Genito-Urinary System

Laboratory Practical 1

Laboratory No. 1
Urinalysis and Urine Culture

1. Describe methods of urine collection.
2. Examine the following characteristics of urine:
    a) Physical
    b) Chemical
    c) Microscopic
3. Demonstrate the laboratory diagnosis of UTI.

What is urine analysis?

- Commonly order panel of test on a urine sample which can evaluate:
  - Kidney failure
  - UTI
  - Stone
  - GU malignancy
  - Volume state
  - Acid base balance

1. Methods of urine collection

Random Specimen

- most commonly
- it is the easiest to obtain and is readily available.
- urinalysis and microscopic analysis, although it is not the specimen of choice.

- Sometimes gives an inaccurate view as specimen is too diluted and analyte values are artificially lowered.

First Morning Specimen

(also called an 8-hour specimen).

- This is the specimen of choice for urinalysis and microscopic analysis,
  - since the urine is generally more concentrated (due to the length of time the urine is allowed to remain in the bladder) and, therefore, contains relatively higher levels of cellular elements and analytes such as protein, if present.

Midstream Clean Catch Specimen

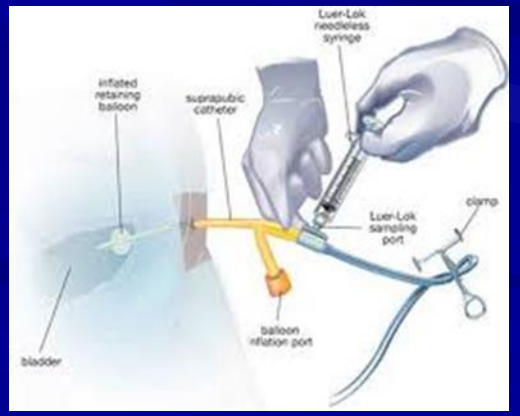
- This is the preferred type of specimen for culture and sensitivity testing
  - reduced incidence of cellular and microbial contamination.
- Patients are required to first cleanse the urethral area with a castile soap towelette.
- The patient should then void the first portion of the urine stream into the toilet, urine midstream is then collected into a clean container.

Timed Collection Specimen

- Among the most commonly performed tests requiring timed specimens (usually 8 or 24 hours)
  - measuring creatinine, urine urea nitrogen, glucose, sodium, potassium, or analytes such as catecholamines and 17-hydroxy-steroids that are affected by diurnal variations.

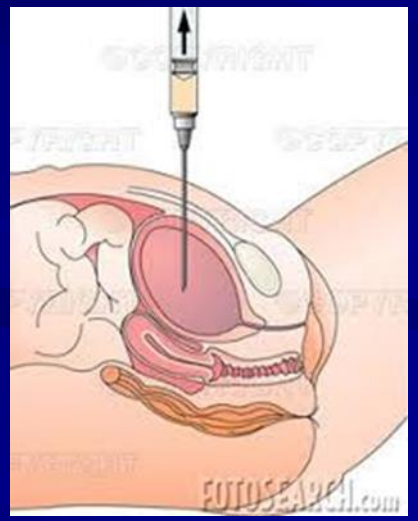
Catheter Collection Specimen

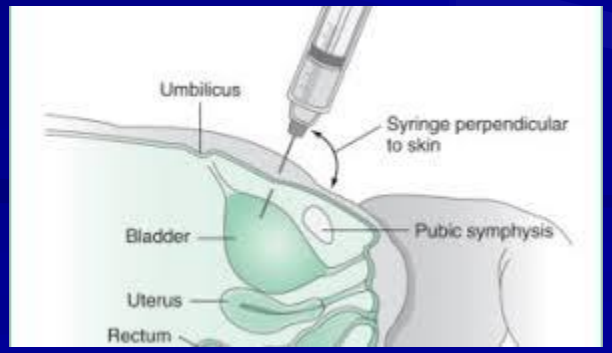
- This assisted procedure is conducted when a patient is bedridden or cannot urinate independently.
- Specimens may be collected directly from a Foley into an evacuated tube or transferred from a syringe into a tube or cup.



