

DATA INTERPRETATION

Objectives:

1. Interpret CBC findings of anaemia (IDA, Normocytic, Macrocytic and haemolytic) and polycythaemia
2. Interpret problems of liver function tests
3. Explain different types of thyroid disorders
4. Recognize the likely explanations for hypocalcemia or hypercalcemia
5. Explain different presentation of Hepatitis B markers.
6. Interpret urine and stool analysis

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References

- Doctor's slides and notes

Important *Notes* *Extra* *Golden*

Editing file [link](#)

1. Complete Blood Count

How to Read CBC result? **IMP**

-Look to **RBC** and **Hb** together to check if decrease in Hb is **matching** with decrease in RBC or not.

-In case of **high RBC** and **Hb** go to **HCT** to check if it exceeds **52** (in WHO **49** in Men and **48** in Women) as this reveals **polycythemia**.

-Look to **MCV** to see the type of anaemia

-Look to **RDW** as if high it reflects Heterogeneity in sizes of RBCs.

-**Reticulocytosis** reflect **hyperactivity of Bone Marrow** as in haemolytic anaemia and early treatment of IDA.

High **RDW** >>>> IDA

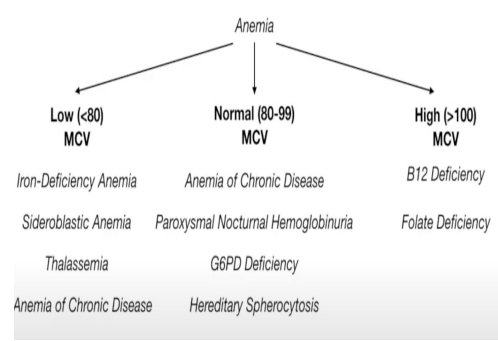
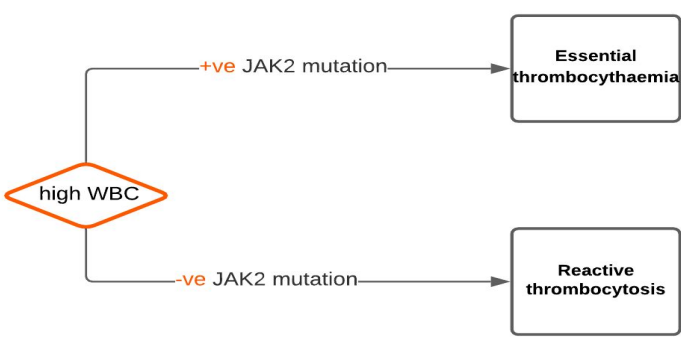
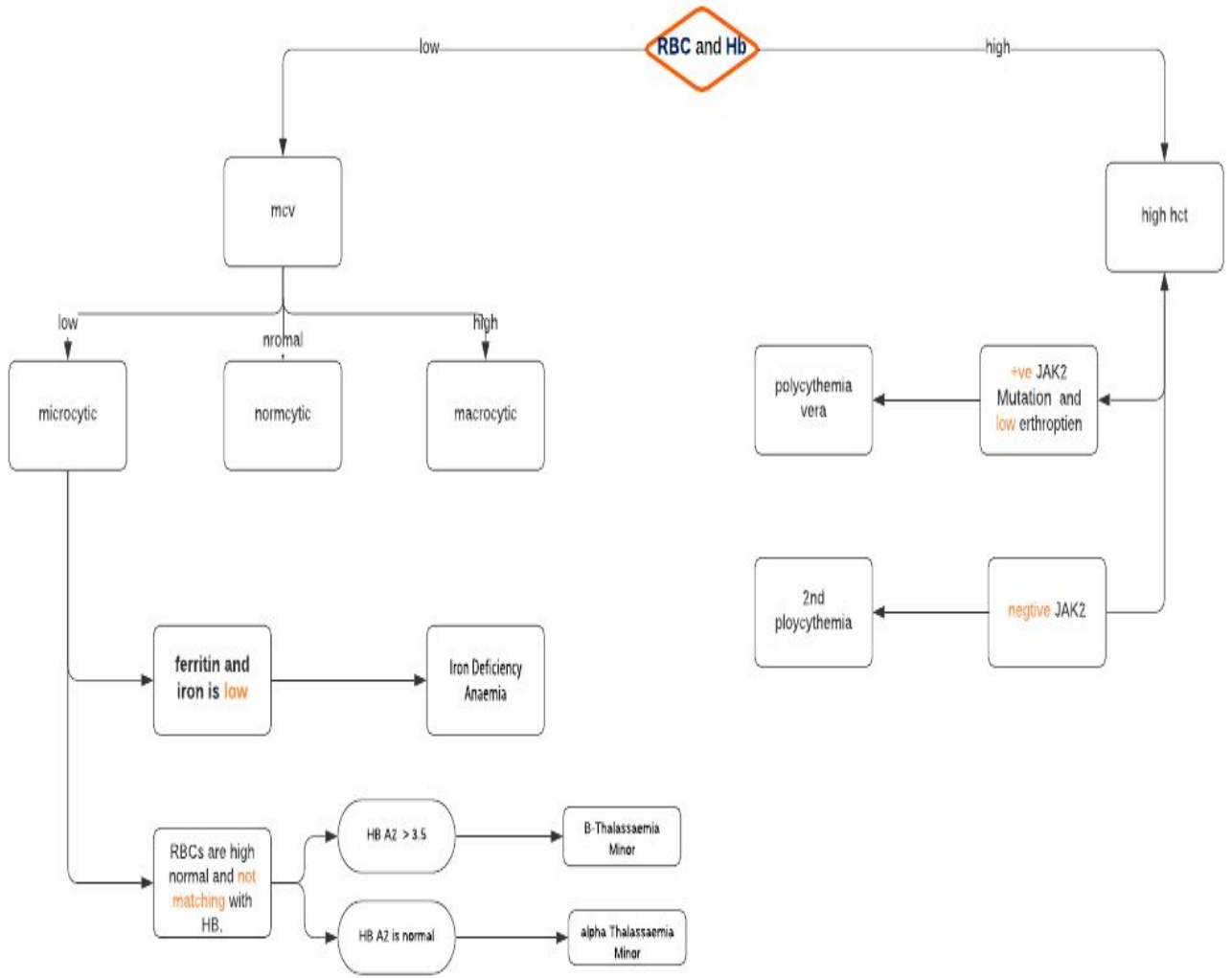
High **-Reticulocytosis** >>>> **hemolytic anemia**

-Look to **WBC** and **Platelet** count for any abnormality

❖ Biochemistry of Iron Deficiency Anaemia

Test	What does it reflect	What is Expected
Iron level	Serum iron	Decreased
Ferritin	Iron stores	Decreased
TIBC	Total Iron Binding Capacity; Iron moves in blood attached to protein called transferrin	Increased
Transferrin Saturation	It is the value of serum iron dividing by TIBC Low Iron / High TIBC = Low	Decreased

Extra



A 37-year-old lady, presents with 3 months H/O dizziness and easy fatigue

The following CBC is shown below

•	WBC	.....	7.0	4	–	11 x10.e9/L
•	RBC	.....	3.68	L	4.2	– 5.5 x10.e12/L
•	HGB	.....	87	L	120	– 160 g/L
•	HCT	.....	27.1	L	42	– 52 %
•	MCV	.....	73.6	L	80	– 94 fl
•	MCH	.....	23.6	L	27	– 32 pg
•	MCHC	.....	321		320	– 360 g/L
•	RDW	.....	15.5	H	11.5	– 14.5 %
•	PLT	.....	445		140	– 450 x10.e9/L

What is your diagnosis?

Hypochromic Microcytic Anaemia (IDA)

What is the next step ?

check for a cause for iron deficiency anemia and treat the cause

On systemic enquiry, she added that she has **menorrhagia** for the last 4 months. (before referring her to gynecology check for hypothyroidism)

Mention one investigation of importance to reach the diagnosis?

TSH: 89 mIU/L (0.25 – 5)

FT4: 8.6 pmol/l(10.3—25 .8)

What is the treatment ?

ferrous sulphate and folic acid “for 4-6 months, ferritin is the marker that tells you when to stop”
+thyroxine for her hypothyroidism “for life”.

