Pyuria

< 5.0 leukocytes / hpf are normal

Increased numbers = pyuria →

Indicate infection or inflammation

In the urinary tract + cast = renal in origin .

Urinary PMN > 30 suggest acute infections .

And repeated sterile culture may indicate TB or nephritis . Gross pyuria reflect rupture of urinary tract abscess .

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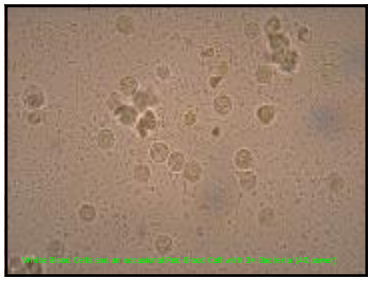

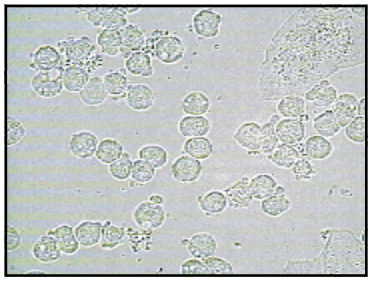

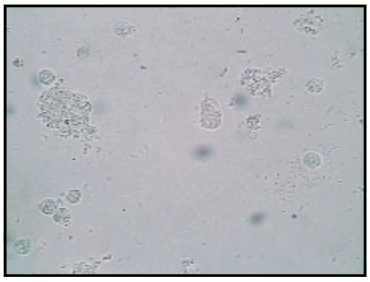

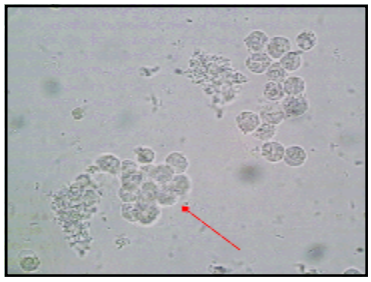

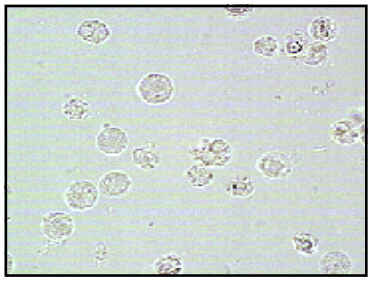

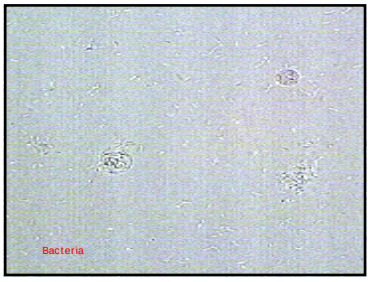

Epithelial cells

Squamous epithelial cells :

These cells are the most frequent epi cell in normal urine and least significant . These cells are large and flat 40- 200µm .

With abundant cytoplasm and small round central nuclei . In female derived from the vagina or vulva. N/C Ratio 1/1

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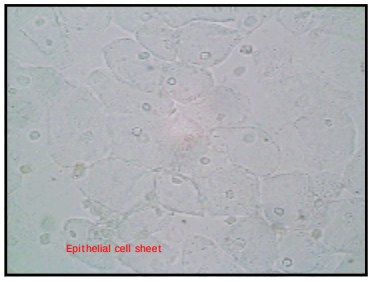

