

**CP105: APPROACHES TO  
DIAGNOSING AND MONITORING  
LIVER DISEASE USING  
LABORATORY TESTS—  
SOMETHING OLD, SOMETHING NEW**

**Part 2—Case Histories**

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## Case 1

A 49 year old male with a history of schizophrenia presented to the emergency room confused, lethargic, and combative, admitting to taking some pills. A urine toxicology screen was negative for abused drugs. He was treated with gastric lavage and administered activated charcoal. Approximately 12 hours after admission, he admitted to taking “a handful” of Tylenol PM tablets; he had been up for three days, and took the pills because he had run out of his usual sleeping pills and was trying to fall asleep. He was unclear about the time he had taken the tablets. Specimens were retrieved from admission, 5 hours after admission, and 10 hours after admission for acetaminophen level; the latter two specimens also had adequate blood for liver related tests. The acetaminophen levels were 269, 305, and 217  $\mu\text{g}/\text{mL}$ , respectively.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
5 hours after admission	78	90	88	0.7	0.1	8.5	4.7	N/D
10 hours after admission	118	128	87	1.1	0.3	8.2	4.5	15.7

Questions:

- What is the significance of the history of acetaminophen ingestion and the levels obtained?
- How do you interpret the liver related tests 5 and 10 hours after admission? Do they suggest that there is no significant injury from acetaminophen ingestion in this case?
- What additional tests, if any, would you do?

The patient was begun on N-acetyl cysteine. Twenty-two hours after admission, a third set of liver tests is drawn. The results are:

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
22 hours after admission	2130	1290	91	1.7	0.6	7.8	4.1	N/D

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Questions:

- What do the results at this time suggest?
- What further tests would you recommend?
- What should be done for the patient?

Laboratory test results over the next two days are shown in the table.

<b>DATE</b>	<b>AST</b>	<b>ALT</b>	<b>ALK. PHOS.</b>	<b>Total Bili.</b>	<b>Direct Bili.</b>	<b>Total Protein</b>	<b>Alb.</b>	<b>Pro. Time</b>
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
5 hours after admission	78	90	88	0.7	0.1	8.5	4.7	N/D
17 hours later	2130	1290	91	1.7	0.6	7.8	4.1	N/D
24 hours later	3150	2230	85	1.5	0.5	7.1	3.7	24.6
48 hours later	5520	4885	83	1.2	0.5	6.5	3.3	32.5

Questions:

- What is the typical time course of enzyme and functional changes in acetaminophen toxicity?
- What additional tests are helpful in predicting prognosis?

## Case 2

An 52 year old man with a history of sarcoidosis and schizophrenia presented with a 15 hour history of nausea and dull, constant epigastric abdominal pain; the pain resolved abruptly on the morning of admission, leaving only mild right upper quadrant tenderness. He denied diarrhea, constipation, or change in bowel habits. He was on no medications for the past several months. On physical examination he had no fever, a normal sized liver, and had tenderness in the right upper abdomen on palpation. Admission laboratory results were essentially normal except for his liver tests (shown in the table below); amylase was 82 U/L (reference 50-180 U/L) and lipase was 94 U/L (reference 50-240 U/L). A CT scan of the abdomen revealed a dilated common bile duct and intrahepatic bile ducts, and an enlarged head of the pancreas; the gall bladder was said to be unremarkable, and no stones were seen in the gallbladder or the bile ducts.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
One year earlier	19	19	79	0.5	0.2	7.2	4.4	N/D
Admission	259	151	116	0.7	0.2	7.7	4.3	10.6
Second day	438	686	176	4.1	2.5	7.0	4.0	N/D
Third day	191	418	183	1.6	0.2	6.9	3.9	11.3

### Questions:

- What pattern or patterns of injury are suggested by the liver enzymes and function tests at the time of admission?
- How do the dilated bile duct and enlarged pancreas fit with your tentative diagnosis?
- What additional tests would be helpful in evaluating this patient?