A 68-year-old man presented to PCC with SOB and loss of weight. He looked very pale H/O similar attack 2 years ago and transfusion. No H/O chronic diseases or GIT bleeding. Or diarrhoea.
Non smoker

21 May, 2016 00:00 AST - 21 December, 2017						
Lab View	09/11/2017 00:00	08/11/2017 00:00	06/11/2017 00:00	05/11/2017 00:00	02/11/2017 00:00	01/11/2017 00:00
General Hematology						
WBC	6.500					6.700 - 7.200 [I] 7.000
RBC	4.2 (L)					2.8 [2][H] 2.9 (L)
Hgb	88.0 (L)					48.0 [2][H] 49.0 (L)
Hct	29.2 (L)					18.4 - 19.7 [2][H] 19.8 (L)
MCV	67.8 (L)					57.7 - 58.4 [2][H] 57.8 (L)
MCH	21.2 (L)					16.7 - 16.9 [2][H] 16.8 (L)
MCHC	313.0 (L)					285.0 - 293.0 [2] 290.0 (L)
RDW	29.5 (H)					21.5 - 21.7 [2][H] 20.8 (H)
Platelet	227.0					336.0 - 383.0 [2] 408.0
Ferritin 5.1 ug/L (30 - 400)						
Serum Iron 3.5 umol/L (11 - 31)						
TIBC 96 umol/L (44.8 - 80.6)						
Tumor Marker						
CEA				0.564	(Normal)	
Immunology						
ANA						Negative *
ANA Pattern						Not Applicable
ASAP						+3.000
Reticulin Ab						
Glutamin IgA				No Reagent *		<20 -ve
TRC IgA				9.69 *		20 - 30 weak +ve
Glutamin IgG				35.26 *		>30 mod to strong +ve
TRC IgG				1.29 *		
Endomysial Ab				No Reagent *		

WHAT IS THE CAUSE OF IDA?

Think in Causes: Malignancy like Ca. Colon, Ca Stomach, Malabsorption, PUD,

What is the cause of IDA?

Malignancy like (Ca. Colon, Ca Stomach) , Malabsorption, PUD

(this patient have done biopsy and showed there is malabsorption not colon cancer)

Treatment ?

Admit for blood transfusion and do tumor and immunology markers

Why not inflammation ?

Because ferritin is low

A 17 year old lady presents with dizziness and bouts of fall.

● WBC.....	7.4	x10.e9/L	4 -11
● RBC.....	3.57	x10.e12/L	4.2 - 5.5
● HGB	57	g/L	120 -160
● HCT	20.1	%	37 - 47
● MCV	56.2	fl	80 - 94
● MCH	15.9	pg	27 - 32
● MCHC	282	g/L	320 - 360
● RDW	25.0	%	11.5 - 14.5
● PLT	578	x10.e9/L	140 - 450
● Iron	1.0	umol/L	9 - 30
● TIPC	89.6	umol/L	44.8 - 80.6

Always check for a cause for IDA and treat the cause .

● What is the treatment ?

Transfused (one pint of blood) and Put on ferrous sulphate and folic acid

● When we add blood transfusion?

1- if HGB less than 7 mg/dl and patient does not have any disease

2- if HGB less than 10 mg/dl and have other comorbidity disease

Cont. A 17 year old lady with low Hb, after 6 weeks.

● WBC	8.4	x10.e9/L	4 -11
● RBC	4.71	x10.e12/L	4.2 - 5.5
● HGB	105	g/L	120 -160
● HCT	32.5	%	37 - 47
● MCV	68.9	fl	80 - 94
● MCH	22.3	pg	27 - 32
● MCHC	324	g/L	320 - 360
● RDW	35.7	%	11.5 - 14.5
● PLT	296	x10.e9/L	140 - 450
● Ferritin	6.77	ug/L	13 -150

Hb Electrophoresis:

● Hemoglobin A2	2.3	%	2.0 - 3.5
● Hemoglobin F	0.0	%	0 - 2.0
● Hemoglobin A	97.7	%	95 - 99
● Hemoglobin S	0.0		

◆ Microcytosis: low MCV

	Serum Iron	Ferritin
● IDA	Low	Low
● Thalassemia Minor	Normal	Normal

RDW: Red Cell Distribution Width: **When increased reflect**, heterogeneity in cell size. **Also indicating low serum iron level**

➤ Iron Deficiency Anaemia

Oral iron therapy, characterized by a modest **reticulocytosis** beginning in about five to seven days, followed by an increase in **haemoglobin** at a rate of about **1 gm weekly** until the hemoglobin concentration returns to normal.

The serum or plasma **ferritin** concentration is an excellent indicator of **iron stores**.

A 70-year-old man presents with weakness of his right arm and leg and recurrent headache. He is a nonsmoker. His medical history is significant for high blood pressure. His oxygen saturation is 95% on room air.

● WBC	21.8	4 – 11	x10.e9/L
● RBC	8.59	4.7 – 6.1	x10.e12/L
● HGB	213	130 – 180	g/L
● HCT	66.6	42 – 52	%
● MCV	81	80 – 94	fl
● MCH	28.3	27 – 32	pg
● RDW	14.3	11.5 – 14.5	%
● PLT	350	140 – 450	x10.e9/L

What is the most appropriate test of choice to be requested?

JAK2 Mutation **Positive** (molecular marker [Janus kinase 2], JAK2V617F) that is present in 95% with **PV** and exon 12 in 4% of PV)

we have to know if it's vera or secondary by JAK2 mutation test



Diagnosis of Polycythaemia Vera:

PV is defined by **JAK2 mutation positive with low serum erythropoietin** level, makes the diagnosis of PV more likely.

Erythropoietin <2 (2.6 -18.5 mIU/mL)

Leukocyte Alkaline Phosphatase (LAP) SCORE 237 (20 – 80)

LAP score is high in all myeloproliferative disorders except CML. myeloproliferative disorders includes (polycythemia vera, essential thrombocythemia, myelofibrosis, CML)

What is the first thing to do after diagnosed of polycythemia vera ?

Phlebotomy and low dose aspirin

❖ WHO Criteria to diagnose PV: (2016)

The doctor said they are similar but go with the british criteria if you are confused

Major criteria to diagnose PV are as follows:

- Haemoglobin >16.5 g/dL in men and >16 g/dL in women, or hematocrit >49% in men and >48% in women.
- Bone marrow biopsy showing hypercellularity for erythroid, granulocytic, and megakaryocytic proliferation and variation in size. Ordered in certain situations only
- Presence of **JAK2 Gene Mutation** (*JAK2V617F* or *JAK2* exon 12 mutation) (very strong indicator)

The minor criterion is as follows:

Serum erythropoietin level below the reference range for normal.



◆ The British Committee for Standards in Hematology (2018)

Are similar to those of the WHO criteria, with the exception that they are based upon an **elevated hematocrit** (>**52%** in men, >**48%** in women), rather than an elevated hemoglobin.

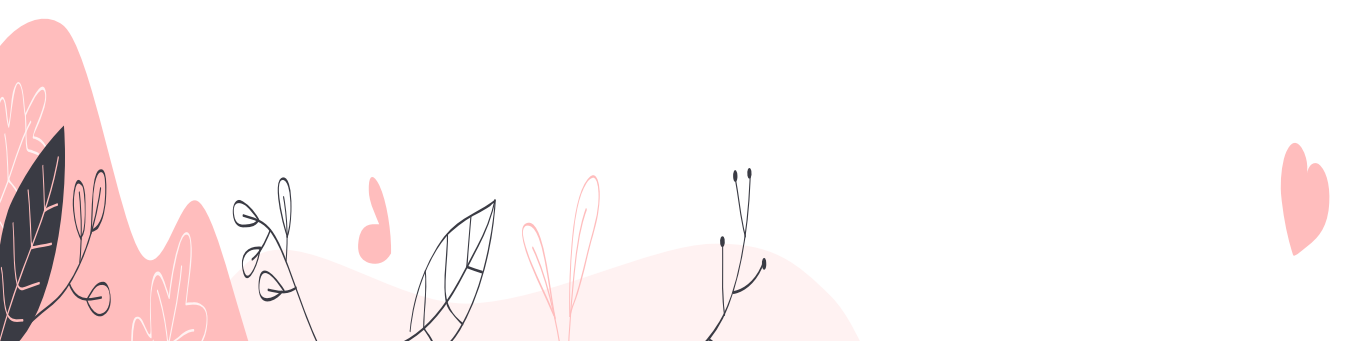
Findings that are often present in patients with PV, but are not required for diagnosis:
don't confirm, just support the diagnosis

- Thrombocytosis (>400,000 platelets/ μ L)
- Leukocytosis (>12,000/ μ L) (as seen in the previous case)
- Leukocyte alkaline phosphatase score (LAP) >100 units/L in the absence of fever or infection

Note:

Splenomegaly, leukocytosis, and thrombocytosis are common to all of the chronic myeloproliferative neoplasms, including PV, chronic myeloid leukemia, essential thrombocythemia, and primary myelofibrosis.

