URINE: SPECIAL EXAMINATION AND RENAL FUNCTION TESTS

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(1) Quantitative estimation of sugar in urine:

When the qualitative Benedict’s test is positive, sugar in urine can be estimated quantitatively by Benedict’s quantitative test as well as by other tests used in estimation of blood sugar. Quantitative estimation of sugar in urine was thought to be having prognostic value in Diabetes Mellitus, but now it is not useful. Other tests, having prognostic value in diabetes e.g. Glycosylated Haemoglobin (HbA1c) etc. are useful now-a-days.
(2) Quantitative estimation of Proteins in urine:

For this, 24 hours urine is to be collected and after thorough mixture, some amount of it can be tested by any of the following methods.

(a) Esbach’s Albuminometer:

In this instrument, urine is taken upto mark “U”. Then, Esbach’s reagent, which consists of citric acid and picric acid, is added upto mark “R”. Then, it is kept overnight. Next day, proteins which are precipitated form whitish clot- like coagulum which is read as per markings on the instrument. The results are recorded in gms/Lt 24 hours.
Esbach’s albuminometer:
Reagent

Urine
(b) **Biuret method:**

As it is a colorimetric method, it is less time consuming, more specific, routinely used and more reliable method.

(c) **Sulphosalicylic acid / Trichloroacetic acid methods:**

They are turbidimetric and semiquantitative methods.
Quantitative estimation of proteins in urine has got prognostic significance in many kidney diseases.

Classification:

(a) Heavy proteinuria: Nephrotic syndrome, malignant hypertension, toxaemia of pregnancy, metal poisoning etc.

(b) Moderate Proteinuria: Acute glomerulonephritis, chronic glomerulonephritis, etc.

(c) Mild proteinuria: Pyelonephritis, benign nephrosclerosis, multiple myeloma etc.
Test for Bence Jones Proteinuria:

- Bence Jones proteins are light chains of Y(Gamma)globulin. Bence-Jones proteinuria is not specific for multiple myeloma but can also be found in case of lymphoma, macroglobulinemia, leukemia, osteogenic sarcoma, amyloidosis, and other malignancies.
Bence jones proteins have a characteristic thermal behaviour. When heated, bence jones proteins precipitate at temperatures between 40°C to 60°C (other proteins precipitate between 60-70°C), and precipitate disappears on further heating at 85-100°C (while precipitate of other proteins does not). When cooled (60-85 °C), there is reappearance of precipitate of bence jones proteins.
(3) **Urobilinogen**:

Conjugated bilirubin, through bile, reaches in the colon, where it is hydrolysed to form urobilinogen and sterocobilinogen. From colon, urobilinogen is absorbed and from blood circulation, reaches to the kidney to be excreted in urine.

Urobilinogen is normally present in urine and is quite unstable in acid urine. When exposed to light, it is reduced to form a pigment, urobilin.

- **Method**: Reagents:
  
  1. Fresh sample of urine
  2. Ehrlich’s reagent- consisting of paradiethyl-amino-benzaldehyde
**Principle:**
Formation of red coloured azo dye with diazonium compound.

**Significance:**

In hemolytic jaundice - It is increased.
In hepatocellular jaundice
- Early stage, increased
- Later stage, decreased
In obstructive jaundice
- It is absent or decreased
(4) **Hormones:**

Urine can be tested for presence of various hormones in various endocrine disorders, particularly of ovary, adrenal and pitutary. Hormones can be tested by

1. **Chemical methods**
2. **Radioimmunoassay and**
3. **Serological / Immunological methods.**

- All these tests are very sensitive and require utmost care.
Pregnancy tests:

Actually, the term “Pregnancy test” is a misnomer. By the testing, pregnancy is not detected, but Human Chorionic Gonadotropin (HCG) which is produced by trophoblastic cells, is detected. By detecting presence of HCG, Possibility of pregnancy can be determined very early during first trimester.

Methods:

Previously, methods in which animal inoculation was carried out were in practice e.g. Aschheim-Zondek test, Freidman’s test etc. As these methods were time-consuming and less reliable, immunological methods which are rapid, easy to perform, and more reliable are in use these days.
• **LAI (Latex Agglutination Inhibition) Pregnancy test:**
  In this method, Patient’s urine is first mixed with serum containing anti-HCG. If HCG is present in urine, it will be neutralised by anti-HCG. So, in cases of Patient having HCG in their urine, there will be no agglutination will be suggestive of positive test.

