Family Medicine
436 Team

Data Interpretation

Color Index	IMPORTANT	NOTES	GOLD	EXTRA

OBJECTIVES

- Interpret CBC findings of anemia (IDA, Normocytic, Macrocytic and hemolytic)
- Distinguish two types of polycythemia
- Interpret problems of liver function tests
- Explain different types of thyroid disorders
- Recognize hypocalcemia due to vit D deficiency and hypoparathyroidism
- Recognize hypercalcemia due to hyperparathyroidism
- Explain different presentation of Hepatitis B markers
- Interpret urine and stool analysis

DONE BY

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Safe CBC interpretation

Major CBC components

- Hemoglobin
- WBCs
- Platelets

If all major components are normal, then it is very less likely you miss a serious disease.

CBC

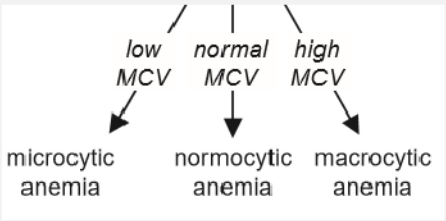
1- look at Hemoglobin if low >> look at other major components (WBCs and Platelets) to not miss bone marrow disease.

2- if there is no striking abnormality of WBC and platelet then check MCV to classify the anemia into microcytic, normocytic or macrocytic.

3- some references recommend checking reticulocyte before MCV to not miss hemolytic anemia but not practical.

REMEMBER: Anemia is a symptom not a disease.

So, look for underlying cause.

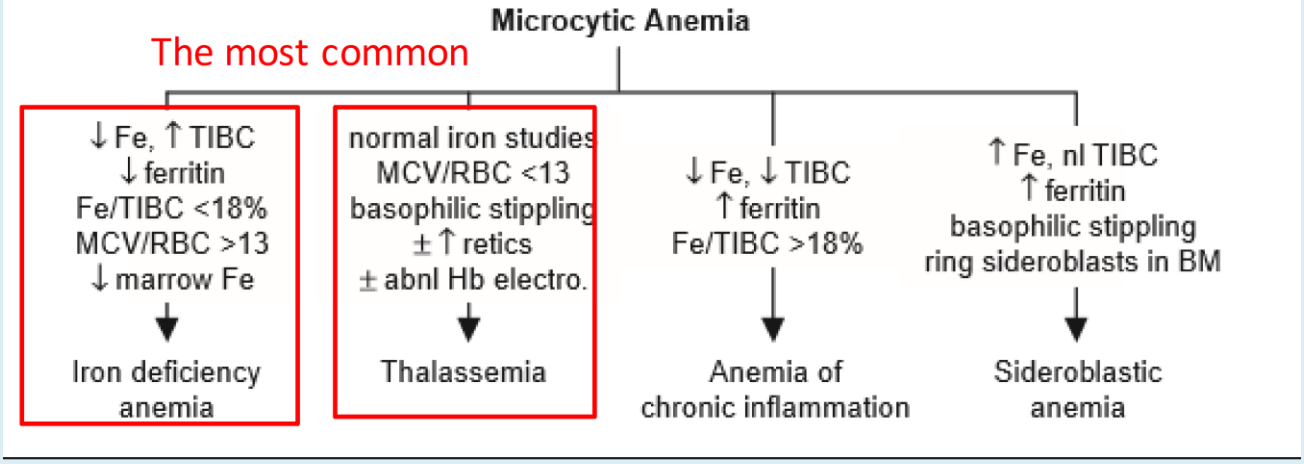


Helpful parameters to diagnose the underlying anemia cause

- Size of red blood cells (MCV): (small/ normal/ big)
- Abnormal cells on microscopic examination (like blast cells in leukemia)
- Status of leukocytes and platelets (bone marrow function)
- Reticulocyte count (ability of marrow to respond to anemia)>> can help in hemolytic anemia (**if high**) and in marrow suppression (**if low**).
- Evidence of destruction(hemolysis) as elevated LDH and **indirect bilirubin**

Microcytic anemia:

Figure 5-2 Approach to microcytic anemias



Iron Deficiency anemia features

A. Iron studies – Low serum iron
B. High total iron binding capacity (TIBC, Transferrin concentration)
C. Low % transferrin saturation
D. Low ferritin (the most sensitive test esp. if < 15)

IDA Vs. Thalassemia

Features might help in distinguishing between IDA and Thalassemia

Feature	IDA	Thalassemia
RBC	Low, Low normal	High, High normal
MCV	Mild to moderate low (most likely above 70)	Very low (< 70)
RDW	Mostly High	Mostly normal
Mentzer index: MCV/RBC	> 13	< 13

A 25-year-old lady, presented with 2 months H/O dizziness and fatigue

The following CBC is shown below:

WBC	7. 0		(4– 11) x10.e9/L
RBC	3.7	L	(4.2– 5.5) x10.e12/L
HGB	90	L	(120 – 160) g/L
HCT	28	L	(42 – 52) %
MCV	73	L	(80 – 94) fl
MCH	23.6	L	(27 – 32) pg
MCHC	320		(320 – 360) g/L
RDW	15.8	H	(11.5 – 14.5) %
PLT 330			(140 – 450) x10.e9/L

Hypochromic microcytic anemia
Most likely: IDA

In this patient (IDA) what do you expect (Ferritin, TIBC, Fe and Transferrin saturation) to be?

- Ferritin: Low (especially if < 15)
- Total Iron Binding capacity TIBC: High
- Fe: Low
- Transferrin sat.: Low

IDA Treatment

Oral (Fe) three times a day (less if not tolerated)

How much hemoglobin raise is expected with treatment?

- Around 2 to 4 g/dL every three weeks.
- (if the rate is slower check for an ongoing bleeding).

How long is the treatment course?

- It takes around 6 weeks to correct anemia and 6 months to replete iron stores.

NOTE: consider upper and lower GI endoscopy for any males (esp. elderly) and postmenopausal women to rule out GI malignancy.

65 years old gentleman presented with Hx of SOB and generalized weakness

the following CBC is shown below:

WBC	7. 9		(4– 11) x10.e9/L
RBC	3.1	L	(4.2– 5.5) x10.e12/L
HGB	5.7	L	(120 – 160) g/L
HCT	24	L	(42 – 52) %
MCV	74	L	(80 – 94) fl
MCH	23.9	L	(27 – 32) pg
MCHC	319		(320 – 360) g/L
RDW	16.9	H	(11.5 – 14.5) %
PLT	410		(140 – 450) x10.e9/L

Most likely IDA
Need Urgent Blood transfusion

Generally The Hb threshold for blood transfusion for asymptomatic patient is <7 g/L

A 31-year-old man came for pre-marital checkup.

the following CBC is shown below:

WBC	8.5		(4– 11) x10.e9/L
RBC	5.9	L	(4.7– 6.1) x10.e12/L
HGB	122	L	(130 – 180) g/L
HCT	39	L	(42 – 52) %
MCV	63.5	L	(80 – 94) fl
MCH	20.4	L	(27 – 32) pg
MCHC	317		(320 – 360) g/L
RDW	14		(11.5 – 14.5) %
PLT	177		(140 – 450) x10.e9/L

hypochromic microcytic anemia
Most likely thalassemia

-What will you order to confirm the diagnosis in this case?

Hemoglobin electrophoresis (HE)

-What do you expect to find in (HE)?

