Urological Investigations

Urinalysis

The urinalysis is a fundamental test that should be performed in all urologic patients. Although, in many instances, a simple dipstick urinalysis will provide the necessary information, a complete urinalysis includes both chemical and microscopic analyses.

Collection of Urinary Specimens

Male a midstream urine sample is obtained. 4 tubes test used to distinguish site of infection Voided Bladder 1, Voided Bladder 2, Expressed Prostatic Secretions, and Voided Bladder 3 (VB1, VB2, EPS, and VB3). VB1 sample represents urethral flora; the VB2, bladder flora; and the EPS and VB3 samples, prostatic flora.

Female it is more difficult to obtain a clean-catch midstream specimen. The female patient should cleanse the vulva, separate the labia, and collect a midstream specimen. If infection is suspected, however, the midstream specimen is unreliable and should never be sent for culture and sensitivity. To evaluate for a possible infection in a female, a catheterized urine sample should always be obtained.

Neonates and Infants a sterile plastic bag with an adhesive collar over the infant's genitalia.. The best way to obtain an uncontaminated specimen from the bladder is by percutaneous suprapubic aspiration of urine.

All urine samples should be examined within 1 hour of collection and plated for culture and sensitivity if indicated. If urine is allowed to stand at room temperature for longer periods of time, bacterial overgrowth may occur, the pH may change, and red and white blood cell casts may disintegrate. If it is not possible to examine the urine promptly, it should be refrigerated at 5°C.

A- Physical Examination of Urine

The physical examination of the urine includes an evaluation of

1-Color The normal pale yellow color of urine is due to the presence of the pigment urochrome. Urine color varies most commonly because of concentration, but many foods, medications, metabolic products, and infection may produce abnormal urine color.

2-Turbidity Freshly voided urine is clear. Cloudy urine is most commonly due to phosphaturia. Pyuria is readily distinguished from phosphaturia either by smelling the urine (infected urine has a characteristic pungent odor) or by microscopic examination

3-Specific Gravity and Osmolality

Specific gravity of urine is easily determined from a urinary dipstick and usually varies from 1.001 to 1.035.In general, specific gravity reflects the state of hydration, but also affords some idea of renal concentrating ability.

Osmolality is a measure of the amount of material dissolved in the urine and usually varies between 50 and 1200 mOsm/L.

4-pH the average pH varies between 5.5 and 6.5. A urinary pH between 4.5 and 5.5 is considered acidic, whereas a pH between 6.5 and 8 is considered alkaline. the urinary pH reflects the pH in the serum.In patients with a presumed UTI, an alkaline urine with a pH greater than 7.5 suggests infection with a urea-splitting organism, most commonly Proteus. Urinary pH is usually acidic in patients with uric acid and cystine lithiasis.

B- Chemical Examination of Urine

Urine Dipsticks are short, plastic strips with small marker pads that are impregnated with different chemical reagents that react with abnormal substances in the urine to produce a colorimetric change. The abnormal substances commonly tested for with a dipstick include.

1-Hematuria Normal urine should contain less than three red blood cells per HPF. A positive dipstick for blood in the urine indicates either hematuria, hemoglobinuria, or myoglobinuria.Hematuria can be distinguished from hemoglobinuria and myoglobinuria by microscopic examination of the centrifuged urine;

the presence of a large number of erythrocytes establishes the diagnosis of hematuria. If erythrocytes are absent, examination of the serum will distinguish hemoglobinuria and myoglobinuria.

2-Proteinuria healthy adults excrete 80 to 150 mg of protein in the urine daily; the qualitative detection of proteinuria in the urinalysis should raise the suspicion of underlying renal disease. Proteinuria may be the first indication of renovascular, glomerular, or tubulointerstitial renal disease, or it may represent the overflow of abnormal proteins into the urine in conditions such as multiple myeloma.

***3-Glucose and Ketone*:** renal threshold corresponds to serum glucose of about 180 mg/dL; above this level, glucose will be detected in the urine.

4-Leukocyte Esterase and Nitrite Tests

Leukocyte esterase activity indicates the presence of white blood cells in the urine. The presence of nitrites in the urine is strongly suggestive of bacteriuria
specificity of the nitrite dipstick for detecting bacteriuria is over 90% . The sensitivity of the test, however, is considerably less, varying from 35% to 85%.

5- urobilinogen and bilirubin

C- Microscopic Examination

Microscopic analysis of the urinary sediment should be performed with both low-power (×100 magnification) and high-power (×400 magnification) lenses. the urinary sediment should be examined microscopically for (1) cells, (2) casts, (3) crystals, (4) bacteria, (5) yeast, and (6) parasites.

1-Cells

Erythrocyte and Leukocytes can generally be identified under high-power magnification. It is normal to find 1 or 2 leukocytes/HPF in men and up to 5/HPF in women in whom the urine sample may be contaminated with vaginal secretions.

Epithelial cells are commonly observed in the normal urinary sediment.

