Accuracy of dipstick urinalysis as a screening method for detection of glucose, protein, nitrites and blood

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دقة تحليل البول بالغميسة باعتبارها طريقة للتحرِّي لكشف الجلوكوز والبروتين والنتـريت والدم في البول

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الخلاصـة: تفحصت هذه الدراسة موثوقية تحليل البول باستخدام الغميسة لكشف البروتين والجلوكوز والدم والنتـريت في عينات غير عشوائية من البول جمعت من 300 شخص تتجاوز أعمارهم 50 عاماً، ممن يراجعون مراكز صحية لإجراء فحوصات طبية دورية. وقد كانت المعايير الذهبية عيار غلوكوز الدم على الريق (في الصيام) عند وجود بيلة سكرية، وطريقة حمض السلفوساليسيليك لكشف البروتين في البول. كما أجرى الباحثون دراسة مجهرية للراسب البولي وزرع البول عند ظهور نتائج إيجابية للغميسة بالنسبة للبيلة الدموية والنيتـريت. وقد وجد الباحثون بالنسبة لكشف البروتين أن الحساسية 80٪ والنوعية 95٪ والقيمة التنبؤية الإيجابية 22.2٪ والقيمة التنبؤية السلبية 99.6٪، وبالنسبة لكشف الغلوكوز أن الحساسية 100٪ والنوعية 98.5٪ والقيمة التنبؤية الإيجابية 87٪ والقيمة التنبؤية السلبية 100٪. ومن ذلك يتضح أن تحليل البول بالغميسة يمكن أن يكون طريقة موثوقة للتحرِّي عن تشخيص العدوى في الطرق البولية والسكري، ولكن ليس لكشف البيلة البروتينية.

ABSTRACT This study determined the reliability of dipstick urinalysis for detection of protein, glucose, blood and nitrites in non-random urine samples from 300 people aged > 50 years attending a health centre for check-up. The gold standards were fasting blood glucose for glucosuria and the sulfosalicylic acid method for urine protein. Microscopic examination of urinary sediment and urine culture were also performed for positive dipstick results for haematuria and nitrites. The sensitivity, specificity and positive and negative predictive values of the dipstick test for detection of protein were 80.0%, 95.0%, 22.2% and 99.6% and for glucose were 100%, 98.5%, 87.0% and 100% respectively. Dipstick urinalysis can be a reliable screening method for diagnosis of urinary tract infection and diabetes mellitus but not for proteinuria.

Justesse de l'analyse d'urine au moyen de bandelettes comme méthode de recherche de glucose, de protéines, de nitrites et de sang

RÉSUMÉ Cette étude a déterminé la fiabilité de l'analyse d'urine au moyen de bandelettes aux fins de la détection de protéines, de glucose, de sang et de nitrites dans des échantillons d'urine non aléatoires provenant de 300 personnes âgées de plus de 50 ans qui s'étaient rendues dans un centre médical pour un bilan de santé. La référence était la glycémie à jeun pour la glycosurie et l'acide sulfosalicylique pour la protéinurie. On a également procédé à un examen microscopique du sédiment urinaire et à une uroculture lorsque la recherche de l'hématurie et des nitrites à l'aide de bandelettes était positive. La sensibilité, la spécificité et les valeurs prédictives positives et négatives du test par bandelette pour la détection de la protéine étaient respectivement de 80,0 %, 95,0 %, 22,2 % et 99,6 % et, pour le glucose, de 100 %, 98,5 %, 87,0 % et 100 %. L'analyse d'urine au moyen de bandelettes peut être une méthode de dépistage fiable aux fins du diagnostic d'infection urinaire et de diabète sucré, mais pas de protéinurie.

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Received: 28/11/06; accepted: 15/05/07

Introduction

The use of dipstick urinalysis for detection of leukocyte esterase, nitrites, protein and blood has been shown to be of value in screening urine for bacteriuria and urinary tract infection [1–8].

In the general population a negative test result for either nitrites or leukocyte esterase in dipstick urinalysis has sufficient predictive value to exclude disease, and when both test results are positive there is sufficient evidence to confirm infection, except in the elderly, pregnant women and surgery or urology populations, where it may still indicate further work-up [4].

A dipstick test for proteinuria is also widely available, but no information on its sensitivity or specificity is available when implementing current guidelines [9]. In a primary care setting a positive standard dipstick test of random spot urine in patients with newly diagnosed hypertension may indicate the presence of microalbuminuria with high specificity. However, because of its low sensitivity, the standard urinary dipstick test cannot be recommended as the sole method of screening for renal target organ damage [10–12].

Some investigators believe that dipstick urinalysis for blood or urinary tract infection (UTI) is a reliable diagnostic test in emergency patients compared with urine microscopy, and that an 18% reduction in microscopically examined and cultured urines could be achieved if dipstick screening is used [1,13]. Other investigators show that this test for urinary nitrites is fairly unreliable in symptomatic UTI [14] and have concluded that the use of dipsticks to screen urine samples is not cost-effective in microbiology laboratories [1].