• **Clinical applications of pregnancy tests:**

  (1) Diagnosis of pregnancy early in first trimester
  (2) Diagnosis of ectopic pregnancy
  (3) Diagnosis of threatened abortion
  (4) In trophoblastic tumours
  (5) Some nontrophoblastic tumours secreting HCG e.g. Medullary carcinoma of thyroid.
hCG Pregnancy Tests Results

Control Test

Positive

Negative
(5) **Haemoglobin**: 

Presence of haemoglobin in urine is referred as haemoglobinuria. Haemoglobinuria is seen in

1. *Falciparum Malaria*-known as ‘black water fever’
2. Mismatched blood transfusion reactions
3. Heamolytic anaemias
4. Crush injuries.
- Presence of haemoglobin in urine can be tested by

  1. Spectroscope
  2. Benzidine test.

- Haemoglobinuria is to be differentiated from haematuria, in which plenty of RBCs are seen in urine, eg, tumour, inflammation, parasite (Bilharssiasis) while microscopically no RBCs are seen in haemoglobinuria.
(6) **Exfoliative cytology:**

Urine can be tested for cytology examination for early detection of cancers of urinary bladder, urethra and kidney. For this, urine sample is collected in mixture of ether alcohol and then smears are stained by Papanicolaou stain.
RENAL FUNCTION TESTS

- **The object of these tests:**
  1. detect renal damage and
  2. to assess the severity of the damage.

- **Limitations of such tests:**
  1. Nature of disease cannot be known.
  2. Whether damage is due to renal or extrarenal causes cannot be known.
  3. Exact anatomical site of damage cannot be known.
  4. Mild or early damage cannot be detected.
(1) Clinical History:
Symptoms like oliguria, oedema face-feet etc, and radiological investigations including IVP are much helpful.

(2) Routine urine examination:
It is very much helpful. Volume of urine, specific gravity, proteinuria, urinary casts on microscopic examination etc., will provide useful guidelines of renal damage.
(3) Biochemical tests in blood:
Blood urea and serum creatinine will provide very useful guidelines for renal function.

- BLOOD UREA:

Urea is end product of protein and aminoacid metabolism. It is produced in liver through ‘Urea cycle’. Then, it is very freely distributed to all extracellular and intracellular fluids. Lastly, it is excreted mainly by kidney and also by sweat and intestines.

Urea forms 50% of all solids in urine and 80-90% of all nitrogenous compounds in urine.
**BUN**: Sometimes, blood urea is expressed as its pure nitrogenous component i.e as blood urea nitrogen. 
Urea : BUN x 2.14.

Factors affecting Blood urea levels depend on

(1) Diet protein intake
(2) Rate of protein catabolism
(3) State of hydration.

**Normal value**: 20-40 mgms%
SERUM CREATININE:
In contrast to urea, levels of creatinine do not depend on above mentioned factors. So, serum creatinine is a better guide for renal function in comparison to blood urea.

Normal value: 0.6 - 1.2 mgms%.
Azotemia and Uraemia:

Both these terms are related with increased levels of urea and creatinine. Azotemia is simply a biochemical abnormality denoting higher levels of Urea and Creatinine, while uraemia is a term, meaning systemic manifestations due to increased levels of urea and creatinine. It is a syndrome having involvement of many organs and systems like kidneys, CVS, CNS, bones, GIT, etc.
• Causes

**Prerenal:**
Congestive cardiac failure, severe infections, GIT haemorrhage, Addison’s diseases, high grade fever, etc.

**Renal:**
End stage of glomerulonephritis, pyelonephritis, nephrosclerosis, renal artery diseases, etc.

**Post Renal:**
Obstruction in Urinary tract e.g. stricture urethra, bladder stone, tumour, prostatic enlargement, ureteric stone, etc.
(4) **Loading tests:**

These are rather crude tests for detecting renal damage. Here, some substance in a measured amount is given to a person and after some fixed time, its excretion in urine calculated. From this, function of kidney is determined.

- **Loading with normal substances:**
  - Dilution test
  - Concentration test.

- **Loading with foreign substances:**
  - Indigocarmine
  - Phenol sulphnaphthalein
(5) Clearance tests:
These tests can be done by giving clearing substance of a measure amount. Then, urinary clearance of that substance after some fixed time is measured.

- Formula \( C = \frac{U \times V}{P} \)

  \( C = \) Clearance  
  \( U = \) Concentration of that substance in urine  
  \( V = \) Volume of urine in ml formed per minute  
  \( P = \) Concentration of that substance in plasma.

- Substance used for clearance tests are
  (1) Urea  
  (2) Inulin  
  (3) Creatinine  
  (4) Paraamino-hippuric acid.
(6) Renal Biopsy:

Since the advent of percutaneous technique of kidney biopsy, it has become easier and are popular. By carrying out kidney biopsy, end stage and severity of renal diseases like glomerulonephritis, vascular disease, pyelonephritis etc, as well as involvement of kidney in certain systemic diseases like diabetes, SLE, Amyloidosis can be estimated perfectly.
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