

LABORATORY INVESTIGATIONS

Dr. Sunila

Medical Officer, Department of Homeopathy, Govt of Kerala

BLOOD VALUES

1. COMPLETE BLOOD CELL COUNT (CBC)

- **HAEMOGLOBIN: Male- 13-18 gm/ dl; Female- 12-16gm/dl (Normal values)**
- **HAEMATOCRIT: Male-45-62%; Female- 37-48%**
- **MEAN CORPUSCULAR VOLUME (MCV): 83-103 fl (femtolitres) or cum m/red cell (Normal); increased in liver disease, alcoholism, sprue, deficiency of folate or B12; decreased in iron deficiency anaemia, pernicious anaemia, thalassemia & chlorosis.**
- **MEAN CORPUSCULAR HAEMOGLOBIN CONCENTRATION (MCHC): 32-36% (Normal); increased in spherocytosis; decreased in iron deficiency, macrocytic anaemia, pyridoxine responsive anaemia & thalassemia.**
- **MEAN CORPUSCULAR HAEMOGLOBIN (MCH): 27- 32 pg/cell (Normal)**
- **PLATLET COUNT: 150000-350000 per cmm (Normal); increase in cancer, chronic leukemia, polycythemia vera, splenectomy, heart disease & rheumatoid arthritis.**
- **WBC COUNT: 4,300-10,800 cells/ μ L/ cu mm (Norma)**
 - ✓ **Leukocytosis: increase of WBC above 10000/ cu mm; increased in any infection, haemorrhage, trauma/ tissue injury, serum sickness, malignancy, leukemia & tissue necrosis; decreased in viral infection, hypersplenism, & bone marrow depression due to drugs.**
 - ✓ **Neutrophils: 40-70%**
 - ✓ **Eosinophilia: increase more than 5%; increased in allergies, parasitic diseases, lung & bone cancer, chronic skin affections & Hodgkin's disease; decreased in infectious mononucleosis, hypersplenism, congestive cardiac failure, cushing's syndrome, aplastic anaemia & use of ACTH.**
 - ✓ **Basophils: < 1%**
 - ✓ **Lymphocytes: 20-40% (Normal); increased in upper respiratory tract infections, viral diseases like mumps, bacterial infections like TB, hypothyroidism & lymphocytic leukemia; decreased in hodgkin's disease, L.E, after ACTH, after burns & trauma & chronic uraemia.**

2. RBC: 4. 2- 6. 9 million/ μ L/ cu mm (Normal value)

3. ESR : Male: 1-13 mm/hr; Female: 1-20mm/ hr

- **ESR is raised in**
 - ✓ **Slow rising ESR: pregnancy (after 4th month), anaemia, acute myocardial infarction, rheumatoid arthritis, carcinomatosis, pulmonary TB, acute gout, burns, acute infections & after fracture & operations.**
 - ✓ **Rapid rise in ESR: kala azar & multiple myeloma.**

