

Chemical Examination of Urine:

Urinalysis (UA): is one of the commonest investigations used in medical diagnosis, because it is an easily obtained specimen. It also gives a quick indication to glucose status, hepatobiliary & kidney function.

The chemical examination of urine including:

-PH of urine

The normal hydrogen ion (pH) concentration, in the urine (5-8) depends on the type of diet. Vegetable diet, citrus fruits (also bacterial infections) produce **alkaline urine**, while high protein diet (also blood acidosis where $\text{PH} < 7.35$, some microbial infections, ketones elevation due to diabetes or aspirin intake) produce **acidic urine**.

PH measured by paper strip or pH meter.

-Proteins of urine:

A little quantity, of protein are found normally in urine (150 mg/day) any excess in protein called proteinuria which is an indication for many diseases like kidney diseases, fever and pregnancy.

Types of protein in urine:

1-**Albumine:** is the first protein appearing in urine due to its low molecular weight and size (albuminuria), this protein appears in Diabetes and hypertension.

2- **Immunoglobulins:** appear in urine due to inflammations and microbial infections

3-**Hemoglobine:** found in urine due to blood hemolysis.

Test: (Robert's test)

Principle: Precipitation of protein by strong acid

A positive test is indicated by a white ring at the zone of concentration, which should be read against a dark background and reported as:

Negative - No ring at the zone of concentration

Note: In many clinical laboratories, Robert's test is routine method as it is simple, quick and easy to read even when only a small amount of protein presents.

-Glucose in urine:

No glucose is present in the urine normally which passes glomerular filter, because it is completely absorbed in the tubules. It present when the blood glucose level elevated to(180mg/ml) which is called **renal threshold**, when blood glucose elevated the glucose present in urine as in diabetes.

Glucose Test

Method: Qualitative method (Benedicts test)

Principle: Reducing sugars present in the urine react with the copper sulphate to reduce the copric ions to cuprous oxide giving a Color change from blue (negative) to green, yellow and red depending on the amount of reducing substances present

-Acetone (Ketone body) (ketones):

The ketone bodies include acetone, acetoacetic acid (diacetic acid) and betahydroxybutric acid. A state in which these substances are present in increased amount in the blood and urine is called ketosis. Acetoacetic acid and beta hydroxyl butric acid from which acetone is derived is normal **intermediate product of fat metabolism**.

When greater amounts of fatty acids are utilized with the production of more acetoacetic acid and beta-hydroxybutric acid can be oxidized by the tissues. These bodies accumulate in the blood and are excreted in the urine (**ketonuria**).This bodies present in urine in starvation or low blood glucose levels.

most of urine macroscopic examination can be done using special strips for rapid urinalysis



4. Nitrite:

It is a semi-quantitative test done by reduction of nitrate to nitrite by bacterial enzymes, nitrite increases in bacterial infection.

5. Leukocyte esterase:

It is an enzyme present in WBCs, it increases in pyuria (pus cells in urine).

6. Bilirubin/urobilinogen:

Normal urine contains no bilirubin & small amount of urobilinogen. A fresh urine sample is required because bilirubin is unstable when exposed to light & room temperature that may be oxidized to biliverdin which gives a false negative result.

Bilirubinuria; occurs in hepatitis or biliary obstruction.

Increases of urobilinogen in urine occurs in hepatitis or RBCs haemolysis.

7. Hb/blood:

Haematuria is the presence of blood in urine whether intact or lysed RBCs. Its causes are:

- Renal stone.
- UTI.
- Renal tract injury.
- Renal tract tumor.

Miscellaneous elements may notice in GUE including:

- **Bacteria:** fresh urine should be sterile, bacteruria indicates UTI.
 - Asymptomatic bacteruria occur in DM & pregnancy.
- **Pinworms** present in urine indicate fecal contamination of the sample.
- **Sperms** in male urine indicate prostatic disorder.

Urine Culture:

Urine is the specimen most frequently submitted for culture. The most common sites of urinary tract infection (UTI) are the urinary bladder (cystitis) and the urethra. From these sites the infection may ascend into the ureters (ureteritis) and subsequently involve the kidney (pyelonephritis). Females are more prone to infection of the urinary tract than are males. In both males and females, UTI may be asymptomatic, acute, or chronic.

-Asymptomatic infection can be diagnosed by culture.

-Acute UTI is more frequently seen in females of all ages; these patients are usually treated on an outpatient basis and are rarely admitted to hospital.

-Chronic UTI in both males and females of all ages is usually associated with an underlying disease (e.g. pyelonephritis, prostatic disease, or congenital anomaly of the genitourinary tract) and these patients are most often hospitalized.

Since urine itself is a good culture medium, all specimens should be processed by the laboratory within **2 hours** of collection, or be kept refrigerated at **4C** until delivery to the laboratory and processed no longer than 18 hours after collection. The examination procedure includes the following steps:

1. **Examination of a Gram-stained smear.** (for the presence or absence of bacteria, polymorphonuclear leukocytes, and squamous epithelial cells). One or more bacterial cells per oil-immersion field usually imply that there are 10⁵ or more bacteria per milliliter in the specimen. The presence of one or more leukocytes per oil-immersion field is a further indication of UTI.

2. **A screening test for significant bacteriuria.** The absence of leukocytes and bacteria in a Gram-stained smear of a clean catch urine sample prepared as described above is good evidence that the **urine is not infected**. A urine specimen that is “negative” on careful examination of the Gram-stained smear does not need to be cultured.

An alternative simple and effective **screening test is the test strip for leukocyte esterase/nitrate reduction**. The strip is dipped into the urine specimen as instructed in the package literature. **Any pink colour is a positive** reaction indicating the presence of leukocyte esterase and/or bacteria in excess of 10⁵ per ml. Urine samples that are positive in the screening test should be cultured as soon as possible to prevent possible overgrowth by no significant bacteria. If the strip does not develop a pink colour it is interpreted as a negative screening test, is so reported, and no culture is indicated. The test strip may not be sensitive enough to detect bacterial counts of less than 10⁵ per ml of urine.

3. A definitive culture for urine specimens found to be positive in the screening test, and for all specimens obtained by cystoscopy, suprapubic bladder puncture (SBP), or catheterization.

4. Susceptibility tests on clinically significant bacterial isolates should only be performed on well-isolated colonies of similar appearance. Susceptibility tests are generally more important on cultures obtained from patients who are hospitalized or have a history of recurring UTI.

