# Organ Function Tests

## Introduction of Organ Function Tests

- Organ Function Tests (OFTs) are clinical laboratory investigations used to assess the physiological performance of specific organs. These tests help in:
    - Diagnosing diseases
    - Monitoring disease progression
    - Evaluating therapy effectiveness
    - Screening for subclinical dysfunctions

## Purpose of Organ Function Tests

- To detect functional abnormalities in major organs.
- To differentiate between similar clinical conditions.
- To monitor organ damage due to drugs, infections, or systemic diseases.
- To assess baseline function before surgeries or treatment (e.g., chemotherapy).

## Types of Organ Function Tests

| Organ | Function Evaluated | Examples of Tests |
|---|---|---|
| **Kidney** | Excretion, filtration, electrolyte balance, pH control | Serum creatinine, urea, BUN, eGFR, electrolytes, urinalysis |
| **Liver** | Metabolism, detoxification, bile production, synthesis | ALT, AST, ALP, bilirubin, albumin, PT/INR |
| **Heart** | Cardiac muscle damage, myocardial function | Troponins, CK-MB, LDH, BNP |
| **Lungs** | Gas exchange, pulmonary capacity | Arterial blood gases (ABG), spirometry |
| **Pancreas** | Endocrine (insulin) and exocrine (digestive enzyme) roles | Blood glucose, amylase, lipase |
| **Thyroid** | Hormonal regulation of metabolism | TSH, T3, T4 |
| **Lipid System** | Cholesterol and fat transport | Total cholesterol, LDL, HDL, triglycerides |

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# Functions of the Kidney

The kidneys are vital organs responsible for several critical physiological functions. These include:

### A. Excretion of Waste Products:

- Removal of nitrogenous wastes such as urea, creatinine, and uric acid, which are byproducts of protein and nucleic acid metabolism.

### B. Regulation of Water and Electrolyte Balance:

- Maintains balance of sodium ($Na^+$), potassium ($K^+$), calcium ($Ca^{2+}$), chloride ($Cl^-$), and phosphate, which are essential for cellular functions.

### C. Regulation of Acid-Base Balance:

- Helps maintain blood pH by excreting hydrogen ions ($H^+$) and reabsorbing bicarbonate ($HCO_3^-$).

### D. Endocrine Functions:

- **Erythropoietin**: Stimulates red blood cell production in response to hypoxia.
- **Renin**: Regulates blood pressure through the renin-angiotensin-aldosterone system.
- **Calcitriol (active form of vitamin D)**: Regulates calcium and phosphate metabolism.

### E. Regulation of Blood Pressure:

- Through control of blood volume and the renin-angiotensin system.

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# Routine Kidney Function Tests (Renal Function Tests - RFTs)

These tests assess different aspects of renal function and help diagnose acute or chronic kidney diseases.

### 1. Blood Urea Nitrogen (BUN):

- **Definition**: Measures the concentration of urea nitrogen in the blood.
- **Normal range**: 7–20 mg/dL.
- **Clinical significance**:
  - Elevated in renal dysfunction, dehydration, high-protein diet, GI bleeding.
  - Decreased in liver disease, malnutrition, overhydration.

### 2. Serum Creatinine:

- **Definition**: Creatinine is a waste product of muscle metabolism, filtered by the kidneys.
- **Normal range**:

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- Men: 0.7–1.3 mg/dL
- Women: 0.6–1.1 mg/dL

➢ **Clinical significance**:

- Elevated in kidney impairment.
- More specific than BUN for renal function because it is less affected by diet and hydration.

## 3. BUN/Creatinine Ratio:

➢ **Normal ratio**: 10:1 to 20:1.

➢ **Clinical significance**:

- Increased in prerenal causes of kidney dysfunction (e.g., dehydration).
- Decreased in liver disease or postrenal obstruction.

## 4. Estimated Glomerular Filtration Rate (eGFR):

➢ **Definition**: Calculated from serum creatinine, age, sex, and race; estimates the rate at which the kidneys filter blood.

➢ **Normal value**: >90 mL/min/1.73 $m^2$.

➢ **Clinical significance**:

- <60 indicates chronic kidney disease (CKD).
- <15 indicates kidney failure (end-stage renal disease).

## 5. Creatinine Clearance Test (CCT):

➢ **Definition**: Measures the rate at which creatinine is cleared from the blood by the kidneys.

➢ **Normal range**: 90–140 mL/min (varies by age, sex, and body size).

➢ **Clinical significance**:

- Reflects GFR; reduced in renal impairment.
- Requires 24-hour urine collection and a serum creatinine test.

## 6. Urinalysis:

➢ **Includes**: Physical, chemical, and microscopic examination of urine.

➢ **Tests involved**:

- **Proteinuria**: Presence of protein (especially albumin) suggests glomerular damage.
- **Hematuria**: May indicate infection, stones, or glomerular disease.
- **Specific gravity**: Assesses concentrating ability of the kidney.

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- **Urine pH**: Reflects acid-base status.

➢ **Clinical significance**:

- Provides clues to both acute and chronic kidney disease.

### 7. Microalbuminuria:

➢ **Definition**: Small amounts of albumin in the urine (30–300 mg/day).

➢ **Clinical significance**:

- Early indicator of diabetic nephropathy and cardiovascular risk.
- Used in screening diabetic and hypertensive patients.

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# Functions of the Liver

The liver is a vital organ with multiple metabolic, synthetic, detoxifying, and storage functions. These include:

### A. Metabolic Functions

➢ **Carbohydrate metabolism**: Glycogenesis, glycogenolysis, and gluconeogenesis.

➢ **Protein metabolism**: Deamination of amino acids, urea synthesis.

➢ **Lipid metabolism**: Synthesis and breakdown of cholesterol, lipoproteins, triglycerides.

### B. Synthetic (Biosynthetic) Functions

➢ **Plasma proteins**: Synthesis of albumin, clotting factors (fibrinogen, prothrombin, factors VII, IX, X).

➢ Lipoproteins and apolipoproteins.

### C. Detoxification

➢ Biotransformation of drugs, hormones, and toxins.

➢ Conversion of ammonia to urea (urea cycle).

### D. Bile Formation and Secretion

➢ Excretion of bilirubin, cholesterol, bile acids.

➢ Essential for fat digestion and absorption.

### E. Storage Functions

➢ Stores glycogen, vitamins (A, D, B12, K), iron, and copper.

### F. Immune Function

➢ Kupffer cells in liver sinusoids act as macrophages, clearing pathogens and debris.

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