If HbA2 is GREATER than 3.5 > b-Thalassemia minor

If HbA2 is normal > alpha Thalassemia minor

Normocytic anemia

Differential diagnosis of normocytic anemia

Anemia of chronic disease or inflammation like:

- Chronic kidney disease
- Autoimmune disorders
- Chronic infection
- Malignancy

55-year-old gentleman k/c of CKD came for follow up

the following CBC is shown below:

WBC	8.9		(4– 11) x10.e9/L
RBC	5.1	L	(4.7– 6.1) x10.e12/L
HGB	111	L	(130 – 180) g/L
HCT	41	L	(42 – 52) %
MCV	88	L	(80 – 94) fl
MCH	30	L	(27 – 32) pg
MCHC	352		(320 – 360) g/L
RDW	14		(11.5 – 14.5) %
PLT	199		(140 – 450) x10.e9/L
Creatinine.....	188		(53– 106) µmol/L
Urea.....	7		(2.5– 7.1) mmol/L
eGFR.....	34		mL/min/1.73m^2

What is the diagnosis?

- Normocytic normochromic anemia most likely secondary to CKD
- What CKD stage? (Stage **3B** where the GFR = 30-44 mL/min)

Macrocytic anemias

Causes

- **Megaloblastic:**
  1. Vitamin B12 deficiency
  2. Folate deficiency
- **Non-megaloblastic:**
  1. Liver disease
  2. Myelodysplastic syndrome
  3. Increased reticulocyte count
  4. Alcoholism > Bone marrow suppression & macrocytosis independent of folate/B12 deficiency or cirrhosis.

41-year-old alcoholic complains of fatigue:

the following CBC is shown below:

WBC	9.6		(4– 11) x10.e9/L
RBC	5.5	L	(4.7– 6.1) x10.e12/L
HGB	121	L	(130 – 180) g/L
HCT	41	L	(42 – 52) %
MCV	99	L	(80 – 94) fl
MCH	38	L	(27 – 32) pg
MCHC	362		(320 – 360) g/L
RDW	13		(11.5 – 14.5) %
PLT	320		(140 – 450) x10.e9/L

What lab you will order for this patient?

1- Vit. b12

2- Folate

Macrocytic hyperchromic anemia

Hemolytic anemia findings

- **High** reticulocyte (percentage > 4%)
- **High** LDH, and **low** haptoglobin and hemoglobinuria (If intravascular hemolysis)

14 years old complains of generalized weakness and yellowish discoloration of skin for 2 days

the following CBC is shown below:

WBC	9.2		(4– 11) x10.e9/L
RBC	5.5	L	(4.7– 6.1) x10.e12/L
HGB	9.5	L	(130 – 180) g/L
HCT	41	L	(42 – 52) %
MCV	81	L	(80 – 94) fl
MCH	28	L	(27 – 32) pg
MCHC	322		(320 – 360) g/L
RDW	14.4		(11.5 – 14.5) %
PLT	188		(140 – 450) x10.e9/L

LFT:

Total bilirubin.....	48 H	(3 – 17) umol/L
Direct bilirubin.....	4 L	(0 – 5) umol/L
Total protein	73	(60-80 g/L)
Albumin	38	(35-50 g/L)
Alkaline phosphatase	55	(50-136u/L)
Alanine aminotransferase	40	(20-65 u/L)
Aspartate aminotransferase ...	22	(10-31 u/L)
G.G. Transferase	40	(5-55 u/L)

What will you order to confirm your diagnosis?

- Reticulocytes is the most important
- (LDH will be high and haptoglobin will be low)

Polycythemia approach

- **What is the most important test to approach polycythemia?**
  - **Erythropoietin**
- **Low** erythropoietin = most likely primary polycythemia (Vera)
- **High** erythropoietin = most likely secondary polycythemia (Smoking, COPD, Hypoxia)
- Polycythemia Vera sometimes combined with high WBC and/or platelet.

A 51-year-old man presents with 2-month history of headache

the following CBC is shown below:

WBC	20.8	(4– 11) x10.e9/L
RBC	8.33 L	(4.7– 6.1) x10.e12/L
HGB	201 L	(130 – 180) g/L
HCT	62.6 L	(42 – 52) %
MCV	81 L	(80 – 94) fl
MCH	28.9 L	(27 – 32) pg
MCHC	329	(320 – 360) g/L
RDW	14.0	(11.5 – 14.5) %
PLT	300	(140 – 450) x10.e9/L

polycythemia

32 years old gentleman came for regular check up

the following CBC is shown below:

WBC	10.9	(4– 11) x10.e9/L
RBC	6 L	(4.7– 6.1) x10.e12/L
HGB	14.6 L	(130 – 180) g/L
HCT	51 L	(42 – 52) %
MCV	81 L	(80 – 94) fl
MCH	30L	(27 – 32) pg
MCHC	340	(320 – 360) g/L
RDW	12.8.	(11.5 – 14.5) %
PLT	86	(140 – 450) x10.e9/L

Thrombocytopenia

Thrombocytopenia

- Thrombocytopenia (i.e., platelet count <150,000/microL [150 x 109/L])
- Severe spontaneous bleeding is most likely with platelet counts <20,000 to 30,000/microL, especially below 10,000/microL.
- Surgical bleeding generally may be a concern with platelet counts <50,000/microL
- DDx is wide and including bone marrow malignancy.

Thrombocytosis

patients with elevated platelet counts, the initial diagnostic question is whether their thrombocytosis is

- A reactive phenomenon (Infection, Post-surgery, Trauma)

OR

- A marker for the presence of a hematologic disorder (Chronic myeloproliferative neoplasms)

A 48 years old lady complains of leg redness and hotness (cellulitis)

the following CBC is shown below:

WBC	10.2	(4– 11) x10.e9/L
RBC	5.7 L	(4.7– 6.1) x10.e12/L
HGB	15.6 L	(130 – 180) g/L
HCT	50 L	(42 – 52) %
MCV	91 L	(80 – 94) fl
MCH	31 L	(27 – 32) pg
MCHC	360	(320 – 360) g/L
RDW	12.6	(11.5 – 14.5) %
PLT	665	(140 – 450) x10.e9/L

Thrombocytosis
Most likely reactive

Neutropenia Vs leukopenia

- ❖ Leukopenia = low WBCs
- ❖ Neutropenia = low absolute neutrophils count (ANC)
- ❖ Leukopenia does not equal neutropenia
- ❖ Febrile neutropenia is a medical emergency
- ❖ Neutropenia classification is based on Absolute Neutrophils Count (ANC)
  - Mild < 1.5 K/ul (1500 cells/MicroL)
  - Moderate < 1.0 K/ul (1000 cells/MicroL)
  - Severe < 0.5 K/ul (500 cells/MicroL)

A 28-year-old gentleman k/c of AML on chemotherapy complains of Fever

the following CBC is shown below:

Test Name	Result	Units	Flag	Reference Range
CBC W/ 5 PART DIFF. (X6)				*Run by:*
WBC	2.2	K/uL		4.0 - 11.2
RBC	4.35	M/uL		4.00 - 5.60
HGB	14.5	gm/dL		12.0 - 16.0
HCT	41.7	%VOL		35.0 - 50.0
MCV	96	fl		82 - 98
PLATELETS	210	K/uL		140 - 440
MCH	33.3	pg		26.0 - 36.0
MCHC	34.7	g/dL		27.0 - 36.0
RDW	12.0	%		9.0 - 18.0
MPV	7.4	fl		6.0 - 12.0
NEU%	42.3	%		45.0 - 65.0
LYMPH%	38.6	%		20.0 - 50.0
MONO%	14.3	%		0.0 - 11.0
EOS%	3.9	%		0.0 - 7.0
BASO%	0.9	%		0.0 - 3.0
NEUT#	0.91	K/uL		2.00 - 8.00
LYMPH#	0.83	K/uL		1.80 - 4.80
MONO#	0.31	K/uL		0.10 - 1.10
EOS#	0.08	K/dl		0.00 - 0.80
BASO#	0.02	K/dl		0.00 - 0.30

