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Correlation of Urine Dipstick test to Serum Creatinine in the Emergency Department

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ABSTRACT

Early identification of patients who are at high risk of developing Acute Kidney Injury and Chronic Kidney Disease is beneficial. Serum Creatinine measurement is routinely recommended to detect renal dysfunction. Urine dipstick analysis aids in detection of elevated serum Creatinine. This prospective study determines whether urine dipstick screening analysis can reliably detect urine abnormalities and correlate with an elevation in serum Creatinine > 1.2 mg/dL amongst patients in the Emergency Department. Data was collected from 100 patients coming to the Emergency Department of a tertiary care center located in Salem, Tamil Nadu India. Abnormal elevated serum Creatinine values were found in 39 patients with a significant relationship between gender and presence of high serum Creatinine. This study demonstrated that dipstick proteinuria correlates directly with elevated serum Creatinine > 1.2 mg/dL having high sensitivity but with low specificity in undifferentiated Emergency Department patients. Highly significant association was observed between abnormal serum Creatinine and dipstick glucose. Urine dipstick test was seen to be sensitive but less specific in detecting Diabetic Ketoacidosis. No significant correlation was found between serum Creatinine and Urinary dipstick ketones, Specific Gravity and pH.

Keywords: Emergency department, Urine dipstick, Serum Creatinine, Proteinuria, Glucosuria, Acute Kidney Injury, Chronic kidney disease

1. INTRODUCTION

Acute kidney injury (AKI) results in the inability to maintain fluid, electrolyte and acid-base balance manifested clinically as an abrupt and sustained rise in urea and creatinine with life threatening consequences. It is associated with excess mortality, maximum Sequential Organ Failure Assessment (SOFA) and extended stay in the intensive care unit[1]. AKI is increasingly common with an incidence estimated at 5–7% in the hospitalized patient population with an increased morbidity, mortality and hospitalization costs[2].

Acute kidney injury can be detected by using any of the criteria, in line with RIFLE [3], AKIN [4] or KDIGO [5] definitions.Changes in the serum creatinine (SCr) or urine output often lag behind acute changes in renal function and, therefore, underestimate the degree of renal dysfunction in

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acute care settings[6]. Proteinuria is a major symptom of renal diseases and the excretive amounts of protein in the urine could be an index for evaluating the pathological stage of renal diseases [7].

New improvements in understanding AKI have resulted in the implementation of proteinuria as a means of more accurate assessment of the condition. It is established that the risks of death and injury progression, or end-stage renal disease associated with AKI, vary with levels of proteinuria. It has recently been shown that even small increases in urinary protein or albumin excretion are early predictors of kidney failure and end-stage renal disease. Patients with diabetes and/or hypertension are the primary risk groups[8].

Chronic kidney disease (CKD) is defined as abnormalities of kidney structure or function, present for more than 3 months, with implications for health. CKD is characterized by a gradual loss of kidney function eventually leading to kidney failure needing dialysis or a kidney transplant to maintain life [9]. It is classified based on cause, GFR category and albuminuria category (CGA). The five stages of CKD are based on measured or estimated GFR. Kidney function is normal in Stage1 and slightly reduced in Stage 2.Early detection and treatment can prevent the disease from getting worse.

The two main causes of CKD namely diabetes and high blood pressure, account for up to two-thirds of the cases. An increased life expectancy of Indians - 64 years in males and 68 years in females has been reported [10]which along with an increasing high prevalence of Diabetes and Hypertension account for 40–60% cases of CKD in India. Persistent proteinuria and simple tests like blood pressure; urine albumin and serum creatinine canhelp detect the renal disease [11, 12]

The purpose of performing renal function tests in the Emergency Department is to reveal evidence of acute renal dysfunction necessitating urgent intervention. The absence of hematuria and/or proteinuria by dipstick testing reliably excludes acute elevation in SCr[13, 14].Urine dipstick (Udip) has been used successfully as a screening test for serum creatinine elevation in Emergency Department patients[15]. Protein in the urine could indicate the rise of creatinine a bit early and may have predictive value in the occurrence of the AKI and CKD.