4. LIVER FUNCTION TEST

❖ SERUM BILIRUBIN

- **Normal total** **0.3-1.1 mg/100 ml**

- **Direct** 0.1- 0.4 mg/100ml
- **Indirect** 0.2- 0.7 mg/100ml
- **Rise of indirect serum bilirubin** In haemolytic diseases, Gilbert's disease & Acute or chronic hepatitis
- **Rise of total bilirubin:** Biliary tract obstruction, Cancer of head of pancreas & in Gall stones
- ❖ **SERUM PROTEINS**
 - **SERUM ALBUMIN**
 - **Normal** 3.5-5.5gm/100ml.
 - **Increased in** Haemoconcentration shock & Dehydration
 - **Decreased in** Malnutrition, Starvation, Glomerulonephritis, Hepatic insufficiency, Leukemia & in Other malignancies
 - **SERUM GLOBULIN**
 - **Normal** : 1. 5-3 gm/100 ml.
 - **Elevated in** Hepatic disease, Multiple myeloma, Bacterial & viral infection, Typhus & malaria
 - **Decreased in** Starvation with malnutrition, Lymphatic leukemia & Agammaglobulinemia
- ❖ **SERUM ALKALINE PHOSPHATASE**
 - **Normal** : 5-13 KA or 2-5 Bodansky units/100 ml
 - **Elevated in** Severe osteomalacia, Osteogenic sarcoma, Metastasis to bone, Paget's disease, Myeloid leukemia, Hyperthyroidism & in Pregnancy
 - **Decreased in** Hypothyroidism & Growth retardation
- ❖ **TRANSAMINASES**
 - **SGPT; SERUM GLUTAMIC PYRUVIC ACID TRANSAMINASE (ALT- ALANINE)**
 - **Normal** : 5-35 sigma frankel/ml, 4-24 IU/litre
 - **Increased in** Hepatocellular diseases, Active cirrhosis, Metastatic liver tumour & obstructive liver tumour, Obstructive jaundice, Liver congestion, Pancreatitis & in Hepatic injury in myocardial infection
 - **SGOT; SERUM GLUTAMIC OXALOACETIC TRANSAMINASE (AST- ASPARTATE)**
 - **Normal** : 5-40 sigma frankel/ml, 0-36 IU/litre
 - **Increased in** MI, Liver diseases, Acute pancreatitis, Acute haemolytic anaemia, Severe burns, Recent brain trauma
 - **Decreased in** Beriberi & Uncontrolled diabetes
- ❖ **PROTHROMBIN TIME: normal- 11-16 seconds; increased in** prothrombin deficiency, Vit. K deficiency, haemorrhagic disease, liver disease, biliary obstruction & hypervitaminosis A.

5. **LIPIDS**

- ❖ **SERUM TRIGLYCERIDE**
 - **Normal** : < 165 mg/100 ml
 - **Elevated in** Hyperthyroidism, Diabetes mellitus, Biliary obstruction & Primary hyperproteinemias.
 - **Decreased in** Malabsorption, Malnutrition & Primary hypolipoproteinemias.
- ❖ **SERUM CHOLESTEROL**
 - **Normal** 150-250 mg/ 100ml
 - **Increased in** Xanthomatosis, Pregnancy, Alcohol & fatty diet, Myxoedema, Diabetes mellitus, Obesity & Nephritic syndrome.
 - **Decreased in** Hyperthyroidism, Acute infections & Anaemia with malnutrition.
- ❖ **HDL CHOLESTEROL: > 40 mg%**
 - **Normal** 44mg/ 100ml in men & 55 mg/dl in women.
 - **Increased in** Chronic liver disorder, increased physical activity & Moderate intake of alcohol.
 - **Decreased in** Smokers & High risk patients of MI.
- ❖ **LDL CHOLESTEROL: < 130 mg%**