An acute hepatitis panel was drawn; all serologic markers were negative. The patient continued to feel well clinically, and a GI consult was obtained. The GI staff felt that he had biliary obstruction, and could not distinguish whether the enlarged pancreas was due to edema from pancreatitis or due to a tumor. They recommended daily measurement of amylase, lipase, and liver enzymes. On the third hospital day, he developed dull, constant abdominal pain which continued through the night, associated with nausea. A surgery consultant recommended an abdominal ultrasound on the morning of the fourth hospital day. Amylase and lipase drawn on the morning of the fourth hospital day were now markedly elevated (amylase 1,078 U/L, lipase 5,130 U/L). Repeat liver enzymes were as follows:

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<b>DATE</b>	<b>AST</b>	<b>ALT</b>	<b>ALK. PHOS.</b>	<b>Total Bili.</b>	<b>Direct Bili.</b>	<b>Total Protein</b>	<b>Alb.</b>	<b>Pro. Time</b>
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
Third day	191	418	183	1.6	0.2	6.9	3.9	11.3
Fourth day	168	386	236	2.9	1.5	6.7	3.8	ND

Questions:

- Do the changes in laboratory results after admission support any of the diagnostic possibilities? Which is most likely given the additional studies obtained?
- Are all of the results consistent with your diagnosis? If not, which would suggest another diagnostic possibility? What further tests would you suggest to the clinicians?

### Case 3

A 62 year old male presented to clinic for a follow-up visit. He was complaining of fatigue over the past one month and had lost 10 pounds over the same period. He had also lost his appetite, and had epigastric pain occasionally along with nausea. He had noted that over the past two weeks his stool had become very pale and his urine very dark. Approximately 2-3 days before this visit, he had noted that his skin and eyes were yellow.

His past medical history is significant for ulcerative colitis, which was diagnosed 18 years before and had been minimally symptomatic; he was on no treatment for this. He also had a history of arthritis involving his spine and multiple other joints; this was thought to be inflammatory in nature, as C-reactive protein was elevated, but rheumatoid factor was negative. He denied any exposure to toxins; he use Tylenol occasionally but not in “excessive” amounts. He has had no exposure to any person with hepatitis, has never used intravenous drugs, and has never had blood transfusions. He has a past history of heavy alcohol abuse but has been abstinent from alcohol for 14 years. He was taking no medications at the time of admission.

Physical examination included normal vital signs except for temperature of 99.3° F. The liver was normal in size and was mildly tender. He was markedly icteric. His hematocrit was normal, as was his WBC count, with a normal differential. Laboratory results at the time of admission and at the time of a clinic visit two weeks earlier are shown in the table.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
Three years earlier	19	14	63	0.5	0.1	7.3	4.7	N/D
Two weeks earlier	1888	2400	342	12.4	7.4	7.4	3.9	N/D
Admission	643	912	328	28.2	16.5	5.9	3.4	13.3

#### Questions:

- What pattern or patterns of injury are suggested by the liver enzymes and function tests at the time of admission?
- Does his history of ulcerative colitis suggest any specific disorder that might be responsible for his laboratory findings? Are they consistent with that diagnosis?
- What is the significance of the increase in bilirubin and prothrombin time in light of the falling enzyme levels?
- What additional tests would be helpful in evaluating this patient?

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His condition continued to improve clinically, and by 6 days after admission AST was 157 U/L, his ALT 308 U/L, alkaline phosphatase was 298 U/L, total bilirubin was 11.1 mg/dL, direct bilirubin was 5.0 mg/dL, albumin was 3.6 g/dL, and prothrombin time was 12.2 sec.

Does the change in laboratory results alter your differential diagnosis as well? What do you think about the severity of disease based on the function tests such as bilirubin, prothrombin time, and albumin?

Hepatitis serologies were reported on the 6<sup>th</sup> day after admission. They included negative anti-HAV, negative anti-HCV, negative anti-HBs, positive HBsAg, positive total anti-HBc, and positive IgM anti-HBc.