For all patients with PV

- Offer low-dose **aspirin** unless there are contraindications (Strong recommendation).
 - Offer **phlebotomy** and maintain hematocrit at <**45%** (Strong recommendation).
- 

A 55-year-old man, who is a known case of hypertension on 25 mg hydrochlorothiazide. He is a **smoker** of 20 - 30 cig. per day for >20 years. BP 138/88. He came for routine follow up.

- WBC.....6.5 4—11 x 10.e9/L
- RBC.....**7.1** H 4.7—6.1 x 10.e12/L
- HB.....**197** H 130—180 g/L
- HCT.....**56.3** H 42—52 %
- MCV.....88 80 - 94 fl
- MCH.....30.3 27 - 32 pg
- PLT.....305 140 - 450 x 10.e9/L
- JAK2 Mutation **Negative**

What is the most likely diagnosis?

2nd Polycythemia based on HB, HCT, RBC & **negative** JAK2 ,(mostly due to smoking)

How are you going to manage this patient?

U/S abdomen (in female we do us abdomen and pelvis) to R/O other causes, Advise to stop smoking, give aspirin ,blood Phlebotomy e.g. every two weeks till **HCT** reaches **45**

What about management of hypertension?

Discontinue hydrochlorothiazide and give him CCB “bc it causes dehydration → ↑HB → inaccurate reading”

Polycythaemia Vera

- ↑ RBC, **HB** and **HCT**
- Increase in RBCs usually with ↑in WBCs (previous case was normal) or ↑Platelets or both
- JAK2 mutation is positive
- Low erythropoietin

Secondary Polycythaemia: (Erythropoietin is expected to be raised)

- Smoking
- High altitude
- Renal Cysts
- Hypernephroma
- Hepatoma
- Cerebellar Hemangioblastoma
- COPD.
- Cyanotic Cong. H.D
- Uterine Fibromyoma
- Adrenal adenoma
- Pheochromocytoma
- Sleep Apnea**

A 58-year-old woman known diabetic, hypertensive and hypothyroid for FU.

Lab View	23/11/2017 00:00	20/11/2017 00:00	09/02/2017 00:00
General Hematology			
WBC	13.700 (H)	10.900	11.300 (H)
RBC	4.4	4.2	4.6
Hgb	114.0 (L)	113.0 (L)	121.0
Hct	36.4 (L)	35.0 (L)	38.5
MCV	83.1	82.8	83.1
MCH	26.0 (L)	26.7 (L)	26.1 (L)
MCHC	313.0 (L)	322.0	315.0 (L)
RDW	17.2 (H)	17.9 (H)	16.8 (H)
Platelet	598.0 (H)	608.0 (H)	462.0 (H)
MPV	7.9	7.7	7.9
Neutro Auto #	9.0 (H)		
Neutro Auto %	66.1		
Lymph Auto #	3.7		
Lymph Auto %	26.8		
Mono Auto #	0.8		
Mono Auto %	6.0		
Eos Auto %	0.6		
Eos Auto #	0.10		
Baso Auto #	0.10		
Baso Auto %	0.50		
NRBC	0.0000		
ESR	65 (H)		40 (H)

Interpret?

Patient with high **WBC AND platelet** , low iron and normal ferritin most likely it's inflammation

What other test you are going to do ?

JAK2 mutation “we are afraid from essential thrombocythemia (one of the chronic myeloproliferative neoplasms) so we should order it”

Lab View	23/11/2017 00:00	20/11/2017 00:00	09/02/2017 00:00
Routine Chemistry			
ALT		22.0	24.0
AST		11 (L)	8 (L)
Albumin		29.08 (L)	32.72 (L)
Alk Phos		133	145
BUN		6.7 * (H)	6.5 * (H)
Creatinine Lvl		64	55
Bili Direct		2.16	2.64
Bili Indirect		10	7
Bili Total		12.53	9.89
CO2		30	25
Calcium		2.34 *	2.33 *
Chloride		101	104
Glucose		7.96 * (H)	9.54 * (H)
Potassium		4.9 *	4.8 *
Sodium		137 *	141 *
Total Protein		66 *	68 *
GGT		68 (H)	73 (H)
Corr Calcium		2.56 * (H)	2.48 *
Phosphorus		1.06 [2]	1.32 [2]
Osmolality		289	298 (H)
Iron	5.0 (L)		6.8 (L)
TIBC	68.5		37.3
Ferritin		9.5 (H)	9.7 (H)
Hgb A1c		288	
Uric Acid		293.4	182.2
Vitamin B12		45.78 * (L)	
Vitamin D 25 OH			
Lipids			
Chol		5.27 (H)	5.45 (H)
HDL		1.51	1.30
LDL		2.78	3.00
Trig		2.16 (H)	2.52 (H)
Endocrine			

Endocrine			
T4 Free		13.650 *	
TSH		7.790 (H)	6.830 (H)
Random Urine Chemistry			
A/C Ratio		7.93	
U Creat		10,038.66	
U Microalbumin		9	
Immunology			
CRP	22.200 *		24.500 *
Molecular Genetics			
JAK 2 Mutation	Negative		
JAK2 Interp	Negative		

What is the diagnosis ?

Reactive thrombocytosis

Causes of Thrombocytosis

Reactive thrombocytosis (more common)

- Acute bleeding and blood loss
- Cancer
- Infections
- Iron deficiency
- Removal of spleen
- Haemolytic anemia
- Inflammatory disorders, such as rheumatoid arthritis, IBD, ...
- Surgery or other type of trauma

Essential thrombocythemia

Myeloproliferative disorder (**Molecular genetics; Jak 2** and bone marrow aspiration)

A 25 year old man came for pre-marital check up. The following CBC is shown below:

● WBC	.....	6.6		4 - 11	x 10.e 9/ L
● RBC	.....	5.87		4.7 – 6.1	x 10 .e12/L
● HGB	.....	121	L	130 – 180	g/L
● HCT	.....	38.1	L	42 - 52	%
● MCV	.....	64.0	L	80 – 94	fl
● MCH	.....	20.6	L	27 – 32	pg
● MCHC	.....	318	L	320 – 360	g/L
● RDW	.....	14.3		11.5 – 14.5	%
● PLT	.....	271		140 - 450	x 10.e9/L

Interpret this data.

Low HB (slight), **RBCs** are high normal and **not matching** with **HB**.
The decrease in **MCV** is more and is **disproportionate** to the **HB** level

What is other test your going to do ?

Haemoglobin Electrophoresis

- Hemoglobin A 94.5 (95 -99 %)
- Hemoglobin F 0.6 (0 - 2.0 %)
- Hemoglobin A2 **4.9** H (2.0 -3.5 %) high: beta , normal: alpha
- Hemoglobin S 0.0
- Hemoglobin E 0.0
- Hemoglobin C 0.0

What is the diagnosis?

Beta Thalassemia Trait as HbA2 is high

A 34-year-old man came to check some of results because of being have IBS

#Test	Result	Unit	Range
EDTA Whole Blood - SAMPLE: 1			
1 WBC	7.70	$\times 10^9/L$	4 - 11
2 RBC	6.83	$\times 10^{12}/L$	4.7 - 6.1
3 HGB	130.	g/L	13 - 18.
4 HCT	43.	%	42 - 52
5 MCV	63.	fL	8 - 95
6 MCH	19.8	pg	27 - 32
7 MCHC	314.	g/L	32 - 36.
8 RDW	16.2.	%	11.0 - 14.0
9 PLT	170	$\times 10^9/L$	14 - 40.

