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URINE DIPSTICK AS A TOOL FOR SCREENING CHRONIC KIDNEY DISEASE AMONG DIABETICS & HYPERTENSIVES – ITS VALIDITY AND UTILITY

Community Medicine

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ABSTRACT

Background: The presence of relatively high levels of urine protein can be an early marker of increased risk of progressive kidney disease, poor cardiovascular outcomes, and death. The urine dipstick test can be used as an initial screening tool for detecting proteinuria (a predictor of CKD) in primary health care level because of its low cost and ability to provide rapid information to clinicians and patients.

Objective: To assess the validity of urine dipstick as a screening test for detecting CKD among Diabetics and Hypertensives.

Methodology: At a Primary Health Centre, a prospective study was carried out on 200 people aged 30 years and above with history of Diabetes or Hypertension and were on treatment for past 1 year or more. People who were already diagnosed of chronic kidney disease, pregnant women and women during active menstruation were excluded from the study. Those subjects enrolled in the study underwent a dipstick urine analysis for proteinuria initially and another urine analysis after 3 months followed by a blood sample analysis for serum creatinine.

Results: There were totally 205 subjects, out of which75 were males and 130 were females. 51 (24.9%) were diagnosed as Chronic Kidney Disease with eGFR < 60 ml/min. When proteinuria 1+ or more is set as criteria for detecting CKD, the sensitivity was 82.35% , specificity was 94.8% and κ coefficient of agreement was 0.776. The Area under Curve (AUC) of the ROC curve was 0.927 (0.878 – 0.977) and the 1+ proteinuria was closest to the ideal test point.

Conclusion: The urine dipstick test can be used an effective screening tool in detecting CKD among diabetics and hypertensives in primary care level with high diagnostic efficacy if proteinuria cut-off taken as dipstick 1+ or more.

KEYWORDS

INTRODUCTION

Chronic Kidney Disease (CKD) is a global public health problem with rising trend in prevalence. By the time the symptoms of CKD manifest, the disease would have progressed to advanced stage leading to End Stage Renal Disease (ESRD). In India, the projected number of deaths due to chronic kidney disease was around 5.21 million in 2008 and is expected to rise to 7.63 million by 2020 (66.7% of all deaths) [(1)]. Indeed, it has been recently estimated that the age-adjusted incidence rate of ESRD in India to be 229 per million population[(2)]. More than 100,000 new patients enter renal replacement programs annually in India[(3)]. Hence, early screening offers the advantage of delaying the progression and modification of risk factors identified. Growing evidence indicates that the presence of relatively high levels of urine protein can be an early marker of increased risk of progressive kidney disease, poor cardiovascular outcomes, and death[(4)(5)]. Prescription of angiotensin-converting enzyme (ACE) inhibitor or Angiotensin II-receptor blocker (ARB) therapy in persons with proteinuria and chronic kidney disease has been demonstrated to decrease both the progression of kidney disease toward ESRD as well the incidence of cardiovascular events and death[(6)].The urine dipstick test can be used as an initial screening tool for detecting proteinuria (a predictor of CKD) in primary health care level because of its low cost and ability to provide rapid information to clinicians and patients[(7)(8)]. But its diagnostic accuracy in detecting chronic kidney disease has not been sufficiently validated. Early screening programs in high risk groups including those with diabetes mellitus, hypertension, neglected urinary tract infection and first degree relatives of CKD patients will have major impact on the overall health status of the population[(9)].This study tends to elucidate the validity and the utility of the urine dipstick as a screening test for detecting chronic kidney disease among diabetics and hypertensives so that incidence of ESRD can be reduced.

MATERIALS & METHODS

Study Design

A prospective study was carried out at Medavakkam Primary Health Centre, Kanchipuram district in South India among the people aged 30 years and above attending the Non Communicable Diseases (NCD) clinic at the Health Centre. Those who had history of Diabetes or Hypertension and were on anti-diabetic or anti-hypertensive medications for past 1 year or more (confirmed from their medical records) were included in the study. People who were already diagnosed of chronic kidney disease, pregnant women and women during active menstruation were excluded from the study. Those subjects enrolled in the study underwent a dipstick urine analysis for proteinuria initially and another urine analysis after 3 months followed by a blood sample analysis for serum creatinine. The lowest grading of the proteinuria in either of the urine analysis done is considered as the final grading for analysis. If either of the proteinuria tests were negative, then the subject is considered as negative for proteinuria.