Neutrophil percentage ✖

Absolute neutrophil count ✓

Febrile Neutropenia

Pancytopenia DDx

1. Bone marrow malignancy
2. Viral Infection
3. Drug induced

WBC	3.1		(4– 11) x10.e9/L
RBC	5.7	L	(4.7– 6.1) x10.e12/L
HGB	105	L	(130 – 180) g/L
HCT	40	L	(42 – 52) %
MCV	90	L	(80 – 94) fl
MCH	31	L	(27 – 32) pg
MCHC	362		(320 – 360) g/L
RDW	13.3		(11.5 – 14.5) %
PLT	117		(140 – 450) x10.e9/L

Pancytopenia (need a carful management)

Urine data interpretation

Kidney function assessment

- Assessing kidney function is different from screening for kidney disease
- Measured GFR is the best overall index of kidney function in health and disease
- eGFR (estimated GFR) maybe the best available way to assess kidney function despite having some limitations

eGFR staging when there is an evidence of kidney pathology (lab, image or histology)

GFR stages	GFR (mL/min/1.73 m^2)	
G1	≥90	Normal or high
G2	60 to 89	Mildly decreased
G3a	45 to 59	Mildly to moderately decreased
G3b	30 to 44	Moderately to severely decreased
G4	15 to 29	Severely decreased
G5	<15	Kidney failure (add D if treated by dialysis)

Relative risk mortality with eGFR stage and albumin creatinine ratio (ACR)

All-cause mortality

	ACR <10	ACR 10-29	ACR 30-299	ACR ≥300
eGFR >105	1.1	1.5	2.2	5.0
eGFR 90-105	Ref	1.4	1.5	3.1
eGFR 75-90	1.0	1.3	1.7	2.3
eGFR 60-75	1.0	1.4	1.8	2.7
eGFR 45-60	1.3	1.7	2.2	3.6
eGFR 30-45	1.9	2.3	3.3	4.9
eGFR 15-30	5.3	3.6	4.7	6.6

UTI

- What urine analysis finding could be seen in UTI?
  - Positive WBCs: a number of leukocytes (WBCs) >10/microL indicate significant pyuria
  - Positive Nitrite
  - Positive leukocyte esterase
  - Positive RBCs??
- NOTE: Presence of WBCs Cast indicates upper urinary tract infection (pyelonephritis)
- Urine culture: If > 100.000 (CFU)/mL indicates a positive urine culture

Urine analysis clinical tips

- microscopic hematuria (which is defined as 3 RBCs or more per high-power field)
- red blood cell (RBC) casts is suggestive of glomerular hematuria and an underlying glomerulonephritis
- Protein in urine analysis cannot detect microalbuminuria (early sign of kidney damage in some diseases like diabetic nephropathy).
- To detect microalbuminuria, we need to order urine Albumin/creatinine ratio (A/C ratio).
- nephrotic pattern is characterized by proteinuria that is usually above 3.5 g/day usually by 24h urine collection.

29 years old male complains of fever, chills, right flank pain and dysuria

the following urinalysis is shown below:

- NITRITE ..... negative
- leukocyte esterase..... Positive
- PH 8.1
- PROTEIN ..... 1+
- GLUCOSE ..... NIL
- KETONE ..... TRACE
- BLOOD ..... 3+
- HEMOGLOBIN ..... 3+
- WHITE BLOOD CELLS ..... 512 cmm
- RED BLOOD CELLS ..... 671 cmm
- RBC CAST ..... NIL
- WBC CAST ..... Positive
- OTHERS ..... BACTERIA ++
- SPECIFICGRAVITY 1.025

Acute pyelonephritis (upper urinary tract infection)

45 years old gentleman complains of facial swelling in the morning and lower limb swelling

the following urinalysis is shown below:

NITRITE	negative
PH	5.8
PROTEIN	4+
WBC	10 / CMM
RBC	10 / CMM
CASTS	NIL
ANTIBACTERIAL ACTIVITY	NIL
HEMOGLOBIN	NIL
CULTURE	NO GROWTH

Heavy Proteinuria
most likely nephrotic syndrome.
To Confirm it we need 24 urine collection
If > 3.5 g/day.

CBC (review)

- Safe CBC interpretation
- How to Approach to Anemia
- What is the Hb level indicating blood transfusion?
- How to distinguish IDA from Thalassemia?
- what is DDX of normocytic and macrocytic anemia?
- What finding suggest hemolytic anemia and what laboratory orders can confirm it?
- How to distinguish primary Vs secondary polycythemia
- At what level spontaneous bleeding risk is very high in thrombocytopenic patient?
- What are the main two types Thrombocytosis?
- what medical emergency can occur in Neutropenic patient?
- What is the main three DDx of Pancytopenia?

Urine (review)

- How to assess kidney function?
- What are the urine analysis findings in UTI?
- What is the urine analysis finding indicating Pyelonephritis?
- What is the lowest abnormal value for RBC in microscopic urine analysis?
- At what level of protein nephrotic range start to be diagnosed?

Liver Function test

Component of LFT

• Alanine amino transferase (ALT) • Aspartate amino transferase (AST)	→ Hepatocyte
• Alkaline phosphatase • Bilirubin	→ Cholestasis
• G Glutamyl transferase (GGT)	→ Hepatocyte and Biliary function
• Prothrombin time • Serum albumin	→ Tests "true" liver function /chronic process

A 40-year-old man came for routine medical checkup.

The following LFT is shown below:

Total bilirubin	10	(3– 17 umol/L)
Total protein	73	(60–80 g/L)
Albumin	38	(35–50 g/L)
Alkaline phosphatase	116	(50–136u/L)
Alanine aminotransferase	55	(20–65 u/L)
Aspartate aminotransferase	27	(10–31 u/L)
G.G. Transferase	198 H	(5–55 u/L)

Mention two causes for the abnormality?

- Drugs like anti-epileptics e.g. Carbamazepine
- Alcohol
- Fatty liver

A 32-year-old man referred from PHC Center because of Jaundice.

The following LFT is shown below:

Liver function test Profile

Total Bilirubin	57 H	3 – 17	mmol/L
Direct Bilirubin	6	0 – 5	umol/L
Total Protein	78	60 – 80	g/L
Albumin	47	30 – 50	g/L
Alkaline phosphatase	69	50 – 136	u/L
Alanine Aminotransferase	63	20 – 65	u/L
Asparate Aminotransferase	31	12 – 37	u/L
Gamma Glutamyl transferase	25	15 – 85	u/L

How are you going to deal with this gentleman?

- Request CBC and Reticulocytes to R/O hemolytic anemia
- If came normal, so mostly Gilbert's syndrome
- Impairment in conjugation; Glucuronyl transferase activity is decreased
- Unconjugated Bilirubin increases during fasting and stress.

