

Urinalysis

We screen the urine at routine intervals to help us pick up urinary tract infections or abnormalities in the way your child filters the kidneys. It is also helpful to diagnose diseases that are present in other areas of the body like with diabetes.

URINE DIPSTICK CHEMICAL ANALYSIS

pH

The glomerular filtrate of blood plasma is usually acidified by renal tubules and collecting ducts from a pH of 7.4 to about 6 in the final urine. However, depending on the acid-base status, urinary pH may range from as low as 4.5 to as high as 8.0. The change to the acid side of 7.4 is accomplished in the distal convoluted tubule and the collecting duct.

Specific Gravity (sp gr)

Specific gravity (which is directly proportional to urine osmolality which measures solute concentration) measures urine density, or the ability of the kidney to concentrate or dilute the urine over that of plasma. Dipsticks are available that also measure specific gravity in approximations. Most laboratories measure specific gravity with a refractometer.

Specific gravity between 1.002 and 1.035 on a random sample should be considered normal if kidney function is normal. Since the sp gr of the glomerular filtrate in Bowman's space ranges from 1.007 to 1.010, any measurement below this range indicates hydration and any measurement above it indicates relative dehydration.

If sp gr is not > 1.022 after a 12 hour period without food or water, renal concentrating ability is impaired and the patient either has generalized renal impairment or nephrogenic diabetes insipidus. In end-stage renal disease, sp gr tends to become 1.007 to 1.010.

Any urine having a specific gravity over 1.035 is either contaminated, contains very high levels of glucose, or the patient may have recently received high density radiopaque dyes intravenously for radiographic studies or low molecular weight dextran solutions. Subtract 0.004 for every 1% glucose to determine non-glucose solute concentration.

Protein

Dipstick screening for protein is done on whole urine, but semi-quantitative tests for urine protein should be performed on the supernatant of centrifuged urine since the cells suspended in normal urine can produce a falsely high estimation of protein. Normally, only small plasma proteins filtered at the glomerulus are reabsorbed by the renal tubule. However, a small amount of filtered plasma proteins and protein secreted by the nephron (Tamm-Horsfall protein) can be found in normal urine. Normal total protein excretion does not usually exceed 150 mg/24 hours or 10 mg/100 ml in any single specimen. More than 150 mg/day is defined as proteinuria. Proteinuria > 3.5 gm/24 hours is severe and known as nephrotic syndrome.

Dipsticks detect protein by production of color with an indicator dye, Bromphenol blue, which is most sensitive to albumin but detects globulins and Bence-Jones protein poorly. Precipitation by

heat is a better semiquantitative method, but overall, it is not a highly sensitive test. The sulfosalicylic acid test is a more sensitive precipitation test. It can detect albumin, globulins, and Bence-Jones protein at low concentrations.

In rough terms, trace positive results (which represent a slightly hazy appearance in urine) are equivalent to 10 mg/100 ml or about 150 mg/24 hours (the upper limit of normal). 1+ corresponds to about 200-500 mg/24 hours, a 2+ to 0.5-1.5 gm/24 hours, a 3+ to 2-5 gm/24 hours, and a 4+ represents 7 gm/24 hours or greater.

Glucose

Less than 0.1% of glucose normally filtered by the glomerulus appears in urine (< 130 mg/24 hr). Glycosuria (excess sugar in urine) generally means diabetes mellitus. Dipsticks employing the glucose oxidase reaction for screening are specific for glucose but can miss other reducing sugars such as galactose and fructose. For this reason, most newborn and infant urines are routinely screened for reducing sugars by methods other than glucose oxidase (such as the Clinitest, a modified Benedict's copper reduction test).

Ketones

Ketones (acetone, acetoacetic acid, beta-hydroxybutyric acid) resulting from either diabetic ketosis or some other form of calorie deprivation (starvation), are easily detected using either dipsticks or test tablets containing sodium nitroprusside.

Nitrite

A positive nitrite test indicates that bacteria may be present in significant numbers in urine. Gram negative rods such as E. coli are more likely to give a positive test.

Leukocyte Esterase

A positive leukocyte esterase test results from the presence of white blood cells either as whole cells or as lysed cells. Pyuria can be detected even if the urine sample contains damaged or lysed WBC's. A negative leukocyte esterase test means that an infection is unlikely and that, without additional evidence of urinary tract infection, microscopic exam and/or urine culture need not be done to rule out significant bacteriuria.