How do you interpret these serologic findings?

## Case 4

A 54 year old male presents for a routine physical examination. He has a history of alcohol abuse for many years, and has been on treatment for depression with Zoloft. On physical examination, the only abnormal finding was high blood pressure; he was begun on hydrochlorothiazide. Routine laboratory results of liver status are shown in the table. He was advised to reduce his drinking and told to return in 6 months for a repeat check; results are shown in the table. He states that he has significantly reduced his alcohol intake. The only other complaint he has at this second visit is erectile dysfunction.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
Initial	119	155	68	0.7	0.2	7.3	4.9	N/D
6 months later	116	151	66	0.7	0.1	7.6	4.8	N/D

Questions:

- What do the laboratory results suggest? Would these findings be consistent with alcohol induced liver disease?
- What additional tests would you recommend to evaluate this patient?

Hepatitis serologies were drawn two months later; liver tests were essentially unchanged at that time. Anti-HCV, anti-HBc, anti-HBs, and HBsAg were all negative.

What are common causes of chronic liver injury other than alcohol and viral hepatitis?

What would you do next to evaluate this patient?

He denied any history of ingestion of other medications besides those prescribed. He again stated that he had reduced his alcohol intake to only an occasional drink. Serum iron, iron binding capacity, and ferritin were ordered. Serum iron was 268  $\mu\text{g/dL}$ , iron binding capacity was 293  $\mu\text{g/dL}$ , and ferritin 4,768  $\text{ng/mL}$ .

What disorder do these results suggest? What additional testing should be done to confirm the diagnosis?

## Case 5

SM is a 40 year old male diagnosed with hepatitis C in 1994 during a routine physical examination. At that time he had abnormal liver enzymes and a positive hepatitis C antibody test. The patient has a history of alcohol and IV drug abuse in the distant past. In 1995 he was treated with interferon and reportedly cleared the virus from his bloodstream. A biopsy performed at the end of his treatment course showed mild chronic active hepatitis with no significant increase in fibrosis. He presents to the Hepatology Clinic in March 1998 with the complaints of increasing fatigue and weight gain. He was entered into a re-treatment protocol with both interferon (3 MIU/week) and ribavirin (1,000 mg/day).

Test	AST	ALT	Alk. Phos.	Tot. Bili	Tot. Prot.	Albumin	Viral Load
Reference range	0-40	0-45	50-130	0.3-1.3	6.7-8.0	3.7-5.0	< 50
Day 0	61	146	69	0.5	7.2	4.8	4.0 x 10 <sup>6</sup>
Week 24	32	45	75	0.7	6.7	4.0	3.8 x 10 <sup>4</sup>
Week 48	24	36	74	0.6	6.7	3.9	2.5 x 10 <sup>4</sup>

### Questions:

- How would you interpret this patient's response to therapy at 12 weeks? At 24 weeks? What are the criteria for treatment response?
- Of those who respond to treatment at 12 or 24 weeks, what is the likelihood of viral "clearance" once treatment is discontinued?
- What factors help predict response to therapy? Does the fact that he did not respond to treatment with interferon monotherapy in the past reduce the likelihood that he will be successfully treated with combination therapy? Was it appropriate to re-treat him based on the information provided?
- The patient is infected with HCV genotype 1b. Is his response to therapy typical for patients infected with this genotype?

