BODY FLUIDS

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NPN (NON PROTEIN NITROGENOUS COMPOUNDS)

NPN	Blood (15- 60 mg/dl)	Urine (25-35 g/day)
Urea	10-50 mg/dl	25 g/day
Uric acid	3 - 6 mg/dl (♀), 4-7 mg/dl (♂).	100-500 mg/day
Creatinine	0.6 -1.4 mg/dl	1.4 g/day
Creatine	0.2 -0.9 mg/dl	50-150 mg/day
Ammonia	< 0.05 mg/dl	0.7 g/day.
Amino acids	3-6 mg/dl.	100-200 mg/day

BLOOD UREA (10-50 mg/dl)

* The chief end product of protein catabolism
*Formed in liver, transported in blood & excreted in urine

↑ Urea in plasma	↓ Urea in plasma
*Temporary after a high protein meal. *** Renal failure (↓ excret.).** *↑ protein catabolism e.g. after glucocorticoids	*Severe protein restriction. *↑ protein synthesis (pregnancy, growth & administrat. of anabolic hormones) ***Severe liver diseases (↓ format.).**

BLOOD FREE AMINO ACIDS (3-6 mg/dl)

↑amino acids in blood	↓amino acids in blood
*After a protein meal. *↑ protein catabolism. *Liver damage (↓deaminat.)	*↑ protein synthesis (anabolic hormones)

BLOOD URIC ACID

* 3 - 6 mg/dl (in ♀), 4-7 mg/dl (in ♂).
* formed by purine catabolism in liver & excreted by kidneys

↑Uric acid in blood	↓Uric acid in blood
Metabolic: **1ry: 1. Von Gierke's disease** **2- Lesch-Nyhan syndrome** **3- ↑ activity of PRPP synthetase** **2ry e.g. hemolytic anemia, cancer.** ***Renal: 1ry and 2ry***	**1. Xanthine oxidase deficiency** **2. Adenosine deaminase deficiency** **3. Purine nucleoside phosphorylase deficiency**

BLOOD CREATINE (0.2 -0.9 mg/dl) and

BLOOD CREATININE (0.6 -1.4 mg/dl)

Creatinine is the metabolic end products of creatine metabolism. Creatinine level increases in **renal diseases** (due to ↓ excret. in urine) it is good index for renal functions as its level is not affected by diet.

BLOOD AMMONIA: (< 0.05 mg/dl)

*Ammonia is toxic to the CNS & formed by:

Sources: Deamination of amino acids (main source).
Purine and pyrimidines catabolism.
The effect of intestinal bacteria on unabsorbed amino acids in large intestine.