A 25-year-old man on 4 drug anti-tuberculous treatment. On 2 months follow up visit, he presents with mildly elevated transaminases. Physical examination is unremarkable.

The following LFT is shown below:

Total bilirubin	10		(3– 17 umol/L)
Total protein	71		(60–80 g/L)
Albumin	37		(35–50 g/L)
Alkaline phosphatase	126		(50–136u/L)
Alanine aminotransferase	99	H	(20–65 u/L)
Aspartate aminotransferase	65	H	(10–31 u/L)
G.G. Transferase	98	H	(5–55 u/L)

What is the most likely diagnosis?

- Drug induced Hepatitis, mostly due to Isoniazid.
- Continue the medication and follow LFT

A 58-year-old asymptomatic woman presents with elevated liver enzymes on routine screening. Her past medical history is significant for HTN, DM 2 and dyslipidemia. On examination, her BMI is 38 and there is significant acanthosis nigricans on her neck.

The following LFT is shown below:

CBC ..... Normal		U&E ..... Normal	
Total bilirubin	10		(3– 17 umol/L)
Total protein	69		(60–80 g/L)
Albumin	38		(35–50 g/L)
Alkaline phosphatase	146	H	(50–136u/L)
Alanine aminotransferase	112	H	(20–65 u/L)
Aspartate aminotransferase	61	H	(10–31 u/L)
G.G. Transferase	126	H	(5–55 u/L)
T. chol. 6.1	Trig. .. 3.2		INR .....1.2 (Normal)

Mention two investigations of significance?

- Viral serology B & C (Negative) U/S liver (increased echogenicity)

What is the most likely diagnosis?

- NAFLD (non-alcoholic fatty liver disease)

A 19-year-old girl presents with new onset fatigue, jaundice and mild pruritus. Her past medical history is significant for acne, which is being treated with minocycline for the past 2 months. There is no history of travel or contact with patients with viral hepatitis. On examination there is mild icterus, no organomegaly

The following LFT is shown below:

Total bilirubin	58	H	(3– 17 umol/L)
Indirect bilirubin	5		
Albumin	38		(35–50 g/L)
Alkaline phosphatase	346	H	(50–136u/L)
Alanine aminotransferase	116	H	(20–65 u/L)
Aspartate aminotransferase	91	H	(10–31 u/L)

Viral serology for B and C is Negative

U/S liver is within normal

What is the most likely diagnosis?

- Drug induced cholestasis- secondary to minocycline.
- Symptoms resolve within 2 weeks of drug discontinuation
- Liver profile normalize within 8 weeks.

A 38-year-old lady presented with 2 weeks H/O yellowish discoloration of sclera together with weakness.

The following LFT is shown below:

Total bilirubin	98	H	(3– 17 umol/L)
Indirect bilirubin	43		
Albumin	36		(35–50 g/L)
Alkaline phosphatase	356	H	(50–136u/L)
Alanine aminotransferase	316	H	(20–65 u/L)
Aspartate aminotransferase	291	H	(10–31 u/L)
G.G. Transferase	286	H	(5–55 u/L)
INR	normal		

What is the possible DD?

- Viral Hepatitis
- Autoimmune Hepatitis
- Primary biliary cirrhosis
- Alcoholic hepatitis
- Drug induced

What are essential investigations needed to help to reach diagnosis?

- Viral markers (screening) for B, C and A
- Ultrasound liver
- Autoimmune antibodies (ANA, Anti mitoch. Ab and Anti smooth musc. Ab)
- Liver biopsy

A 62-year-old man is a known case of HCV +ve.

The following LFT is shown below:

Total bilirubin	6		(3– 17 umol/L)		
Indirect bilirubin	3				
Albumin	23	L	(35–50 g/L)		
Alkaline phosphatase	180	H	(50–136u/L)		
Alanine aminotransferase	71	H	(20–65 u/L)		
Aspartate aminotransferase	77	H	(10–31 u/L)		
G.G. Transferase	111	H	(5–55 u/L)		
INR	1.36	H	(0.8 – 1.2)		
RBC	3. 08	L	4.2 – 5.5	x10.e12/L	
HGB	88.0	L	120 – 160	g/L	
HCT	26.7	L	42 – 52	%	
MCV	86.7		80 – 94	fl	
MCH	28.5		27 – 32	pg	

What is your diagnosis?

- Chronic liver disease (CLD), uncompensated, post HC virus.
- Normocytic Normochromic Anemia due to CLD.

Diabetes Mellitus

A 53-year-old man known case of dyslipidemia.

As a routine investigation:

The following LFT is shown below:

FPG: 6.2 mmol/L
5.9 mmol/L

What is your diagnosis?

- Impaired FPG

OGTT is requested (FPG and 2 hr post 75 gm glucose)

FPG: 6.9 mmol/L
2 hr: 13.4 mmol/l

What is your diagnosis?

- Diabetes

Diagnosis of Diabetes:

- FPG ≤ 5.5 mmol/L = normal
- FPG ≥ 5.6 mmol/L to 6.9 mmol/L= IFG

(If OGTT is requested)

- 2-h post 75 gm glucose < 7.8 mmol/L = normal GTT
- 2-h post 75 gm glucose ≥ 7.8 mmol/L and

< 11.1 mmol/L = impaired GTT

- 2-h post 75 gm glucose ≥ 11.1 mmol/L = DM

Metabolic Disorders

A 70-year-old blind man known case of hypothyroidism, vitiligo and left ventricle. dysfunction presents with 2m H/O SOB, bouts of dry and irritating cough, loss of appetite, hoarseness of voice and low mood.

TSH:	0.288	miu/L	.....(0.25 – 5)
T4:	20.5	pmol/L	.....(10.3 – 25.8)
Ca.	1.4	mmol/L	.....(2.10 – 2.55)
Ph.	1.67	mmol/L	.....(0.74 – 1.30)
Alb.	35	gm/L	.....(30 – 50)
Alk. Ph.	86	u/l	.....(50 – 136)

What is your diagnosis?

- Primary hypoparathyroidism

What is the next investigation of choice?

- Parathyroid hormone 0.353 pmol/L …….(1.65 – 6.9)

What is your management?

- Vitamin D
- Oral Calcium

What other organs or diseases you may screen for?

- Diabetes (FPG/A1C)
- Adrenal gland (Cortisol level)

A 14-year-old girl presents with 1-year H/O pain in lower limbs.

O/E: unremarkable

The following results is shown below:

Calcium	1.62 L	2.10 – 2.55	mmol/L
Corrected calcium	1.6 L	2.10 – 2.55	mmol/L
Inorganic Phosphorus	1.13	0.87 – 1.45	mmol/L
Albumin	39	35 – 50	g/L
Alkaline phosphatase	1191 H	195 – 476	u/L

Vit D ..... 4.0 nmol/L

[Defeciency <25 Insuffeciency 25 – 75
Suffecient 75 – 250 Toxicity >250]

Vitamin D is measured in two forms of units (ng/ml or nmol/L)

- 1ng/ml = 2.5 nmol/liter
- Example:
- 20 ng/mL (50 nmol/liter)

Radiology report: Widened growth plate with fraying, splaying and cupping of the Metaphysis Involving both distal both Femurs and proximal Tibias and fibulas suggestive of Rickets.

She was put on Vit. D3 45000 U /week and calcium carbonate 600 mg BID for 2 months.

