

## **Class 2 BLI Notes**

Case 1" Patient presents with complaints of fatigue. On observation patient has pale sclera and on examination HR 110 b/min. Blood work shows **low RBC, Hg, Hct**. What is the next test you would like to see?

- MCV is >100 (increased/high)

What is the next test you would like to see?

- Blood levels of B12 and Folate – Folate comes back normal and B12 is low.

Which test you would order to rule out Pernicious anemia?

- Schilling test – looks how well B12 is being absorbed – if it is positive. B12 is not being absorbed.
- Intrinsic factor (parietal cell – HCL acid, atrophic gastritis)

What is the next test that should be ordered?

- **Autoantibodies against parietal cells/intrinsic factor**

What is the cause of patient B12 def?

- Pernicious anemia

What is the best treatment for this patient?

- Tx: B12 injection, B12 + intrinsic factor complex

Case 2: Patient presents with complaints of fatigue. On observation patient has pale sclera and on examination HR 110 b/min. Blood work shows **low RBC, Hg, Hct**. What is the next test you would like to see?

- MCV is >100 (increased/high)

What is the next test you would like to see?

Blood levels of B12 and Folate – Normal folate, and normal, but at the lowest range B12.

- What test can be ordered to see if the patient still has B12 deficiency

- Serum methylmalonic acid (MMA) levels. An elevated levels of MMA support B12 deficiency. Can also be elevated in kidney failure. MMA can be used to monitor effects of treatment
- Homocysteine – levels are elevated (Drives cholesterol into arteries and increases the risk of developing atherosclerosis)

If this deficiency is not detected, other than anemia, what is another problem that can develop in this patient – permanent neurologic deficit.

If the patient takes high levels of Folate in can mask B12 deficiency anemia

Case 3: Patient presents with complaints of fatigue. On observation patient has pale sclera and on examination HR 110 b/min. Blood work shows **low RBC, Hg, Hct**. Patient started to eat lost ice recently. What is the next test you would like to see?

- MCV - <80 (low, decreased)

What is the next best test to confirm my diagnosis?

- Ferritin – low

What is the patient reason for anemia?

- Fe deficiency
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What if the ferritin levels are not conclusive, but you still suspect iron def. What is the next best test – bone marrow biopsy

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Liver panel

### **Liver enzyme**

1. ALT (alanine aminotransferase) – enzyme inside liver cells
2. AST (aspartate aminotransferase) – enzyme inside liver cells
3. ALP (alkaline phosphatase)

ALT and AST can be part of Metabolic panels (Basic, Comprehensive) to screen for liver disease

### **Protein**

Most blood proteins are made in liver

1. Albumin
2. Total protein
3. Bilirubin

Depending of Lab there can be other test included

1. GGT
2. LD/LDH (Lactate dehydrogenase)
3. PT (Prothrombin time)
4. AFP (alpha-fetoprotein)
5. Autoimmune antibodies

Test for liver cell injury

1. Hepatocellular necrosis – marked, moderate or mild - values of ALT and AST elevation. Most specific for liver cell injury is ALT
2. **Markedly high values of ALT** and AST (>10 times normal, Example lab value is 40, patient will have >500)
  - a. Acute viral hepatitis
  - b. Toxin and drug induced hepatitis
  - c. Ischemic/hypoxic hepatitis
3. Moderately elevated ALT and AST
  - a. Chronic hepatitis B
  - b. Passage of stone through common bile duct
  - c. Wilsons disease – copper toxicity (Ceruloplasmin deficiency/genetic disease)
  - d. Acute fatty liver of pregnancy
4. Mildly elevated ALT and AST
  - a. Cirrhosis
  - b. Cholestasis
  - c. Hepatocellular cancer
  - d. Alcohol related liver disease
5. Levels normal
  - a. Hemochromatosis – iron toxicity
  - b. Chronic hepatitis B
  - c. Chronic hepatitis C
  - d. Primary biliary cholangitis

ALT is more specific for liver cell injury, biliary obstruction, pancreatitis

AST – liver cells, heart muscle cells, skeletal muscle cells, kidney, RBC

AST:ALT ratio.

1. AST:ALT >2 (600:200 =3) = Alcoholic liver disease
2. AST: ALT <1 (200:600 = 0.33) = Viral hepatitis

Patient presents with jaundice (yellow skin = icterus). On examination patient has also yellow sclera. Blood work shows markedly elevated ALT and AST and AST:ALT ratio is <1. (This indicative of Viral hepatitis), What is next test(s) to confirm your hypothesis?

- Serology test (Screening tests for viral hepatitis)

Other test that can help determine problems with liver cells injury

Lactate dehydrogenase (LDH) (LDH1 -5)

1. **Liver – LDH5**
2. Skeletal muscle – LDH5
3. Testicular tumors – LDH 5
4. Lungs – LDH2 and 3
5. MI – LDH1 and 2
6. RBC – LDH 1
7. Renal – LDH1
8. Lymphoma – LDH2 and 3
9. Pancreatitis – LDH4

How specific is elevated LDH for liver disease – not very

Tests for cholestasis

1. Total bilirubin (Pre-hepatic, Hepatic, post-hepatic hyperbilirubinemia)
  - a. RBC issue – Polycythemia (too many RBC), Hemolysis (RBC due too fast)
  - b. Liver problem – hepatitis
  - c. Bile duct problem – cholestasis
2. Unconjugated bilirubin – elevated
  - a. Increased production – Hemolytic anemia, autoimmune destruction, Polycythemia, hypersplenism

- b. Liver problems – cannot conjugate (lack of enzymes) – Gilberts syndrome
- 3. Conjugated bilirubin – elevated
  - a. Liver disease
  - b. Gallbladder disease
  - c. Bile ducts disease

Unconjugated bilirubin is water insoluble and bound to albumin.