What is other test your going to do ? Haemoglobin Electrophoresis to know the type

#Test	Result	Unit	Range
Venous Blood - SAMPLE: 1			
1 Hemoglobin A2	2.0	%	2.0 - 3.0
2 Hemoglobin F	0.0	%	- 2.0
3 Hemoglobin A	97.0	%	90 - 99
4 Hemoglobin S	-		-
5 Hemoglobin C	-		-
6 Hemoglobin E	-		-
7 Hemoglobin O	-	%	-

What is the diagnosis?

Thalassemia Trait mostly "alpha Thalassemia" as Hb A2 is normal.

❖ Thalassaemia Minor

- Microcytosis is much more profound, and the anemia **much milder** than that seen in IDA.
- Patients with **thalassemia minor/trait** also tend to have total **RBC** counts higher than normal, often into the "polycythaemic" range.
- The RDW in patients with thalassemia trait tends to be normal, since virtually all cells are **hypochromic and microcytic**.

Thalassaemia Minor **IMP**

- **MCV usually < 70 fL**
- **The decrease in MCV is disproportionate to the HB level.**
- **Mentzer Index: MCV / RBC is < 13 (very important)**
- If RDW is high, Correct Iron level first before proceeding to HB electrophoresis, otherwise giving a false negative result
- If HB A2 > 3.5 → B-Thalassaemia Minor
- If HB A2 is normal → alpha Thalassaemia Minor

Hb A2 high >> beta thalassemia trait

Hb A2 high and Hb S >> SCA with thalassemia trait

Hb A2 normal >> alpha thalassemia

Hb S high alone >> SCA

A 22 year old man followed for Hypothyroidism.

# Test	Result	Unit	Range
EDTA Whole Blood - SAMPLE: 1			
1 WBC	11.6	H x10.e9/L	4 - 11
2 RBC	2.3	L x10.e12/L	4.7 - 6.1
3 HGB	82	L g/L	130 - 180
4 HCT	22.1	L %	42 - 52
5 MCV	98.1	H fl	80 - 94
6 MCH	35.4	H pg	27 - 32
7 MCHC	372	H g/L	320 - 360
8 RDW	23.6	H %	11.5 - 14.5
9 PLT	506	H x10.e9/L	140 - 450

matching

macrocytic

Retic Count % 7.78 0.2 - 2.0

# Test	Result	Unit	Range
Venous Blood - SAMPLE: 1			
1 Hemoglobin A2	2.6	%	2.0 - 3.5
2 Hemoglobin F	26.0	%	0 - 2.0
3 Hemoglobin A	0.0	H %	95 - 99
4 Hemoglobin S	71.4		-
5 Hemoglobin C	0.0		-
6 Hemoglobin E	0.0		-
7 Hemoglobin O	0.0	%	-

What is the diagnosis ?

SCA and patient is on Hydroxyurea

What does high reticulocytes indicate ?

Haemolytic anaemia

Why Hemoglobin F is high ?

Because patient is taking Hydroxyurea

A 31-year-old man presents with heartburn and known to have IBS. The following CBC is shown below.

# Test	Result	Unit	Range
EDTA Whole Blood - SAMPLE: 1			
1 WBC	13.6	H x10.e9/L	4 - 11
2 RBC	4.94	x10.e12/L	4.7 - 6.1
3 HGB	106	L g/L	130 - 180
4 HCT	33.1	L %	42 - 52
5 MCV	67.1	L fl	80 - 94
6 MCH	21.4	L pg	27 - 32
7 MCHC	319	L g/L	320 - 360
8 RDW	19.7	H %	11.5 - 14.5
9 HDW	0.0	g/L	0 - 0
10 PLT	375	x10.e9/L	140 - 450

# Test	Result	Unit	Range
Venous Blood - SAMPLE: 1			
1 Hemoglobin A2	7.3	H %	2.0 - 3.5
2 Hemoglobin F	5.2	H %	0 - 2.0
3 Hemoglobin A	0.0	L %	95 - 99
4 Hemoglobin S	87.5	H %	-
5 Hemoglobin C	0.0		-
6 Hemoglobin E	0.0		-
7 Hemoglobin O	0.0	%	-

(MCV is low in this case because of the beta trait)

What is your diagnosis? SCA and Beta Thalassemia Trait

❖ Haemolytic Anaemia

TEST	WHAT DOES IT REFLECT	WHAT IS EXPECTED
Reticulocytes	Immature RBCs due to bone marrow activity	Increased
Indirect Bilirubin	Unconjugated Hb breakdown	Increased
Haptoglobin	Binds free plasma haemoglobin	Decreased
LDH	Abundant in RBCs so released when haemolysed /damaged	Increased

A 49-year-old woman presents with weakness and easy tiredness.

The following investigations are shown:

- WBC 7.8 4 – 11 x10.e9/L
- RBC 4.46 4.2– 5.5 x10.e12/L
- HGB 76 L 120 – 160 g/L
- HCT 25.2 L 37– 47 %
- MCV 60.6 L 80 – 94 fl
- MCH 18.3 L 27 – 32 pg
- MCHC 303 L 320– 360 g/L
- RDW 19.2 H 11.5 – 14.5 %
- PLT 383 140 – 450 x10.e9/L
- Iron 2.0 umol/L (9 - 30)
- Ferritin 4.57 ug/L (13 - 150)
- Total Iron-Binding cap ... 89.3 umol/L (44.8 - 80.6)

What is your diagnosis?

Iron def. anaemia + Thalassaemia trait (because of RBCs are normal and not matching with HB)

This pt was falsely diagnosed as IDA and was put on iron supplements

	41yo SF pre-op screening	45 yo Indian male pre-employment	52 yo Filipino male HTN	Normal
Anemia	Microcytic	Microcytic	Microcytic	
RBC	3.40	5.87	4.98	4.7 -6.1x 10.e 12/L
Hb	89	126	119	130 – 180 g/L
MCV	70.9	63.3	70.8	80-94 fl
S. Iron	2.6	13	34	9-30µmol/L
Ferritin	3.39 ↓	266.7	691 ↑	30-400µg/L
Hemogl.A2	2.1	5.4	2.2	2.0-3.5
Hemogl F	0	<0.5	0	0-2.0
Hemogl A	97.9	>94	97.8	95-99
Hemogl S	0	0	0	-
Hemogl C	0	0	0	-
	IDA	B Th. Trait	Th. Trait, alpha	

A 44 year old man, who is a known case of HCV positive.

- WBC.....2.0 L 4—11 x 10.e9/L
- RBC.....2.95 L 4.7—6.1 x 10.e12/L
- HB.....110 L 130—180 g/L
- HCT.....31.9 L 42—52 %
- MCV.....108.1 H 80 - 94 fl
- MCH.....37.3 H 27 - 32 pg
- RDW 19.5 % 11.5 – 14.5
- PLT.....92 L 140 - 450 x 10.e9/L
 - HEPATITIS C RNA QUALITATIVE Positive
 - HEPATITIS C RNA QUANTITATIVE 389744 IU/ML

What is your diagnosis?

Pancytopenia (Bone Marrow Depression) 2nd to therapy Like interferon.

A 70-year-old man, presents with 2 month H/O easy fatigue and tiredness. PMH: unremarkable

The following CBC is shown below:

●	WBC	7.8		4	–	11	x10.e9/L
●	RBC	2.26	L	4.7	–	6.1	x10.e12/L
●	HGB	69	L	130	–	180	g/L
●	HCT	20.2	L	42	–	52	%
●	MCV	89.3		80	–	94	fl
●	MCH	30.6		27	–	32	pg
●	MCHC	343		320	–	360	g/L
●	RDW	15.8	H	11.5	–	14.5	%
●	PLT	179		140	–	450	x10.e9/L

What is your diagnosis?

Normocytic Normochromic Anaemia

D. D. :Hypothyroidism, Chronic Diseases, Malignancy
 (Hypothyroidism in male lead to macrocytic and normocytic anemia while in female lead to normocytic , microcytic and macrocytic anemia.)