The results are shown below:

Calcium	2.27	2.10 – 2.55	mmol/L
Corrected calcium	2.30	2.10 – 2.55	mmol/L
Inorganic Phosphorus	2.00 H	0.87 – 1.45	mmol/L
Albumin	39	35 – 50	g/L
Alkaline phosphatase	687 H	195 – 476	u/L

Vitamin D is measured in two forms of units

1 ng/ml = 2.5 nmol/liter, **Example: 20 ng/mL (50 nmol/liter)**

Rickets / Osteomalacia

- Low calcium
- Low or Normal phosphate
- High alkaline phosphatase

Hypoparathyroidism

- Low calcium
- High phosphate
- Normal alkaline phosphatase

A 19-year-old lady presents with 2 months H/O generalized aches and inability to stand from sitting position. She gave H/O passing 1 – 3 motions of bulky stools. She lost 5 Kg.

<u>The following results is shown below:</u>

Stool analysis: Fat cells, undigested food particles
No RBC, No WBC, NO ova and NO cysts

HGB	98	L	120 – 160	g/L
Serum Iron	7	L	11.0 – 31.0	umol /L
Calcium	1.97		2.10 – 2.55	mmol/L
Corrected calcium	1.954	L	2.10 – 2.55	mmol/L
Inorganic Phosphorus	0.85	L	0.87 – 1.45	mmol/L
Albumin	33		35 – 50	g/L
Alkaline phosphatase	525	H	60 – 190	u/L

What is your provisional diagnosis?

- Malabsorption syndrome / Coeliac disease

What further investigations are you going to do?

- Coeliac antibodies / upper endoscopy for biopsy

A 52- year- old woman presents to your office with 6-month H/O polyuria and lethargy.

O/E: looks dehydrated and has a neck swelling (she has the swelling for years and informed to be a simple goiter)

The following results is shown below:

- Ca:..... 3.4 mmol/L (2.1 – 2.6)
- Ph: ..... 0.62 mmol/L (0.8 – 1.4)
- Urea: ..... 9.2 mmol/L (2.6 – 6.6)
- Chloride:..113 mmol/L (95 – 105)

- **What is your diagnosis?**

  Hyperparathyroidism mostly due to parathyroid adenoma

A 48-year-old woman presents with 5 months

H/O difficulty in raising from sitting position.

The following results is shown below:

Calcium	1.65 mmol/L	(2.1 – 2.6)
Phosph.	1.52 mmol/L	(0.8 – 1.4)
Alk. Phos.	134 mmol/L	(43 – 154)
Albumen	38 g/L	(35 – 50)

- **What is your diagnosis?**

  Hyporparathyroidism.

A 15-year-old girl referred to obesity clinic. BMI 34

The following results is shown below:

	Test	Result	Unit	Range		
				Serum - SAMPLE: 1		
1	Prolactin	165.900	MIU\L	102	-	496
2	Lutenizing Hormone	3.150	IU/L		-	
3	Follicle Stimulating Horm	1.550	IU/L		-	
4	Para Thyroid Hormone	**9.020**	PM/L	1.65	-	6.9
5	FT4	13.040	PM/L	10.3	-	25.8
6	Thyroid Stimulating Hormo	3.860	MIU/L	0.25	-	5
7	VITAMIN D - T	**27.870**	nmol/L	75	-	250
8	Insulin	**103.500**	MIU/L	2.6	-	24.9
9	Cortisol	194.000	NM/L	193	-	690
10	Vitamin B12	277.800	PM/L	145	-	637
11	Ferritin	97.350	ug/L	13	-	150
12	Folate	25.670	NM\L	4.5	-	20.7

#	Test		Result	Unit	Range		
					Serum - SAMPLE: 1		
1	C-PEPTIDE		**3.560**	NM/L	0.37	-	1.47
2	Fasting Sugar		4.3	mmol/L	3.3		5.5

Interpret the results:

- Hyperparathyroidism 2nd to Vit. D deficiency
- Insulin resistance

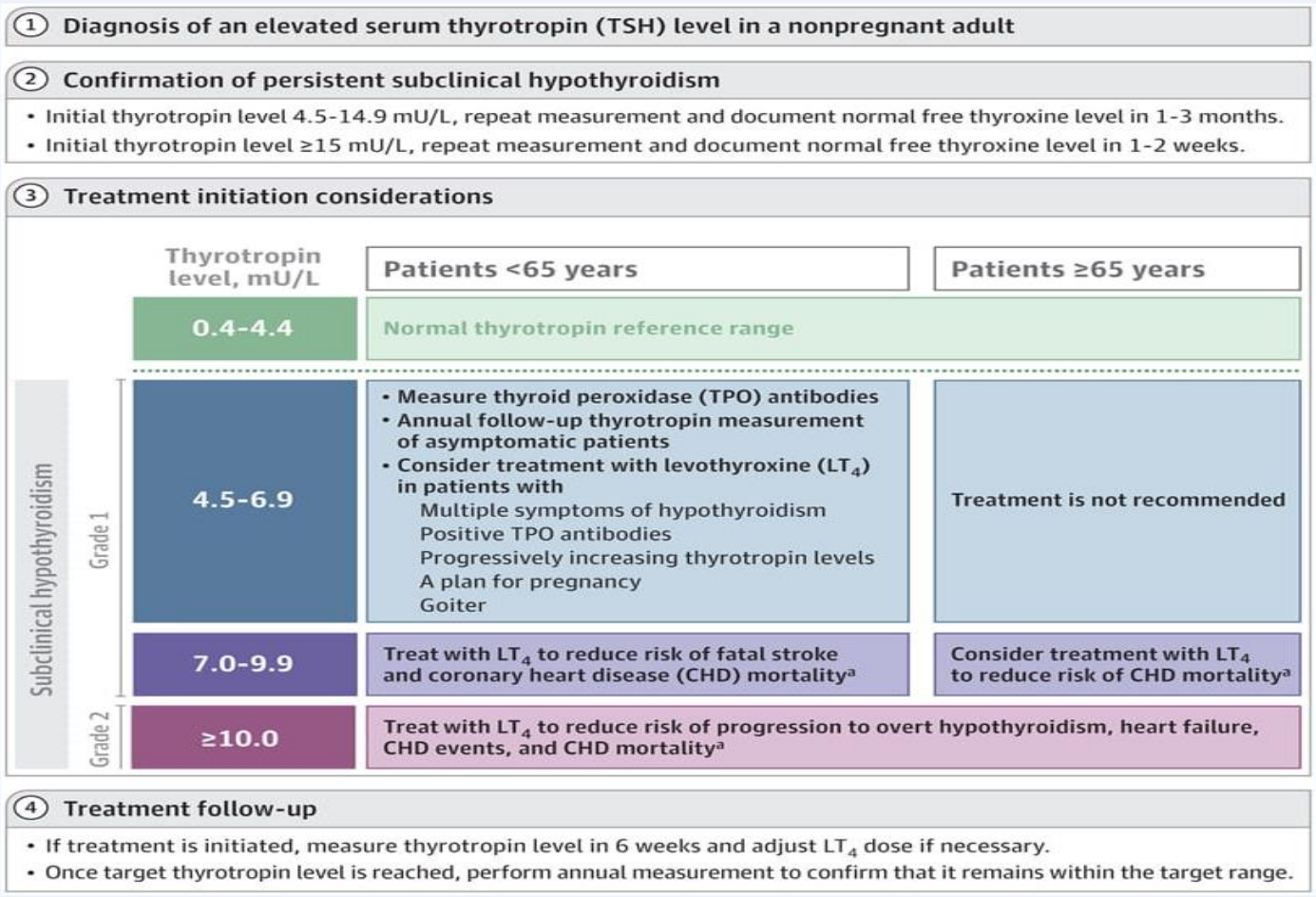
Thyroid Problems

A 50 year- old man presents to your office with 6-month H/O of fatigue and weakness. O/E: no objective positive findings.

