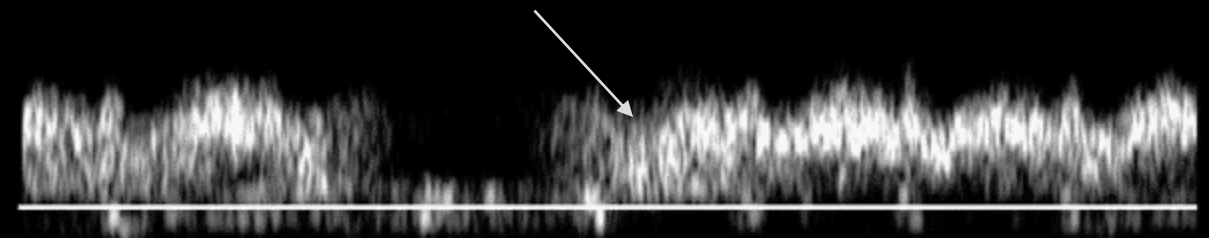


Normal

D
37%
55
Med
Gen
F
56%
700Hz
VF 52Hz
led



Strong pulsatile, positive waveform

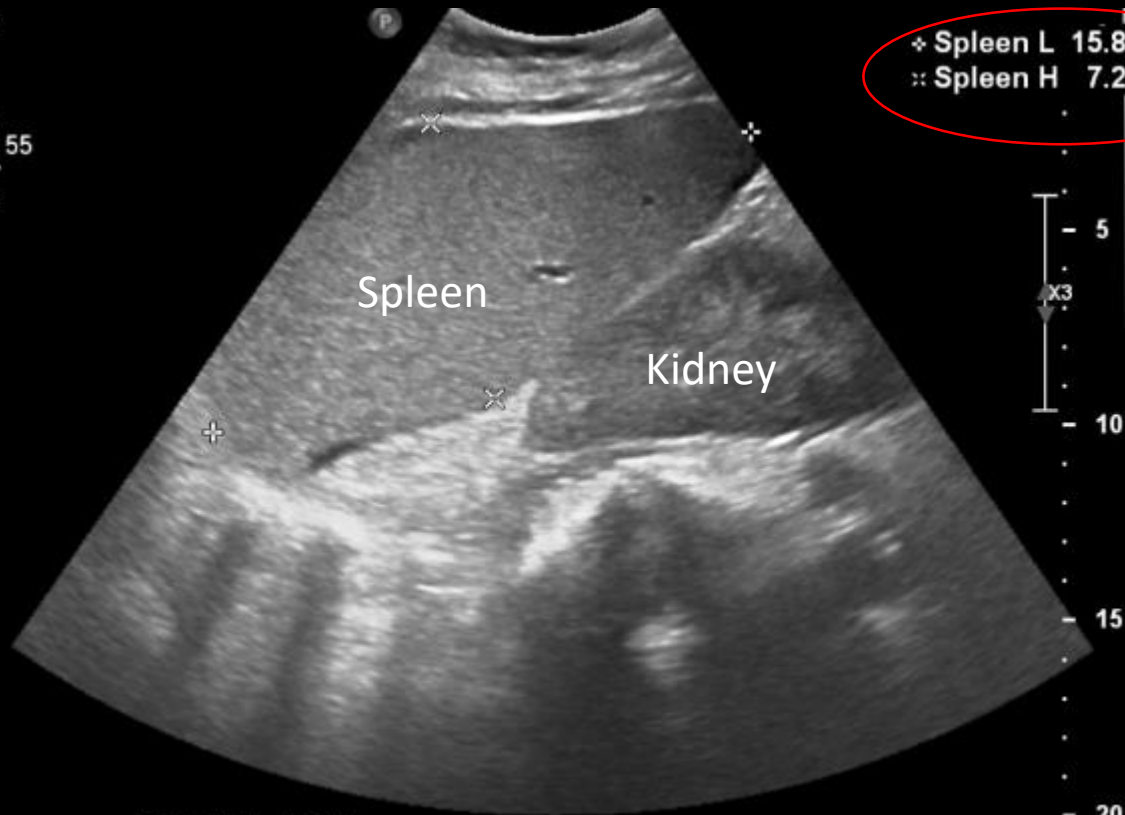


