Comparison and Interpretation of Urinalysis Performed by a Nephrologist Versus a Hospital-Based Clinical Laboratory

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• ***Background:*** **Urinalysis (UA) is considered the most important laboratory test in evaluating patients with kidney disease. Anecdotally, we have observed differences between results of UA performed by nephrologists compared with those performed by certified medical technologists or clinical laboratory scientists that could affect a clinician's diagnosis. Whether there are differences between UA performed by the clinical laboratory and that performed by a nephrologist was determined, and accuracy of diagnosis based on interpretation of the UA was compared.** ***Methods:*** **Urine samples were obtained from 26 patients with acute renal failure (ARF). An aliquot of urine was sent to the clinical laboratory for UA. Nephrologist A, blinded to the patient's clinical information, performed a UA on the other aliquot of urine, generated a report, and assigned the most likely diagnosis for ARF based on UA findings. Nephrologist B, also blinded to the clinical information, reviewed nephrologist A's UA reports and assigned a diagnosis for ARF to each report. Nephrologists A and B both assigned a diagnosis (or diagnoses) for the ARF based on laboratory UA results. These 4 sets of diagnoses were compared with those assigned by the consult nephrologists.** ***Results:*** **Nephrologist A correctly diagnosed the cause of ARF in 24 of 26 samples (92.3% success rate) based on his performance of the UA. Diagnoses by nephrologists A and B, based on their review of the clinical laboratory UA report, were correct in only 23.1% and 19.2% of the samples, respectively. Accuracy of diagnosis for nephrologist B improved to 69.3% when she reviewed UA reports from nephrologist A. Nephrologist A's review of urine sediment was significantly more accurate than interpretations by nephrologist A or B of clinical laboratory reports (sign test, $P < 0.001$). Nephrologist A reported a greater number of renal tubular epithelial (RTE) cells ($P < 0.0001$), granular casts ($P = 0.0017$), hyaline casts ($P = 0.0233$), RTE casts ($P = 0.0008$), and dysmorphic red blood cells. The laboratory noted a greater number of squamous cells ($P = 0.0034$).** ***Conclusion:*** **A nephrologist is more likely to recognize the presence of RTE cells, granular casts, RTE casts, and dysmorphic red blood cells in urine. The laboratory may be reporting RTE cells incorrectly as squamous epithelial cells. Nephrologist-performed UA is superior to laboratory-performed UA in determining the correct diagnosis.** ***Am J Kidney Dis*** **46:820-829.**

INDEX WORDS: Urinalysis; clinical laboratory; acute renal failure.

URINALYSIS (UA) is the first and most important laboratory test in evaluating a patient with suspected kidney disease.[1-7] In the past, both clinicians and laboratory technologists have performed macroscopic (direct observation of physical characteristics and chemical dipstick testing) and microscopic examination of urine. Recently, there has been much greater reliance on the clinical laboratory and medical technologists for performance of UA, in part because of implementation of Clinical Laboratory Improvement Amendments (CLIA) of 1988.[8] Because CLIA mandates that most laboratory tests be performed by CLIA-certified personnel, who are usually technologists, UA performance is becoming a dying art among clinicians,[9] and many physicians have not been adequately trained to perform urine microscopy.[10]

In our medical center, nephrologists and nephrologists in training perform the UA when a consultation for renal disease is requested. However, non-nephrologists frequently rely on the clinical laboratory to perform the UA. Anecdotally, we have observed major differences between the nephrologist and clinical laboratory evaluations of urinary sediment of a given patient that could affect the clinical diagnosis. The purpose of this study is to test the hypothesis that such differences exist and determine which UA evaluation and subsequent interpretation leads to the most accurate clinical diagnosis.

METHODS

Twenty-six patients admitted to the University of California Davis Medical Center (Sacramento, CA) between Sep-

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tember 2001 and March 2002 were enrolled after each patient's primary service requested nephrology consultation for evaluation of acute renal failure (ARF), defined as a daily increase in serum creatinine level greater than 0.5 to 1.0 mg/dL (>44 to 88 μmol/L). Patients with urine output less than 40 mL/d or on dialysis therapy were excluded. Forty milliliters of urine were obtained from each patient within 24 hours after the consultation request and divided equally into 2 aliquots. One aliquot was used by nephrologist A to perform a UA, and the other was sent to the CLIA-certified clinical laboratory at the University of California Davis Medical Center for a clinical medical scientist (medical technologist) to perform a UA. The source of urine was documented as either clean catch or catheterized specimen.