- TSH: 12.2 miu/l (0.25—5)
- FT4: 11.6 pmol/l (10.3—25 .8)

What is your diagnosis?

a- Primary Hypothyroidism
b- Subclinical Hyperthyroidism
c- Subacute Thyroiditis
d- Subclinical Hypothyroidism
e- Secondary Hypothyroidism



A 19-year-old lady presents with 3 weeks H/O a neck swelling discovered incidentally. The swelling move with deglutition and related to left lobe of thyroid and no

L N swellings. She is euthyroid.

TSH and T4 are within normal.

What is the most appropriate step in management?

A- Observation

B- Referral urgent to endocrine

C- Thyroglobulin antibodies

D- Technetium thyroid scan

E- U/S thyroid

(Note: U/S to see its type solid or cystic, size, one nodule or more and also to localize the nodule for biopsy)

Approach to thyroid nodule based of American Thyroid Guidelines 2015

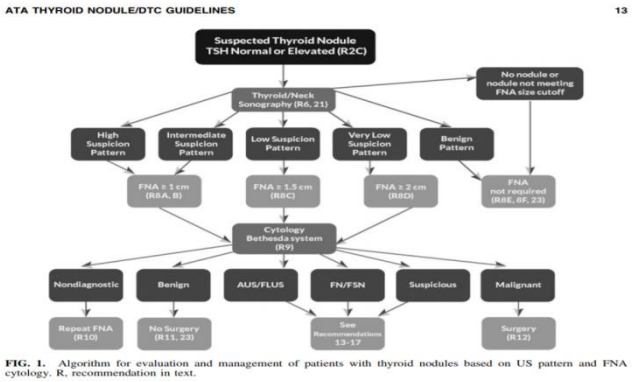


FIG. 1. Algorithm for evaluation and management of patients with thyroid nodules based on US pattern and FNA cytology. R, recommendation in text.

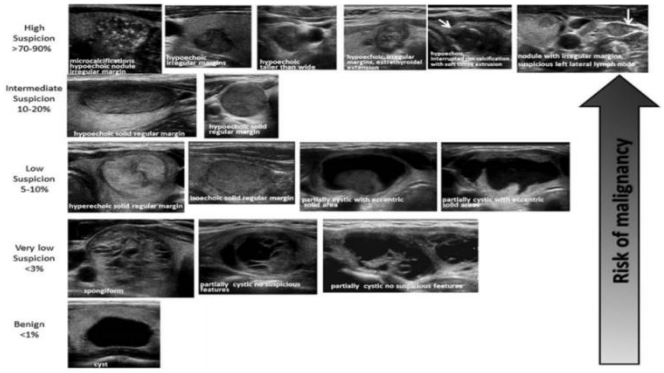


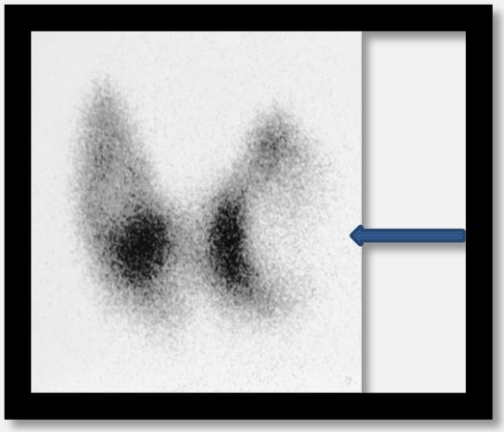
FIG. 2. ATA nodule sonographic patterns and risk of malignancy.

TABLE 6. SONOGRAPHIC PATTERNS, ESTIMATED RISK OF MALIGNANCY, AND FINE-NEEDLE ASPIRATION GUIDANCE FOR THYROID NODULES

Sonographic pattern	*US features*	*Estimated risk of malignancy, %*	*FNA size cutoff (largest dimension)*
High suspicion	Solid hypoechoic nodule or solid hypoechoic component of a partially cystic nodule ***with*** one or more of the following features: irregular margins (infiltrative, microlobulated), microcalcifications, taller than wide shape, rim calcifications with small extrusive soft tissue component, evidence of ETE	>70–90[a]	Recommend FNA at ≥1 cm
Intermediate suspicion	Hypoechoic solid nodule with smooth margins ***without*** microcalcifications, ETE, or taller than wide shape	10–20	Recommend FNA at ≥1 cm
Low suspicion	Isoechoic or hyperechoic solid nodule, or partially cystic nodule with eccentric solid areas, ***without*** microcalcification, irregular margin or ETE, or taller than wide shape.	5–10	Recommend FNA at ≥1.5 cm
Very low suspicion	Spongiform or partially cystic nodules ***without*** any of the sonographic features described in low, intermediate, or high suspicion patterns	<3	Consider FNA at ≥2 cm Observation without FNA is also a reasonable option
Benign	Purely cystic nodules (no solid component)	<1	No biopsy[b]

US-guided FNA is recommended for cervical lymph nodes that are sonographically suspicious for thyroid cancer (see Table 7).
[a]The estimate is derived from high volume centers, the overall risk of malignancy may be lower given the interobserver variability in sonography.
[b]Aspiration of the cyst may be considered for symptomatic or cosmetic drainage.
ETE, extrathyroidal extension.

A 22-year-old lady presents with 3 weeks H/O a neck swelling. TSH and T4 are normal and US showed solid nodule.



A Technetium-99m pertechnetate thyroid scan is ordered, what is the finding?
Cold nodule of left lobe of thyroid.

A 32-year-old lady, nurse, single presented with one-month H/O palpitation and loss of weight.

O/E: pulse 116 / min Bp 140 / 70

Apart from fine tremors nothing was significant.

WBC : 8.4			ESR : 4
TSH:	< 0.01	miu/l	(0.25—5)
FT4:	92.6	pmol/l	(10.3—25 .8)

Thyroid scan: Reduced iodine uptake

- **Mention three causes of reduced iodine uptake.**

1- Subacute thyroiditis
2- Post-partum thyroiditis
3- Factitious thyroiditis

A 42-year-old man booked recently in the clinic. Followed in a private psychiatry clinic because of depression mainly insomnia, weakness and fatigue, on 40 mg Paroxetine.

Still not improving, so another antipsychotic drug was added.

The patient has good insight and very cooperative.

Mention one investigation of importance for this patient.

TSH :	329.0	H	mIU/L	(0.25 – 5)
FT4:	2.87	L	pmol/L	(10.3 – 25.8)

Cholesterol:	9.86	mmol/L
Trig.:	3.12	mmol/L

A 27-year-old man presents with 3 months H/O weakness and tendency to sleep. The following investigation is shown.