- ❖ **VLDL: 25-50%.**
6. **BLOOD UREA**
- **Normal** **10-15 mg/100ml.**
 - **Increased in** *Impaired renal function, Shock/ dehydration, Diabetes, Acute myocardial infarction, Gout & Excessive protein intake.*
 - **Decreased in** *Liver failure, Malnutrition, Impaired absorption, In celiac disease, Nephritic syndrome & Over hydration.*
7. **UREA NITROGEN (BUN): 7-18 mg/dl (Normal value)**
8. **CREATININE: 0. 6- 1. 2 mg/ dl; BUN/CREATININE RATIO: 5-35**
9. **CREATININE PHOSPHOKINASE, total**
- **Normal** **: 20-200 IU/ LITRE.**
- CREATININE PHOSPHOKINASE, isoenzymes**
- **MM fraction** **: 94-95%**
 - **MB fraction** **: 0-5%**
 - **BB fraction** **: 0-2%**
- Heart: 80% MM, 20% MB Brain: 100% BB Skeletal muscles: 95% MM, 2% MB.**
10. **BLOOD URICACID**
- **Normal** **2.2-8 mg%**
 - **Increased in** *Gout, Metastatic cancer, Starvation/shock, Alcoholism, Multiple myeloma, Diabetic ketosis & leukemia*
 - **Decreased in** *Aspirin & Sulfinpyrazone*
11. **SERUM CALCIUM**
- **Normal** **9.6- 10.9 mg/ 100ml**
 - **Elevated** *in Hyperparathyroidism (20 mg), Hypervitaminosis D (17 mg), Multiple myeloma & Cushing's syndrome.*
 - **Decreased** *in Hyperparathyroidism, Osteomalacia/ rickets & Malabsorption syndrome.*
12. **SERUM AMYLASE**
- **Normal** **: 0. 5- 2 Bodansky units**
 - **Elevated** *in Acute pancreatitis, Carcinoma of pancreas, perforated peptic ulcer, acute cholecystitis, Cirrhosis liver, Mumps & Renal failure.*
 - **Decreased** *in Necrotising hepatitis, Severe burns, Toxaemia of pregnancy.*
13. **SERUM IRON**
- **Normal** **: 75 mcg/100 ml.**
 - **Elevated** *in Haemochromatosis, Aplastic anaemia, Haemosiderosis, Haemolytic anaemias, Pernicious anaemia*
 - **Decreased in** *Iron deficiency anaemia, Nephrosis, Chronic renal insufficiency, Paroxysmal nocturnal haematuria.*
14. **LACTIC ACID DEHYDROGENASE**
- **Normal** **: 63-155 units**
 - **Increased in** *Acute MI, Acute leukemia, Hepatic disease, Extensive cancer, Shock & anoxia*
 - **Decreased in:** *Good response to cancer*
15. **THYROXINE TOTAL T4**
- **Normal** **: 5-12. 5 µg/ dl**
 - **Increased** *in Hyperthyroidism , Acute thyroiditis, Sub acute thyroiditis, Hepatitis*
 - **Decreased in** *Cretinism, Myxoedema, Simmond's disease, Hypothyroidism, Nephrosis.*
16. **TRIIODOTHYRONINE (T3)**
- **Normal: 110-230ng/ 100 ml.**
 - **Increased in** *hyperthyroidism, T3 thyrotoxicosis, acute thyroiditis, idiopathic TBG elevation.*
 - **Decreased in** *hypothyroidism, starvation, acute illness, idiopathic TBG decrease.*
17. **BLOOD SUGAR**

- **Fasting blood sugar: normal value- 60-100 mg %.** Increased in *diabetes, cushing's disease, acute stress, pheochromocytoma, hyperthyroidism, pancreatitis, chronic liver disease & chronic malnutrition.* Decreased in over dose of insulin, *addison's disease, bacterial sepsis, islet cell carcinoma, hepatic necrosis, hypothyroidism & psychogenic causes.*

18. **ASO (ANTI STREPTOLYSIN O) TITRE**

- **Normal: Below 200 units.**
- **Increased:** recent infection with streptococci or an exaggerated immune response to an earlier exposure in a hypersensitive person.