❖ Normocytic Normochromic Anaemia

Anaemia of chronic diseases is characterized by:(**first 2 are important**)

- Serum Iron Low
- Ferritin Normal or High (it's an inflammatory marker)
- RDW Normal or High

Causes:

- Hypothyroidism
- Chronic Diseases
- Malignancy
- Acute blood loss (if you write blood loss alone without acute you will get zero)

A 70-year-old man, known diabetic, admitted because of abdominal pain.

# Test	Result	Unit	Range
EDTA Whole Blood - SAMPLE: 1			
1 WBC	7.0	10.e9/L	4 - 11
2 RBC	3.38	10.e12/L	4.7 - 6.1
3 HGB	101	g/L	130 - 180
4 HCT	30.0	%	42 - 52
5 MCV	88.8	fl	80 - 94
6 MCH	29.9	pg	27 - 32
7 MCHC	336	g/L	320 - 360
8 RDW	17.8	%	11.5 - 14.5
9 HDW	0	g/L	-
# Test	Result	Unit	Range
Serum - SAMPLE: 1			
1 Ferritin	1583.000	ug/L	30 - 400
2 Vitamin B12	630.600	PM/L	145 - 637
# Test	Result	Unit	Range
Serum - SAMPLE: 1			
1 Iron	9.4	umol/L	11 - 31

Interpret the results:

normocytic normochromic anaemia, due to chronic disease, malignancy, hypothyroidism

#	Result	Unit	Range
1 Urea	21.0	mmol/L	2.9 - 7.5
2 Serum Creatinine	330	umol/L	62 - 115
3 Sodium	128	mmol/L	135 - 145
4 Potassium	4.2	mmol/L	3.5 - 5.1
7 Random Blood Sugar	8.6	mmol/L	3.9 - 9
10 Albumin	37	g/L	30 - 50
11 Corrected Calcium	2.4	mmol/L	2.1 - 2.55
12 Inorganic Phosphorus	1.68	mmol/L	0.74 - 1.3
13 Total Bilirubin	58	umol/L	3 - 17
14 Direct Bilirubin	42	umol/L	0 - 5
15 Total Proteins	84	g/L	60 - 80
16 Alkaline Phosphatase	189	U/L	50 - 136
17 Alanine Aminotransferase	72	U/L	20 - 65
18 Aspartate Aminotransferase	62	U/L	12 - 37
19 Gamma G T	142	U/L	15 - 85
21 Globulins	47.0	g/L	20 - 40
23 Creatine Kinase	6	U/L	39 - 308
24 Magnesium	0.8	mmol/L	0.7 - 1.1
25 Amylase	168	U/L	25 - 125
26 Lipase	1414.0	U/L	0 - 200

What is the diagnosis?

Chronic kidney disease with normocytic anaemia

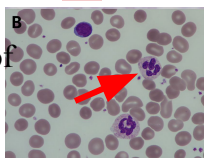
What caused the abdominal pain?

Acute pancreatitis (very high lipase)

A 57 year old man presents with 6 weeks H/O numbness and weakness of the lower limbs. He was looked pale with signs of peripheral neuropathy. The following CBC is shown below:

●	WBC	3.20	L	4 – 11	x10.e9/L
●	RBC	1.90	L	4.7	– 6.1 x10.e12/L
●	HGB	53	L	130 – 180	g/L
●	HCT	15	L	42	– 52 %
●	MCV	118	H	80	– 94 fl
●	MCH	40	H	27	– 32 pg
●	MCHC	134	L	320	– 360 g/L
●	RDW	24.6	H	11.5	– 14.5 %
●	PLT	39	L	140	– 450 x10.e9/L

Blood film : Hypersegmentation of neutrophils. pathognomonic



What is the most likely diagnosis?

Vitamin B12 Deficiency / Pernicious Anaemia

Vitamin B 12 level **67 PM/L** (145 – 637)

How are you going to manage this patient?

Admission for blood transfusion and further assessment like bone marrow Aspiration. The patient in need for B12 injection for life.

Once you see a very high MCV think of vit B12 def. first



A 53-year-old man booked for control of high blood pressure. He used to smoke 20 – 40 cig. per day and water pipe. The following CBC is shown below:

# Test	Result	Unit	Range
EDTA Whole Blood - SAMPLE: 1			
1 WBC	3.9	10.e9/L	4 - 11
2 RBC	7.18	10.e12/L	4.7 - 6.1
3 HGB	224	g/L	130 - 180
4 HCT	66.6	%	42 - 52
5 MCV	92.7	fl	80 - 94
6 MCH	31.3	pg	27 - 32
7 MCHC	337	g/L	320 - 360
8 RDW	13.7	%	11.5 - 14.5
9 HDW	0	g/L	-
10 PLT	163.0	10.e9/L	140 - 450

What is your diagnosis?

1. 2nd Polycythemia “JAK2 is negative”
2. Think in secondary causes: Smoking, COPD,
3. US abdomen / Advise to stop smoking /Blood donation or phlebotomy / Control of BP / Aspirin

A 63 year old woman presents with a 2 months' H/O tiredness and easy bruising. O/E cervical lymph nodes are felt and her spleen is palpable 4 cm below the costal margin.

The following investigations are shown below:

•	WBC	42.7	H	4	-	11	x10.e9/L
•	RBC	2.6	L	4.7	-	6.1	x10.e12/L
•	HGB	83	L	130	-	180	g/L
•	HCT	30.2	L	42	-	52	%
•	MCV	102	H	80	-	94	fl
•	MCH	36.4	H	27	-	32	pg
•	PLT	52	L	140	-	450	x10.e9/L

Differential

•	NEUT	8.5%	40	-	75	%
•	LYMP	89%	20	-	45	%
•	RETIC.....	5.3%	0.2	-	2	%

Immunoglobulins

•	IGG.....	3.5	8	-	18	g/L
•	IGM.....	0.1	0.6	-	2.5	g/L
•	IGA.....	0.1	0.9	-	4.5	g/L

Impaired Ig with high lymphocytes

Interpret the results and what complications are seen?

Interpretations:

- High WBCs with mainly lymphocytes predominant
- Lymphadenopathy and splenomegaly
- **Diagnosis:** chronic lymphocytic leukaemia with haemolytic anaemia

Complications:

- Autoimmune Haemolytic Anaemia based on: Low Hb and high reticulocytes
- Thrombocytopenia (bone marrow filtration)
- Hypogammaglobulinemia

A 12-year-old boy presented with two days H/O of lethargy. His mother has noted him to be jaundiced. He was usually well.

His PMH is unremarkable. O/E, he was pale and obviously jaundiced, no hepatomegaly

- HB **76** L 130 – 180 g/L
- WBC 6.90 4 – 11 x10.e9/L
- PLT..... 413 140 - 450 x10 .e9/L
- Retic. **5.4 %** H (**hemolytic anemia**)
- Total bilirubin..... 94 H (3- 17 umol/L)
- Direct bilirubin 5 (**so indirect bilirubin is high here**)
- Alanine aminotransferase 35 (20-65 u/L)
- Urine urobilinogen :..... +ve

1- What is the most likely diagnosis?

G6PD deficiency

2- What additional details in history and further investigations?

- **H/O exposure to Fava Beans / Drugs**
- **Screening test for G6PD, when haemolysis is not present.**(if there is haemolysis it will lead to false negative)

A 55-year-old woman; Nurse; known to have HTN, and worried about her CBC results.

Lab View	14/12/2017 00:00	28/02/2017 00:00	02/08/2016 00:00
General Hematology			
<input type="checkbox"/> WBC	7.000	6.900	6.900
<input type="checkbox"/> RBC	6.4 (H)	6.0 (H)	6.0 (H)
<input type="checkbox"/> Hgb	134.0	123.0	123.0
<input type="checkbox"/> Hct	42.4	40.0	39.9
<input type="checkbox"/> MCV	66.3 (L)	67.0 (L)	66.7 (L)
<input type="checkbox"/> MCH	20.9 (L)	20.7 (L)	20.5 (L)
<input type="checkbox"/> MCHC	315.0 (L)	309.0 (L)	308.0 (L)
<input type="checkbox"/> RDW	16.4 (H)	15.9 (H)	17.6 (H)
<input type="checkbox"/> Platelet	322.0	282.0	292.0
<input type="checkbox"/> MPV	9.0	8.3	8.6
<input type="checkbox"/> Iron			20.3
<input type="checkbox"/> TIBC			.
<input type="checkbox"/> Hgb A1c	5.9		5.7
<input type="checkbox"/> Uric Acid	261	257	246
<input type="checkbox"/> Vitamin B12			604.0
<input type="checkbox"/> Vitamin D 25 OH	99.73 *		127.40 *

Remember in polycythemia we depend on the HB NOT RBCs



There is mismatching between HB and RBCs and as you can see MCV is much reduce so this is thalassemia minor
Mentzer Index: MCV / RBC is 10.3 “<13”

A 23-year-old female presents with 3 weeks H/O fever and oral ulcers. She received two courses of antibiotics in private centers.