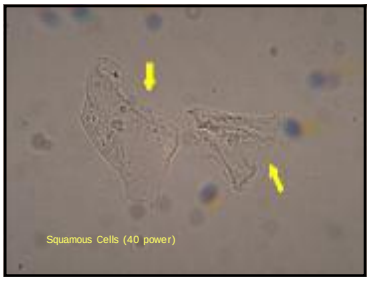

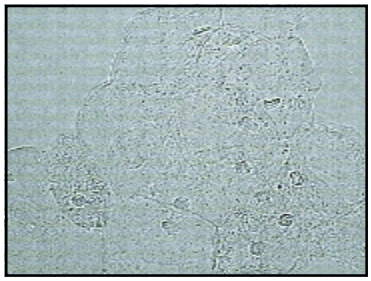

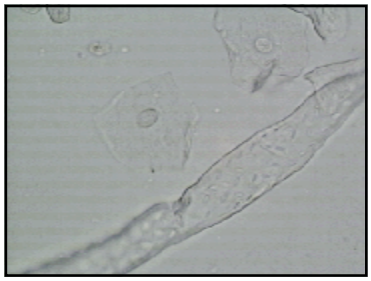

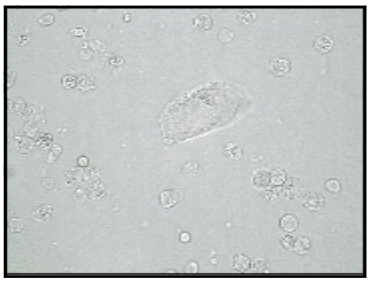

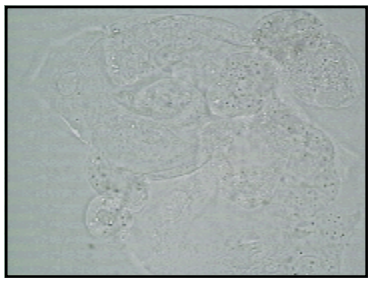

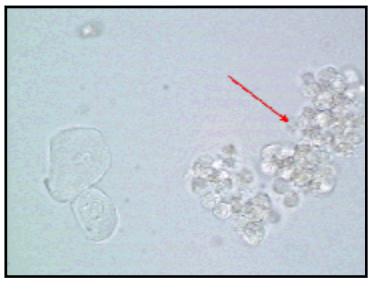

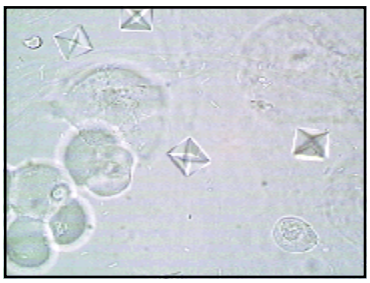

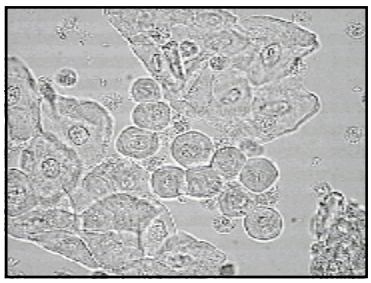

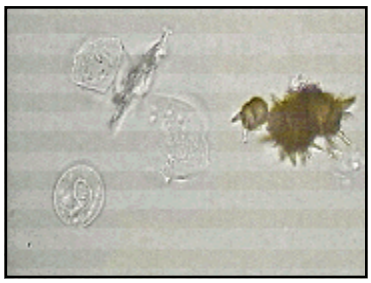

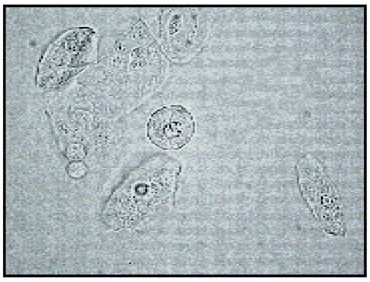

Transitional (urothelial) cells

Line the urinary tract from renal pelvis to the lower third of the urethra . These cells are smaller then squamous cells , they are round or pear shaped with a round centrally located nuclei. occasionally binucleate like squamous cells they are rarely pathologic significance . Except clumps or sheets evaluate for possible transional cell carsinoma.

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Renal tubular epithelial cells

These are the most signicant type of epi cells found in urine because the finding of an increased number indicates tubular damage .are seen in ATN and drug or heavy metal toxicity .lipids in renal tubular epi cell , nephrotic pigment in renal t.epi cell Hb , Mb , melanin absorbed

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Renal Cell (in the center), 7 Squamous Cells and trace of Mucous (40 power)

Casts

Casts are the only formed elements that have the kidney as their sole site of origin .

Tamm – Horsfall protein is the glycoprotein secreted by the tick part of the ascending loop of Henle .

It is generally held that this protein forms the matrix of all casts . The protein forms a meshwork of fibrils that can potentially trap any elements present in the tubular filtrate including cells , cell fragments , or granular material.....

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Casts .....

Casts can be quite variable in appearance , size, shape and stability. The width depends on the size of the tubule in which it was formed . Broad cast seen in dilated tubules or with stasis in CD. Thin cast occur in tubules compressed by swollen interstitial tissue. Cast may be short or long and convoluted. Casts have parallel sides and blunt ends. Large number of cast indicate kidney disease. Cast formation increase with lower PH , increased ionic concentration , stasis or obstruction or excess proteins . Casts may be classified according to their matrix , inclusions , pigments , and cells present.

