What are Blood Tests?

Your Health in a Drop!

Praveena Kuchipudi

Introduction - The Power of a Drop

What if a tiny drop of blood could tell us a whole story about your health?

- Blood tests are laboratory analyses of a blood sample
- Crucial for diagnosis, monitoring, and overall health assessment

What is Blood?

Components of Blood

- Plasma (liquid matrix)
- Red Blood Cells (oxygen transport)
- White Blood Cells (immune system)
- Platelets (clotting)

Each component offers distinct health insights.

Why Are Blood Tests So Important?

- **Diagnostic Tool:**
  - Detecting diseases (infections, anemia, diabetes, kidney/liver issues)
  - Identifying inflammation and nutrient deficiencies
- **Monitoring Health Conditions:**
  - Tracking chronic diseases (e.g., diabetes, thyroid disorders)
  - Assessing treatment effectiveness
- **Assessing Organ Function:**
  - Kidneys, Liver, Thyroid, Heart
- **General Health Check-up:**
  - Baseline measurements for future comparison
  - Proactive identification of potential issues

Types of Blood Samples

- **Whole Blood**
  - Blood collected with an anticoagulant, preventing it from clotting. Contains all blood components (red blood cells, white blood cells, platelets, plasma).
  - Uses: Complete Blood Count (CBC), blood typing, and some genetic tests.
- **Plasma**
  - The liquid portion of blood after anticoagulation and centrifugation, which separates the cellular components from the fluid. Contains clotting factors.
  - Centrifugation is a laboratory technique used to separate components of a mixture (eg: blood cells, urine, cell components) .
  - Uses: Coagulation studies (e.g., prothrombin time (PT), partial thromboplastin time (PTT)), some drug levels, some protein assays.
- **Serum**
  - The liquid portion of blood after it has clotted and the clot has been removed (by centrifugation). Lacks clotting factors (coagulation factors.
    Clotting factors are a group of proteins in the blood that work to stop the bleeding and form a blood clot.
  - Uses: Most chemistry tests (e.g., electrolytes, glucose, kidney/liver function), hormone tests, antibody tests, tumor markers.

Blood Tests based on Category

Metabolic Tests

- **Fasting Blood Glucose**
  - Measures blood sugar levels after an overnight fast
  - Screening for diabetes and prediabetes
- **HbA1c (Glycated Hemoglobin)**
  - Provides an average of blood sugar levels over the past 2-3 months
  - Used for diabetes diagnosis and management
- **Lipid Panel**
  - Measures cholesterol (total cholesterol, VLDL, LDL, HDL) and triglycerides, assessing cardiovascular risk
- **Electrolyte Panel (Na, K, Cl, CO2)**
  - Measures key electrolytes crucial for fluid balance, nerve, and muscle function
- **Uric Acid**
  - Evaluates for gout or kidney stone risk

Blood Tests based on Category

Inflammatory Tests

- **C-Reactive Protein (CRP)**
  - A general marker of inflammation in the body
- **Erythrocyte Sedimentation Rate (ESR)**
  - A general indicator of inflammation or infection
- **Procalcitonin**
  - Used to assess the risk of developing systemic bacterial infection or sepsis

Blood Tests based on Category

Hormonal Tests

- **Thyroid Stimulating Hormone (TSH)**
  - Screens for thyroid disorders (hypothyroidism or hyperthyroidism)
- **Thyroid Hormones (T_3, T_4)**
  - Measures the actual thyroid hormones
- **Vitamin D**
  - A crucial hormone/vitamin measured to assess bone health and immune function
- **Testosterone (Male/Female)**
  - Evaluates reproductive and overall health
- **Estrogen/Progesterone (Female)**
  - Assess menstrual cycle and reproductive health
- **Cortisol**
  - Assess adrenal gland function and stress response

Blood Tests based on Category

Organ-Specific Tests

- **Kidney Function**
  - Creatinine – A waste product, indicates kidney filtration
  - Blood Urea Nitrogen (BUN) – Another waste product, indicates kidney function and hydration
- **Liver Function Test (Liver Panel)**
  - Alanine Aminotransferase (ALT)\Aspartate Aminotransferase (AST) – indicates liver cell damage.
  - Alkaline Phosphatase (ALP)\Gamma-Glutamyl Transferase (GGT) – indicates bile duct issues \liver cell damage
- **Cardiac\Heart**
  - Troponin – Specific marker for heart muscle damage, used in suspected heart attacks
  - Brain Natriuretic Peptic (BNP) – Assesses heart failure
- **Pancreatic**
  - Amylase \ Lipase – enzymes used to diagnose pancreatitis

Common Blood Tests – Deep Dive 1

- **Complete Blood Count (CBC)**
  - **What it measures:** Red blood cells, white blood cells, platelets.
  - **What it indicates:** Anemia, infection, inflammation, clotting issues, and some blood cancers.