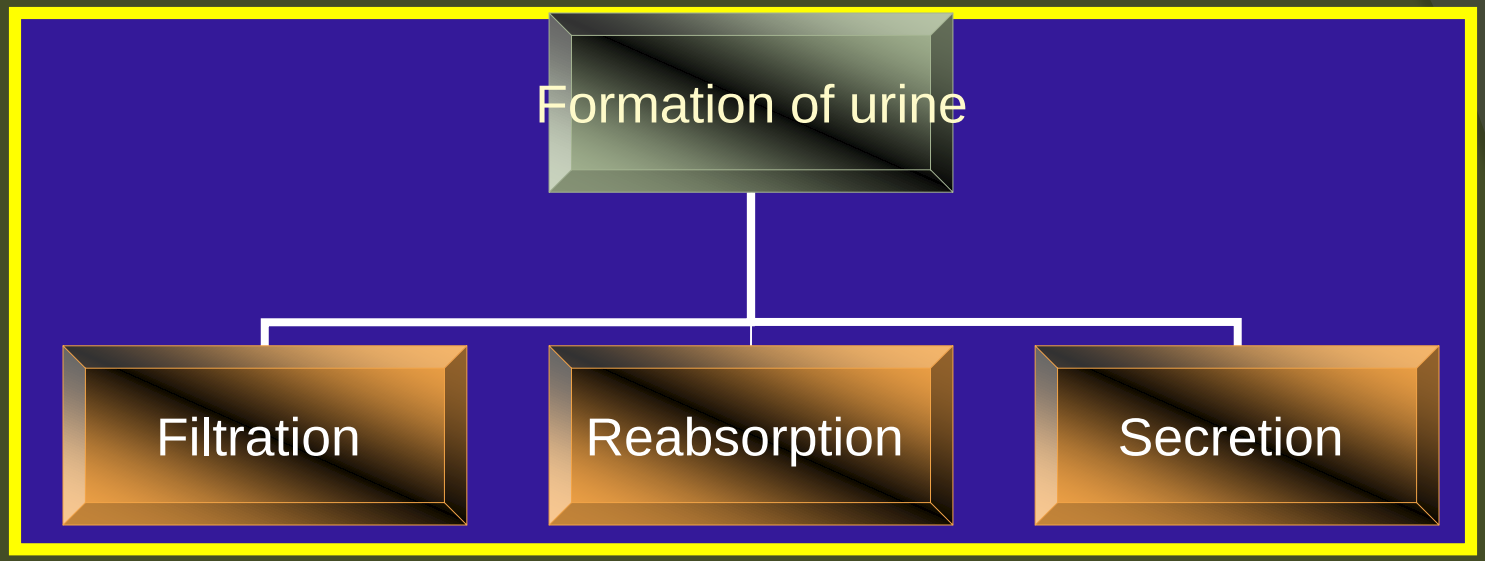
Fate: removed as urea (liver) & to lesser extent as ammonia (kidney) by action of glutaminase on glutamine

***Its blood level increases in sever liver diseases (hepatic encephalopathy; ammonia intoxication) due to:**

1. **The decreased hepatic ability to convert ammonia to urea**
2. As portal blood bypass the liver, systemic blood ammonia rises to toxic levels. Ammonia reacts with *α*-ketoglutarate to form glutamate, with depletion of *α*-ketoglutarate that impairs the tricarboxylic acid (TCA) cycle in neurons.

1. URINE

Urine is a fluid formed by 3 main renal processes:



Selective reabsorpt. of certain subs.
(salts, water, glucose & aa).
Secretion of subs. from blood
(K^+, uric acid, organic acid & H^+.)

URINE UREA (25 g/day)

*The main end products of **protein catabolism**;

*Its excretion is directly related to protein intake.

↑ Urea in urine	↓ Urea in urine
*↑ protein catabolism: -Fever, -DM -Hyperactivity of adrenal cortex & thyroid	*↑Protein synthesis (pregnancy) *Renal failure (↓ excret.) *Severe liver dis. (↓product.) *Acidosis (↑ NH_4^+ product.)

URINE AMMONIA (0.7 g/day)

*formed in the **renal tubular epithelium**:

60% by glutaminase & the rest by deamination of aa

*NH_3 + H^+ → NH_4^+ (tubular urine) thus ↓ H^+ conc.

→further passage of H^+ into lumen in exchange for Na^+

↑ Ammonia in urine	↓ Ammonia in urine
***Acidosis:** **-Ketosis** **-Ingestion of acids or NH_4Cl** ***High ptn diet (↑ acid product.)**	***All cases of alkalosis.** ***Acidosis of renal origin (failure of excret.)**

URINE CREATININE AND CREATINE

A. **Urine Creatine** (50-150 mg/day)

* It is not excreted in significant amounts in urine (**complete reabsorp**. at its normal plasma level).

A. **Urine Creatinine** (1.4 g/day)

*Formed from creatine in constant amounts daily (2% of body creatine),

*All of which is excreted in urine by glomerular filteration & tubular excretion

*The excretion is determined by **muscle mass.**

*Creatinine clearance is > 100 ml/minute

(it decreases if glomerular filtration is impaired)

URINE AMINO ACIDS (100-200 mg/day)

*aa excreted in urine are free & combined (hippuric acid).

* **AMINOACIDURIA:** presence of aa in abnormal conc. in urine

a.Physiological aminoaciduria: in new born & pregnancy.

b. Pathological aminoaciduria:

1. over flow: ↑aa in plasma:

*Severe liver diseases (↓ deamination)

*Inherited defects in aa metabolizing enz:

- Phenylalanine hydroxylase (phenyl ketonuria),
- Histidase (histidinemia)
- Branched chain ketoacids decarboxylase (maple syrup urine d.)