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Cast matrix

Hyaline casts :

Most frequently observed , consisting almost entirely of Tamm- Horssfall protein , 0 – 2 LPF is normal.

Hyaline cast are translucent , increased in renal disease , exercise , heat exposure , dehydration , fever , CHF , diuretic trapy

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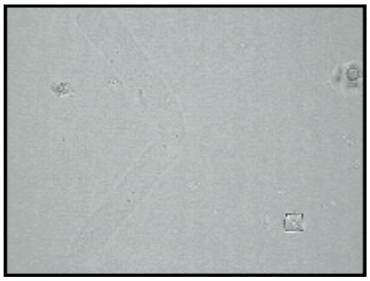
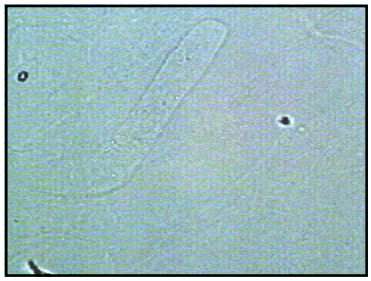
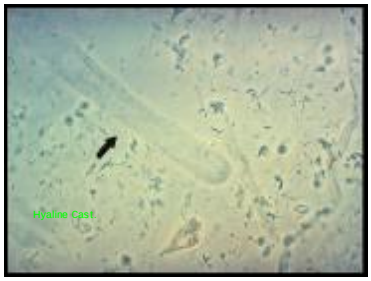
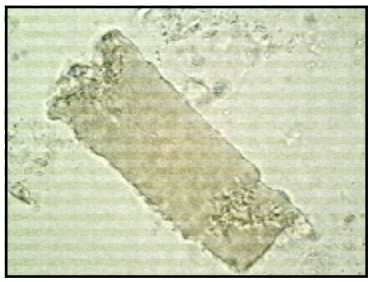


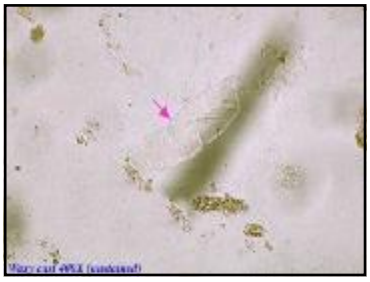


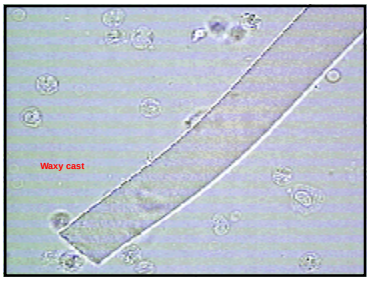


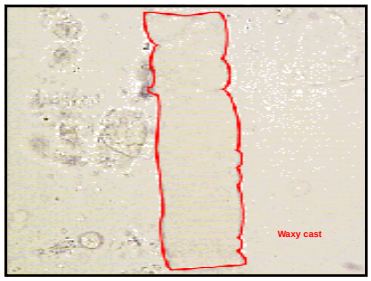
Waxy cast

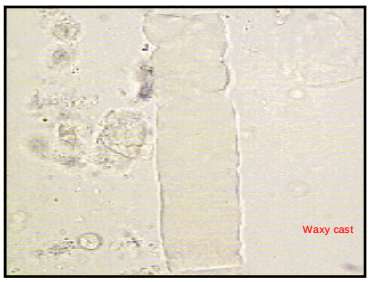
With chronic renal disease , some cast become denser , known as waxy . Waxy casts associated with tubular inflammation and degeneration . Seen in CRF , renal allograft rejection , early waxy cast believed to reflect the final phase of dissolution of the fine granules of granular casts. because time is required for granules to undergo lysis , waxy casts imply localized nephron obstruction and oliguria. When waxy cast are broad they known as renal failure cast.sharply defined edges , blunt ends and homogenous texture.