AIM: The aim of this prospective study was to analyze the 'Correlation of urine dipstick test to serum creatinine in patients coming to the emergency department'

OBJECTIVES: To determine the value of quick and cost effective dipstick urinalysis spot test in the early diagnosis of AKI and CKD byestimation of Serum creatinine and performingsemi quantitative Dipstick urine analysis of the patients in our study and then, to ascertain whether there is any correlation between the urine dipstick analysis and Serum creatinine levels for the following parameters:Proteins, Sugar, Ketones, Specific gravity, pH

2. MATERIALS AND METHOD

This was a prospective study conducted at the Vinayaka Mission KirupanandaVariyar Medical College Hospital (VMKVMCH) during the period, from June 2013 to September 2015. VMKVMC Hospital is one of the Level 1 Tertiary Care Centers located in Salem, Tamil Nadu in the southern part of India. Data was collected as per the inclusion and exclusion criteria from 100 patients coming to the Emergency department with different chief complaints and presentations.

Normal Serum Creatinine value was defined for this study as 1.2 mg/dL. Sensitivity, specificity, and predictive values were calculated at various definitions of a positive test / test cutoff points. Tables and graphs were made using Microsoft excel and word programs.

All patients of the age between 18 - 75yearscoming to our ED were studied.Patients beyond the age limit, Females with symptomatic vaginal discharge, Previous H/O dialysis and Presence of macroscopic hematuria were excluded from the study.A 10 parameter Multistix SG (Rapha Company, USA) dipstick was used for this study. This standard urine test strip comprising of up to 10 different chemical pads or reagents react (change color) when immersed in, and then removed from, a urine sample. The test is read in 60 to 120 seconds after dipping.

METHOD: In this study, the patient's fresh clean-catch or catheterized (a small quantity of initial urine was drained before drawing from the sampling port) urine specimen was tested immediately using a Multistix SG reagent test strip immersed completely to the level indicated (marked) in a well- mixed sample of urine for a short period of time (60 – 120 sec) and then extracting it from the container.The edges of the strip were dried on an absorbent paper to remove excess urine which can cause the reagents to leak onto adjacent pads resulting in distortion of the colors. The strip was supported over the mouth of the container horizontally for the reactions to occur (1 to 2 minutes), and finally the colors that appeared were compared against the chromatic scale provided by the manufacturer.To ensure reliability, accuracy with consistency of the results, the researcher and two nurses were trained specifically for the purpose of reading the test strips in the data collection. Verification and recording of the results was done immediately. The dipstick strips used were of the same manufacturer (Rapha) and were at least one year prior from expiry date. Bias of color and timing error was overcome by involvingsame two trained nurses for testing and by strictly following the instructions of the manufacturer.The urine dipstick results and the laboratory results were tabulated and analyzed using the statistical package of SPSS version 11.5 and by the ‘chi square’ test to find the significance of association between the two attributes. Further, the methodology of ROC curve and likelihood ratios was used for assessing the value of performing a diagnostic test. Sensitivity and Specificity tests were performed.

3. RESULTS

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Table 1 – Distribution of Gender

	Frequency	Percent
Male	65	65
Female	35	35
Total	100	100

Table 2 – Distribution of Age

Age in years	Frequency	Percent
18 to 40	20	20
41 – 50	20	20
51 – 60	27	27
61 – 70	33	33
Total	100	100

Table 3 – Distribution of urine abnormalities and SCr by Age of patients

		Age								**Total**	**Chi square**	**p**
		Up to 40		**41 – 50**		**51 - 60**		**61 – 70**				
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**			
Proteins	Absent	11	55	7	35	7	26	13	39	38	4.23	0.238
	Present	9	45	13	65	20	74	20	61	62		
Sugar	Absent	13	65	14	70	15	56	21	64	63	1.10	0.776
	Present	7	35	6	30	12	44	12	36	37		
Ketones	Absent	15	75	17	85	26	96	29	88	87	4.70	0.195
	Present	5	25	3	15	1	4	4	12	13		
Specific Gravity	Up to 1.02	15	75	14	70	15	56	27	82	71	5.17	0.160
	Above 1.02	5	25	6	30	12	44	6	18	29		
pH	Up to 6.5	18	90	18	90	24	89	31	94	91	0.54	0.909
	Above 6.5	2	10	2	10	3	11	2	6	9		
Serum Creatinine	Normal	16	80	11	55	15	56	19	58	61	3.84	0.280
	Abnormal	4	20	9	45	12	44	14	42	39		
Total		20	100	20	100	27	100	33	100	100		