•	WBC	2.2	4 – 11	x10.e9/L
•	RBC	4.7	4.7 – 6.1	x10.e12/L
•	HGB	93	130 – 180	g/L
•	HCT	29.8	42 – 52	%
•	MCV	63.1	80 – 94	fl
•	MCH	19.7	27 – 32	pg
•	MCHC	313	320 – 360	g/L
•	RDW	15.6	11.5 – 14.5	%
•	PLT	219	140 – 450	x10.e9/L

Interpret The results.

She has Leucopenia, Hypochromic Microcytic Anaemia (Mostly IDA) & Thalassaemia trait.

What are the most likely Causes of WBC count?

Viral infection, Connective tissue disease e.g. SLE

A 15 year old girl presents with 6 m H/O hair fall. The following investigations are shown.

(in case of hair fall, you should order these 5 things)

1. Hb 111 g/L (120 – 160)
2. Ferritin 4.7 ng/ml (13 – 150)
3. Vit D11.2 nmol/L (75 – 250)
4. TSH 3.2 mIU/L (0.25 – 5)
5. Zinc 10.2 umol/L (7.65 – 22.95)

What is your management?

Ferrous fumarate and folic acid to restore Ferritin level \ Vitamin D3

A 62-year-old lady, known case of IHD presents with one week H/O black stools which is documented to be melena on PR. She was pale and abdomen is soft. Investigations revealed:

- HGB 96 120 – 160 g/L
- PLT 260 140 – 450 x10.e9/L

What is the most common cause could be responsible for this condition? Aspirin

The most appropriate next step to do is:

- A- Start her on ferrous sulphate
- B- Start her on H2 blocker
- C- Start her on proton pump inhibitor
- D- Refer her for gastroscopy

Answer **D**

MISCELLANEOUS

Whole section was skipped by the doctor

A 24 year old man presents with 2 days H/O loose motions, 3 – 5 times per day with blood and mucous. He gave H/O URTI and a course of antibiotic.

Stool analysis:

- Mucous ++
- RBCs 30 – 40 /HPF
- WBCs 10 – 20 /HPF
- C/S: No growth
- **Mention two differential diagnosis.**
 1. Acute dysentery e.g. Shigella / Amoebic
 2. Pseudo Membranous Colitis
- **What is the most appropriate diagnosis based on the scenario?**

Pseudo Membranous Colitis
- **Mention three drugs responsible for that picture.**
 1. Clindamycin
 2. Ciprofloxacin
 3. Amoxicillin
- **What is the causative agent?**

Clostridium Difficile
- **Management:**

Discontinue Antibiotic \ Oral fluids \ Metronidazole \ In severe cases, Vancomycin

A 42 year old lady presented with 2 days H/O lower abdominal pain and vomiting.

Result Unit Range *URINE - SAMPLE: 1*

- NITRITE POSITIVE
- PH 8.5
- PROTEIN 1+
- GLUCOSE NIL
- KETONE TRACE
- BLOOD 3+
- HEMOGLOBIN 3+
- WHITE BLOOD CELLS 467 cmm
- RED BLOOD CELLS 968 cmm
- CAST NIL
- CRYSTAL NIL
- OTHERS BACTERIA ++
- SPECIFIC GRAVITY 1.025

What is your diagnosis? Lower UTI, Cystitis

A 14 year-old boy presents with one month H/O puffiness of eyelids mainly by morning.

The following urine analysis 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

Interpret the results

Proteinuria and mostly Nephrotic syndrome

A 32 year old man who is a known case of IBS for the last 3 years, has the stool analysis shown below.

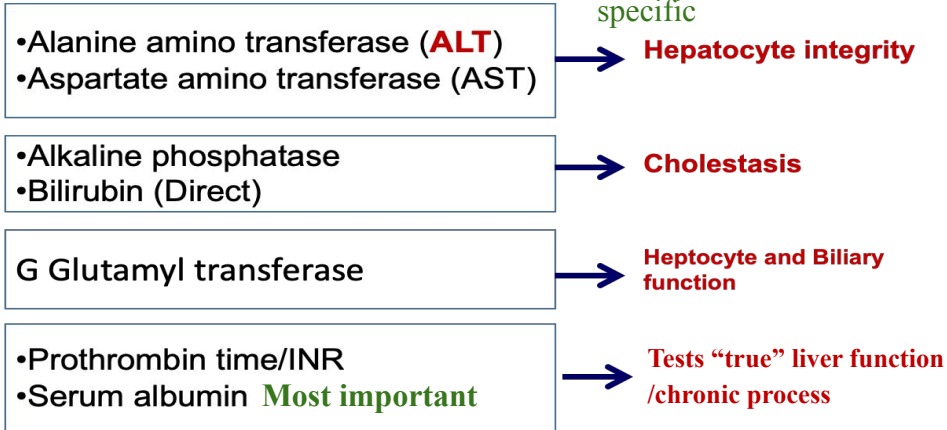
- OCCULT BLOOD: NEGATIVE
- OVA,CYST & PARASITE: no ova cyst or parasite seen
- CULTURE:.....SALMONELLA SEROGROUP C1

How are you going to manage this patient?

Self limiting and no need for antibiotic

2. Liver function test

ALT is more important than AST because it's more specific



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)

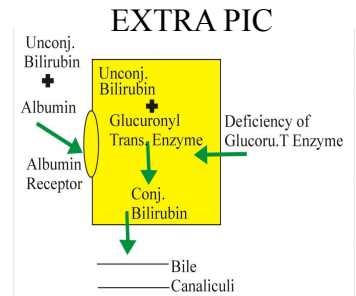
High in hepatocytes or biliary, but since the other parameters are normal think about other causes

Mention two causes for the abnormality?

- **Drugs like antiepileptics e.g. Carbamazepine \ Alcohol \ Fatty liver**

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

- Total Bilirubin57 H 3 – 17 mmol/L
- Direct Bilirubin6 0 – 5 umol/L
- Total Protein78 60 – 80 g/L
- Albumin47 30 – 50 g/L
- Alkaline phosphatase69 50 – 136 u/L
- Alanine Aminotransferase63 20 – 65 u/L
- Aspartate Aminotransferase31 12 – 37 u/L
- Gamma Glutamyl transferase25 15 – 85 u/L



How are you going to deal with this gentleman?

Request CBC and Reticulocytes to R/O hemolytic anemia

If the further investigation is showed normal what is diagnosis?

If came normal, so mostly **Gilbert's syndrome** (it's a benign condition, mostly just reassure the patient) :

It's impairment in **conjugation**; Glucuronyl transferase activity is decreased Unconjugated Bilirubin increases during fasting and stress.

When do we see yellowish of skin ? If the Bilirubin is 3 times higher than normal

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.

- Total bilirubin 10 (3- 17 umol/L)
- Total protein71 (60-80 g/L)
- Albumin 37 (35-50 g/L)
- Alkaline phosphatase126 (50-136 u/L)
- Alanine aminotransferase 99 H (20-65 u/L)
- Aspartate aminotransferase65 H (10-31 u/L)
- G.G. Transferase 98 H (5-55 u/L)

interpret ?

Increase of ALT 1.5 times (mild elevation)

If it's increase 3 times then we say high

What is the most likely diagnosis? And what you will do?

- Drug induced Hepatitis, mostly due to Isoniazid.
- Follow up and no further actions taken **Continue the medication and follow LFT, because its a mild elevation**

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.