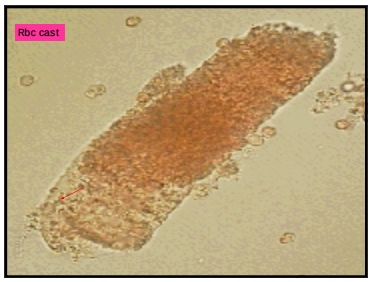


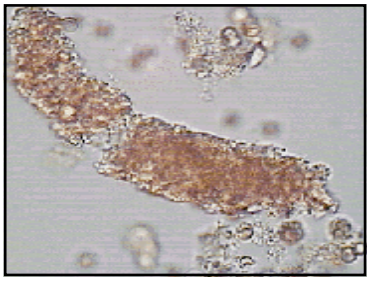


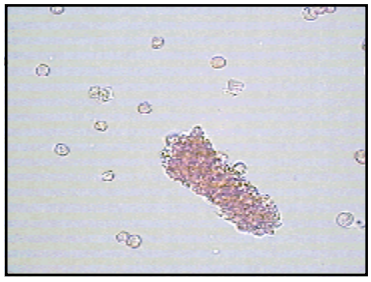
Cellular casts

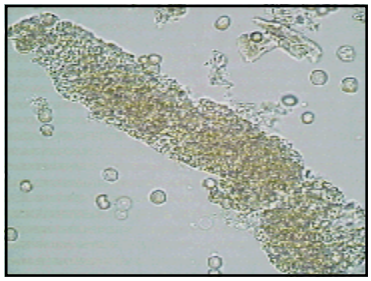
RBC cast:

is quite significant , an indication
eding within the nephron. Glumerular
age allows RBC to escape into the
and with proteinuria conditions are
al for cast formation. It is one of
e critical finding of differential
nosis of acute glomerulonephritis.



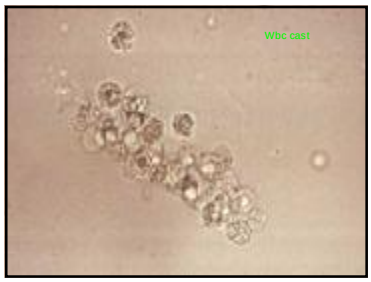






WBC casts

Leukocytes usually enter tubular lamina from interstitum ,reflect tubulointerstitial disease with PMN exudates and interstitial inflammation .pylonephritis most common disease , SLE , urinary infection



به نام آفریننده علم و آگاهی

خداوند توانا و مهربان

با سلام

1 Dr A.A.MOTAMEDI RAD D.M.T SUMS

Urinalysis

Important clinical information may be obtained from laboratory analysis of urine specimens. Much progress has been made since ancient times, when urine was poured on the ground and the attraction of insects to it indicated an abnormal specimen. Physical and chemical analysis of urine and microscopic examination of sediment, often performed today with sophisticated instrumentation, are as useful in physicians' office laboratories as they are in large clinical laboratories.

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Urinalysis is performed for a variety of reasons, including:

1. to aid in the diagnosis of disease
2. to screen a population for symptomatic, congenital, or hereditary diseases (i.e., to monitor wellness)
3. to monitor the progress of disease
4. to monitor the effectiveness or complications of therapy
5. to screen asymptomatic industrial workers for acquired diseases

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Urinalysis

Types of urinalysis

-The dipstick (reagent strip) .١

- The basic (Routine) .٢

- The specialized cytopathologic .٣

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Urine formation

25% of C.O approximately 1200 ml of blood perfuses the kidneys each minute Ultimately the original filtrate volume of about 180 L in 24hours is reduced to 1-2 L depending on the status of hydration .

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Kidneys functions

1- *Elimination of waste products*

2- *Regulation of homeostasis and Acid-base status*

3- *Hormonal regulation*

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Components of Routine urinalysis

1- specimen evaluation
2- gross/ physical examination
3- chemical screening
4- sediment examination

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Specimen evaluation

Proper labeling

proper specimen For the requested examination

proper preservative

visible sign of contamination

transportation delay

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Odor

It have a faint , aromatic odor

Bacterial overgrowth	ammonia cal
Isovaleric acidemia	sweaty feet
Maple syrup urine disease	maple syrup
Methionine malabsorbtion	cabbage
Phenylketonuria	mousy
Thyrosinemia	rancid

Lack of odor in acute renal failure suggest ATN

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Clarity

Urine is normally clear

Cloudy : Turbidity may be due to precipitations of crystals or non pathologic salts referred to as amorphous

Phosphate , ammonium urate and carbonate in alkaline PH

Redissolved by acetic acid

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Gross/ Physical Examinations