Distribution of urine abnormalities by Age of patients was not significant.

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Table 4 - Prevalence of Urine Abnormality association with Serum Creatinine

		Creatinine				Total
		Normal		Abnormal		
		N	%	N	%	
Proteins	Absent	31	81.58	7	18.42	38
	Present	30	48.39	32	51.61	62
Sugar	Absent	46	73.02	17	26.98	63
	Present	15	40.54	22	59.46	37
Ketones	Absent	54	62.07	33	37.93	87
	Present	7	53.85	6	46.15	13
Total		61	61	39	39	100

Table-4Red indicates group with abnormal serum creatinine present and blue for those with normal serum creatinine. (51.6 %) had urine abnormality for proteins, (59.5%) had urine abnormality due to sugar & (46.2%) had abnormal urine due to ketones.

Table: 5 - Association between gender, urine abnormality and SCr.

		Sex				Total	Chi square	p
		Male		Female				
		N	%	N	%			
Proteins	Absent	20	30.8	18	51.4	38	4.12	0.042*
	Present	45	69.2	17	48.6	62		
Sugar	Absent	39	60.0	24	68.6	63	0.717	0.397
	Present	26	40.0	11	31.4	37		
Ketones	Absent	59	90.8	28	80.0	87	2.33	0.127
	Present	6	9.2	7	20.0	13		
S.G	Up to 1.02	45	69.2	26	74.3	71	0.282	0.595

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	Above 1.02	20	30.8	9	25.7	29		
pH	Up to 6.5	58	89.2	33	94.3	91	0.710	0.400
	Above 6.5	7	10.8	2	5.7	9		
Creatinine	Normal	39	60.0	22	62.9	61	0.078	0.780
	Abnormal	26	40.0	13	37.1	39		
Total		65	100.0	35	100.0	100		

Serum creatinine abnormality above normal study value of > 1.2 mg/dL was found in 13 (37.1%) females and in 26 (40%) of the males (Odds ratio – 0.886, S.E -0.432, P-95% and CI – 2.066). A significant relationship is seen between gender and presence of abnormal elevated SCr($p<0.05$).

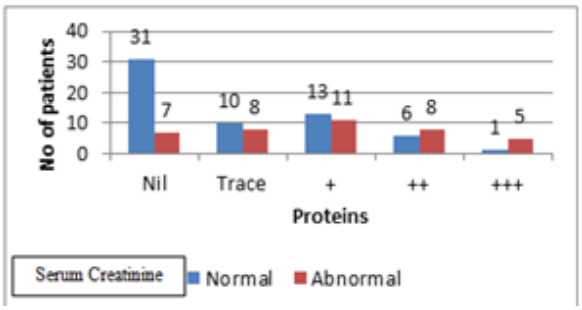
Table 6 - Distribution of Serum Creatinine abnormality

Creatinine	Frequency	Percent
Normal	61	61
Abnormal	39	39
Total	100	100

Table: 7 – Distribution of Protein abnormality in the urine

Proteins	Frequency	Percent
Nil	38	38
Trace	18	18
+	24	24
++	14	14
+++	6	6
Total	100	100

Graph 1 - Association of urine Proteins with Serum Creatinine



31% pts with a normal SCr had 'nil' proteinuria or no presence of protein in their urine; 10% with normal SCr had a minimal amount of protein in their urine. There was a slight difference among patients with normal and abnormal SCr in 1+ proteinuria.2+ and 3+ proteinuria was seen more among patients with an abnormal Serum Creatinine.