## Case 6

A 59 year old black male with a history of diabetes (controlled by diet), carotid artery stenosis, and benign prostatic hyperplasia, came to the hospital 12/2/01 complaining of fatigue, vomiting, and dark colored stools. He was found to have heme-positive stools and iron deficiency anemia. In addition, routine admission laboratories showed elevation of AST and ALT, as shown in the table. In retrospect, he had elevated enzymes for several months, and had transient elevation of ALT approximately 10 years earlier that lasted for one month. All other systems were reviewed and were negative. He did not drink, smoke or use illicit drugs. His medications on admission included terazosin, chlorzoxazone, piroxicam, and ticlid. Laboratory results are summarized in the table.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
9 yrs previously	42	83	64	1.1	0.2	8.6	4.5	N/D
8 to 2 yrs previous	21-29	31-38	55-60	0.3-0.9	0.1	7.4-8.6	4.1-4.3	ND
3 months previous	243	365	87	0.6	0.3	6.2	3.1	11.9
1 month previous	279	424	176	1.4	1.4	7.1	2.8	12.7
Admission	468	453	244	3.4	2.1	7.1	2.8	15.2

### Questions:

- What do the laboratory results suggest? Is there anything in the laboratory results that is not consistent with acute hepatitis?
- What additional tests would you recommend to evaluate this patient?
- Hepatitis serologies were drawn, including anti-HCV, anti-HBc, and HbsAg; all were negative. Anti HAV had been noted to be positive in 1992 and was not repeated.
- How would you interpret the viral serologic results? Do they rule out acute viral hepatitis?
- What are other causes of acute liver injury other than alcohol and viral hepatitis? Are these results consistent with ischemic or toxic liver injury?
- In reviewing his previous laboratories, it was noted that he had a high titer anti-nuclear antibody in 1992, which had never been further evaluated.
- What would you do next to evaluate this patient?

## Case 7

A 57 year old Taiwanese man was referred to the liver clinic for evaluation of elevated enzymes and positive hepatitis B surface antigen. He denied multiple sex partners, substance abuse, or blood transfusions. He relates that his father has some form of hepatitis, but that neither his mother nor his siblings have ever been diagnosed with hepatitis. He admits to mild fatigue, but has no other symptoms.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	mg/dL	g/dL	g/dL	sec.
Eight years earlier	55	137	79	1.3	0.2	8.5	4.9	N/D
Five years earlier	52	109	75	1.0	0.2	7.9	4.2	N/D
One year earlier	64	119	66	1.4	0.2	8.1	4.0	ND
Clinic visit	112	262	92	0.6	0.1	7.8	3.9	11.5

His viral markers are as follows:

Marker	Status
Anti-HAV	<b>Positive</b>
HBsAg	<b>Positive</b>
HBeAg	Negative
Anti-HBc	<b>Positive</b>
Anti-HBsAg	Negative
Anti-HBe	<b>Positive</b>
Anti-HCV	Negative

In reviewing his records, he was noted to have persistently positive HBsAg since at least 1994, with negative HBeAg and positive anti-HBe.

Questions:

- How do you interpret the results of his laboratory tests and his serologic studies? Are the liver enzyme results compatible with a chronic carrier state of hepatitis B?
- Because he likely was infected in Asia, where there is a high prevalence of pre-core mutants of hepatitis B, HBV DNA was measured. The viral load was 230,000 copies/mL using a commercial PCR assay. What is the significance of this level of HBV DNA? What, if anything, should be done about his HBV viremia?
- He was started on oral lamivudine treatment in November of 2002. Two weeks after initiation of treatment, his AST was 34 IU/L and his ALT was 54 IU/L. After three months on therapy, his AST was 26 IU/L and his ALT was 29 IU/L. A repeat HBV DNA was below the detection limits of 200 copies/mL, but HBsAg remained positive. What are the goals of treatment of chronic HBV infection?

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- After two and a half years of treatment, his viral load (which had been < 200 copies/mL) was 16,015 despite continued lamivudine treatment. Repeat tests 6 and 12 months later had similar viral loads, although his ALT remained normal. What is the likely cause for the increase in HBV DNA? What tests could be done to prove one particular cause? What other options exist for treating this patient?
- About 3.5 years after initially being started on lamivudine, adefovir dipivoxil was added to his regimen. HBV DNA three months after starting treatment was < 200 copies/mL. Lamivudine was discontinued and he is currently on treatment with adefovir. What is the likelihood that resistant mutants will develop?