2. Renal:

- Renal tubular damage
- Genetic defects (cystinuria & glycinuria)

URINE URIC ACID (100-500 mg/day)

■ It is the main end product of purine catabolism, it is excreted by an active tubular excret.

■ In urine of PH 6.0, uric acid is present as Na & K salts

■ The amount of uric acid excreted depends on:

•The quantity of nucleoproteins ingested (exogenous)

•Tissue nucleic acid (endogenous).

*On purine free diet; its excret. is constant 100- 500 mg/d

* Its excret. is ↑ in metabolic gout.

ABNORMAL CONSTITUENTS OF URINE:

These include mainly the following:

* Proteinuria
* Glucosuria
* Ketone bodies
* Bile pigments

PROTEINURIA

* It is the presence of proteins (mainly) albumin in abnormal conc. in urine >300 mg/day.

1-Physiological proteinuria:

- After severe muscular exercise.
- After high protein meal.
- Orthostatic or postural (temporary impaired renal circulation)

2-Pathological proteinuria:

- **Prerenal:** heart failure and hypertension.
- **Renal:**

*↑ permeability of glomeruli in kidney diseases

- Glomerulonephritis
- Nephrotic syndrome

* Poisoning of renal tubules:

- Heavy metals (mercury & arsenic).

- **Post renal:** inflammation of urinary tract.

3-Bence Jones proteinuria:

*Special types of globulines

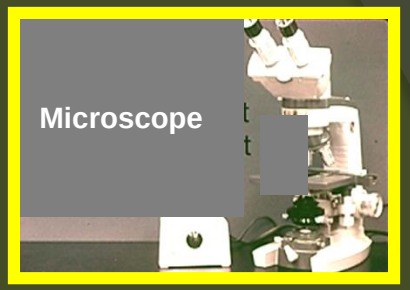
*Of low molecular weight

*Found in serum

*Excreted in urine (myloid leukemia & multiple myeloma)

*Precipitated at 45^{o}C- 60^{o}C but redissolve on boiling and reprecipitate on cooling.

URINARY SEDIMENTS (DEPOSITS)

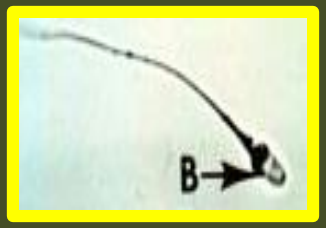


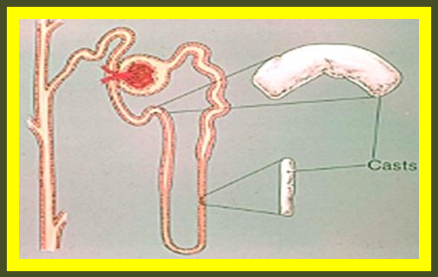
*Collected by centrifuging urine

*Examined by the microscope

A- Organized Urinary Sediments:

1) ***Epithelial cells:*** few, ↑ in urin. tract infect.
2) ***Pus cells:*** few, ↑ in urin. tract infect.
3) ***Bacteria:*** few, ↑ in urin. tract infect.
4) ***Red cells:*** in hematuria.
5) ***Sperms:*** in ♂ urine after ejaculat.
6) ***Casts:*** formed in **collecting tubules** by coagulation of albuminous materials.