Table: 8- Statistical data of dipstick Proteinuria and SCr in the study

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		95 % Confidence Interval	
	Estimated value	**Lower Limit**	**Upper Limit**
Prevalence	**0.61**	**0.507**	**0.704**
Sensitivity (%)	**0.885**	**0.772**	**0.949**
Specificity (%)	**0.385**	**0.238**	**0.554**
Positive predictive value (%)	**0.692**	**0.576**	**0.789**
Negative predictive value (%)	**0.682**	**0.451**	**0.853**
Likelihood ratio for positive	**1.439**	**1.105**	**1.873**
Likelihood ratio for Negative	**0.298**	**0.137**	**0.649**

Sensitivity of proteinuria for elevated Cr was 88.52% (95% confidence interval [CI], 77%-95%) Specificity was 38.5% (95% CI, 24%-55%).

Positive predictive value was 69.2% (95% CI: 57.6%-78.9%) andNegative predictive value was 68.2% (95% CI: 45-85%). The likelihood ratio for a positive test was 1.44(95% CI: 1.11-1.87). The likelihood ratio for a negative test was 0.298 (95% CI: 0.137-0.649).

Graph 2 - Association of urine Proteins with Serum Creatinine

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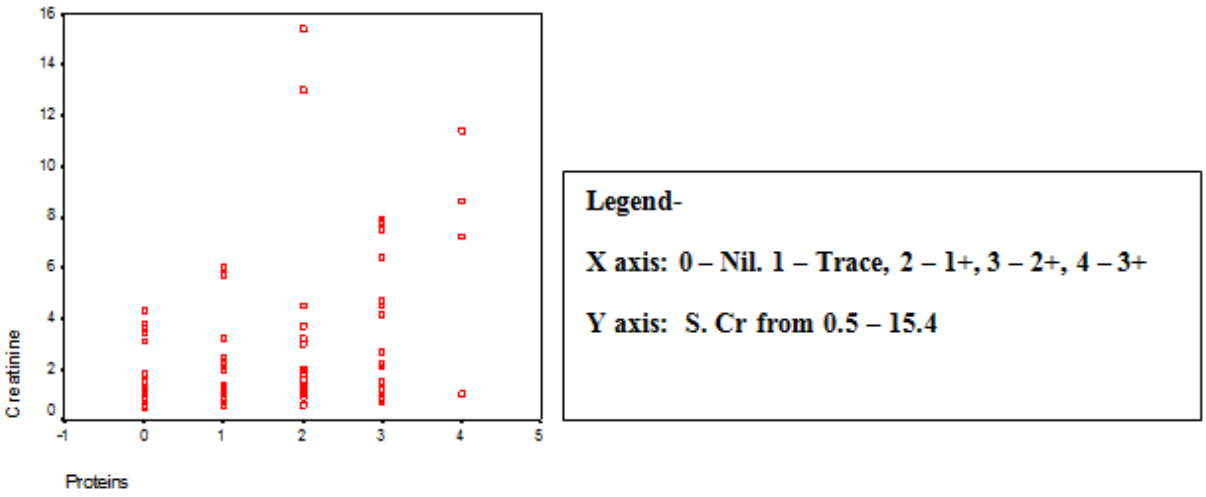
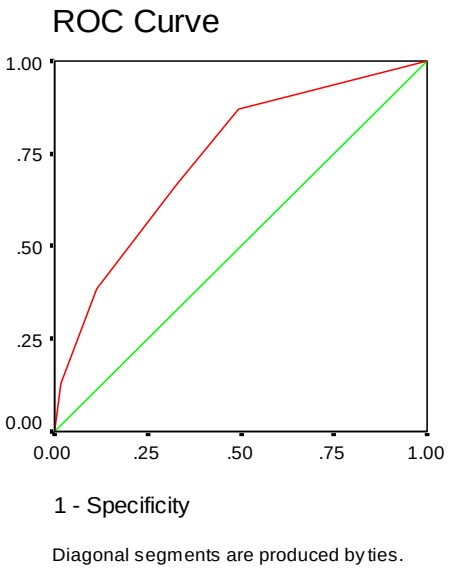


The above diagram depicts the amount of proteinuria in relation to SCr. indicating that patients with 2+ or more proteinuria had a comparatively higher risk of having abnormal renal parameters.