## Case 8

A 59 year old male with a history of alcohol abuse and positive serologies for hepatitis C had the following laboratory test results over a follow-up period of 2 years from first visit to the liver clinic.

<b>DATE</b>	<b>AST</b>	<b>ALT</b>	<b>ALK. PHOS.</b>	<b>Total Bili.</b>	<b>Direct Bili.</b>	<b>Total Protein</b>	<b>Alb.</b>	<b>Pro. Time</b>
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	Mg/dL	Mg/dL	g/dL	g/dL	sec.
2 yrs previously	98	73	144	0.8	0.2	8.8	3.7	
1 yr previously	105	73	93	0.8	0.3	7.3	3.1	
Current visit	82	69	113	0.7	0.2	8.4	3.7	13.2

Questions:

- What pattern of liver disease do the laboratory test results suggest? What are the late complications of chronic hepatitis?
- Based on that impression, what further testing would you recommend to follow this patient?
- A liver biopsy was performed in 1994 and revealed micronodular cirrhosis. He was begun on periodic screening for AFP, and his initial result in February of 1994 was 79.2 ng/mL (reference 0-9 ng/mL). A repeat test in June of 1994 was 13.3 ng/mL, with results of 31.2 in October of 1994, 26.1 in April of 1995, and 51.3 in March of 1996. During this time, there was no significant change in his liver associated enzymes, bilirubin, or albumin; further prothrombin time testing was not performed.
- How would you interpret this pattern of results? Would you do any further testing?
- Several abdominal ultrasound examinations were performed over this period of time, with no mass detected. In July of 1996, AFP was 255 ng/mL. A repeat ultrasound examination revealed a question of a calcified mass in the liver, but was considered inconclusive. Another AFP performed in October of 1996 was 1,788 ng/mL.
- What do these results suggest? What further tests or other procedures might be of benefit?

## Case 9

A 48 year old female with a history of polysubstance abuse, type 2 diabetes, and bipolar disorder was admitted for symptoms of depression. She had been taking metformin, elavil, and lithium. She had lost her appetite for several days, and had nausea but no vomiting. She also complained of right upper quadrant discomfort, and had mild tenderness in the same area on physical examination. Although not initially noted on admission in the evening, the next morning she was noted to be markedly jaundiced. Laboratory results are illustrated in the table. Review of her previous laboratory results (from earlier admissions and outpatient visits) showed that she had consistently normal liver enzymes over the prior three years; hepatitis serologies done one year earlier were negative for HBsAg, anti-HBc, anti-HBs, and anti-HCV; total antibody to HAV was positive at that time.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	Mg/dL	g/dL	g/dL	sec.
Admission	4372	1233	728	24.4	17.8	6.1	3.4	11.4
24 hours later	5320	1328	601	24.4	17.5	5.5	3.1	11.5
48 hours later	5070	1420	481	23.3	17.2	4.9	2.8	N/D

Questions:

- What pattern of liver injury do these results suggest?
- What additional laboratory tests would you recommend?
- She denied any history of acetaminophen ingestion; an acetaminophen level on admission was below the limits of detection. An imaging study of the abdomen was normal. Hepatitis serologies were unchanged from those of a year before.
- What additional possibilities for acute liver injury should be considered based on these initial results? Do the serologic findings rule out acute viral hepatitis? What additional laboratory tests would you suggest in this case?

Over the next four days, her enzymes gradually decreased, but there was no significant change in her bilirubin or prothrombin time, and albumin remained stable. She was discharged from the hospital and was seen back in clinic three weeks after her initial admission. She felt much better, and her appetite had returned, and her urine had become clear. Laboratory results over this period are illustrated in the table. HCV RNA drawn two days after admission was positive.