Sampling &Sample size:

The sensitivity of the urinary dipstick ranges from 83% to 98%[(10)]. Taking average sensitivity of urine dipstick, Sn = 90%, absolute precision, Δ = 7%, with a confidence level of 95%, Z = 1.96, with a prevalence of CKD among diabetics and hypertensives, p = 35.5%[(11)], the sample size is calculated by the following Buderer's formula[(12)], $\mathbf{N = Z^2 * Sn * (1 - Sn) / \Delta^2 * p = 180.79}$; Allowing a 10% minimal non response rate, total sample size was estimated to be **200 subjects**. The sample population was collected from the consecutive people attending the NCD clinic till the sample size reached.

Study Tools:

After information was given about the study and obtained informed consent of the participants, relevant information was obtained from the respondent about the socio demographic profile of the subject and the history regarding the duration and treatment for Diabetes and Hypertension.

Urine sample analysis:

Proteinuria was detected by urine dipstick method (DIRUI H- series urinalysis strips H10). The study participants were provided with clean container in which fresh urine was collected. Urine sample was mixed well before taking the test. The urine tests were done within 2 hours of sample collection. In room temperature, the reagent area of the strip was immersed in the urine and then the strip was removed quickly. The strip was held horizontally and the colour changes on the strip were compared with the colour chart on the bottle label. A semi quantitative result was read according to the time specified (60 seconds) on the colour chart.

Blood sample collection & testing:

Two ml of venous blood sample (random) was collected from all the

study participants with the subject in the sitting position using disposable syringes and collected in a fresh, clean pilot tube. The blood samples collected were transported to laboratory in a vaccine carrier to maintain cold chain where it was centrifuged and analysed on the same day of collection. Using Jaffe Colorimetric method, serum creatinine was measured in semi auto analyser. Quality control was made ensured by analysing standard sample before checking for the test samples.

Data collection was done after obtaining prior permission from the local health authorities and clearance from the ethical committee.

Operational Definitions:

Proteinuria is defined as excretion of albumin in urine in increased amount and is graded by the urine dipstick as negative (< 0.15 mg/dl), trace (15 to 30 mg/dl), 1+ (30 to 100 mg/dl), 2+ (100 to 300 mg/dl), 3+ (300 to 2000 mg/dl), 4+ (>2000 mg/dl)

CKD (Chronic Kidney Disease) is defined as eGFR <60 ml /min/1.73 m^2 with or without kidney damage. [13] eGFR is calculated using CKD-EPI equation. [14] CKD – EPI gives the best estimation of GFR compared to MDRD and Cock Graft Equations. [15]

Data entry & analysis

The data collected were entered in Microsoft Excel 2013 version and double checked for errors. The data was analysed using Statistical Package for Software Solutions (SPSS) version 21. Totally data was collected from 205 subjects. The validity of the screening test is evaluated using sensitivity and specificity. The diagnostic efficacy of the test is calculated using positive predictive value and κ coefficient of agreement.

RESULTS

There were totally 205 subjects, out of which 75 were males and 130 were females. The age group of the patients ranged from 30 – 80 years with almost 64 (31%) people in 50 – 59 years age group followed by 50 (24%) in 60 – 69 years and 48 (23%) in 40 – 49 years age group. Out of the study population, 76 (37.1%) were diabetic, 110 (53.7%) were hypertensive and 19 (9.3%) were both diabetic and hypertensive. Among the study population, 51 (24.9%) were estimated to have eGFR < 60 ml/min and classified as Chronic Kidney Disease.

Table 1: Distribution of Proteinuria and Chronic Kidney disease status by Diabetes or Hypertension or both diseases among the study subjects.