Graph 3- Association of urine Proteins with Serum Creatinine



The Area under the curve is 0.740 with the confidence interval of (0.641, 0.839).
Test Result Variable(s): Predicted probability

Area	Std. Error(a)	P	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
0.740	0.050	< 0.001	0.641	0.839

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The above results reveal a significant correlation between dipstick Proteinuria (**88.52%)** and Serum Creatinine with high sensitivity and moderate specificity (**38.5%**). Dipstick Proteinuria is seen to have a high predictive value (**69.2%)**

Table: 9 – Association between Creatinine and Glucose

Glucose	Creatinine				Total	Chi square	p
	Normal		Abnormal				
	N	%	N	%			
Nil	46	73.0	17	27.0	63	15.36	0.004**
Trace	4	33.3	8	66.7	12		
+	7	50.0	7	50.0	14		
++	2	22.2	7	77.8	9		
+++	2	100.0			2		
Total	61	61.0	39	39.0	100		

** Significant at 1 % P value < 0.01,

Sensitivity= TP (50)/[TP(50)+FN(11)] * 100 = 50/61 * 100 = 81.967%; Specificity= TN (14)/[TN(14)+FP(25)] * 100 = 14/39 * 100 = 35.897%. Negative Predictive = TN (14) / [TN (14) + FN (11)] = 14/25 = 0. 56;Positive Predictive = TP (50) / [TP (50) + FP (25)] = 50/75 = 0.667. A highly significant association is found between glucose & creatinine with high sensitivity but less specificity.

Table: 10 - Association of Ketones with Serum Creatinine

Ketones	Creatinine				Total	Chi square	p
	Normal		Abnormal				
	N	%	N	%			
Nil	54	62.1	33	37.9	87	2.49	0.778
Trace	1	50.0	1	50.0	2		
+	4	57.1	3	42.9	7		
++	1	50.0	1	50.0	2		
+++	1	100.0			1		

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++++			1	100.0	1		
Total	61	61.0	39	39.0	100		

No significant association was found between ketones & creatinine

Table: 11 - Association of S.G with Serum Creatinine

		Creatinine				Total	Chi square	p
		Normal		Abnormal				
		N	%	N	%			
Specific Gravity	Up to 1.02	45	63.4	26	36.6	71	**0.58**	**0.445**
	Above 1.02	16	55.2	13	44.8	29		
Total		61	61.0	39	39.0	100		

Table 12 – Association of Creatinine in relation to pH

pH	Frequency	Percent

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5 - 5.5	5	5
5.6 – 6	54	54
6.1- 6.5	32	32
6.6 – 7	5	5
7.1 - 7.5	3	3
7.6 - 8	1	1
Total	100	100

No significant association seen between pH and SCr.

Table: 13 – Association of Creatinine to Proteins, Sugar, Ketones, S.G and pH

		Creatinine				Total	Chi square	p
		Normal		Abnormal				
		N	%	N	%			
Proteins	Absent	31	81.6	7	18.4	38	10.91	0.001**
	Present	30	48.4	32	51.6	62		
Sugar	Absent	46	73.0	17	27.0	63	10.33	0.001**
	Present	15	40.5	22	59.5	37		
Ketones	Absent	54	62.1	33	37.9	87	0.32	0.571
	Present	7	53.8	6	46.2	13		
S.G	Up to 1.02	45	63.4	26	36.6	71	0.58	0.445
	Above 1.02	16	55.2	13	44.8	29		
pH	Up to 6.5	55	60.4	36	39.6	91	0.13	0.715
	Above 6.5	6	66.7	3	33.3	9		
Total		61	61.0	39	39.0	100		

Significant at 1 %; P value is ≤ 0.001

4. DISCUSSION

A major challenge for renal medicine in developing countries is the early diagnosis of individuals who are at risk of developing AKI and CKD. The Primary care and Emergency department are very apt settings for this purpose using the simplest and least expensive way of screening subjects by urinalysis. Urine dipsticks are applied worldwide in various clinical

settings and their effectiveness in detecting urinary abnormalities at a relatively low cost is well documented [16].