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<b>DATE</b>	<b>AST</b>	<b>ALT</b>	<b>ALK. PHOS.</b>	<b>Total Bili.</b>	<b>Direct Bili.</b>	<b>Total Protein</b>	<b>Alb.</b>	<b>Pro. Time</b>
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	mg/dL	Mg/dL	g/dL	g/dL	sec.
4 days later	3720	1355	437	25.7	18.8	4.9	2.7	12.4
One week later	1285	796	417	24.7	17.4	5.1	2.9	12.0
Three weeks later	1095	1530	799	10.1	5.7	7.8	4.2	11.6

Questions:

- How would you interpret the positive HCV RNA?
- Is this pattern consistent with acute hepatitis C? What is the time sequence of serologic markers in acute hepatitis C infection?
- What additional tests would you do in this case?

Repeat anti-HCV several months later was strongly positive. Her AST and ALT continued to be elevated at last follow-up 8 months after admission.

## Case 10

A 53 year old male with a history of substance abuse presented to the emergency room on 12/5/02 complaining of fatigue, muscle aches, fever, diarrhea, and jaundice. He related that he had been in a fight approximately 5 weeks earlier, and had been stabbed repeatedly in the hand with a needle that had been used by an injecting drug abuser. He denied any recent drug or alcohol abuse; he stated that his last drug use had been nine months previously. He denied any use of acetaminophen, and denied any use of herbal supplements. He was sent home and told to return in 2 days; on evaluation two days later, he was noted to have worsening liver function and was admitted. On physical examination he had an enlarged, tender liver; he was noted to be markedly jaundiced. Hepatitis serologies had been done in December of 2000; he was negative for HBsAg, anti-HBc, and anti-HCV.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Reference Range	0-40	0-45	50-130	0.3-1.3	0-0.2	6.7-8.0	3.7-5.0	11-12
Units	U/L	U/L	U/L	Mg/dL	Mg/dL	g/dL	g/dL	sec.
7/30/02	29	21	90	0.8	0.1	8.0	4.3	ND
12/5/02	1739	441	189	11.0	7.2	6.6	2.9	15.8
12/7/02	3188	803	191	14.0	9.5	6.1	2.6	17.0

Questions:

- What pattern of liver disease do these results suggest? What additional tests would you order?
- An acute viral hepatitis panel is ordered. Total anti-HAV was negative, as was anti-HCV. HBsAg was positive, as was HBeAg and total anti-HBc (IgM anti-HBc was pending). How do you interpret these results? Do they rule out acute hepatitis A and hepatitis C? Do they rule in acute hepatitis B?

His clinical picture worsened during the first three days in the hospital; he had poor oral intake, but did not develop encephalopathy, so was transferred to the intensive care unit for closer monitoring. Laboratory results over the next several days are shown in the table below.

DATE	AST	ALT	ALK. PHOS.	Total Bili.	Direct Bili.	Total Protein	Alb.	Pro. Time
Admission	3188	803	191	14.0	9.5	6.1	2.6	17.0
1 d later	4144	1340	205	16.8	11.5	6.7	2.7	16.8
2 d later	5270	2746	175	17.4	12.9	6.0	2.6	18.9
3 d later	6975	4413	202	21.7	13.4	6.9	3.0	19.8
4 d later	5495	3570	151	18.7	12.0	5.9	2.4	24.8

Questions:

- How would you evaluate the additional laboratory results? Does a decrease in enzymes indicate a favorable prognosis? What laboratory test(s) are best for evaluating severity of liver damage in acute hepatitis?
- On Day 4, IgM anti-HBc was reported as positive. Antibody to HDV (delta agent) was also reported as positive. How do you interpret these results? What is the significance of coinfection with HBV and HDV?
- Over the next week, his laboratory results continued to improve, and he was discharged on the 9<sup>th</sup> day. Repeat hepatitis B serologies were performed one month later; HBsAg was still positive, HBeAg was negative, and anti-HBe was positive. Repeat anti-HCV was negative, and HCV RNA was negative. What is the significance of the HBV serologies at this time? What additional tests would you like to order?