URINE EXAMINATION

- **Specific gravity: 1. 003- 1. 030;** specific gravity increases if excretion of urine decreases. **It is increased in *diabetes mellitus* or nephrosis & in excessive water loss.**
Low specific gravity: *diabetes insipidus, glomerulonephritis, pyelonephritis & in severe renal damage.*
- **Protein: 2-8 mg/ dl (normal value)**
 - ✓ **Proteinuria due to kidney causes:** *TB & cancer of kidney, nephritis, polycystic kidney, ascitis & nephrosis.*
 - ✓ **Proteinuria due to non- renal causes:** *fever, toxemia, trauma, severe anaemias & aspirin.*
- **PH: 4. 6- 8. 0**
- **Colour of urine:**
 - ✓ **Colourless urine:** *large fluid intake, untreated diabetes mellitus, diuretic therapy, alcohol ingestion, nervousness.*
 - ✓ **Orange coloured urine:** *concentrated urine, excessive sweating, restricted fluid intake & fever.*
 - ✓ **Red or reddish dark brown:** *haemoglobinuria, myoglobin & porphyries.*
 - ✓ **Slack urine:** *alkaptonuria*
 - ✓ **Brown black:** *Lysol poisoning, melanin.*
- **Turbidity: fresh urine is clear.** Urine becomes **turbid** due to **UTI.**
- **Sugar normal values: 100 mg/ 24 hours. Increased in *diabetes mellitus, brain injury & MI.***
- **Red cell cast:** *acute glomerulonephritis, collagen disease, renal infarction & endocarditis.*
 - ✓ **Increased red cells:** *pyelonephritis, renal stone, trauma to kidney, haemophilia, lupus vulgaris, cystitis, TB & malignancy.*
- **White blood cells:** large number of WBC'S indicates **bacterial infection in urinary tract;** if infection is in **kidney,** there may be **associated cellular or granular casts, bacteria, epithelial cells & few RBC'S.**
- **White blood cells & casts:** *pyelonephritis, acute glomerulonephritis & interstitial inflammation of kidney.*
- **Epithelial cells & casts:** *renal epithelial cell casts are formed by cast of tubular cells, hence occasional renal epithelial cells are found. Increased in amyloidosis & poisoning from heavy metals.*

STOOL EXAMINATION

- **Diarrhoea mixed with mucus & blood:** *typhus, typhoid, cholera, amoebiasis & large bowel cancer.*
- **Diarrhoea mixed with mucus & pus:** *ulcerative colitis, shigellosis, regional enteritis, salmonellosis, obstruction of common bile duct (putty like appearance), sprue & celiac disease (stool resembles like aluminium) & in cystic fibrosis (greasy butter stool).*
- **Alteration in shape & size: narrow ribbon like stool:** *spastic bowel, rectal narrowing, decreased elasticity or partial obstruction;* **excessive hard stool:** *increased absorption of fluids, constipation;* very **large caliber stool:** *dilatation of viscus;* **small, round, hard stool:** *habitual moderate constipation.*
- **Colour of feces: yellow to yellow green:** *during breast fed;* **green colour:** *chlorophyll rich vegetables;* **black colour:** *iron, charcoal & bismuth;* **light coloured stool:** *diets high in milk & low in meat;* **clay coloured:** *due to excessive fat;* **red colour:** *due to beets.*

CSF/ normal values

Bilirubin: 0 Cells: 0-5 / mm³; all lymphocytes Chloride: 110-129 meq/ litre.
Glucose: 48- 86 mg/dl or 60% serum glucose. PH: 7. 34- 7. 43.

Pressure: 7-20 cm water Protein, lumbar CSF: 15- 45 mg/ dl
Albumin: 58% alpha 1: 9% alpha 2: 8% beta: 10% gamma: 10%
Protein, cisternal CSF: 15-25 mg/dl Protein, ventricular CSF: 5-12 mg/ dl.

SEMEN ANALYSIS

Volume: 2- 6. 6 ml. Count: >50 million/ ml. Motility: > 75 %
PH: 7. 2- 8 Morphology of sperms: > 60 % normal forms.
Liquefaction: complete in 15 minutes. Spermatocrit: 10%