Estimation of microalbuminuria denotes milligram of protein found in the urine per day - up to 30 mg per day is accepted as normal. Detection of trace or 1+ protein in the urine by dipstick denotes the urine protein level has exceeded 30 mg per day which is pathological [17, 18]. Though dipstick urinalysis is cost effective and quicker, its diagnostic accuracy is unclear. False positive and negative results are not uncommon thus needing further laboratory analysis. [19]

One hundred patients - 65 males and 35 females (Table – 5, Graph – 1), who came to the Emergency Department of V M K V Medical College Hospital with different chief complaints and presentations, were included in this study based on the inclusion / exclusion criteria.Similar studies have been done in different centers with different sample sizes and methodologies. Abnormal (positive) urine dipstick results with elevated SCr varied markedly from study to study[20, 21].Varyingfigures have been reported such as 9%[22], 15.4%[23] and 30% by Sultana et al[24]. Abnormal dipstick figure with elevated SCrwas 39 % in our study which is significantly high.

Regarding the sex distribution of dipstick urinalysis abnormality-40% of males (26 patients) and 37.1% of females (13 patients) showed abnormality. A significant relationship was seen between gender and proteinuria (Table - 6; Graph – 2)

The age of the patients in our study, varied from 18 to 75 years with a mean age of 52.44 years (Tables – 6, 7; graphs - 2, 3). Patients in the age group between 51 and 60 demonstrated a highest urine dipstick protein abnormality upto 74% followed by patients in the age group between 61 - 70 years with an urine dipstick protein abnormality of 65%.Even though, there is no significant statistical association between age and urine abnormality (p=0.280), the results of this study imply that patients between 41 and 60 years should be focused upon for screening in the ED for AKI or CKD risk. In addition, our study revealed that urine dipstick analysis for sugar was positive in maximum number of patients between 41 & 60 years of age.

61% of our patients had normal serum creatinine level and the rest had >1.2 mg/dl of SCr.Urine abnormalities detected for various parameters in the group of patients with >1.2 mg /dLSCr were as follows: Protein was positive in 51.61%, sugar in 59.46% and ketones in 46.15%. The values for the same in the other group with normal SCr were 48.39%, 40.54% and 53.85% respectively (table – 8; graph – 4).

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Serum Creatinine (SCr) measurement is routinely recommended to detect renal dysfunction. Our prospective study was designed to determine if the urine dipstick can reliably indicate a possible elevation in serum Creatinine > 1.2 mg/dL and examine its correlation with the other urine constituents in a whole population of 100 ED patients. Out of the total sample of 100 patients, 61 patients presented with normal Creatinine and 39 patients had abnormal Creatinine levels with a positive Udip and Serum Creatinine > 1.2 md/dL. Past medical history data of the 100 patients in this study revealed that 39 had a history of hypertension and 43 were Diabetic. Some of the patients had prior renal disease and congestive cardiac failure. Thus, the frequency of abnormal serum Creatinine > 1.2 mg/dL detected / predicted by the urine dipstick was 39% in our ED testing. (Table - 10, graph - 6) A highly significant association was found between the levels of dipstick Protein & serum Creatinine. (P value: < 0.01). This closely matches the findings of Karras et al 31 who assessed the utility of the urine dipstick test in screening for acute SCr elevation in a prospective study of 143 adult ED patients.