Some authors believe that urine dipstick testing for leukocytes is of little value as a primary means of screening otherwise healthy children for serious renal disease [15]. But they confirm that in patients with established proteinuria, a positive dipstick result for leukocytes is a simple means of identifying those with more prominent noninfectious renal inflammation, a process that may progress to kidney disease [15].

Although differences in care settings and patient populations have been proposed, the lack of adequate explanation for the heterogeneity of dipstick results stimulates ongoing debate. In view of the widespread use of dipstick urinalysis in bacteriology laboratories, and also due to controversies about the accuracy of these tests for diagnosis of related clinical problems, the objective of this study was to determine the reliability of the dipstick method as a screening procedure for the detection of haematuria, proteinuria, glucosuria and urine nitrites in comparison with the relevant gold standards and confirmatory tests.

Methods

The study sample was 300 people (185 male and 115 female) aged over 50 years [mean age 57 (standard deviation 4) years] referring for routine checkup to the national health clinic in Hore village of Chahar-Mahal province, Islamic Republic of Iran. They were selected using non-random convenience sampling during the 6 months from October 2002 to March 2003.

All participants were interviewed during the first visit and their medical history was obtained using a standardized questionnaire, which covered age, sex and history of clinical disease, e.g. diabetes mellitus, renal disease, hypertension and UTI symptoms. Blood pressure was also measured; systolic blood pressure > 140 mmHg and diastolic pressure > 90 mmHg measured on 3 separate occasions was considered hypertension.

Urine samples were screened for protein, glucose, blood and nitrites using standard dipsticks (Uriyab-8, Bakhtar Chemistry Co., Kermanshah, Islamic Republic of Iran). In patients with positive glucose by dipstick, fasting blood sugar was used as the gold standard for glucosuria (glucose ≥ 50 mg/dL). In specimens with positive protein by dipstick, the sulfosalicylic acid method (SSA) was the gold standard for detection of proteinuria (urine protein ≥ 30 mg/dL). A positive result by dipstick for haematuria (blood of 1+) was compared with microscopy examination of the urinary sediment of the same specimen for red blood cells. Three or more red blood cells per high-powered field was defined as haematuria. Positive results for nitrites by dipstick were confirmed using urine culture as the gold standard. Specimens were cultured using standard bacteriological procedures. Growth of ≥ 105 bacteria/mL in urine cultures from uncentrifuged urine was considered UTI.

The laboratory values and methods performed as gold standards and confirmatory tests were standardized according the manufacturer's instructions and standard methods [*16*].

In participants with proteinuria and haematuria, clinical and paraclinical evaluations were also performed including physical examination, upper and lower urinary tract sonography and serum creatinine estimation.

The accuracy of the dipstick method as a screening procedure for the detection of red blood cells, protein, nitrite and glucose was compared with the gold standards and confirmatory tests. Sensitivity, specificity and positive and negative predictive values of the dipstick tests were calculated by standard methods. Data were analysed using *SPSS*, version 11.

Results

Of 300 random urine samples tested by dipstick urinalysis, 239 (79.7%) were negative for all tests and 61 (20.3%) showed positive findings. Proteinuria was diagnosed in 18 (6.0%) samples, haematuria in 5 (1.7%), proteinuria with haematuria and positive nitrites in 8 (2.7%) and glucosuria in 30 (10.0%). In the study population, 15 patients were hypertensive and 26 were diabetic. The mean fasting blood glucose level in diabetic patients was 104.7 mg/dL.

In 4 cases (22.2%) with positive dipstick results for proteinuria, the SSA method confirmed the dipstick results, and in all the patients with proteinuria, haematuria and positive nitrites, there were microscopy findings indicating UTI. All 8 cases with UTI were female. Dipstick testing for proteinuria was positive in 2 (13.3%) hypertensive patients. Urine samples that were negative by dipstick for protein, red blood cells, nitrites and glucose were generally negative on microscopic examination.

Dipstick testing showed acceptable sensitivity and specificity for detection of glucose in comparison with the gold standard, but the positive predictive value for urine protein and glucose was low (22.2% and 87.0% respectively) (Table 1). A positive dipstick result for nitrites correlated completely with urine microscopic urinalysis. All the patients with positive nitrites in the dipstick test had microscopy and bacteriological findings indicating UTI. Besides, as the results showed, a positive stick result for nitrites correlated completely with urine microscopic urinalysis. Therefore, all the bacteriologically approved UTI cases with positive dipstick results for proteinuria and haematuria also had positive results for nitrites in dipstick urinalysis.