Appearance	cause	remarks
colorless	Very dilute urine	Polyuria,diabetes insipidus
cloudy	Phosphates,carbonates Urates, uric acid Leukocytes Red cells (smoky) Bacteria, yeasts Spermatozoa Prostatic fluid Mucin, mucous threads Calculi Clumps , pus , tissue Fecal contamination Radiographic dye	Soluble in dilute acetic A. Dissolve at 60° C and in alkali insoluble in dilute acetic A. Lyse in dilute acetic A insoluble in dilute acetic A. insoluble in dilute acetic A. May be flocculent Phosphate,oxalates Rectovesical fistula In acid urine

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Gross/ Physical Examinations ….

Milky	Many neutrophiles (pyuria) Fat Lipiduria ,0palescent Chyluria,milky Emulsified paraffin	Insoluble in dilute acetic acid Nephrosis ,crush injury – soluble in ether Lymphatic obstruction - soluble in ether Vaginal creams
Yellow	Acriflavine	Green fluorescence
Yellow -orange	Concentrated urine Urobilin in excess bilirubin	Dehydration, fever No yellow foam Yellow foam,Positive bilirubin
Yellow –green	Billirubin - biliverdin	Yellow foam
Yellow – brown	Billirubin - biliverdin	Beer brown , yellow foam

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Gross/ Physical Examinations ….

Red	Hemoglobin Erythrocytes Myoglobin Porphyrin Fuscin , aniline dye Beets Menstrual contamination	Positive Positive (reagent strip for blood Positive May be colorless Plastic, candy Severe alkaluria , genetic Beets , menses
Red - purple	porphyrins	
Red - brown	Erythrocytes Hemoglobin on standing Methemoglobin Myoglobin Bilifuscin (dipyrrole)	Neut ph Muscle injury Result of unstable hemoglobin
Brown – black	Methemoglobin Homogentisic acid melanin	Blood, acid ph On standing alkaline alkaline , alkaptonuria On standing, rare

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Color

Yellow color is due to urochrome

increased during fever, tyrotoxicosis , starvation.

Small amount of urobilins and uroerythrin

Pale urine , ↓ sp.gr

following high fluid intake

Darker urine withheld urine

Pale urine + ↑ sp. Gr ⟶ DM

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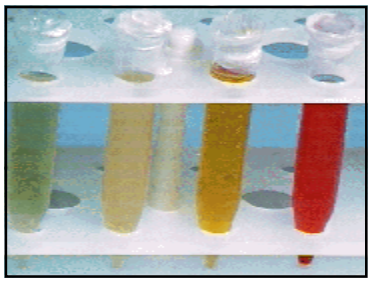

Red urine

Most common abnormal color

In female , menstrual flow should be considered

Hematuria , hemoglubinuria ,myoglobinuria

Produce pink, red or red-brown coloration

Drugs: Phenolsulfonphthalein

Porphyrias , cutanea tarda , hepatic

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Yellow- Brown or Green – Brown urine

Generally associated with bile pigments chiefly bilirubin .

Yellow foam may be seen on shaking .

In sever obstructive jaundice.

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Orange red – or Orange – Brown urine

Urobilinogen is colorless but is converted to urobilin in the presence of light and low PH which is dark yellow to orange

Will not color the foam by shaking by strip find .

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Dark brown or black urine

Acid urine containing Hb will darken on standing due to the formation of met hemoglobin.

Cola –colored urine may be seen with Rhabdomyolysis , L-dopa taking.

Homogentisic acid (alkaptonuria)

More rapidly darken when alkaline.

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Urine volume

The average adult produces from 600 – 2000 ml of urine per day .

Night urine not in excess of 400 ml .

Increased volume : production of > 2000 ml in 24h ⟶ polyuria

>500 ml at night ⟶ nocturia

polydipsia , consumption of alcohol ,caffeine ,thiazides ,DI up to 15L /Day , osmotic diuresis DM

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Volume

Decreases volume :

< 500 ml / day ⟶ oliguria

Near complete suppression ⟶ anuria

Oliguria ⟶ renal failure azotemia

pre renal, renal ,post renal

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Specific gravity

Specific gravity reflect the relative degree of concentration or dilution of urine.

Osmolality indicates the number of particles of solute per unit of solution .

Larger particles (sugar , protein)

Sp.gravity more than electrolytes .