1. **Proteinuria:** People with normal kidney function excrete less than 150 mg of protein per day in their urine, approximately 20 mg of which is albumin. Persistent protein excretion significantly above this level is a marker for kidney disease, its progression, and indicates an increased risk for cardiovascular events [25, 26]. In our study,62% of the patients demonstrated positive proteinuria on the Udip(Table - 9; graph – 5).Correlation done between proteinuria and creatinine gave a p value less than 0.01. It is found that there is a highly significant association between the level of proteins & serum creatinine. Proteinuria by urine dipstick was absent in 38% of the patients

   It is important to consider the possibility of a false positive result, which can be caused by alkaline urine (pH >7), gross hematuria, mucus, semen or leukocytes [27]. Proteinuria may be transient or persistent. Transient, mild proteinuria can be caused by recent strenuous exercise, standing for long periods (orthostatic proteinuria), pregnancy, UTI, acute febrile illness andCongestive heart failure. Orthostatic proteinuria seen mainly in young adults, is typically absent in the morning, occurs in the afternoon; hence a morning sample of urine will obviate the orthostatic factor. In the absence of any suspected transient cause, if persistent proteinuria on dipstick is present, an ACR or PCR should be performed and all patients with ACR > 70 mg/mmol or PCR > 100 mg/mmol require routine referral to nephrology[28].

   Javier Neyra and collaborators [29] found that new-onset dipstick proteinuria at the time of admission was independently associated with a 2.3 times increased likelihood of AKI, after adjusting for age, race, gender, co-morbidities, and other factors. The investigators examined the predictive value of the in expensive de-novo urine dipstick proteinuria as an early biomarker of AKI in septic patients and found a positive predictive value of 75%. They opined that other predictive biomarkers like NGAL or KIM-1 which have being investigated in sepsis and AKI are more expensive than the dipstick proteinuria

test.Dipstick positive proteinuria of more than or equal to 1+ can substitute for an albumin: creatinine ratio.

In our study,the sensitivity of proteinuria for elevated Cr was 88.52% denoting a highly significant correlation of proteinuria by dipstick with serum creatinine. Further, the urine dipstick proteinuria was found to have high sensitivity and good predictive value in detecting elevated creatinine levels. {Table-12, graphs– 2, 3} Serum creatinine (SCr) measurement is routinely recommended to detect renal dysfunction[30].Our prospective study was designed to determine if the urine dipstick can reliably indicate a possible elevation in serum creatinine > 1.2 mg/dL and examine its correlation with the other urine constituents in a whole population of 100 ED patients.Out of the total sample of 100 patients, 61 patients presented with normal creatinine and 39 patients had abnormal creatinine levels with a positive Udip and Serum Creatinine > 1.2 md/dL. Past medical history data of the 100 patients in this study revealed that 39 had a history of hypertension and 43 were Diabetic. Some of the patients had prior renal disease and congestive cardiac failure. Thus, the frequency of abnormal serum creatinine > 1.2 mg/dL detected / predicted by the urine dipstick was 39% in our ED testing. (Table - 10, graph - 6)A highly significant association was found between the levels of dipstick Protein & serum Creatinine. (P value: < 0.01). This closely matches the findings of Karras et al [31] who assessed the utility of the urine dipstick test in screening for acute SCr elevation in a prospective study of 143 adult ED patients. Our study finds high positive as well high negative predictive values with a highly significant association of dipstick proteinuria with serum creatinine in contrast to the study of Shah et al[32], which was retrospective in design and based on a higher defined value of serum creatinine > 1 .3mg/dL

2. **Sugar:** Morris LR et al [33] compared dipstick reported levels from 400 second-voided urines to simultaneous plasma glucose determinations.Diastix readings indicated the low sensitivity of semi-quantitative methods. They concluded that, except for detection of marked hyperglycemia, spot urine dip stick glucose determinations were inadequate as the sole means of clinical assessment for management of diabetic patients. In our study there is a highly significant association found between the level of glucose and serum creatinine (P value < 0.01). Arora et al [34] did a prospective study in 54 DKA patients presenting to the ED to check the accuracy of POC testing for B-hydroxybutyrate versus urine dipstick. The study concluded that POC testing for B-OH and urine dipstick both are equally sensitive for detecting DKA. However it was seen that B-OH was more specific. In our ED study, 63% of patients gave nil results for the amount of glucose in urine, 12% had trace presence, 14% showed 1+ glycosuria, 9% had 2+ and, 2% had 3+ of glycosuria. A highly significant association was found between sugar (glucose) & creatinine (P value < 0.01). (Table – 13, graph - 9) Age group from 41 -50 and 51-60 years had maximum abnormal or positive dipstick for sugar that is up to 30% and 44% respectively.