***Conditions for cast formation**

(Renal stasis, Acidic pH, Proteinuria & Conc. urine)

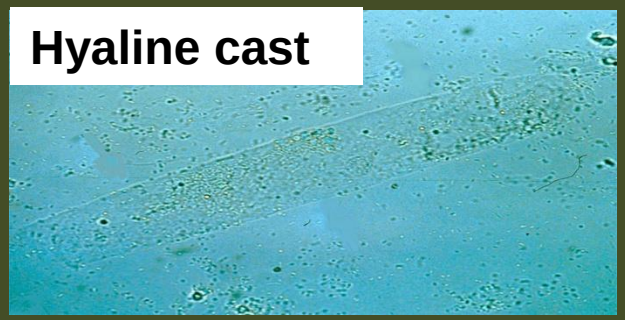
Types of Casts	
Acellular	**Cellular**
Hyaline casts	Red cell casts
Granular casts	White cell casts
Waxy casts	Epithelial cell cast
Fatty casts	
Pigment casts	
Crystal casts	

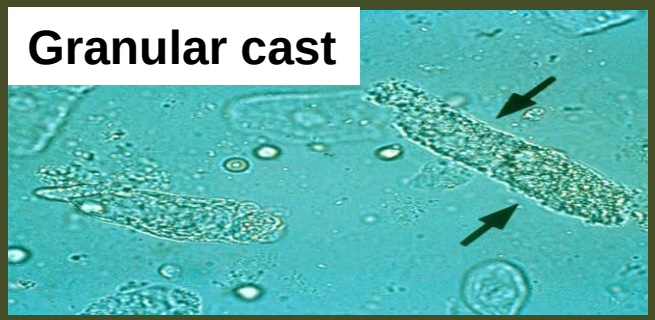
CASTS MAINLY INCLUDE:

A. Hyaline casts: *Transparent, refractile tubular structures
*Few, ↑ after exercise.

B. Granular casts: Similar to hyaline cast but;
*It is dotted with albuminous granules.
*Occur in *late stages of nephritis.*

C. Epithelial, blood & leukocyte casts:
*Central core of hyaline casts
*Cells adhere around the core.
*Indicate *acute phase of nephritis.*





B-Unorganised Urinary Sediments:

<table>
<tr><th colspan="2">Urine Crystals</th></tr>
<tr><td rowspan="2">1. Acidic urine
*Calcium oxalate
*Uric acid
*Cystine
*Leucine</td><td>2. Alkaline urine
• Amorphous phosphate
• Ammonium magnesium phosphates (triple phosphate or Struvite crystals)
*Calcium carbonate</td></tr>
<tr><td>3. Non-pH dependent:
Bilirubin & Cholesterol</td></tr>
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Phosphates: **The commonest is triple phosphate**

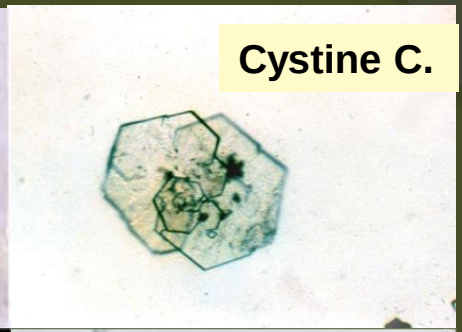
Calcium Oxalate: **envelope shaped**

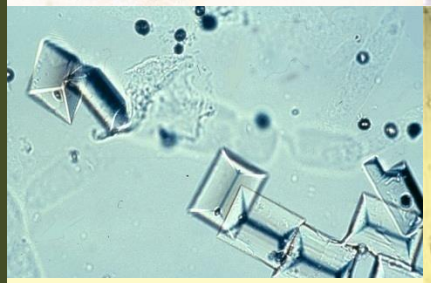
Urates: of different forms; (prisms, needles or rosettes)

Calcium Oxalate C.

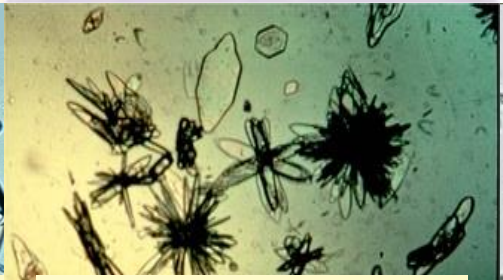
Leucine C.

Cystine C.