Source: <https://www.e-ultrasonography.org>

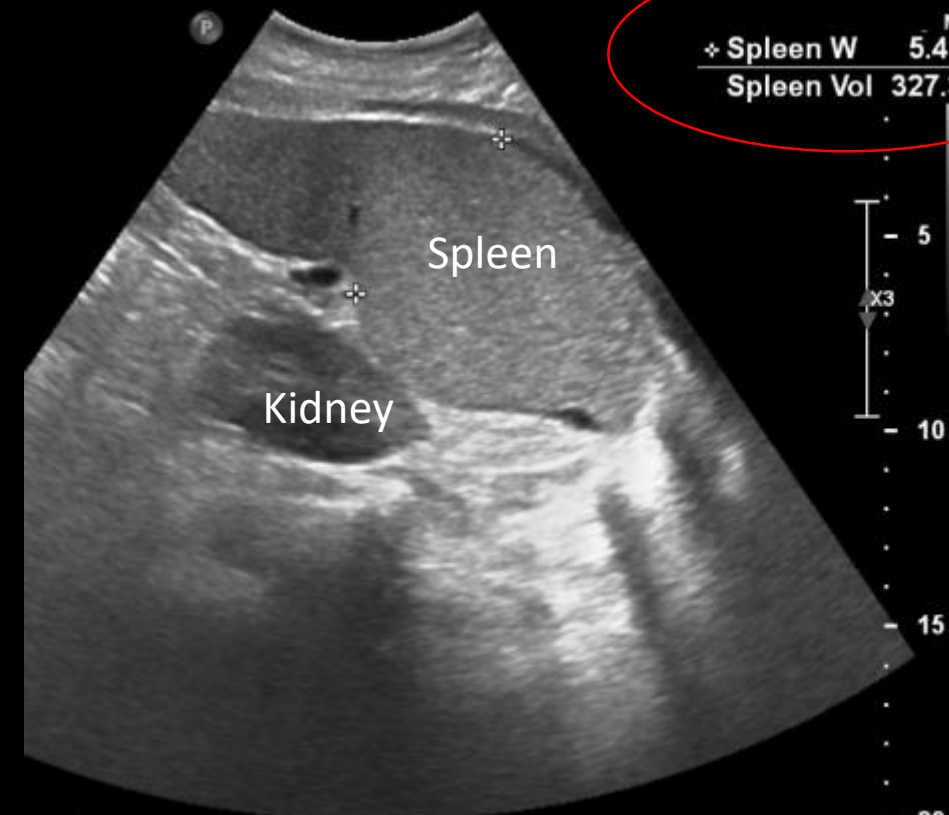
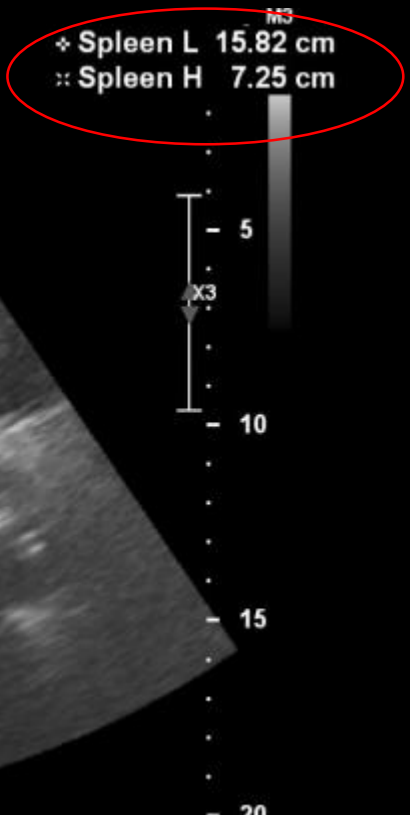
Liver Ultrasound with Doppler (9/29)