Normal sp.gravity 1.016 – 1.022

Hyposthenuric < 1.007 in DI 1.001

Isosthenuric about 1.010 sever renal damage

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Specific gravity …..

Methods :

1- reagent strip

2- refractometer

3- urinometer

4- falting drop

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Specific gravity …..

Reagent strip :

The reagent area has three main ingredients.

Polyelectrolyte , indicator substance and buffer.

The principle is based on the pk_a

Change of the pretreated polyelectrolyte in relation to ionic concentration of urine. when the ionic concentration is high the pk_a Is decreased as is the ph. The indicator substance then changes color .

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Specific gravity …..

Refractometer :

Indirect ,

measures refractive index of a solution .

Urinometer :

This is a hydrometer adapted to directly measure the sp gr at RT .

Temperature influences, 3° above or below calibrate 0.001

Protein0.003 for every 1.0 g/dl subtract

Sugar 0.004 for every 1.0 g/dl subtrac

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Specific gravity …..

Falling drop method:

Direct method more accurate than refractometer and more precise than the urinometer.

This methods utilizes a specially designed column filled with water-immiscible oil.

A measured drop of urine is introduced into the column and as this drop falls it encounters two beam of light , breaking the first beam starts a timer , while breaking the second turns it off. The falling time is measured electronically and expressed as a sp.gr.

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Recommendation for reagent strips

Storage

Protect from moisture and excessive heat

Store in cool , dry area but not in a refrigerator

Check for discoloration with each use , discoloration may indicate loss of reactivity .Do not use discolored strip or tablets .

Keep container tightly stoppered.

Check manufacturers directions with each new lot number for changes in procedure .

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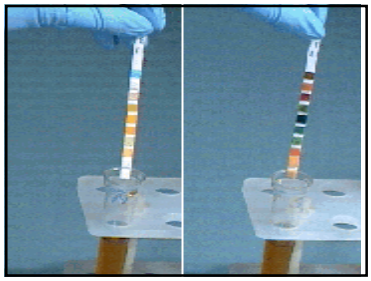

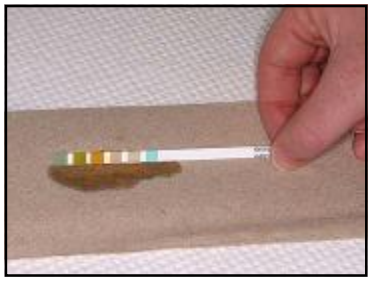

Recommendation for reagent strips

Testing

Test urine as soon as possible after receipt.
Remove only enough strips for immediate use , recap tightly .
Test a well-mixed unspun urine sample.
Urine samples must be at room temperature before testing .
Do not touch the test area with fingers.
Do not use reagent strips in the presence of volatile acids or alkaline fumes.
Dip reagent strip into urine briefly – no longer than one second .
Drain excess urine off – run edge of strip along rim of tube or blot edge on absorbent paper.
Do not allow reagents to run together.
Do not lay reagents strip directly on workbench surface.
Follow exact timing recommendation for each chemical test .
Hold reagent strip close to the color chart and read under good lighting.
Know sources of error , sensitivity , and specificity of each test on the reagent strip.
Think make correlations between patient history and individual test; then follow through.

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Confirmatory Tests

Confirmatory chemical urinalysis tests detect the same substance with the same or greater sensitivity and/or specificity, or they use a different reaction or methodology to detect that substance. Repeating a reagent strip reaction or analysis is not a confirmatory test. Commonly used confirmatory chemical urinalysis tests include the sulfosalicylic acid (SSA) test for albuminuria and the tablet test for bilirubin.

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Chemical screening urine PH

The kidneys and lungs work in concert to maintain acid-base equilibrium .

The lungs excretes co_2 whereas the renal reclaiming and generating Hco_3^- and secreting NH_4^+ . The PCT responsible for the bulk of the Hco_3^- reabsorbtion and DCT the remaining function.

The tubular cells exchange H^+ for NA^+ of the filtrate ,non volatile acids (sulfuric , phosphoric , pyruvic , lactic , citric acids) excreted by glumerulus as salts (Na , Ca and NH_3)

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urine PH…..

Normal Ph

The average adult on a normal diet excrete about 50 – 100 mEq of H^+ in 24 hours to produce urine ph 6 ,may vary 4.6 – 8.0

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urine PH…..