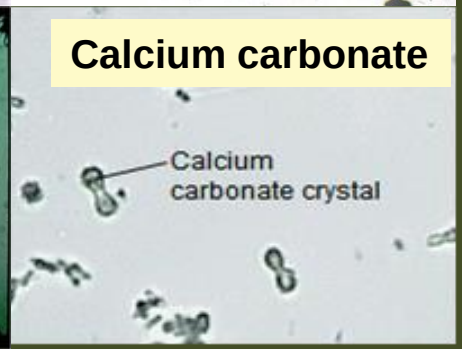


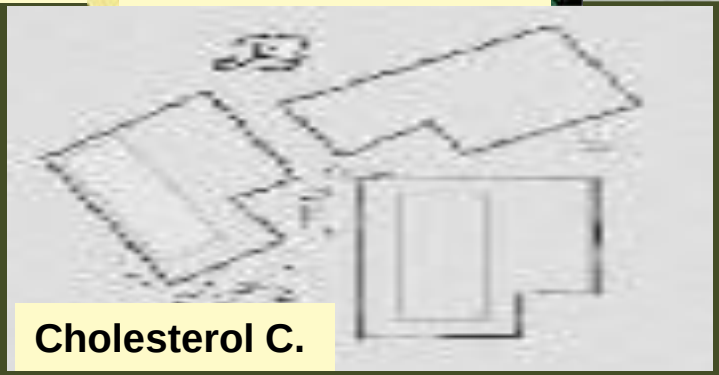
Triple Phosphate C.



Urate C. (rossette)

Calcium carbonate





Cholesterol C.

MILK

Milk is almost complete diet for young infant. Human milk is only deficient in vit. C, K as well as in Fe & Cu

A. Physical properties:

1) **Color:** white, sometimes yellowish (carotenes).
2) **Reaction:** PH of cow's milk (6.6), human milk (7.0).

- It is a good buffer due to its proteins, CHO, phosphates & citrates. It is used in ttt of hyperacidity.

COLOSTRUMS

It is a yellowish fluid secreted by the mammary gland during the first week of lactation.

Points	Colostrum	Mature milk
Proteins	5.5%; rich in IG (immunity)	1.2%
Lactose	3.5 %, less sweet & more suitable for newborns	7.4%
Fats	2.5%, but higher fat sol. vit.	3.5%
Minerals	0.35%	0.2%
Water	88.15%	87.7%
Vitamins	Higher in fat sol. Vit., Lower in water sol. Vit. - More rich in A & E - Adequate in K - Poor other vitamins	Lower in fat sol. Vit., Higher in water sol. vit. - Rich in A & B_2 - Poor in C & K - Fair amounts of other vitamins

B. Chemical Properties of mature milk:

a. Milk fat:

Human milk contains about 3.5% fat. Milk fat includes; TGs, small conc. of chol., phospholipids, fat soluble vit. and carotenes. Milk is rich in vit. A & B_2 contains fair amounts of vit. E & D , but poor in vit. C & K.

b. Milk proteins:

Human milk contains ~1.2% proteins including:

1) **Casein:** 40% **(high biological value phosphoprotein)**
2) **Lactalbumin and lactoglobulins:** 60% (including γ– globulins that form antibodies).
3) **Other proteins:**

- Lactoferrin (enhances iron absorpt. from intestines).
- Many enz. (proteinases, lipase, amylase, peroxidase, catalase, alkaline phosphatase & aldehyde oxidase.)

c. Milk sugar : (Lactose)

Human milk contains lactose (7.4%). Lactose is the most suitable sugar in milk. **WHY?**

1. Source of energy (glucose & galactose)
2. Synthesis of glycolipids for brain growth (galactose)
3. Less sweet so does not causing nausea to infant.
4. It helps growth of lactic acid producing bacteria in the intestines which ferment lactose to lactic acid, thus decrease the intestinal pH helping the absorption of Ca, Mg, phosphates, Fe and Cu.

d. Milk minerals:

Human milk contains 0.2 % minerals. Milk is rich in Ca, K, P & Cl, contains fair amounts of Na & Mg, poor in Fe & Cu.

e. Milk vitamins:

Milk is rich in vitamins A and B_2, poor in vitamin C & K , and contains fair amounts of other vitamins.

QUESTIONS?


thank you
Shuzan Ali