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3. **Ketones:** In the present study when ketones were plotted against SCr it was found that 87% had nil ketonuria& only 13% had showed some ketones in urine. Similarly for presence of ketones in urine, out of 13 patients who showed, 2% had trace results, 7 had 1+ ketonuria, 2 had 2+ ketonuria, 1 had 3+ ketonuria& 1 had 4+ ketones in the urine. (Table – 14, graph – 10) With a P value of 0.778, no significant association was found between ketones & creatinine in this study. Ketones are not normally found in urine. Ketonuria most commonly is associated with uncontrolled diabetes, but it also can occur during pregnancy, carbohydrate-free diets and starvation [35]readily apparent on clinical assessment of the patient, and therefore ketonuria rarely requires independent evaluation [36].

4. **Specific gravity:** Specific gravity of urine is a very general measure of kidney function, correlates with urine osmolality and gives important insight into the patient's hydration. It also reflects the concentrating ability of the kidneys. Normal Urinary SG can range from 1.003 to 1.030, a value of less than 1.010 indicates relative hydration, and a value of greater than 1.020 indicates relative dehydration. A low specific gravity can be seen in intrinsic renal disease and a high specific gravity in patients with dehydration, fever, vomiting and diarrhea. Assuming a thorough history and examination have been undertaken, the urine specific gravity rarely adds to the assessment of the patient[37, 38]. In our study SG up to 1.02 was taken as normal. 29 patients had S.G above 1.02 and amongst these, 16 had normal SCr while 13 demonstrated abnormal SCr results with Chi square 0.58 and P of 0.445. (Table -13) S.G with an abnormal creatinine level had a mean of 1.02, SD of 0.01;'t' value of 2.46 and P level at 0.016. No significant association was found between specific gravity & creatinine.

5. **pH:** Urinary pH can range from 4.5 to 8 but normally is slightly acidic (5.5 to 6.5) because of metabolic activity. Urinary pH generally reflects the serum pH, except in patients with renal tubular acidosis. In isolation, urine pH cannot be reliably interpreted and therefore should be used only in assessing the patient in specific circumstances (for example, renal tubular acidosis). Dipsticks give an accurate result between pH 6.0 and 7.0. If a urine sample is strongly alkaline one should, however, consider a UTI with a urease producing bacteria (urease catalyzes the conversion of urea to ammonia) [39]. In our study no significant correlation was found between pH and serum creatinine. (Table–16, graphs – 14,15) Dipstick testing may be applicable to monitor patients on pH manipulation therapy and modify treatment when necessary [40].

5.CONCLUSION

1. This study has demonstrated that dip stick proteinuria correlates directly with higher serum creatinine >1.2 having high sensitivity but low specificity in undifferentiated Emergency Department patients. There is a highly significant association found between

the level of glucose and serum creatinine (P value < 0.01). Urine dipstick is sensitive but less specific in detecting DKA[40].

2. Urine dip stick is an accurate, simple to use and inexpensive test for detecting bio-markers in urine to identify patients at risk for AKI and CKD. It is useful in triage of patients coming to the Emergency Department.
3. The limitations in our study were that, the urine was tested only once and sample size was modest in number. More studies with larger samples incorporating new multi-parameter reagent strips (for example with urinecreatinine reagent) are needed to evaluate versatility of dip stick urinalysis in different clinical settings.

Ethical Committee approval and Consent from all the patients was obtained.Conflict of Interest: None.

This study is based on part of the dissertation 'Correlation of urine dipstick test to serum creatinine in patients coming to the emergency department' submitted to the Vinayaka Missions University, Salem, India in partial fulfillment of the requirement for the degree of MD in Emergency Medicine.

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