Suprapubic Aspiration Specimen

- This method is used when a bedridden patient cannot be catheterized or a **sterile specimen is required**. The urine specimen is collected by needle aspiration through the abdominal wall into the bladder.





Pediatric Specimen

- For infants and small children, a special urine collection bag is adhered to the skin surrounding the urethral area.
- Urine collected from a diaper is not recommended for laboratory testing since contamination from the diaper material may affect test results.

What is urine analysis?

- Gross inspection: color, turbidity
- Dipstick: Sg, pH, glucose, hem, protein, Leukocyte esterase, Nitrites, ketone, bilirubin
- Microscopy: WBCs, RBCs, Bacteria, crystals, Casts

Cross inspection

- Unusual coloration
- Clear- indicates over-hydration
- Orange urine, from certain medications such as rifampin
- Bloody urine (hematuria), potentially a sign of a bladder infection.
- Consumption of beets can cause urine to have a pinkish tint.شمندر
- Green UTI: P aeruginosa

- Dark orange to brown urine can be a symptom of jaundice or Gilbert’s syndrome
- Dark yellow urine is usually indicative of dehydration

- **Odor**

  Usually odorless, urine can be pungent after the consumption of certain foods. Eating asparagus is known to produce a strong odour in human urine.

- **Turbidity**

  Turbid urine may be a symptom of a bacterial infection, but can also be due to crystallization of salts such as calcium phosphate.

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Chemical analysis (Dipstick)

- Series of pads embedded one reagent strip that provide quick semi quantitative assessment of various potential content of urine

Chemical analysis (Dipstick)

- The pH of urine is close to neutral (7) but can normally vary (4.5 and 8).
  - Strongly acidic or alkaline urine may be symptomatic of disease. acidemia, RTA, alkalemia, UTI proteus, diet
- Normal urine density or specific gravity values vary between 1.003-1.035 ($g.cm^{-3}$).
  - sg= Density of urine/density of water

- Glucose: hyperglycemia
- Heme: UTI, stone, malignancy, rhabdomyolysis
- Protein: glomerular disease
- Leukocyte esterase and nitrites: UTI

	LE (usually graded 1 – 4+)	Nitrites (usually graded "positive" vs. "negative")
Urinary tract infection	X	X
Indwelling urinary catheter	X	X
Recent instrumentation of the GU tract	X	
Urologic malignancy	X	
Chronic interstitial nephritis	X	
Interstitial cystitis	X	
Intra-abdominal inflammatory process adjacent to the GU tract	X	


test D

- Microscopic examination
- A urine sample may contain cells that originated in the blood, the kidney, or the lower urinary tract.

RBCs

- RBCs are quantified as # of cells / "high powered field".
- ≥ 3 RBCs/HPF should be considered abnormal.
- Presence of dysmorphic RBCs is strongly suggestive of glomerular disease.

↑ RBCs

- UTI
- Renal stone
- GU malignancy
- Recent instrumentation (including Foley placement)
- Coagulopathy
- Glomerulonephritis
- Sickle cell anemia
- Renal tuberculosis
- Vigorous exercise
- Contamination with menstrual

WBCs

- WBCs are quantified as # of cells / "high powered field".
- >5 is generally considered to be abnormal.

↑ WBCs

- Urinary tract infection
- Indwelling urinary catheter
- Recent instrumentation of the GU tract
- Urologic malignancy
- Chronic interstitial nephritis
- Interstitial cystitis
- Intra-abdominal inflammatory process adjacent to the GU tract
- Contamination with vaginal secretions

bacteria

Use of the UA to Diagnose a UTI

- Although UAs are frequently used to assist in the diagnosis of a UTI, there are no standardized approaches on how to do this.
- The presence of nitrites is the most specific finding, and has the highest positive predictive value.
- However, leukocyte esterase, WBCs, and even bacteria on microscopic exam are not specific, and their presence does not necessary indicate infection.
- Diagnosis of a UTI also needs to consider the presence of symptoms and a positive urine culture (if one is done, which is probably not necessary in young, otherwise healthy women with typical symptoms).