BLOOD SMEAR: Burr cells: Uraemia Spur cells: Cirrhosis

TESTS/ INVESTIGATIONS

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|---|---|
| Schwartz Watson's test | For porphobilinogen in porphyrias. |
| Hoesch test | For porphobilinogen in porphyries. |
| Hess test | Capillary fragility test |
| Schiller's test | <i>Carcinoma cervix</i> |
| Schilling's test | <i>B₁₂ deficiency</i> |
| Schumm's test | Intravascular haemolysis |
| Guthrie's test | For phenylketonuria |
| Frie's test | <i>Lymphogranuloma venereum</i> |
| Fincham's test | Differential diagnosis of coloured halos |
| Kveim test | <i>sarcoidosis</i> |
| Gordon's biological test | Hodgkin's disease |
| Ito test (Ito cells- vitamin A storing cells in liver) | <i>chancroid</i> |
| ERCP | <i>Obstructive jaundice</i> |
| Tobey Ayer test | Lateral sinus thrombosis |
| Quickenstedt's test | Spinal cord compression |
| Fairley's test | <i>Schistosomiasis</i> |
| Frenkel's skin test | <i>Toxoplasmosis</i> |
| Tzanck test | <i>Acantholysis- pemphigus</i> |
| Schick test, Elek's test | <i>Diphtheria</i> |
| Dick test | <i>Scarlet fever</i> |
| Weil-Felix reactions | <i>Rickettsial infections</i> |
| Barium swallow | Dysphagia |
| VDRL, FTA, TPAH tests, Khan test, Wasserman test | <i>syphilis</i> |
| Fluorescent treponemal antibody test (FTA) | <i>Late congenital syphilis</i> |
| Testosterone levels in serum | <i>Screening test of choice for virilized women</i> |
| Rothera test & Gerhardt test | <i>For ketone bodies in urine</i> |
| Free thyroxine levels | <i>Best hormonal assay for thyroid</i> |
| Radioimmunoassay of TSH | <i>Primary hypothyroidism</i> |
| Mitsuda test, Dharmendra test | <i>Hansen's disease</i> |
| Myelography | Investigation before surgery in spina bifida |
| CPK-MB | Most specific enzyme for detecting <i>myocardial infarction</i> |
| Cyanide nitroprusside test | homocystinuria |
| 8 hr 4 cortisol test | Most specific & reliable &diagnostic test for addison's disease |
| Lange's test | <i>To find proteins in CSF-inflammatory conditions of meninges.</i> |
| Valsalva test | To find autonomic dysfunction |
| Skin scraping test | <i>Fungal infections</i> |
| RAST test (radio allergosorbent technique) | <i>Atopic eczema</i> |
| Patch test | <i>Contact dermatitis</i> |

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| Slit skin test | <i>Leprosy</i> |
| Ellsworth Howard test | <i>To estimate parathyroid function; exaggerated response: hypoparathyroidism</i> |
| Thiazide test | <i>For parathyroid function; hyperparathyroidism</i> |
| Rinne's test | <i>In disease of middle ear, bone conduction is better than air conduction. In nerve deafness both are lost</i> |
| Weber's test | <i>Sensorineural deafness: better heard by uninvolved ear; conduction deafness: better heard by involved ear</i> |
| ABC test (absolute bone conduction test) | <i>Perceptive deafness: examiner hears vibration; patient can't hear.</i> |
| Lundh test | <i>Pancreatic disease</i> |
| Coomb's test | <i>Autoimmune haemolysis</i> |
| Montengero's test or Leishmanian reaction | <i>American cutaneous & musculocutaneous leishmaniasis</i> |
| Napier's aldehyde test | <i>Chronic kala azar</i> |
| Paul bunnel test | <i>Infectious mononucleosis</i> |
| Widal test | <i>Typhoid</i> |
| Zeil neilson method | <i>Tuberculosis</i> |
| Western blot test | <i>AIDS</i> |
| Two glass test | <i>urethritis</i> |
| ASO titer | <i>>200 todd unit: Rheumatic fever</i> |
| Latex fixation test, Rose waaler test (sheep cell agglutination test) | <i>Rheumatoid arthritis</i> |
| Schober's test | <i>Ankylosing spondylitis</i> |
| Ginslin's test | <i>Test for bile pigments</i> |
| Perthe's test | <i>Deep vein thrombosis</i> |
| Shwartz test | <i>Varicose veins</i> |
| The bed shaking test | <i>Early peritonitis</i> |
| ANAC test (antineutrophil cytoplasmic antibody) | <i>Wegner's granulomatosis, vasculitic conditions</i> |
| Genslen's test, Gilles's test, Trendelenburg test | <i>Hip joint disease</i> |
| Bald wings test | <i>Retrocaecal appendicitis</i> |
| Allen's test | <i>Patency of radicular & ulnar arteries</i> |

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