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Laboratory investigations and indications

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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 <u>cancer, chronic leukemia</u>, polycythemia vera, splenectomy, heart disease <u>& rheumatoid arthritis</u>.

WBC COUNT: 4,300-10,800 cells/ µL/ 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** <u>viral infection</u>, hypersplenism, & bone marrow depression due to drugs.

Neutrophils: 40-70%

Eosinophilia: increase more than 5%; increased in allergies, parasitic diseases, <u>lung & bone cancer</u>, chronic skin affections & <u>Hodgkin's disease</u>; **decreased in** <u>infectious mononucleosis</u>, hypersplenism, <u>congestive cardiac failure</u>, <u>cushing's syndrome</u>, aplastic anaemia & use of ACTH.

Basophils:

Lymphocytes: 20-40% (Normal); increased in upper respiratory tract infections, viral diseases like mumps, bacterial infections like TB, hypothyroidism & lymphocytic leukemia; decreased in hongkin's disease, L.E, after ACTH, after burns & trauma & chronic uraemia.

- 2. RBC: 4. 2- 6. 9 million/ µL/ 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), <u>anaemia</u>, <u>acute myocardial infarction</u>, rheumatoid arthritis, carcinomatosis, pulmonary TB, acute gout, <u>burns</u>, acute infections & <u>after fracture & operations</u>.

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 bilurubin In haemolytic diseases, Gilbert's disease&Acute or chronic hepatitis
- · Rise of total bilurubin: Biliary tract obstruction, Cancer of head of pancreas& in Gall stones

SERUM PROTIENS

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SERUM ALBUMIN

- 1. Normal 3.5-5.5gm/100ml.
- 2. Increased in Haemoconcentration shock & Dehydration
- 3. 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& inHepatic 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. <u>LIPIDS SERUM TRIGLYCERIDE</u>

- Normal :
- · 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:

VLDL: 25-50%.

6. BLOOD UREA

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- 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. SERUMIRON

- Normal : 75 mcg/100 ml.
- Elevated in Haemochromatosis, Aplastic anaemia, Haemosiderosis, Haemolytic anaemias, Pernicious anaemia
- Decreased in Iron deficiency anaemia, Nephrosis, Chronic renal insuffiency, 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.

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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. <u>BLOOD SUGAR</u> Fasting blood sugar: normal value- 60-100 mg %. Increased in *diabetes*, <u>cushing's</u> <u>disease</u>, <u>acute</u> <u>stress</u>, <u>pheochromocytoma</u>, <u>hyperthyroidism</u>, <u>pancreatitis</u>, <u>chronic liver disease</u> & <u>chronic malnutrition</u>.

Decreased in over dose of insulin, <u>addison's disease</u>, 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.

<u>URINE EXAMINATION</u> 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)
- Protienuria due to kidney causes: TB &cancer of kidney, nephritis, polycystic kidney, ascitis & nephrosis.
- Protienuria due to non- renal causes: fever, toxaemia, trauma, severe anaemias & aspirin.
- PH: 4. 6- 8. 0

Colour of urine:

- 1. Colourless urine: large fluid intake, untreated diabetes mellitus, diuretic therapy, alcohol ingestion,
- 2. Orange coloured urine: concentrated urine, excessive sweating, restricted fluid intake & fever.
- 3. Red or reddish dark brown: haemoglobinuria, myoglobin & porphyries.
- 4. Slack urine: alkaptonuria
- 5. Brown black: Lysol poisoining, 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, <u>lupus vulgaris</u>, cystitis, TB & malignancy.
- 1. 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.
- 2. White blood cells & casts: pyelonephritis, acute glomerulonephritis & interstitial inflammation of kidney.
- 3. Epithelial cells & casts: renal epithelial cell casts are formed by cast of tubular cells, hence occasional renal epithelial cells are found. Increased in amyloidosis & poisoining from heavy metals.

STOOL EXAMINATION Diarrhoea mixed with mucus & blood: typhus, typhoid, cholera, amoebiasis & large bowel 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 Bilurubin: 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:



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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

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