I. URINE ANALYSIS

URINE ANALYSIS PROCEDURE

For a routine urine analysis, a fresh (<1 hr old), clean-catch urine sample is acceptable. If the analysis cannot be performed immediately, refrigerate the sample. (When urine stands at room temperature for a long period, casts and red blood cells undergo lysis, and the urine becomes alkalized with precipitation of salts.)

1. Pour 5–10 mL of well-mixed urine into a centrifuge tube.
2. Check for appearance (color, turbidity, odor). If the urine sample looks grossly cloudy, it is sometimes advisable to examine an unspun sample. If an unspun sample is used, make note that you have done so. In general, for routine urine analysis, a spun sample is more desirable.
3. Spin a capped sample at 3,000 rpm for 3–5 min.
4. While the sample is in the centrifuge, use the dipstick (Chemstrip, etc.) to perform the dipstick evaluation on the remaining sample. Read the results according to the color chart on the bottle. Allow the correct amount of time before reading the test (usually 1–2 min) to avoid false results. Chemstrip 10 provides 10 tests (specific gravity, pH, ketone bodies, nitrite, protein, urobilinogen, bilirubin, and glucose). Other strips may provide less. Agents that color the urine (eg, phenazopyridine [Pyridium]) may interfere with the reading. Dipstick specific gravity is also available on some assay strips.
5. Decant and discard the supernatant. Mix the remaining sediment by flicking it with your finger and pouring or pipetting 1 or 2 drops onto a microscope slide. Cover with a coverslip.

Examine 10 low-power fields (10X objective) for epithelial cells, crystals, and mucus. Casts and bacteria are usually reported as number per high-power field.

Normal Urine Analysis Values

- Appearance: Yellow, clear, or straw-colored
- Specific gravity: Normal: 1.001–1.035 (with normal fluid intake 1.016–1.023 indicates normal renal concentrating ability.)
- pH: Normal: 4.6–8.0
- Negative for bilirubin, blood, acetone, glucose, protein, nitrite, leukocyte esterase, reducing substances
- Trace: Urobilinogen
- RBCs: The exact definition of microscopic hematuria is debated, but it is generally defined as ≥3 RBC/HF (4X). RBCs ≥4–5/HF
- WBCs: 0–4/HF
- Epithelial cells: Occasional
- Glyeine casts: Occasional

Bacteria: None

Crystal: Some limited crystals, based on urine pH (see below)

Differential Diagnosis for Routine Urine Analysis

- Appearance (see Section II: "Urine, Abnormal Color"): Section II: "Urine, Foaming, Urine, Odor, and Urine, Particles"
- pH: Acids: High protein (meat), ammonium chloride, mandelic acid and other medications, acids (due to ketoadosis [starvation, diabetes]), chronic obstructive pulmonary disease (COPD)
- Basic: Urinary tract infections (UTIs), renal tubular acidosis, (diabetes, nephrotic syndrome, myeloma, pastural diseases) and diabetes, radiation (most epithelial cells are from the section on "Leukocyte Esterase," below.)

Specific gravity: Usually corresponds to osmolarity, except with concomitant disease. A value >1.023 indicates normal renal concentrating ability.
- Increased: Volume depletion, congestive heart failure (CHF), adrenal insufficiency, diabetes mellitus, inappropriate antidiuretic hormone (ADH), increased proteins (nephrosis); if markedly increased (1.041–1.050), suspect allergy or excretion of radiographic contrast media.
- Decreased: Diabetes insipidus, pycnolynphitis, glycogenolysis, water load with normal renal function

Bilirubin:
- Positive: Obstructive jaundice (extrahepatic and intrahepatic), hepatitis (Note: False positive with stool contamination)

Blood:
- Positive: See Section I: "Hematuria" – Positive: If the dipstick is positive for blood, but no RBCs are seen, free hemoglobin may be present from trauma, from a transfusion reaction, or from lysis of RBCs (RBCs) will lyse if the pH is <5 or >8, there may be myoglobin present because of a crush injury, burn, or tissue ischemia.
- Positive: Diabetes mellitus, pancreatitis, pancreatic carcinoma, cholangiocarcinoma, Cushing's syndrome, shock, burns, pain, steroids, hyperpyrexia, renal tubular disease, isometric causes (Note: The glucose oxidase technique in many kits is specific for glucose and will not react with lactose, fructose, or galactose.)

Ketones:
- Detects primarily acetone and acetoacetic acid and not β-hydroxybutyric acid
- Positive: Starvation, high-fat-carnitine diet, diabetes, ketoadiposis, vomiting, diarrhea, hypothyroidism, pregnancy, Marfan states (especially in children)

Nitrite:
- Many bacteria will convert nitrites to nitrates. See also the section on "Leukocyte Esterase," below)
- Positive: Infection (A negative test does not rule out infection, because some organisms, such as Pseudomonas aeruginosa and other gram-positive cocci, will not produce nitrite, and the urine must also be retained in the bladder for several hours to allow the reaction to take place.)

Proteins:
- Indicated by dipstick of persistent proteinuria should be qualified by 24 hr of urine collection
- Positive: Pyelonephritis, glomerulonephritis, Kimmelstiel-Wilson syndrome (diabetes), nephrotic syndrome, myeloma, pastural diseases, and malignancies of the lower tract, causes (fever, stress, heavy exercise), malignant hypertension, congestive heart failure

Leukocyte esterase (see Section I: "Pyuria")
- This test detects <5 WBC/HF in voided WBCs

When combined with the nitrite test, it has a predictable value for UTI if both tests are positive, and >97% if both tests are negative.
- Positive: Infection (false positive with vaginal contamination)

Reducing substance:
- Positive: Glucose, fructose, galactose, false-positive (vitamin C, calcium, antibiotics, etc.)

Urobilinogen:
- Positive: Cirrhosis, CHF with hepatic congestion, hepatitis, hyperpyrexia, suppression of gut flora with antibiotics (Note: With obstructive jaundice, urobilinogen is usually normal, but bilirubin is elevated.)

Urine Sediment

Many labs no longer do microscopic examinations unless specifically requested or if the dipstick test shows evidence of an abnormal finding (such as positive leukocyte esterase)

RBCs: Trauma, pyelonephritis, genitourinary tuberculosis (TB), cystitis, prostatitis, stones, tumors (malignant and benign), staphylococcal, and any cause of blood in the urine (see above) or main indication by dipstick of persistent proteinuria should be qualified by 24 hr of urine collection

WBCs: Krokemosis anywhere in the urinary tract, TB, renal tumors, acute glomerulonephritis, injury, infection and not contamination)

Eosinophils: Acute tubular necrosis (ATN), neocystitis papillitis (most epithelial cells are from an otherwise unremarkable urogram)

Parasites: Trichomonas vaginalis, Schistosoma (Schistosoma infections)

Yeast: Candida albicans infection (especially in diabetics, immunocompromised patients, or if a vaginal yeast infection is present)

Spermatozoa: Normal in males immediately after intercourse or nocturnal emission

Crystals: Note that urine should be examined fresh from the container; it can warm (due to phosphate precipitation may be observed when urine cools)
- Abnormal: Calcium oxalate, double, and hexagonal (normal)
- Normal in alkaline urine: Calcium carbonate, triple phosphate (triple calcitriol)

Amorphous substances: (all usually unimportant)

Mucus: Large amounts suggest uterine disease (normal from ileal conduit or other forms of urinary diversion)

Glitter cells: WBCs are lysed in hypotonic solution.