ORIGINAL RESEARCH

A study to detect the albuminuria in diabetic individuals and evaluation of its association with kidney function and fundus changes

[1]Dr. Aditya Gangwar, [2]Dr. Yuvraj Singh Rathaur, [3]Dr Akash Sharma, [4]Dr. Tapas Kumar

[1,2]Junior Resident, [4]Professor, Department of General Medicine, MGM Medical College, Kishanganj, Bihar, India
[3]Junior Resident, Department of General Medicine, Katihar Medical College, Katihar, Bihar, India

Corresponding Author
Dr. Tapas Kumar
Professor, Department of General Medicine, MGM Medical College, Kishanganj, Bihar, India

Received: 10 February, 2023 Accepted: 16 March, 2023

ABSTRACT

Introduction: Complications of diabetes mellitus include problems that develop rapidly (acute) or over time (chronic) and may affect many organ systems. Hence, the present study was carried to study to evaluate albuminuria (both micro and macro) in type2 diabetes and its association with kidney function and fundus changes. **Material and Methods:** The present analytical study was carried out among 100 diabetic patients who were enrolled in two groups; group A consisted of 50 diabetic patients with albuminuria and group- B comprised of 50 diabetics without albuminuria. A fasting sample of blood was drawn after an overnight fast of 10 hours and samples were collected in the early morning after an overnight fast for required investigations. Student's *t* test was used to compare the means of continuous variables and X^2 test was used to compare proportions. **Results:** Serum creatinine and blood urea values were found to be significantly higher in the group A compareto group-B (p value= <0.0001). Patients with albuminuria have a higher prevalence of NPDR and NPDR with maculopathy compared to those with normo-albuminuria. Specifically, 16% of patients with Group-A, (albuminuria) have NPDR compared to only 4% of patients with Group- B(normo-albuminuria). Similarly, 10% of patients with albuminuria have NPDR with maculopathy, while no patients with normo-albuminuria have this complication. The Chi-square value of 11.686 and the p-value of 0.008. **Conclusion:** The correlation analysis showed a strong positive correlation between creatinine and albuminuria. Overall, these findings emphasize the importance of early detection and management of albuminuria in patients with type 2 diabetes, as it may indicate the development of diabetic nephropathy and other complications such as retinopathy.

Keywords: Albuminuria; Diabetes mellitus type 2; Retinopathy.

INTRODUCTION

Diabetes is one of the most common non-communicable diseases globally and there is evidence that it is an epidemic in many developing and developed countries, thus posing a serious threat to be met in the 21st century. DM is proving to be a global public health burden as this number is expected to rise to another 200 million by 2040.[1]

Complications of diabetes mellitus include problems that develop rapidly (acute) or over time (chronic) and may affect many organ systems. The complications of diabetes can dramatically impair quality of life and cause long- lasting disability. Overall, complications are far less common and less severe in people with well-controlled blood sugar levels.[2,3] Some non-modifiable risk factors such as age at diabetes onset, type of diabetes, gender and genetics may influence risk. Albuminuria in type 2 diabetes mellitus may be secondary to factors unrelated to diabetes mellitus such as hypertension, congestive heart failure, prostate disease, or infection.[4,5]

On the other hand, there is a strong relationship between type 2 diabetes mellitus (T2DM) and fundus changes. Fundus changes, also known as diabetic retinopathy, occur due to damage to the blood vessels in the retina of the eye, caused by high levels of blood glucose. The risk of developing diabetic retinopathy increases with the duration of diabetes, poor glycemic control, hypertension, and dyslipidemia.[6] Hence, the present study was carried to study to evaluate

albuminuria (both micro and macro) in type2 diabetes and its association with kidney function and fundus changes.

MATERIAL AND METHODS

The present cross sectional analytical study was carried out among 100 diabetic patients admitted in the department of General Medicine, MGM Medical College & LSK Hospital, Kishanganj, Bihar over a period of 24 months after obtaining ethical clearance from the Institute Ethics Committee.

Patients aged above 30 years to 70 years, of both genders were enrolled in two groups; group A consisted of 50 diabetic patients with albuminuria and group- B comprised of 50 diabetic without albuminuria. Written informed consent was obtained from all the patients before enrolling them for the study. Inclusion criteria comprised of patients of type 2 diabetes of either sex (male/female) and all patients with FPG >126mg/dl and HbA1C >6.5. Age and sex matched controls were included in the study. Exclusion criteria consisted of not consenting patients, patients in pre diabetic range of blood glucose and non-diabetic patients with proteinuria, pregnant woman, hemoglobinopathies and those with age above 75 years. Diagnostic criteria comprised of FBS >/= 126mgdl, 2 hour plasma glucose >/=200mg/dl during OGTT, RBS >/=200 mg/dl with symptoms and or HBA1C >6.5%. Complete medical history and physical examination was carried out. Laboratory Investigations comprised of urine albumin, blood sugar testing and HbA1C level. Fundus examination was conducted in ophthalmology department.