#	Test		Result	Unit	Range		
					Serum - SAMPLE: 1		
1	**FT4**		0.87	PM/L	10.3	-	25.8
2	**Thyroid Stimulating Hormo**		**1653.00**	MIU/L	0.25	-	5
3	**FT3**		1.69	PM/L	3.96	-	6.8
4	**Lutenizing Hormone**		2.10	IU/L		-	
5	**Follicle Stimulating Horm**		5.81	IU/L		-	

2 months later 0/12/2010

#	Test	Result	Unit	Range		
				Serum - SAMPLE: 1		
1	**FT4**	14.69	PM/L	10.3	-	25.8
2	**Thyroid Stimulating Hormo**	**1549.00**	MIU/L	0.25	-	5
3	**FT3**	1.75	PM/L	3.96	-	6.8
4	**Prolactin**	**549.20**	MIU\L	86	-	324
5	**Cortisol**	476.40	NM/L	193	-	690
	ACTH	8.63	PM/L			

3 months later

#	Test		Result	Unit	Range		
					Serum - SAMPLE: 1		
1	**FT4**		13.63	PM/L	10.3	-	25.8
2	**Thyroid Stimulating Hormo**		0.59	MIU/L	0.25	-	5
3	**Prolactin**		**334.80**	MIU\L	86	-	324

A 30-year-old lady with menstrual irregularities.

- TSH: ..... 44.58 miu/l (0.25 – 5)
- FT4: ..... 5.58 pmol/l (10.3– 25.8)
- Prolactin .. 1499 miu/l (102 – 496)

3 months later: (after 100 micgm thyroxin)

- TSH: ..... 7.37 miu/l (0.25 – 5)
- FT4: ..... 10.68 pmol/l (10.3– 25.8)
- Prolactin .. 1161 miu/l (102 – 496)

3 months later: (after 125 micgm thyroxin)

- TSH: ..... 2.59 miu/l (0.25 – 5)
- FT4: ..... 12.58 pmol/l (10.3– 25.8)
- Prolactin .. 1557 miu/l (102 – 496)

MRI sella turcica: No significant Macro or Microadenoma.
Cabergoline (dopamine agonist) was started 0.5 mg once weekly.

A 27-year-old woman presents with one-month H/O weight loss, sweating and tremors. She has diffuse neck swelling. Pulse: 124 bpm

CBC: normal ESR: 12 mm/h

- TSH: <0.001 miu/l (0.25 –5)
- FT4: 139.2 pmol/l (10.3–25.8)

What is the differential diagnosis?
1- Graves' disease
2- Subacute thyroiditis
3- Multinodular toxic goiter
4- Toxic nodule /adenoma
Mention one appropriate investigation to reach the diagnosis.

1. Thyroid Scan

A 28-year-old woman presents to your office with 10 days H/O palpitation, sweating and neck discomfort. O/E: Wet hands and neck tenderness

pulse: 116/m temp. 37.7

CBC: normal ESR: 82 mm/h

- TSH: <0.01 miu/l (0.25 –5)
- FT4: 89.2 pmol/l (10.3–25.8)

What is the most likely diagnosis?

A- Graves' disease

B- Subacute thyroiditis

C- Hashimotos thyroiditis

D- Multinodular toxic goiter

Select one investigation to confirm your diagnosis.

A- Ultrasound neck

B- Thyroid antibodies

C- Free T3 level

D- Radioactive Iodine thyroid uptake

E- Fine needle aspiration

What is the treatment? Choose one or more.

A- L- Thyroxin

B- B Blockers

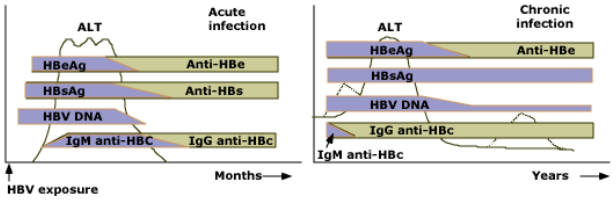
C- NSAID

D- Iodine therapy

E- Carbimazole

Hepatitis B Markers

Serologic responses to HBV infection

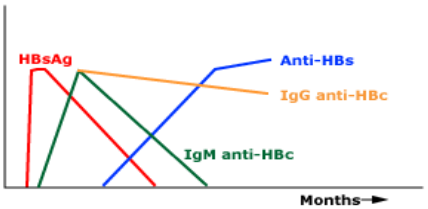


Schematic representation of the serologic responses to acute and chronic hepatitis B virus (HBV) infection in relation to the serum alanine aminotransferase (ALT) concentration. Left panel: Acute infection is characterized initially by the presence of HBeAg (hepatitis B e antigen), HBsAg (hepatitis B surface antigen), and HBV DNA beginning in the preclinical phase. IgM anti-HBc (hepatitis B core antigen) appears early in the clinical phase; the combination of this antibody and HBsAg makes the diagnosis of acute infection. Recovery is accompanied by normalization of the serum ALT, the disappearance of HBV DNA, HBeAg to anti-HBe seroconversion, and subsequently HBsAg to anti-HBs seroconversion and switch from IgM to IgG anti-HBc. Thus, previous HBV infection is characterized by anti-HBs and IgG anti-HBc. Right panel: Chronic infection is characterized by persistence of HBeAg (for a variable period), HBsAg, and HBV DNA in the circulation; anti-HBs is not seen (in approximately 20 percent of patients a non-neutralizing form of anti-HBs can be detected).

Persistence of HBsAg for more than six months after acute infection is considered indicative of chronic infection.

UpToDate

Window period of acute HBV infection



Schematic representation of the serologic findings during the window period of acute hepatitis B virus infection. The disappearance of HBsAg (hepatitis B surface antigen) is followed by the appearance of anti-HBs. In some patients, however, anti-HBs may not be detectable until after a window period of several weeks to months. At this time, neither HBsAg nor anti-HBs can be detected, the serologic diagnosis may be made by the detection of IgM antibodies against hepatitis B core antigen (IgM anti-HBc).

UpToDate

Glossary of clinical terms used in HBV infection

Definitions
Chronic hepatitis B
Chronic necroinflammatory disease of the liver caused by persistent infection with hepatitis B virus. Chronic hepatitis B can be subdivided into HBeAg positive and HBeAg negative chronic hepatitis B.
Inactive HBsAg carrier state
Persistent HBV infection of the liver without significant, ongoing necroinflammatory disease.
Resolved hepatitis B
Previous HBV infection without further virological, biochemical or histological evidence of active virus infection or disease.
Acute exacerbation or flare of hepatitis B
Intermittent elevations of aminotransferase activity to more than 10 times the upper limit of normal and more than twice the baseline value.
Reactivation of hepatitis B
Reappearance of active necroinflammatory disease of the liver in a person known to have the inactive HBsAg carrier state or resolved hepatitis B.
HBeAg clearance
Loss of HBeAg in a person who was previously HBeAg positive.
HBeAg seroconversion
Loss of HBeAg and detection of anti-HBe.