Hyperbilirubinemia (unconjugated hyperbilirubinemia, conjugated hyperbilirubinemia, or combined hyperbilirubinemia), bilirubinuria (increased presence of conjugated bilirubin in urine)

Patient 1 presents with fatigue, jaundice, malaise, slight fever. Blood test shows markedly elevated ALT, AST, with ration  $<1$  , elevated LDH, elevated total bilirubin, with both conjugated and unconjugated fractions elevated. Stool is white. = more indicative of liver necrosis

Patient 2 presents with fatigue, jaundice, malaise, slight fever. Blood test shows mild elevated ALT, AST, with ration 1 , elevated total bilirubin, with conjugated elevated and unconjugated fraction normal. Stool is light. = more indicative of bile ducts, gallbladder obstruction (Cholestasis)

- 4. Alkaline phosphatase (AP, ALP)
  - a. Other liver tests are normal (ALT, AST)
  - b. Liver/bile ducts and **bone**
  - c. Partial bile duct obstruction
  - d. Primary biliary cholangitis
  - e. Primary sclerosing cholangitis
- 5. Gamma-glutamyl transpeptidase (GGT)– increased in hepatocellular dysfunction, especially cholestasis
- 6. 5-Nucleodidase – increased in cholestasis and biliary obstruction (sensitive as alkaline phosphatase, but more specific)

Cholestasis – Conjugated bilirubin, ALP, GGT, 5-Nucleotidase

## Tests for hepatic synthesis capacity

1. PT (Prothrombin time) and INR (International normalized ration) – prolonged
  - a. Liver produces coagulation factors
2. Serum protein (decreased)
  - a. Albumin (Kidney or liver) – low levels lead to edema – water accumulation in interstitial space (area between cells)
  - b. Globulin
  - c. Ceruloplasmin (reduced in Wilson's disease – accumulation of copper)
3. Ammonia
  - a. Nitrogen compounds
  - b. Increased – liver failure
  - c. Hepatic encephalopathy
  - d. Ammonia levels can be increase by – high protein diets, GI bleeding, Metabolic alkalosis (Blood pH >7.45), high doses of chemotherapy, shock, salicylate intoxication

Alpha – fetoprotein levels – increased in primary hepatocellular carcinoma

Patient 1 presents with fatigue, jaundice, malaise, slight fever. Blood test shows markedly elevated ALT, AST, with ration <1 , elevated LDH, elevated total bilirubin, with both conjugated and unconjugated fractions elevated. Stool is white. = more indicative of liver necrosis. Practitioner suspects acute viral hepatitis.

Will screen for Viral hepatitis – serology tests

1. IgM antibody to HAV (IgM anti-HAV). HAV = Hepatitis A Virus
2. Hepatitis B surface antigen (HBsAg)
3. IgM antibody to hepatitis B core (IgM anti-HBc)
4. Antibody to hepatitis C virus (anti-HCV), hepatitis C RNA (HCV-RNA)

## Hepatitis A virus

1. **IgM anti-HAV positive = Acute hepatitis A**
  - a. If it has not been done – do liver panel (ALT, AST)
2. IgG anti-HAV – prior infection (lifelong immunity) or immunization

## Hepatitis B virus

1. HBsAg = anti-HBs (HBsAb)
2. HBcAg = anti-HBc (HBcAb)
3. HBeAg = anti-HBe (HBeAb)

## Acute hepatitis B infection

1. **HBsAg +**
2. Anti-HBs – (negative)
3. **IgM anti-HBe +**
4. IgG anti-HBc –
5. HBeAg +/-
6. Anti-HBe –
7. **HBV-DNA +**

## Chronic hepatitis B infection

1. **HBsAg + (Virus is still present)**
2. Anti-HBs – (negative)
3. **IgM anti-HBe – (negative)**
4. **IgG anti-HBc + (there is some immunity)**
5. HBeAg +/-
6. Anti-Hbe +/-
7. **HBV-DNA +**

## Prior HBV infection

1. HBsAg – (negative)
2. **Anti-HBs +**
3. IgM anti-HBe -
4. **IgG anti-HBc +/-**
5. HBeAg -
6. **Anti-HBe +/-**

## 7. HBV-DNA –

Prior HBV vaccination

1. HBsAg -
2. **Anti-HBs +**
3. IgM anti-HBe -
4. IgG anti-HBc –
5. HBeAg -
6. Anti-Hbe –
7. HBV-DNA –

If still not sure and need more info:

1. Ultrasound
2. Biopsy

Patients' serology is negative for HAV, HBV, HCV, but you suspect there is viral infection affecting this patient from the lab work. Look for less common infections – Epstein-Barr virus (Infectious mononucleosis), cytomegalovirus. If not virus – amebiasis, giardiasis

## **Pancreatic panel**

Patient presents with mid-abdominal pain radiating to the back, loss of appetite, nausea. On observation there is bruising around the umbilicus and over right flank

1. Amylase (pancreatic) – increased
  - a. Acute pancreatitis, penetrating peptic ulcer to the pancreas, necrotic bowel, acute cholecystitis, Parotitis (Mumps), Ruptured ectopic pregnancy
2. **Lipase (pancreatic) – increased = pancreatic disease**
3. Urine amylase test – increased