A preoperative evaluation was carried out in all patients with demographic data like age, gender, weight and detailed clinical history, physical examination including, associated medical co-morbidities, and current medications. A total of 100 patients of type 2 DM meeting the inclusion and exclusion criteria were enrolled in the study. In all study patients, a complete clinical workup was done including height, weight, and body mass index. The body mass index was calculated and expressed as kg/m^2. The blood pressure was recorded in the right upper arm in the sitting posture, after a five minutes rest. A fasting sample of blood was drawn after an overnight fast of 10 hours and the samples were collected in the early morning after an overnight fast and above-mentioned investigations were conducted.

Urine creatinine was determined by Jaffe's reaction. Urine microalbumin in concentration was measured using commercially available immunoturbidometric assay kits.

Statistical analysis was carried out with the help of Statistical package for the social sciences (SPSS) version 19 for windows package (Chicago, IL, USA). The description of the data was done in form of mean ±standard deviation (SD) for quantitative data while in the form of % proportion for qualitative (categorical) data. $p<0.05$ will be considered significant. Student's *t* test was used to compare the means of continuous variables and X^2 test was used to compare proportions.

RESULTS

Table 1: Sex distribution among two groups

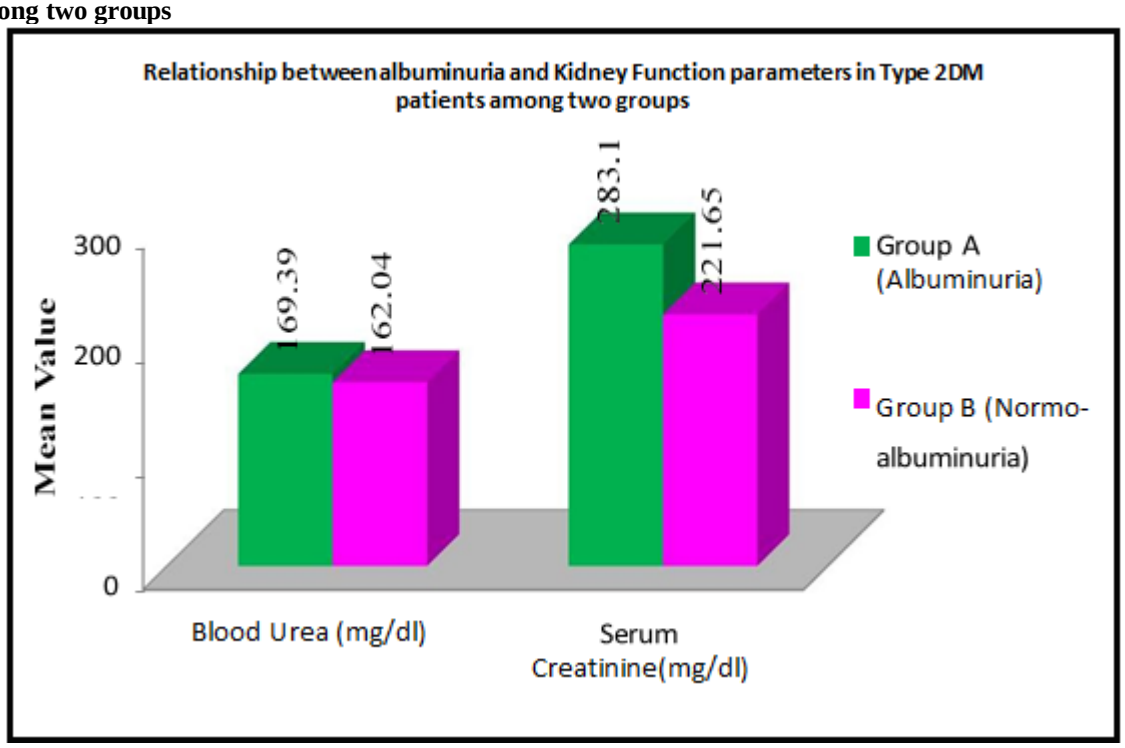
Sex	Group-A (Albuminuria) (n=50)		Group- B (Normo-albuminuria) (n=50)		p value
	Frequency	Percentage	Frequency	Percentage	
Male	35	70.0	28	56.0	Chi-square-2.1021 P value-0.147
Female	15	30.0	22	44.0	
Total	50	100.0	50	100.0	

The table 1 presents the sex distribution of patients in two groups. Male were predominantly higher than female. In Group-A (Albuminuria), 70% of patients are male, while in Group-B (Normo-albuminuria), 56% of patients are male. The chi-square test with a p-value of 0.147 indicates no statistically significant difference in sex distribution between the two groups.

Table 2: Relationship between albuminuria and Kidney Function parameters in Type 2 DM patients among two groups

Variables	Group-A (Albuminuria) (n=50)		Group- B (Normo-albuminuria) (n=50)		p value
	Mean	±SD	Mean	±SD	
Blood Urea (mg/dl)	57.42	±8.86	47.04	±3.28	<0.0001
Serum Creatinine(mg/dl)	1.70	±0.38	0.94	±0.22	<0.0001

Figure1: Relationship between albuminuria and Kidney Function parameters in Type 2 DM patients among two groups



Relationship between albuminuria and kidney function parameters i.e. blood urea and serum creatinine levels is presented in table 2 and figure 1. Serum creatinine and blood urea values were found to be significantly higher in the group A compareto group-B (p value= <0.0001).