HAEMATOLOGY

COMPLETE BLOOD COUNT (CBC)

TEST		VALUE	UNIT	REFERENCE
HEMOGLOBIN		15	g/dl	13 - 17
TOTAL LEUKOCYTE COUNT		5,100	cumm	4,800 - 10,800
DIFFERENTIAL LEUCOCYTE COUNT				
NEUTROPHILS		79	%	40 - 80
LYMPHOCYTE	**L**	**18**	**%**	**20 - 40**
EOSINOPHILS		1	%	1 - 6
MONOCYTES	**L**	**1**	**%**	**2 - 10**
BASOPHILS		1	%	< 2
PLATELET COUNT		3.5	lakhs/cumm	1.5 - 4.1
TOTAL RBC COUNT		5	million/cumm	4.5 - 5.5
HEMATOCRIT VALUE, HCT		42	%	40 - 50
MEAN CORPUSCULAR VOLUME, MCV		84.0	fL	83 - 101
MEAN CELL HAEMOGLOBIN, MCH		30.0	Pg	27 - 32
MEAN CELL HAEMOGLOBIN CON, MCHC	**H**	**35.7**	**%**	**31.5 - 34.5**

Clinical Notes:
A complete blood count (CBC) is used to evaluate overall health and detect a wide range of disorders, including anemia, infection, and leukemia. There have been some reports of WBC and platelet counts being lower in venous blood than in capillary blood samples, although still within these reference ranges.

Possible causes of abnormal parameters:

	High	Low
RBC, Hb, or HCT	Dehydration, polycythemia, shock, chronic hypoxia	Anemia, thalassemia, and other hemoglobinopathies
MCV	Macrocytic anemia, liver disease	Microcytic anemia
WBC	Acute stress, infection, malignancies	Sepsis, marrow hypoplasia
Platelets	Risk of thrombosis	Risk of bleeding

Common Blood Tests – Deep Dive 2

- **Lipid Panel**
  - **What it measures:** Total Cholesterol, VLDL, LDL ("bad"), HDL ("good"), Triglycerides.
  - **What it indicates:** Risk of heart disease, atherosclerosis.

BIOCHEMISTRY

LIPID PROFILE

TEST		VALUE	UNIT	REFERENCE
TOTAL CHOLESTEROL		180	mg/dl	125 - 200
TRIGLYCERIDES		172	mg/dl	25 - 200
HDL CHOLESTEROL		55	mg/dl	35 - 80
LDL CHOLESTEROL		90.60	mg/dl	85 - 130
VLDL CHOLESTEROL		34.40	mg/dl	5 - 40
LDL / HDL		1.65		1.5 - 3.5
TOTAL CHOLESTEROL / HDL	**L**	**3.27**		**3.5 - 5**
TG / HDL		3.13		
NON-HDL CHOLESTEROL		125.00		

Abnormalities of lipids are associated with increased risk of coronary artery disease (CAD) in patients with DM. This risk can be reduced by intensive treatment of lipid abnormalities. The usual pattern of lipid abnormalities in type 2 DM is elevated triglycerides, decreased HDL cholesterol and higher proportion of small, dense LDL particles. Cholesterol is a lipid found in all cell membranes and in blood plasma. It is an essential component of the cell membranes, and is necessary for synthesis of steroid hormones, and for the formation of bile acids. Cholesterol is synthesized by the liver and many other organs, and is also ingested in the diet. Triglycerides are lipids in which three long-chain fatty acids are attached to glycerol. They are present in dietary fat and also synthesized by liver and adipose tissue.

Newer treatment goals and statin initiation thresholds based on the risk categories proposed by Lipid Association of India in 2020.