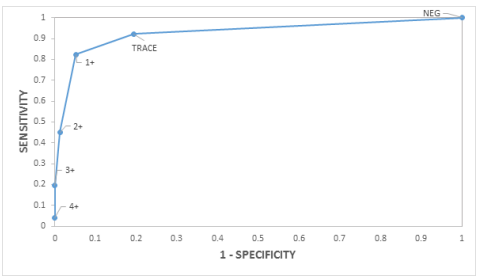
Characteristic	Criteria	Diabetic n = 76	Hypertensive n = 110	Both n = 19	Total n = 205
Proteinuria	Negative	51	71	6	128
	Trace	10	13	4	27
	1+	8	16	1	25
	2+	4	8	3	15
	3+	3	2	3	8
	4+	0	0	2	2
Chronic Kidney Disease	Present	16	26	9	51
	Absent	60	84	10	154

Table2: Comparison of diagnostic performance of urine dipstick in detecting CKD among the study subjects

Cut off criteria	Sensitivity	Specificity	PPV	NPV	κ coefficient of agreement
Trace & above	92.16%	80.52%	61.04%	96.87%	0.621
1+ & above	82.35%	94.8%	84%	94.19%	0.776
2+ & above	45.1%	98.7%	92%	84%	0.528

PPV – Positive Predictive Value, NPV – Negative Predictive Value

Fig 1: ROC curve of urine dipstick proteinuria in detecting CKD.



Area under Curve (AUC): 0.927 (0.878 – 0.977)

DISCUSSION:

The prevalence of Chronic Kidney Disease (<60 ml/min eGFR) in the study group was 24.87%. The prevalence almost correlates with the prevalence of 30% stated by Ephraim et al. [16] but slightly lower than the prevalence of 35.5% stated in the Sweileh et al study (2008) [11] which used Cockgroft equation to calculate eGFR which has a slight difference with the eGFR calculated using CKD-EPI equation which was also shown in the same study.

When proteinuria criteria set at dipstick trace or above for detecting CKD among all subjects, the sensitivity was 92.16% and specificity was 80.52%; when 1+ or more, the sensitivity was 82.35% and specificity was 94.8%. The Area under Curve (AUC) of the ROC curve was 0.927 (0.878 – 0.977) and the 1+ proteinuria was closest to the ideal test point. The κ coefficient of agreement of proteinuria with CKD at dipstick 1+ or above was 0.776 which denotes an excellent agreement. Thus 1+ or more proteinuria in urine dipstick can be taken as a best cut off for detecting CKD among diabetics or hypertensives.

In Lim et al, [17] the sensitivity and specificity of urine dipstick evaluated against protein creatinine ratio and albumin creatinine ratio were more than 80% when 1+ or more proteinuria was used as cut off for proteinuria. White et al [18] states that a dipstick test result of 1+ or less than trace has a high negative predictive value in the general community setting. In Ishani et al study,[7] subjects with baseline proteinuria of 1+ or more identified the maximum incidence of End Stage Renal Disease (ESRD) of more than 85% in the follow up of 25 years.

Conventionally, for detecting proteinuria, serum creatinine test is done among the patients attending the NCD clinic at primary level health care. This test costs about ten times higher than the urine dipstick test and requires skilled technician. The dipstick test can be done even at sub centre levels and also by the patients self. Taking into account the cost benefits of the urine dipstick test, this test can be done at regular intervals to detect proteinuria earlier and start treating with drugs like Angiotensin converting enzyme inhibitors to prevent the progression of CKD to ESRD and other complications.[19]

CONCLUSION

The urine dipstick test can be used an effective screening tool in detecting CKD in primary care level. The test can be done with high diagnostic efficacy to screen people with Diabetes or Hypertension if proteinuria cut-off taken as dipstick 1+ or more.