Table 1 **Accuracy of dipstick urinalysis for diagnosis of urinary protein, glucose, blood and nitrites**

Variable	Dipstick results (n = 300)	Gold standard		Sensitivity	Specificity	Positive predictive value	Negative predictive value
		+ve	−ve				
	No.	No.	No.	%	%	%	%
Protein[a]							
+ve	4	4	14	80.0	95.0	22.2	99.6
−ve	14	1	281				
Glucose[b]							
+ve	26	26	4	100.0	98.5	87.0	100.0
−ve	4	0	270				
Blood[c]							
+ve	4	4	1	100.0	99.6	80.0	100.0
−ve	1	0	295				
Nitrites[d]							
+ve	8	8	0	100.0	100.0	100.0	100.0
−ve	0	0	8				

[a]Gold standard: sulfosalicylic acid method (protein > 30 mg/L). [b]Gold standard: fasting blood glucose (glucose ≥ 50 mg/dL). [c]Gold standard: microscopic sediment urinalysis (3+ red blood cells per high-powered field). [d]Gold standard: microscopic sediment urinalysis and urine culture (≥ 105 bacteria/mL).

Comparison of dipstick tests with the SSA method revealed that the sensitivity, specificity, and positive and negative predictive values for detection of protein were 80.0%, 95.0%, 22.0% and 99.6% respectively. The sensitivity, specificity and positive and negative predictive values for detection of glucose were 100%, 98.5%, 87.0% and 100% respectively (Table 1). The negative predictive value for all the tests was consistently high. The results of dipstick testing for detection of haematuria were mostly confirmed with urinary sediment analysis (Table 1) but no clinical findings contributing to haematuria were found in the patients.

Discussion

In this study, the accuracy of the urine dipstick test for diagnosis of protein, glucose, nitrite and blood was evaluated in 300 people over 50 years old in 1 health centre in the Islamic Republic of Iran. Although the detection of urinary nitrites by dipstick was highly specific for UTI, other investigators have emphasized that the dipstick test for urinary nitrites is fairly unreliable in symptomatic UTI [14]. Some authors have also concluded that the urine dipstick test alone seems to be useful in all populations to exclude the presence of infection if the results for both nitrites and leukocyte-esterase are negative [4]. They also reported that the sensitivities of the combination of both tests varied between 68% and 88% in different patient groups, but speculated that positive test results had to be confirmed and that the usefulness of the dipstick test alone to rule in infection was doubtful. Misdraji and Nguyen concluded that routine urinalysis is important in the management of only certain diseases [17]. They reported that screening urinalysis to detect asymptomatic bacteriuria is recommended in adults 60

years of age or older, diabetic patients of any age, pregnant women and adolescents. The results of the present study showed positive nitrite by the dipstick test was very specific for diagnosis of UTI, probably owing to the age of the patients (> 50 years).

In this study, the results of dipstick testing for detection of haematuria showed high sensitivity and specificity (100% and 99.6% respectively) compared with urinary sediment analysis. Some authors have also concluded that dipstick urinalysis for blood or UTI is a reliable diagnostic test in emergency patients [13]. In 94% of the patients, subsequent findings on urine microscopy did not prompt a change in management, and microscopy added nothing to dipstick results when clinicians suspected conditions causing haematuria alone. Some studies have concluded that evaluation of haematuria should include both dipstick analysis and microscopic examination of urine [17].

A high prevalence of proteinuria (microalbuminuria) in a standard dipstick test in hypertensive patients has been reported by many investigators [9,11,12,18]. But some of these researchers believed that, despite the high specificity, the standard urinary dipstick test cannot be recommended as the sole method of screening for renal target organ damage because of its low sensitivity. Some authors have concluded that it is adequate as a screening tool but not as a diagnostic tool [11,19]. Similarly, in the current study, despite the high specificity

of the dipstick test (95.0%), the positive predictive value for detecting proteinuria was very low (22.2%). On the other hand, in most dipstick-positive cases for proteinuria (77.8%), the SSA test was not positive for protein excretion. Zeller et al. have also reported that the sensitivity, specificity and positive and negative predictive values of the dipstick test for detection of proteinuria were 26%, 89% 45% and 88% respectively [11]. Therefore, it can be concluded that urine screening with dipstick test for proteinuria cannot be recommended as the sole test for screening for renal target organ damage.

The sensitivity, specificity, positive and negative predictive values of the dipstick test for detection of glucosuria in 1 study by random urine glucose testing were 23%, 99%, 48% and 98% respectively [20]. In the present investigation, the sensitivity and specificity were much higher (100% and 98.5% respectively) but the positive predictive value of the test was low (87.0%). Therefore dipstick testing seems to be reliable in urinary screening for detection of glucose.

In general, based on the results of this study, dipstick urinalysis can be a reliable screening method for diagnosis of some clinical disease such as UTI and diabetes mellitus. But it seems that this method cannot be considered as a diagnostic method for detection of proteinuria as a marker of renal insufficiency or renal target organ damage.

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