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 (50-136 u/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 INR1.2 (Normal)

Mention two investigations of significance? **Viral serology B & C** (Negative) **U/S liver** to confirm the diagnosis (increased echogenicity)

What is the most likely diagnosis? **NAFLD** (non-alcoholic fatty liver disease)

What is the routine screening for liver ? **Viral serology B & C** and **U/S liver**

What medication she can take for her condition?

1- pioglitazone 2- metformin 3- statins (pioglitazone was found to enhance both NAFLD & T2DM)

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

- Total bilirubin 58 H (3- 17 umol/L)
- Indirect bilirubin5
- Albumin 38 (35-50 g/L)
- Alkaline phosphatase346 H (50-136 u/L)
- Alanine aminotransferase ... 116 H (20-65 u/L)
- Aspartate aminotransferase 91 H (10-31 u/L)

Viral serology for B & C is negative, U/S is within normal **do it to rule out other causes**

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 23-year-old male presents with 3 days H/O abdominal pain, vomiting and yellowish sclera.

- Total bilirubin 112 (3- 17 umol/L)
- Direct bilirubin 42
- Total protein 71 (60-80 g/L)
- Albumin 37 (35-50 g/L)
- Alkaline phosphatase 212 (50-136 u/L)
- Alanine aminotransferase 1092 (20-65 u/L)
- Aspartate aminotransferase 665 (10-31 u/L)
- G.G. Transferase 198 (5-55 u/L)

What is the most likely diagnosis?

Hepatitis A virus very high ALT mostly seen HepA+ it's the one that causes of abdominal pain and vomiting

What further investigations of choice?

IgM of Hep. A , Hep. B markers / Hepatitis C Ab you need to screen for them

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

- Total bilirubin98 H (3- 17 umol/L)
- Indirect bilirubin43
- Albumin 36 (35-50 g/L)
- Alkaline phosphatase356 H (50-136 u/L)
- Alanine aminotransferase316 H (20-65 u/L)
- Aspartate aminotransferase291 H (10-31 u/L)
- G.G. Transferase286 H (5-55 u/L)
- INR normal

What is the possible DD?

- Viral Hepatitis
- Autoimmune Hepatitis
- Primary biliary cirrhosis (50+ usually)
- Alcoholic hepatitis no Hx
- 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-Mitochondrial Antibody and Anti-Smooth Muscle Antibody)
- Liver biopsy (check degree of inflammation)

A 65-year-old man presents with a 3-month history of numbness and paresthesia in his feet. On examination, there is numbness of both feet (socks distribution). It does not fit a dermatomal distribution.

- Total bilirubin32 H (3- 17 umol/L)
- Indirect bilirubin21
- Albumin 38 (35-50 g/L)
- Alkaline phosphatase156 H (50-136 u/L)
- Alanine aminotransferase112 H (20-65 u/L)
- Aspartate aminotransferase359 H (10-31 u/L)
- G.G. Transferase246 H (5-55 u/L)

What is the most likely diagnosis? **Alcoholic hepatitis and peripheral neuritis**
(AST:ALT ratio >2 suspect alcoholic liver disease and if >3 the percentage increase to 96%)

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

- Total bilirubin 6 (3- 17 umol/L)
- Indirect bilirubin 3
- **Albumin** **23** L (35-50 g/L)(function is affected)
- Alkaline phosphatase 180 H (50-136 u/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** 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 Anaemia due to CLD.

3. Metabolic Disorders

A 70-year-old blind man known case of hypothyroidism, vitiligo and left ventric. 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 if no improvement give PTH injection

What other organs or diseases you may screen for? Diabetes (FPG), Adrenal gland (Cortisol level) other autoimmune disease

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

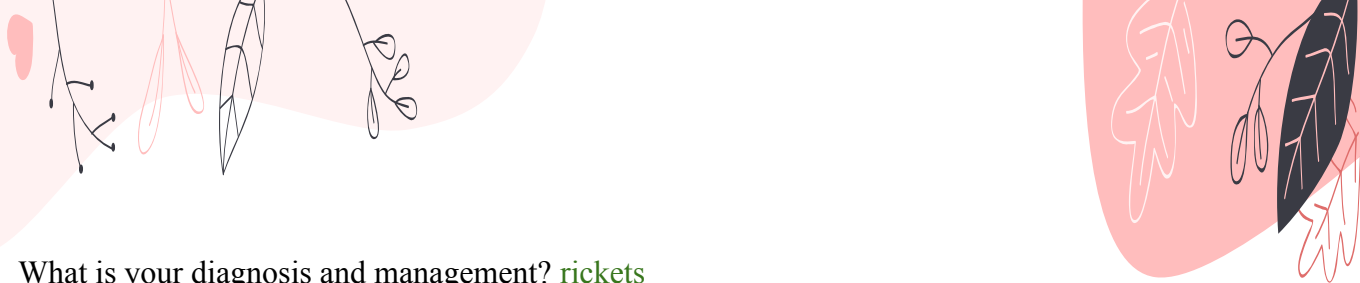
The following results are shown:

- 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
 - [Deficiency <25 Insufficiency 25 – 75
 - Sufficient 75 – 250 Toxicity >250]

See attached X-Ray

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.





What is your diagnosis and management? **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

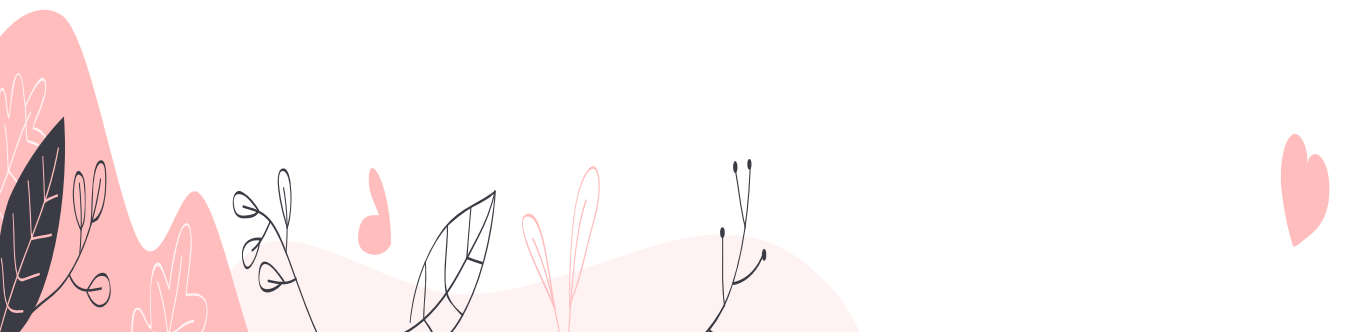
important

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.

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 months 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 goitre)

● Ca:.....	3.4	mmol/L	(2.1 - 2.6)	(very high! it might lead to cardiac arrest)
● 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 due to parathyroid adenoma

Which investigation of choice are you going to request ?

Nuclear scan for parathyroid gland + parathyroid hormone

First thing in management is fluid + loop diuretics “furosemide” to lower ca and prevent cardiac complications, then refer to an endocrine surgeon

A 48 year old woman presents with 5 month H/O difficulty in raising from sitting position.

- **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)
- **Albumin** 38 g/L (35 – 50)

What is your diagnosis? Hypoparathyroidism

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

Test	Result	Unit	Range
<i>Serum - SAMPLE: 1</i>			
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	NML 4.5 - 20.7
# Test	Result	Unit	Range
<i>Serum - SAMPLE: 11</i>			
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

How to differentiate between iatrogenic insulin and Insulin resistance ?

By c-peptide

In **iatrogenic insulin** >>>>> c-peptide will be low

In **Insulin resistance** >>>>> c-peptide will be high

4. 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

Answer **D**

◆ Subclinical Hypothyroidism

Indication of treatment:

- Clinical symptoms
- Presence of goiter
- TSH > 10 miu/l
- High positive antithyroid antibodies

If TSH < 10 and asymptomatic:

- Repeat TSH after 6 – 12 months
- Request thyroid antibodies, if high +ve then treat.