Patient

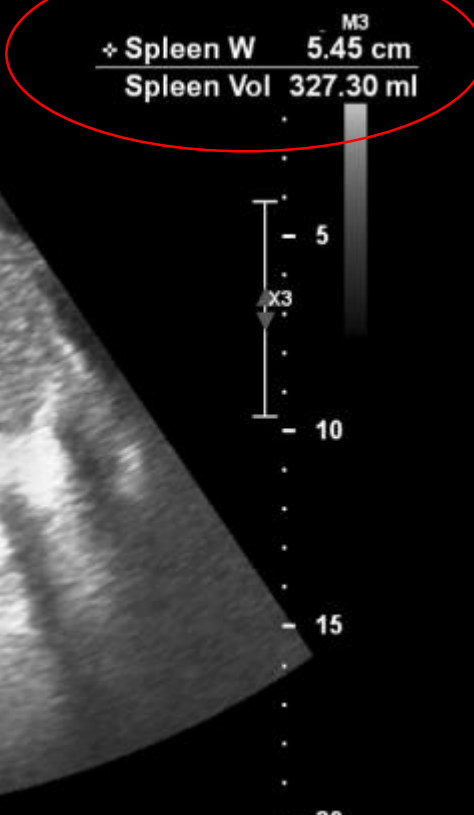
26HZ
RS
2D
74%
Dyn R 55
P Low
HGen



SPLEEN LONG

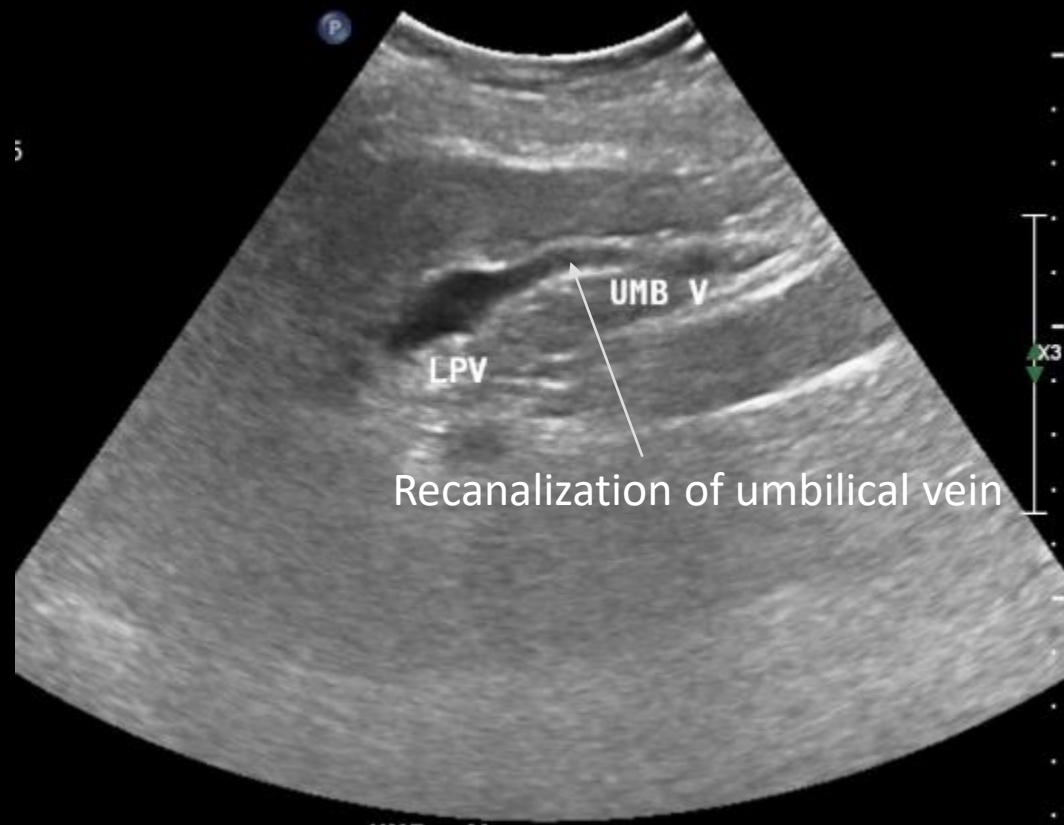


EEN TRANS



Liver Ultrasound with Doppler

Another Patient*



Summary

Liver ultrasound with Doppler findings:

- Ascites
- Coarsened liver texture
- Nodular contour
- Increased echogenicity of liver
- Hepatofugal portal venous flow
- Splenomegaly
- Recanalization of the umbilical vein*

Clinical History

- Confused and “not acting like herself”

Physical Exam Findings:

- A&Ox1
- Jaundice, scleral icterus
- 1+ pitting edema in BLE
- Abdominal tenderness on palpation with guarding

Cirrhosis Classification

Child-Turcotte-Pugh Classification for Severity of Cirrhosis

Clinical and Lab Criteria	Points*		
	1	2	3
Encephalopathy	None	Grade 1 or 2	Grade 3 or 4
Ascites	None	Mild to moderate (diuretic responsive)	Severe (diuretic refractory)
Bilirubin (mg/dL)	< 2	2-3	>3
Albumin (g/dL)	> 3.5	2.8-3.5	<2.8
Prothrombin time			
Seconds prolonged	<4	4-6	>6
or			
International normalized ratio	<1.7	1.7-2.3	>2.3

*Child-Turcotte-Pugh Class obtained by adding score for each parameter (total points)