Interpretation of the hepatitis B serologic panel

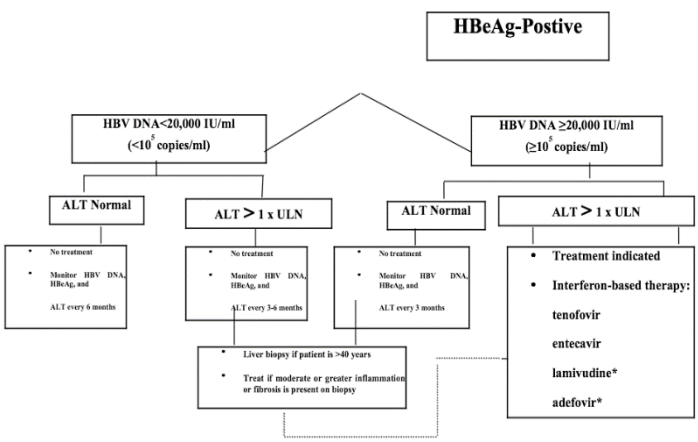
Tests	Results	Interpretation
HBsAg	Negative	Susceptible
anti-HBc	Negative	
anti-HBs	Negative	
HBsAg	Negative	Immune due to natural infection
anti-HBc	Positive	
anti-HBs	Positive	
HBsAg	Negative	Immune due to hepatitis B vaccination*
anti-HBc	Negative	
anti-HBs	Positive	
HBsAg	Positive	Acutely infected
anti-HBc	Positive	
IgM anti-HBc	Positive	
anti-HBs	Negative	
HBsAg	Positive	Chronically infected
anti-HBc	Positive	
IgM anti-HBc	Negative	
anti-HBs	Negative	
HBsAg	Negative	Four interpretations possible*
anti-HBc	Positive	
anti-HBs	Negative	

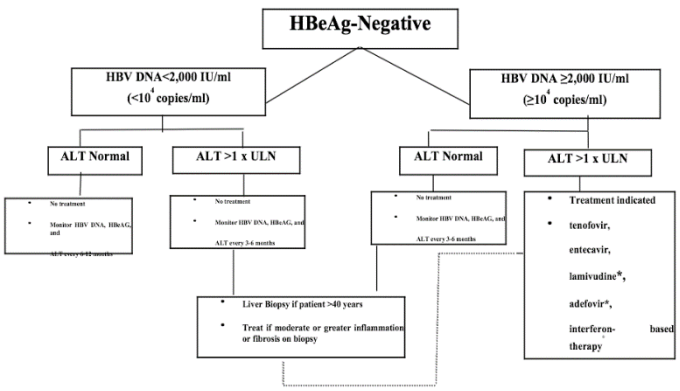
* Antibody response (anti-HBs) can be measured quantitatively or qualitatively. A protective antibody response is reported quantitatively as 10 or more milliinternational units (>=10 mIU/mL) or qualitatively as positive. Post-vaccination testing should be completed 1-2 months after the third vaccine dose for results to be meaningful.
• Four interpretations:
1. Might be recovering from acute HBV infection.
2. Might be distantly immune and test not sensitive enough to detect very low level of anti-HBs in serum.
3. Might be susceptible with a false positive anti-HBc.
4. Might be undetectable level of HBsAg present in the serum and the person is actually chronically infected.

Centers for Disease Control and Prevention, Hepatitis B information for health professionals: Interpretation of hepatitis B serologic test results. Available from the CDC website.

UpToDate

UpToDate





A 28-year-old man referred from Blood Bank because of being HBsAg positive.

- Hepatitis B S antigen..... **Reactive**
- Anti-Hepa B Core IgG ..... **Reactive**
- Hep-B e Antigen ..... Nonreactive
- Anti- Hepa B e Antigen ..... **Reactive**
- Anti- Hepa B Surface ..... Nonreactive

■ **What is your next step?**

LFT, U/S liver, PCR,

- HEPATITIS B DNA QUALITATIVE ..... Positive
- HEPATITIS B DNA QUANTITATIVE ..... 889796 IU/ML

■ **How are you going to deal with patient?**

Measure for Family Contacts, screen and vaccinate the negative ones

Referral to hepatologist, No blood donation

A 35-year-old man came to the clinic for screening, as one member in his family is HBV positive.

- Hepatitis B S antigen ..... Nonreactive
- Anti-Hepa B Core IgG ..... **Reactive**
- Hep B e Antigen ..... Nonreactive
- Anti- Hepa B e Antigen ... Nonreactive
- Anti- Hepa B Surface ..... **Reactive**

What is your diagnosis?

Immune post exposure to HB virus

- **How are you going to deal with patient?**
- Reassurance, no further actions could be taken

A 23-year-medical student came to the clinic for screening.

- Hepatitis B S antigen ..... Nonreactive
- Anti-Hepa B Core IgG ..... Nonreactive
- Hep B e Antigen ..... Nonreactive
- Anti- Hepa B e Antigen ... Nonreactive
- Anti- Hepa B Surface ..... **1000.0 mIU/ml (> 10.0 Positive)**

- **What is your diagnosis?**
  Immune post Vaccination

A 32-year old man presents to your clinic for routine checkup.

- Hepatitis B S antigen ..... Nonreactive
- Anti-Hepa B Core IgG ..... **Reactive**
- Hep- B e Antigen ..... Nonreactive
- Anti- Hepa B e Antigen ... Nonreactive
- Anti-Hepa B Surface ... Nonreactive

Interpret the results:

- H/O chronic exposure to HB virus

How:

1- May be recovering from acute HBV infection (window period)

2- May be distantly immune and test is not sensitive enough to detect very low level of anti-HBs in serum.

3- May be undetectable level of HBsAg present in the serum and the person is actually a carrier.

4- May be a false positive anti-HBc.

- HEPATITIS B DNA QUALITATIVE Positive
- HEPATITIS B DNA QUANTITATIVE **<20 IU**/ML

Actions:

- Measures to Contacts
- No blood donation
- Not candidate for treatment by e.g. Interferon

A 26-year-old female came for premarital checkup.

- Hepatitis B S antigen..... **Reactive**
- Anti-Hepa B Core lgG..... **Reactive**
- Hep- B e Antigen ..... **Reactive**
- Anti- Hepa B e Antigen ... Nonreactive
- Anti-Hepa B Surface..... Nonreactive

- **HEPATITIS B DNA QUALITATIVE** Positive

HEPATITIS B DNA QUANTITATIVE >110 million IU/ML

Total bilirubin	15	(3- 17 umol/L)
Albumin	39	(35-50 g/L)
Alkaline phosphatase	225	(50-136u/L)
Alanine aminotransferase	960	(20-65 u/L)
Aspartate aminotransferase	296	(10-31 u/L)
G.G. Transferase	235	(5-55 u/L)

What is your diagnosis and What actions are you going to do?

- Chronic viral Hepatitis with active replication and highly infectious (e antigen is positive)

After one and half year of treatment:

#	Test	Result	Unit	Range
				Serum - SAMPLE: 1
1	HEPATITISBDNAQUALITATIVE	Positive0		-
2	HEPATITISBDNAQUANTITATIVE	31 IU/ML		-

#	Test	Result	Unit	Range
				Serum - SAMPLE: 1
1	Urea	4.6	mmol/L	2.5 - 6.4
2	SerumCreatinine	75	umol/L	62 - 115
3	Sodium	138	mmol/L	135 - 145
4	Potassium	4.4	mmol/L	3.5 - 5.1
5	Chloride	102	mmol/L	98 - 107
6	CarbonDioxide	29.2	mmol/L	22 - 32
7	TotalBilirubin	10	umol/L	3 - 17
8	TotalProteins	74	g/L	60 - 80
9	Albumin	42	g/L	30 - 50
10	AlkalinePhosphatase	94	U/L	50 - 136
11	AlanineAminotransferase	52	U/L	20 - 65
12	AspartateAminotransfer.	27	U/L	12 - 37
13	Calcium	2.26	mm/L	2.1 - 2.55
14	InorganicPhosphorus	1.15	mmol/L	0.87 - 1.45
15	Albumin	42	g/L	30 - 50
16	AlkalinePhosphatase	94	U/L	50 - 136
17	CorrectedCalcium	2.2	mml/L	2.1 - 2.55