To treat, start with Thyroxin 25 ugm OD

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 (you might as well order FNA under US B/C if US showed solid nodule you need to go again and do FNA)

Answer E

(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 (just read it)

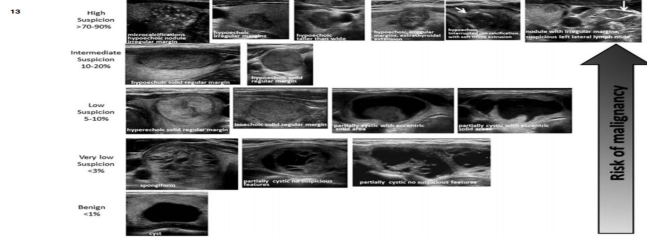
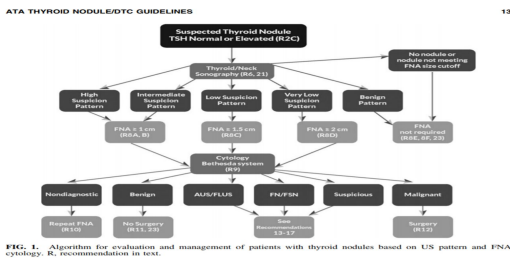


TABLE 6. SONOGRAPHIC PATTERNS, ESTIMATED RISK OF MALIGNANCY, AND FINE-NEEDLE ASPIRATION GUIDANCE FOR THYROID NODULES

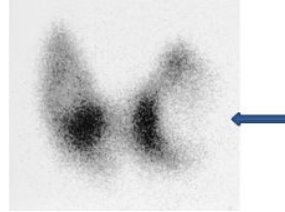
Sonographic pattern	US features	Estimated risk of malignancy, %	FNA size cutoff (largest dimension)
High suspicion	Solid hypoechoic nodule or solid hypoechoic component of a partially cystic nodule with one or more of the following features: irregular margins (infiltrative, microlobulated), microcalcifications,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

^aUS-guided FNA is recommended for cervical lymph nodes that are sonographically suspicious for thyroid cancer (see Table 7).
^bThe estimate is derived from high volume centers, the overall risk of malignancy may be lower given the interobserver variability in sonography.
^cAspiration 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)

As a rule, all thyrotoxicosis require thyroid scan except if it's clearly graves



What next step to do? Thyroid scan: Reduced iodine uptake

Mention three causes of reduced iodine uptake. IMP

- 1- Subacute thyroiditis (ESR is normal+ no tender LN)
- 2- Post-partum thyroiditis (she's single)
- 3- Factitious thyroiditis (this is the cause) she took thyroxine to lose weight

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? Thyroid function test

- 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

What is your diagnosis? Primary hypothyroidism , secondary hypercholesterolemia

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 L	PM/L	10.3 - 25.8
2	Thyroid Stimulating Hormo <small>Highest result doctor have seen</small>	1653.00 H	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 01/12/2010

#	Test	Result	Unit	Range
Serum - SAMPLE: 1				
1	FT4	14.69	PM/L	10.3 - 25.8
2	Thyroid Stimulating Hormo <small>Better but still high</small>	1549.00 H	MIU/L	0.25 - 5
3	FT3	1.75	PM/L	3.96 - 6.8
4	Prolactin <small>TSH stimulate prolactin</small>	549.20 H	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 <small>Takes longer time to normalize + it's close to normal</small>	334.80 H	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.

What is the diagnoses ? **Idiopathic hyperprolactinemia**

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 are 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- Hashimoto's thyroiditis D- Multinodular toxic goiter

Answer B

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

Answer D

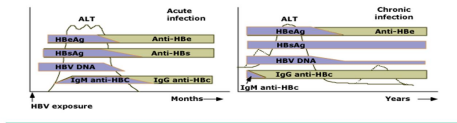
What is the treatment? Choose one or more.

- A- L- Thyroxin B- B Blockers
C- NSAID D- Iodine therapy
E- Carbimazole

Answer B and C (symptomatic Tx which is enough) NEVER give antithyroid

5. Hepatitis B markers

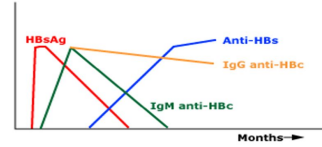
Serologic responses to HBV infection



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 90 percent of patients a non-neutralizing form of anti-HBe 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

What do the different hepatitis B serologic markers mean? (IMP)

- **Hepatitis B surface antigen (HBsAg):** The presence of HBsAg, a protein on the surface of HBV, indicates that the person is infectious.
- **Hepatitis B surface antibody (anti-HBs):** The presence of anti-HBs is generally interpreted as indicating recovery and immunity from HBV infection or been successfully vaccinated against hepatitis B.
- **Total hepatitis B core antibody (anti-HBc):** The presence of anti-HBc indicates previous or ongoing infection with HBV in an undefined time frame.
- **IgM antibody to hepatitis B core antigen (IgM anti-HBc):** Positivity indicates recent infection with HBV (≤ 6 months). Its presence indicates acute infection.
- **IgG antibody to hepatitis B core antigen (IgG anti-HBc):** presence indicates chronic infection (more than 6 months) or past exposure
- **Hepatitis B e antigen (HBeAg):** The presence of HBeAg indicates that the virus is replicating and the infected person has high levels of HBV.
- **Hepatitis B e antibody (HBeAb or anti-HBe):** Spontaneous conversion from e antigen to e antibody (a change known as seroconversion) indicates lower levels of HBV.

Nice table from first aid

	HBsAg	Anti-HBs	HBeAg	Anti-HBe	Anti-HBc
Acute HBV	✓		✓		IgM
Window				✓	IgM
Chronic HBV (high infectivity)	✓		✓		IgG
Chronic HBV (low infectivity)	✓			✓	IgG
Recovery		✓		✓	IgG
Immunized		✓			

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 any patient in general?

- **Measures for the patient:** Request LFT, U/S liver, PCR , Referral to hepatologist, No blood donation
- **Measures for Family Contacts:** Screen and Vaccinate the negative ones.

Which test of HepB markers could be done in Blood Bank?

Anti-Hepa B Core (IgM or IgG) only. b/c HBsAg might be so low that it's undetectable by ELISA which is what is used in blood banks

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

Can blood bank take blood from him ? No

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

Which test of HB markers could be done in Blood Bank? Anti-Hepa B Core (IgM or IgG)

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

- 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

see Explanations:

- 1- May be recovering from acute HBV infection (window period) >>>> here we repeat after 6 months
- 2- May be distantly immune and test is not sensitive enough to detect very low level of anti-HBs in serum >>>> after we roll out 1,3,4.
- 3- May be undetectable level of HBsAg present in the serum and the person is actually a carrier. >>>> here we order PCR
- 4- May be a false positive anti-HBc. >>>>> repeat after 6 months.

Cont. A 32-year old man presents to your clinic for routine check up.

- 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 (b/c he's on the safe side. In Fact, If an infected individual had treatment and he reached these levels of Hep B DNA, we consider the Tx successful)

A 26-year-old female came for premarital check up.

- Hepatitis B S antigen..... **Reactive**
- Anti-Hepa B Core IgG..... **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) (so high you'd think this is hep A! But it's actually because of the presence of Hep-E Ag)
- 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
<i>Serum - SAMPLE: 1</i>				
	HEPATITISBDNAQUALITATIVE	Positive0		-
	HEPATITISBDNAQUANTITATIVE	31	IU/ML	-
Considered success				
#	Test	Result	Unit	Range
<i>Serum - SAMPLE: 1</i>				
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

A 28-year old man presents to your clinic for medical check up as new employee.

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

Interpret the results? Acute HB virus infection (IgM is positive), high replication

What is your next step?

- Request LFT, Measures for contact
- Ask to repeat the markers after 6 months for seroconversion

Don't do PCR just repeat the markers after 6 months

A 58-year old man known case of chronic hepatitis C presents to your clinic because of fatigue and weakness.

- 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 ... 420 mIU/ml (> 10.0 Positive)
- Anti-HCV Positive we have to ask for PCR to if its active or not if he is not diagnosed previously
- Alpha fetoprotein High positive

What is your interpretation?

- He is immune post Hep B vaccination
- Hepatitis C positive with possibility of Hepatoma

What is your next step?

- Urgent US or better CT scan of liver/abdomen
- Urgent referral to hepatology