Technical Performance of UA

Nephrologist A used a urinary dipstick to test for the presence of albumin and blood. Urine then was centrifuged at 2,500 rpm for 3 minutes. After decanting the supernatant, the pellet was resuspended in a minimal volume of urine by gently agitating the bottom of the centrifugation tube. A single drop of the resuspended pellet was transferred to a glass slide and placed under a glass cover slip for bright-field microscopic examination under low-power (original magnification ×100) and high-power (original magnification ×400) fields. Nephrologist A performed a microscopic examination of urine sediment and recorded his findings using the laboratory's standard report form. Elements of urine sediment listed in the standard laboratory form include the presence and quantification of white blood cells (WBCs), red blood cells (RBCs), renal tubular epithelial (RTE) cells, squamous epithelial cells, transitional epithelial cells, oval fat bodies, bacteria, yeasts, and crystals (including types of crystals) under high-power-field microscopy and the presence of WBC casts, RBC casts, granular casts, hyaline casts, and RTE casts under low-power microscopy.

The laboratory procedure states that UA should be performed within 2 hours of collection if not refrigerated and within 8 hours of collection if refrigerated. In practice, UA results typically are available within 4 hours after collection. The clinical laboratory uses either a manual (Multistix 10 SG Reagent Strips; Bayer Corp, Elkhart, IN) or automated (Clinitek Atlas; Bayer Corp) method for the appearance, specific gravity, and chemistry portion of the UA. Uncentrifuged urine is used for this part of the assay. Microscopic examination is performed only when the urine is not clear or yellow, urine is turbid, or leukocyte esterase, nitrite, blood, or protein is detected. For microscopy, urine is centrifuged at 2,200 rpm for 5 minutes. Most of the supernatant was decanted, leaving 1 mL in the tube. The pellet was resuspended in the remaining 1 mL of supernatant by using a vortex mixer at moderate speed. The resultant mixture was transferred to a slide, allowing the covered chamber to fill by capillary action. After 1 minute, sediment was examined using original magnification ×100 objective and low-light conditions (condenser down) for the presence of casts and mucus and original magnification ×400 objective and moderate light conditions (condenser up) for the presence of RBCs, WBCs, RTEs, transitional cells, epithelial cells, oval fat bodies, crystals, and microbes. A copy of the laboratory-generated UA report was used for subsequent data analysis.

Using the laboratory-generated UA and the UA generated by nephrologist A, 2 nephrologists (nephrologist A and nephrologist B) assigned 1 or more clinical diagnoses to each patient. Nephrologists A and B knew only that the patient had ARF and whether urine was a catheterized specimen, but were blinded to the remainder of the patient's clinical history. Urine results were presented in random order to prevent any possible correlation between the laboratory and nephrologist UAs for an individual patient. The 2 nephrologists were blinded to each other's diagnosis. Having nephrologist A review laboratory UA reports and assign a diagnosis to each patient addressed potential bias from interobserver variability. Criteria for diagnosing acute tubular necrosis, tubulointerstitial nephritis, urinary tract infection, and glomerulonephritis are the usual guidelines taught to medical students, residents, and nephrology fellows, listed in Table 1. In the event of more than 1 diagnosis, the primary diagnosis was listed first.

Criteria for Concordance

A third nephrologist reviewed the patient's chart and recorded the cause of ARF as determined by the consulting nephrologist. The diagnosis given by the consulting nephrolo-

Table 1. Criteria for Diagnosis of Cause of ARF

Diagnosis	UA Finding	Other Requirement
Acute tubular necrosis	Granular casts OR RTE cells OR RTE cell casts	
Tubulointerstitial nephritis	WBCs OR WBC casts	No bacteria
Urinary tract infection	WBCs OR WBC casts	Bacteria and/or leukocyte esterase or nitrite positive
Glomerulonephritis	Protein, 300 mg/dL OR RBCs* OR RBC casts	
Hepatorenal syndrome	Bilirubin positive	No cellular elements or casts
No diagnosis	Dipstick results negative AND microscopy negative	

*If the specimen was obtained with catheterization and RBCs were present, diagnosis of glomerulonephritis was made only if dysmorphic RBCs or RBC casts were present.