II. URINE PHYSICAL PROPERTIES

A. Physical Properties – a group of extremely simple and useful observations

1. Importance

   a. Gives clues to subsequent findings

   b. Abnormal physical properties can dictate the need for additional tests not always included in routine UA

2. Volume - not usually recorded except for timed (24hr) quantitave tests. Volume depends on the body's state of dehydration. Influenced by fluid intake, loss by non renal sources (sweat, fever, vomiting, diarrhea), ADH secretion, increased need to secrete large amounts of glucose or salts.

   a. Normal = 600-1600 ml/24 hour (produce 2-3 times more during day than night)

   b. Polyuria – constant elimination of abnormally large amounts of urine

   c. Diuresis – any increase in volume, even if temporary

   d. Oliguria – decrease in volume

   e. Anuria – absence of urine formation

   f. Nocturia – excretion of urine at night

   g. QNS - quantity not sufficient.

3. Color

   a. Varies with concentration

   b. Listed as: straw, light yellow, yellow, dark yellow, and amber

   c. Caused by a mixture of the following pigments

      1) Urochrome – yellow pigment (predominant)

      2) Uroerythrin – red pigment

3) Urobilin – orange-red pigment

d. Abnormal urine colors

1) Very pale

2) Brown – bile or bilirubin

3) Orange-red – increased urobilin

4) Clear red – hemoglobin or myoglobin

5) Cloudy red – intact red cells

6) Port wine – porphyrins

7) Cola – myoglobin and others

8) Black – melanin and homogentisic acid

9) Bizarre – i.e., greens, blues can be due to drugs and chemicals

10) Amber - possible bile or bilirubin, often associated with hepatitis

4. Transparency

a. Clear – normal

b. Classifications: clear, slightly hazy, hazy, cloudy, very cloudy, turbid

c. Causes

1) Mucin

2) Amorphous crystalline material

3) Pus and bacteria

4) Cells

5) Other substances

5. Odor - not normally reported out

a. Normal – aromatic

b. Ammonia – from bacterial breakdown of urea

c. Others – sweet, fruity, maple syrup, mousy, etc.

6. Foam - not reported out

a. White foam – possible protein

b. Yellow foam – may be due to bile/bilirubin

7. Specific Gravity (Concentration of Dissolved Solutes) - measure of the kidney's ability to reabsorb water and chemicals.

a. **Definition:** Relation of the weight of a solution to the weight of an equal volume of water at a given temperature

1) A measure of the density of a solution

2) Describes the weight of a solution as compared to the weight of an equal volume of distilled water at the same temperature

3) Water is used as the point of reference and is assigned the value of 1.000 (sp. gr. is a ratio and has no units)

4) Addition of solutes (electrolytes, urea, etc.) increase sp. gr.

b. Normal value

1) Overall – 1.015 - 1.025

2) First morning specimens – greater than 1.020

3) Kidneys are capable of 1.001-1.030

4) Isosthenuria - specific gravity is fixed at 1.010

c. Clinical significance

1) Osmotic pressure – Sp. gr. is a means of assessing kidneys ability to regulate osmotic pressure

2) Kidney function

3) State of hydration

4) Oliguria

acute renal failure	severe dehydration

5) Diabetes insipidus (not to be confused with diabetes mellitus) Deficiency of ADH (antidiuretic hormone, vasopressin). Patients excrete very large volumes of dilute, low specific gravity urine.

d. Measurement

1) Urinometer - rarely used

a) Also called a hydrometer

b) A floating device with a mercury weight in its bottom and an air bulb with a graduate stem above

c) The float displaces a certain weight and the level to which it sinks is a measure of specific gravity

d) The problem with routinely using the urinometer for specific gravity is that (in addition to the volume of urine it requires) it may require corrective calculations for temperature, increased amounts of glucose and protein

e) The following is a summary of the information concerning these calculations

(1) Temperature – most urinometers are calibrated at 20°C
(a) For every 3°C below the calibration temperature, you must subtract 0.001 from the reading

(b) For every 3°C above the calibration temperature, you add 0.001 to the reading

(2) Protein – Every gram of protein will cause the urinometer to read 0.003 higher than it is supposed to read. Therefore, you must subtract the 0.003 amount for each gm/dl of protein demonstrated by the dipstick

(3) Glucose – Each gram of glucose causes the urinometer to read 0.004 higher than it is supposed to read. So again, you must subtract the amount (0.004) from the original reading to obtain a corrected specific gravity result

2) Refractometer (total solids or TS meter)

a) Measures density of solutions by their refractive index - compares the velocity of light in air vs velocity of light in solution. Depends on the concentration of dissolved substances.

b) Advantages - small volume needed, less interference

3) Osmometer

a) Not routinely used

b) Measurement is a function of the number of dissolved particles

c) Two types

(1) Vapor pressure depression

(2) Freezing point depression - most common

d) Values are reported in milliosmoles/kg
Normal for serum = 275 - 300 mOsm/kg
Normal for urine = no set normals. The ratio of serum to urine is more important and should be 1:1

4) Urine dipstix with specific gravity – Most common method used today. The polyelectrolytes in the reagent area contain acid groups which dissociate according to the ionic concentration of the specimen. Bromthymol blue measures the pH change.