Risk Category	Treatment Goal		Consider Therapy	
	LDL Cholesterol (LDL-C) (Mg\dl)	Non-HDL Cholesterol (Non HDL-C) (Mg\dl)	LDL cholesterol (LDL-C) (Mg\dl)	Non- HDL Cholesterol (Non HDL-C) (Mg\dl)
Extreme Risk Group Category A	< 50 (Optional Goal<=30)	<80 (Optional Goal<=60)	>=50	>=80
Extreme Risk Group Category A	<=30	<=60	>30	>60
Very High	<50	<80	>=50	>=80
High	<70	<100	>=70	>=100

Common Blood Tests – Deep Dive 3

- **Blood Glucose Test\Diabetic Panel**
  - **What it measures:** Sugar (glucose) in blood.
  - **What it indicates:** Diabetes, pre-diabetes, hypoglycemia.
  - **Test parameters,**
    - **Fasting Blood Glucose** – measured overnight fasting of 9-10 hours.
    - **Post Prandial Blood Glucose** - measured 2 hours post-meal ingestion

BIOCHEMISTRY

BLOOD SUGAR FASTING & PP

TEST	VALUE	UNIT	REFERENCE
FASTING BLOOD SUGAR	82	mg/dl	70 - 100
BLOOD SUGAR PP	132	mg/dl	< 140 mg/dl

Clinical Notes

Elevated glucose levels (hyperglycemia) are most often encountered clinically in the setting of diabetes mellitus, but they may also occur with pancreatic neoplasms, hyperthyroidism, and adrenocortical dysfunction. Decreased glucose levels (hypoglycemia) may result from endogenous or exogenous insulin excess, prolonged starvation, or liver disease.

Fasting Glucose	2 hours PP Glucose	Diagnosis
<100	<140	Normal
100 to 125	140 to 199	Pre Diabetes
>126	>200	Diabetes

A level of 126 mg/dL or above, confirmed by repeating the test on another day, means a person has diabetes.
IGT (2 hrs Post meal), means a person has an increased risk of developing type 2 diabetes but does not have it yet.
A 2-hour glucose level of 200 mg/dL or above, confirmed by repeating the test on another day, means a person has diabetes

--- End of report ---

Common Blood Tests – Deep Dive 4

- **Thyroid Function Test**
  - **What it measures:** Thyroid hormones (TSH, T3, T4).
  - **What it indicates:** Hypothyroidism, Hyperthyroidism, thyroid disorders.

ENDOCRINOLOGY

THYROID FUNCTION TEST (TFT)

TEST	VALUE	UNIT	REFERENCE
SERUM TRIIODOTHYRONINE, T3	1.86	ng/mL	0.69 - 2.15
SERUM THYROXINE, T4	98	ng/mL	52 - 127
THYROID-STIMULATING HORMONE, TSH	3.3	µIU/mL	0.3 - 4.5

Physiologic Basis

Total T4 is a measure of thyroid gland secretion of T4, bound and free, and thus is influenced by levels of thyroid hormone binding proteins. Only free T4 is biologically active.

TSH is an anterior pituitary hormone that stimulates the thyroid gland to produce thyroid hormones. Secretion is stimulated by thyrotropin releasing hormones from the hypothalamus. There is negative feedback on TSH secretion by circulating thyroid hormone.

T3 is the primary active thyroid hormone. Approximately 80% of T3 is produced by extrathyroidal deiodination of T4 and the rest by thyroid gland. Total T3 is influenced by levels of thyroxine binding proteins.

Patterns of Thyroid Function Tests in Patients with Thyroid Disease

Type of disease	T4	T3	TSH
Conventional hyperthyroidism (95%)	Raised	Raised	Undetectable
T3 hyperthyroidism (5%)	Normal	Raised	Undetectable
Subclinical hyperthyroidism	Normal	Normal	Undetectable
Primary hypothyroidism	Low	Not indicated	Raised
Subclinical hypothyroidism	Normal	Not indicated	Raised
Secondary hypothyroidism	Low	Not indicated	Undetectable

--- End of report ---

Common Blood Tests – Deep Dive 5

- **Liver Function Test**
  - **What it measures:** Liver enzymes (ALT, AST, ALP), Bilirubin, Proteins.
  - **What it indicates:** Liver damage, inflammation, disease (e.g., hepatitis, cirrhosis).