Methods :

Reagent strip , ph Electrode , titrable acidity

Methyl red , bromothymol blue give a range of orange green and blue color as the ph rises within 5-9 measure on freshly voided , on standing , the ph tends to rise because of loss of co_2 and bacterial growth produces ammonia from urea.

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Protein in urine

Normally up to 150mg excreted in the urine daily.`

Demonstrated more than 200 urinary protein derived both from plasma and urinary tract .

Plasma pr with mw < 50000 pass through the glomerular basement membrane and normally reabsorbed by PCT . Tamm – Horsfall glycoprotein (uromucoid) secreted by DCT cells and ascending loop of Henle constitutes 1/3 of total normal pr loss.

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Protein in urine…..

Detection of an abnormal amount of protein in urine is an important indicator of renal disease because protein has a very low maximal tubular rate of reabsorption , increased filtration of protein quickly saturates the reabsorptive mechanism.
Screening methods are routinely used to differentiate normal protein excretion from abnormal and therefore should not detect < 8-10 mg/dl in a normal adult with a normal rate of urine flow.

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Protein in urine…..

The strip is sensitive to albumin , the acid precipitation detect all proteins and indicate the presence of globulins as well as albumin.
Because a positive result for pr is significant it should be confirmed by a second method and on repeated specimen

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Protein in urine…..

Postural proteinuria (orthostatic)
Occurs in 3% to 5% of young adults.
In this condition proteinuria is found during the day but not at night when a recumbent position .
The total daily excretion rarely exceeds 1.0g.
The patient is instructed to empty bladder upon going to bed in the evening . Immediately upon rising in the morning the patient voids and saves the specimen . **After two hours of standing and walking about the patient voids and saves again if the first is negative and the second positive the patient may have postural proteinuria.**

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Proteinuria quantification

Diagnosis of kidney disease obtained by analyzing excretion over 24h period.
Heavy proteinuria (> 4.0 g/day)
Seen in nephrotic syndrome . Classically , a low serum albumin level , generalized edema , and increased serum lipids. Many granular cast , fatty cast seen in sediment.DM, SLE cause glumeral injury and heavy proteinuria . Urine sediment may be telescoped , display all kinds of cells and casts in SLE nephritis .
Malaria , malignant hypertension , toxemia of pregnancy , neoplasia ,sickle cell , renal transplant rejection may additional causes of heavy proteinuria.

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Moderate proteinuria (1.0 - 4.0 g/day)

Inflammatory condition of lower urinary tract such as calculi

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Minimal proteinuria (< 1.0 g/day)

١. Chronic pyelonehritis
٢. nephrosclerosis
٣. polycystic disease

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Qualitative categories of proteinuria

The detection of the type of protein by electrophoretic separation.
Proteinuria may be separated into a glomerular and tubular pattern.

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Protein in urine….. Glomerular pattern

Glomerular disease causes proteinuria which may be heavy > 3.0 to 4.0 g/day
A loss or reduction of the fixed negative charge on the glomerular basment membrane allows albumin to permeate into bowman's space in large quantities ,more than can be reabsorbed by PCT.

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Protein in urine….. Tubular pattern

Occurs in fanconi's syndrome , cystinosis , Wilson's disease and pylonephritis , and renal transplant rejection , amount of proteinuria is about 1-2 g/day .
These proteins are usually low MW (alfa$_1$microglobulin ,beta-globulin such as beta$_2$microglobulin , light chain Ig and lysozyme). Tubular proteinuria may be missed by strip because of the absence or very low albumin but +ve by SSA.

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Protein in urine…..

Overflow proteinuria

Is due to overflow of excess levels of a protein in the circulation and can be seen with Hb , Mb , and Ig loss into the urine .

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Protein in urine…..

Bence Jones proteinuria

Associated with multiple myelooma ,macroglobulinemia and malignant lymphoma

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Protein in urine…..

Microalbuminuria

The presence of albumin in urine above normal level but below the detectable range of conventional urine dipstick methods .

20-200 mg/day

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Protein in urine…..

Methods :

Reagent strip : the strip is impregnated with tetrabromophenol blue buffered to an acid ph of 3 or tetrabromosulfophetalein . In the absence of pr the strip is yellow 30-60 seconds following urine application , variable shades of green develop .

Result as neg , trace , 1+ to 4+

Most methods detect 5.0 to 20 mg of alb/dl

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