Class A = 5 to 6 points

Class B = 7 to 9 points

Class C = 10 to 15 points

Child-Pugh Score: used to assess the severity and prognosis of chronic liver disease, mainly cirrhosis

For this patient:

Child-Pugh Score = Class C

Life Expectancy = 1-3 years

Source: <https://www.hepatitisc.uw.edu/>

Differential/Final Diagnosis

Chief Complaint: Altered Mental Status

- Hepatic encephalopathy secondary to Class C Cirrhosis
- SBP
- Sepsis
- UTI
- Hyperosmolar hyperglycemic syndrome (HHS)

Pathophysiologic explanation

- Cirrhosis causing hepatic encephalopathy due to toxin build-up such as ammonia and changes in neurotransmission and circulating amino acids
- Sepsis causes a systemic inflammatory response
- UTI spreading to cross the blood-brain barrier
- HHS secondary to hyperosmolarity and hyperglycemia

ACR appropriateness Criteria

**American College of Radiology
ACR Appropriateness Criteria®
Acute Mental Status Change, Delirium, and New Onset Psychosis**

Variant 1:

Acute mental status change. Increased risk for intracranial bleeding (ie, anticoagulant use, coagulopathy), hypertensive emergency, or clinical suspicion for intracranial infection, mass, or elevated intracranial pressure. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
CT head without IV contrast	Usually Appropriate	☼ ☼ ☼
MRI head without IV contrast	Usually Appropriate	0
MRI head without and with IV contrast	May Be Appropriate	0
CT head without and with IV contrast	May Be Appropriate	☼ ☼ ☼
CT head with IV contrast	Usually Not Appropriate	☼ ☼ ☼

Source: <https://acsearch.acr.org>

MCGOVERN MEDICAL SCHOOL

ACR appropriateness Criteria

**American College of Radiology
ACR Appropriateness Criteria®
Acute Nonlocalized Abdominal Pain**

Variant 1: Acute nonlocalized abdominal pain and fever. No recent surgery. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
CT abdomen and pelvis with IV contrast	Usually Appropriate	⊕⊕⊕
MRI abdomen and pelvis without and with IV contrast	May Be Appropriate	○
US abdomen	May Be Appropriate	○
CT abdomen and pelvis without IV contrast	May Be Appropriate	⊕⊕⊕
MRI abdomen and pelvis without IV contrast	May Be Appropriate	○
CT abdomen and pelvis without and with IV contrast	May Be Appropriate	⊕⊕⊕⊕
Radiography abdomen	May Be Appropriate	⊕⊕
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	⊕⊕⊕⊕
WBC scan abdomen and pelvis	Usually Not Appropriate	⊕⊕⊕⊕
Nuclear medicine scan gallbladder	Usually Not Appropriate	⊕⊕
Fluoroscopy contrast enema	Usually Not Appropriate	⊕⊕⊕
Fluoroscopy upper GI series with small bowel follow-through	Usually Not Appropriate	⊕⊕⊕

Cost

- Liver ultrasound with Doppler = \$537
- CT Abdomen/Pelvis with contrast = \$1,994
- CT Head w/o contrast = \$1,137
- TTE: \$1,655

Sources:

- <https://www.memorialhermann.org/patients-caregivers/pricing-estimates-and-information/>
- <https://www.mdsave.com/procedures/echocardiography-with-or-without-color-doppler/d784fbc8>

Take Home Points / Teaching points

- Altered mental status has a broad differential
- Imaging findings of cirrhosis is largely due to distortion of architecture
- Recanalization of the umbilical vein is abnormal because after birth it should become the round ligament

References

- American College of Radiology. (n.d.). *ACR Appropriateness Criteria*. <https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria>. Retrieved October 14, 2020, from <https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria>
- *Pricing Estimates and Information | Memorial Hermann*. (2019, February 25). Memorialhermann. <https://www.memorialhermann.org/patients-caregivers/pricing-estimates-and-information/>
- Thorton, K. T. (2018, May 18). *Evaluation and Prognosis of Patients with Cirrhosis*. <https://www.hepatitisc.uw.edu/go/evaluation-staging-monitoring/evaluation-prognosis-cirrhosis/core-concept/all>. <https://www.hepatitisc.uw.edu/go/evaluation-staging-monitoring/evaluation-prognosis-cirrhosis/core-concept/all>
- UCSF Emergency Medicine Ultrasound. (n.d.). *UCSF ED Liver and Gallbladder/Biliary Ultrasound Protocol*. <https://edus.ucsf.edu/>. Retrieved October 14, 2020, from <https://edus.ucsf.edu/>
- First Aid
- UptoDate



Questions?