BIOCHEMISTRY

LIVER FUNCTION TEST (LFT)

TEST	VALUE	UNIT	REFERENCE
SERUM BILIRUBIN (TOTAL)	0.9	mg/dl	0.2 - 1.2
SERUM BILIRUBIN (DIRECT)	0.2	mg/dl	0 - 0.3
SERUM BILIRUBIN (INDIRECT)	0.70	mg/dl	0.2 - 1
SGPT (ALT)	36	U/l	13 - 40
SGOT (AST)	32	U/l	0 - 37
SERUM ALKALINE PHOSPHATASE	11	U/l	
SERUM PROTEIN	7.2	g/dl	6.4 - 8.3
SERUM ALBUMIN	4.7	g/dl	3.5 - 5.2
GLOBULIN	2.50	g/dl	1.8 - 3.6
A/G RATIO	1.88		1.1 - 2.1

LFT Interpretation
Liver Function Blood Test gives an insight into your liver health and helps identify problems like hepatitis, cirrhosis, and fatty liver disease, which may cause similar symptoms but require different treatments to recover.

Test Significance
Besides diagnosing liver problems, LFT's also monitor overall liver functioning. Monitoring helps people with liver disease or taking medication, as it helps screen whether the treatment works fine or requires adjustments. Moreover, Liver Function Tests help determine if someone is at risk of developing liver diseases. Apart from assessing your chances, this test also checks the severity of the liver damage to help the doctor plan and prescribe appropriate treatment.

Increased in: Acute or chronic hepatitis, cirrhosis, biliary tract obstruction, toxic hepatitis, neonatal jaundice (neonatal hyperbilirubinemia), congenital liver enzyme abnormalities (Dubin-Johnson, Rotor, Gilbert, Crigler-Najjar syndromes), fasting, hemolytic disorders. Hepatotoxic drugs.

--- End of report ---

Common Blood Tests – Deep Dive 6

- **Kidney Function Test**
  - **What it measures:** Creatinine, Urea Nitrogen (BUN), GFR.
  - **What it indicates:** Kidney efficiency, kidney disease

Reported on : 16/12/2024 05:37 PM

BIOCHEMISTRY

KIDNEY FUNCTION TEST (KFT)

TEST		VALUE	UNIT	REFERENCE
BUN		10.27	mg/dl	7.9 - 20
SERUM UREA		22	mg/dl	21 - 43
SERUM CREATININE		1.01	mg/dl	0.55 - 1.02
EGFR Method: Calculated	L	**50.32**	**ml/min/1.73m^2**	**> 90**
EGFR CATEGORY Method: Calculated		G3a		
SERUM CALCIUM		9.2	mg/dl	8.8 - 10.6
SERUM POTASSIUM		3.6	mmol/L	3.5 - 5.1
SERUM SODIUM		138	mmol/L	136 - 146
SERUM URIC ACID		4	mg/dl	2.6 - 6
UREA \ CREATININE RATIO		21.78		
BUN \ CREATININE RATIO		10.17		

Creatinine is a nitrogenous waste product formed in muscle from creatine phosphate. Endogenous production of creatinine is proportional to muscle mass and body weight.

Causes of Increased Serum Creatinine Level	Causes of Decreased Serum Creatinine Level
1. Pre-renal, renal, and post-renal azotemia 2. Large amount of dietary meat 3. Active acromegaly and gigantism	1. Pregnancy 2. Increasing age (reduction in muscle mass)

GFR is measured to (i) detect suspected incipient kidney disease (i.e. early detection), (ii)monitor the course of established kidney disease, (iii) plan renal replacement therapy in advanced renal disease, and (iv) adjust the dosage of certain drugs which are nephrotoxic.

BUN\creatinine ratio is to discriminate pre-renal and post-renal azotemia from renal azotemia.

--- End of report ---

Understanding The Results

- **Laboratory Analysis:** Samples are processed in specialized laboratories.
- **Reference Ranges:** "Normal" vs "Abnormal" values.
- **Interpretation by Doctor:**
  - Results are part of a larger picture (symptoms, medical history).
  - Not just a number – context is key.

  They need to be understood in relation to the overall health situation.
- Don't hesitate to seek clarification from the doctor

Takeaways

- Blood tests are a fundamental tool in modern healthcare.
- They provide vital insights into the body's functioning.
- Early detection and monitoring are crucial for achieving better health outcomes.
- Always discuss the results and any concerns with the healthcare provider.
- Be proactive about your health!

Time for Q/A

Resources\References

- Sample report formats sourced from https://www.labsmartis.com/
- https://medlineplus.gov/lab-tests/