REFERENCES

1. Chronic Kidney Disease: Current Status, Challenges and Management... chap130.pdf Available from: http://www.apiindia.org/medicine_update_2013/chap130.pdf
2. Modi GK, Jha V. The incidence of end-stage renal disease in India: a population-based study. Kidney Int. 2006 Dec;70(12):2131–3.
3. Kher V. End-stage renal disease in developing countries. Kidney Int. 2002 Jul;62(1):350–62.
4. Mann JF, Gerstein HC, Pogue J, Bosch J, Yusuf S. Renal insufficiency as a predictor of cardiovascular outcomes and the impact of ramipril: the HOPE randomized trial. Ann Intern Med. 2001 Apr 17;134(8):629–36.
5. Lindholm LH, Ibsen H, Dahlöf B, Devereux RB, Beevers G, de Faire U, et al. Cardiovascular morbidity and mortality in patients with diabetes in the Losartan Intervention For Endpoint reduction in hypertension study (LIFE): a randomised trial against atenolol. Lancet Lond Engl. 2002 Mar 23;359(9311):1004–10.
6. Gerstein HC, Mann JF, Yi Q, Zinman B, Dinneen SF, Hoogwerf B, et al. Albuminuria and risk of cardiovascular events, death, and heart failure in diabetic and nondiabetic individuals. JAMA. 2001 Jul 25;286(4):421–6.
7. Ishani A, Grandits GA, Grimm RH, Svendsen KH, Collins AJ, Prineas RJ, et al. Association of Single Measurements of Dipstick Proteinuria, Estimated Glomerular Filtration Rate, and Hematocrit with 25-Year Incidence of End-Stage Renal Disease in the Multiple Risk Factor Intervention Trial. J Am Soc Nephrol. 2006 May 1;17(5):1444–52.
8. White SL, Yu R, Craig JC, Polkinghorne KR, Atkins RC, Chadban SJ. Diagnostic accuracy of urine dipsticks for detection of albuminuria in the general community. Am J Kidney Dis Off J Natl Kidney Found. 2011 Jul;58(1):19–28.
9. Jaar BG, Khatib R, Plantinga L, Boulware LE, Powe NR. Principles of Screening for Chronic Kidney Disease. Clin J Am Soc Nephrol. 2008 Mar 1;3(2):601–9.
10. Waheed S, Acknowledgements. Assessment of proteinuria. Available from: http://bestpractice.bmj.com/best-practice/monograph/875.html
11. Sweileh WM, Sawalha AF, Zyoud SH, Al-Jabi1 SW, Shraim NY. Prevalence of reduced renal function among diabetic hypertensive patients. Int J Physiol Pathophysiol Pharmacol. 2008 Nov 20;1(1):41–7.
12. Buderer NMF. Statistical Methodology: I. Incorporating the Prevalence of Disease into the Sample Size Calculation for Sensitivity and Specificity. Acad Emerg Med. 1996 Sep 1;3(9):895–900.
13. KDOQI CKD Guidelines. Available from: http: // www2.kidney.org / professionals / KDOQI / guidelines_ckd /p4_class_g1.htm
14. GFR Calculator. Available from: http://ckdepi.org/equations/gfr-calculator/
15. Michels WM, Grootendorst DC, Verduijn M, Elliott EG, Dekker FW, Krediet RT. Performance of the Cockcroft-Gault, MDRD, and New CKD-EPI Formulas in Relation to GFR, Age, and Body Size. Clin J Am Soc Nephrol CJASN. 2010 Jun;5(6):1003–9.
16. Ephraim RK, Biekpe S, Sakyi SA, Adoba P, Agbodjakey H, Antoh EO. Prevalence of chronic kidney disease among the high risk population in South-Western Ghana; a cross sectional study. Can J Kidney Health Dis. 2015;2:40.

17. Lim D, Lee D-Y, Cho SH, Kim OZ, Cho SW, An SK, et al. Diagnostic accuracy of urine dipstick for proteinuria in older outpatients. Kidney Res Clin Pract. 2014 Jan 12;33(4):199–203.
18. White SL, Yu R, Craig JC, Polkinghorne KR, Atkins RC, Chadban SJ. Diagnostic Accuracy of Urine Dipsticks for Detection of Albuminuria in the General Community. Am J Kidney Dis. 2011 Jan 7;58(1):19–28.
19. Howard K, White S, Salkeld G, McDonald S, Craig JC, Chadban S, et al. Cost-Effectiveness of Screening and Optimal Management for Diabetes, Hypertension, and Chronic Kidney Disease: A Modeled Analysis. Value Health. 2010 Mar 1;13(2):196–208.