2-Casts

A cast is a protein coagulum that is formed in the renal tubule and traps any tubular luminal contents within the matrix. Tamm-Horsfall mucoprotein is the basic matrix of all renal casts; it originates from tubular epithelial cells and is always present in the urine. When the casts contain only mucoproteins, they are called hyaline casts and may not have any pathologic significance. Hyaline casts may be seen in the urine after exercise or heat exposure, but may also be observed in pyelonephritis or chronic renal disease. Red blood cell casts contain entrapped erythrocytes and are diagnostic of glomerular bleeding. White blood cell casts are observed in acute glomerulonephritis, acute pyelonephritis, and acute tubulointerstitial nephritis.

3-Crystals

Identification of crystals in the urine is particularly important in patients with stone disease, because it may help determine the etiology. Crystals precipitated in acidic urine include calcium oxalate, uric acid, and cystine. Crystals precipitated in an alkaline urine include calcium phosphate and triple-phosphate (struvite) crystals.

4-Bacteria

Normal urine should not contain bacteria, and, in a fresh uncontaminated specimen, the finding of bacteria is indicative of a UTI.5 bacteria/HPF reflects colony counts of about 100,000/mL.The finding of any bacteria in a properly collected midstream specimen from a male should be further evaluated with a urine culture.

D-Other urinary examination: Urine Culture, Urine cytology and bladder tumor antigens

Blood Examination: Renal function (B.urea and S. createnin), hormones, complete blood count, Electrolytes, Prostatic specific antigen

Imaging of Urinary tract

Abdominal Plain Radiography

An abdominal plain radiograph is most often referred to as a KUB (kidneys, ureters, and bladder). An anteroposterior radiograph of the abdomen may also be referred to as a *scout film* before the administration of IV contrast material for an IV urogram.

plain radiograph of the abdomen and pelvis includes the area above both adrenal glands and extends to 2 cm below the symphysis pubis. If one film is not large enough to map this area and two films are required.

Excretory (Intravenous) Urography(IVU)

Contrast Media triiodinated benzoic acid derivatives There are both ionic and nonionic contrast agents. Most ionic contrast agents are hypertonic and are often referred to as high osmolar contrast media (HOCMs). (Renografin, Hypaque, and Conray). These substances are excreted by glomerular filtration, and thus the degree of opacification is determined by the dose of contrast medium administered and the patient's glomerular filtration rate (GFR)

A major disadvantage of these agents is their hypertonicity. The hypertonicity of the contrast media may have ill effects on the cardiovascular system, the coagulation cascade, the blood-brain barrier, and the kidneys.

In order to reduce the osmolality and therefore the toxicity of contrast media, low osmolar contrast media (LOCMs) were developed. This class of compounds provides an approximately 50% reduction in osmolality with an equivalent iodine load but until recently had been 5 to 10 times more expensive than the older HOCMs

The dose: between 1-2 ml/kg of contrast material containing 300 mg of I2/ml is generally used. This results in a total dose of between 50 and 100 ml of contrast material for an average patient.

Filming Sequence

1-The study begins by obtaining a scout (KUB) film taken before the administration of contrast material

2-Nephrotomograms

Immediately after the injection of contrast material, a series of three nephrotomograms is made. When the tomograms are obtained during the early phase of excretion, all the excreted contrast material is in the renal tubules, producing homogeneous opacification of the renal parenchyma; the tomogram at this stage is known as the **nephrogram**. Within 2 to 3 minutes, the contrast material begins to fill the calyces and the renal pelvis; the tomogram during this phase of urography is referred to as the **pyelogram.**

3- 5-minute full abdominal film is obtained to demonstrate the full pyelographic phase

4- 10-minute postinjection radiograph is often obtained with abdominal compression, which causes better distention of the calyces and ureters .

5-Additional views, including **delayed** films upto 24 hr. **Oblique** films maybe helpful in evaluating filling defects or calcifications within the urinary tract. **Prone** films can help distend the distal ureter. **Erect** films are best for viewing renal ptosis and cystoceles as well as the drainage of the contrast material from the upper tract. **Postvoid** films help assess bladder outlet obstruction and vesicoureteral reflux.

Antegrade Pyelography by injecting contrast material directly to the collecting system through percutanuous puncture.

Retrograde Pyelography is the opacification of the ureter and pelvicalyceal system by the retrograde injection of contrast media. The procedure requires cystoscopy and visualization of the ureteral orifice.

Cystourethrography
Static Cystogram
Voiding Cystourethrography
Retrograde Urethrography

Ultrasonography
A brief pulse of high-frequency sound energy produced by a transducer is transmitted into the patient. The sound waves interact with the tissue and are either reflected, refracted, or absorbed, depending on the type of tissue involved. For example, 100% is reflected by air and 100% is absorbed by bone.

Computed Tomography
Like the images in conventional radiography, CT images are produced because of attenuation of x-ray photons by the patient. CT uses a computer to mathematically reconstruct a cross-sectional image of the body from measurements of x-ray transmission through thin slices of the patient's tissue
Spiral CT, also called helical or volume-acquisition CT, is performed by advancing the patient on the gantry during simultaneous tube rotation with continuous x-ray exposure (slip-ring technology)

Magnetic Resonance Imaging (MRI)
Nuclear Imaging (Renography)
Angiography (ARTERIOGRAPHY AND VENOGRAPHY)