Crystals

- Crystals are highly organized, microscopic solids usually composed of a small number of different ions and/or molecules.
- Formation of crystals is most dependent upon:
  - Concentration of ions and molecules
  - Urine pH
- Small amounts of most types of crystals are not necessarily pathologic

crystals


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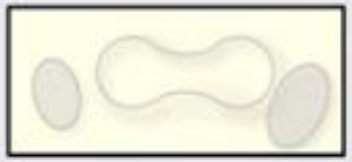
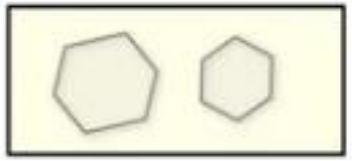
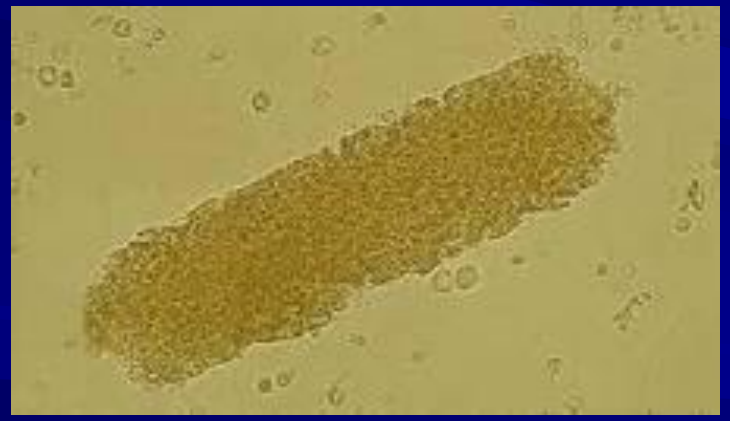
Crystals	Characteristics of Formation	Appearance	Diagnostic Utility
Uric Acid	Formation promoted by acidic urine		Seen in tumor lysis syndrome
Calcium phosphate	Formation promoted by alkaline urine		Not suggestive of any specific systemic disease
Magnesium ammonium phosphate (a.k.a. struvite or "triple phosphate")	Formation promoted by alkaline urine		Seen in UTIs by urease-producing organisms (e.g. *Proteus, Klebsiella*)
Calcium oxalate dihydrate	Formation is largely independent of urine pH		Not suggestive of any specific systemic disease
Calcium oxalate monohydrate	Formation is largely independent of urine pH		Seen in ethylene glycol ingestion
Cystine	Formation promoted by acidic urine		Diagnostic of cystinuria

- Urinary casts are microscopic cylindrical structures produced by the kidney and present in the urine in certain disease states



- The presence of cellular casts (casts containing RBCs, WBCs, or epithelial cells) identifies the kidneys, rather than the lower urinary tract.

Normal Results

- Normal urine is clear straw-colored, but may also be slightly hazy. It has a slight odor.
- It may contain some normal crystals as well as squamous or transitional epithelial cells from bladder, lower urinary tract, or vagina.
- Normal urine contains a small amount of urobilinogen, and may contain a few RBCs and WBCs.

- Normal values used in many laboratories
- Glucose: negative (quantitative less than 130 mg/day or 30 mg/dL).
- Bilirubin: negative (quantitative less than 0.02 mg/dL).
- Ketones: negative (quantitative 0.5–3.0 mg/dL).
- pH: 5.0–8.0.
- Protein: negative (quantitative 15–150 mg/day, less than 10 mg/dL).

- Blood: negative.
- Nitrite: negative.
- Specific gravity: 1.003-1.035.
- Leukocyte esterase: negative.
- Red blood cells: 0–2 per high power field.
- White blood cells: 0–5 per high power field.