Table 3: Relationship between albuminuria and fundus changes in Type 2 DM patients among two groups

MicrovascularComplications	Group-A (Albuminuria) (n=50)		Group- B (Normo-albuminuria) (n=50)	
	Frequency	Percentage	Frequency	Percentage
NPDR	8	16.0	2	4.0
NPDR with Maculopathy	5	10.0	0	0.0
Proliferative Retinopathy	3	6.0	1	2.0
No Changes	34	68.0	47	96.0
Total	50	100.0	50	
Statistical Inferences	Chi-square value- 11.686 P value- 0.008			

The table 3 indicates that there is a significant relationship between albuminuria and fundus changes in Type 2 DM patients. Patients with albuminuria have a higher prevalence of NPDR and NPDR with maculopathy compared to those with normo-albuminuria. Specifically, 16% of patients with Group-A, (albuminuria) have NPDR compared to only 4% of patients with Group- B(normo-albuminuria). Similarly, 10% of patients with albuminuria have NPDR with maculopathy, while no patients with normo-albuminuria have this complication. The Chi-square value of 11.686 and the p-value of 0.008.

Table 4: Correlation between albuminuria with Urea and Creatinine in Type 2 DM patients.

Correlations of Albuminuria with Urea and Creatinine			
	Albumin uria	**Urea**	**Creatinine**
Pearson Correlation	1	-.004	.591**
p Value		.978	**.000**
No of Cases	50	50	50

In this table 4, a correlation coefficient of 1 is shown for albuminuria, indicating perfect positive correlation with itself. The correlation coefficient for urea is close to 0 (-0.004), indicating no correlation with albuminuria (figure 2). The correlation coefficient for creatinine is positive (0.591), indicating a strong positive correlation

with albuminuria (figure 3).

Figure 2: Correlation between albuminuria with Urea

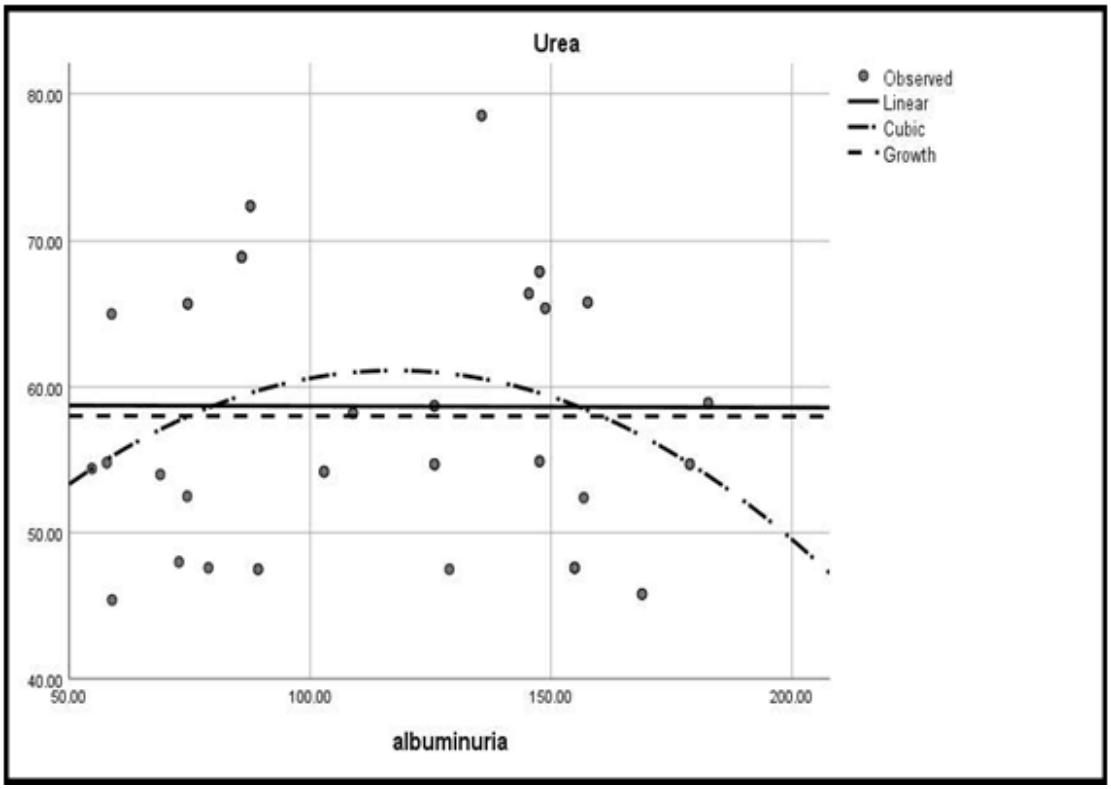
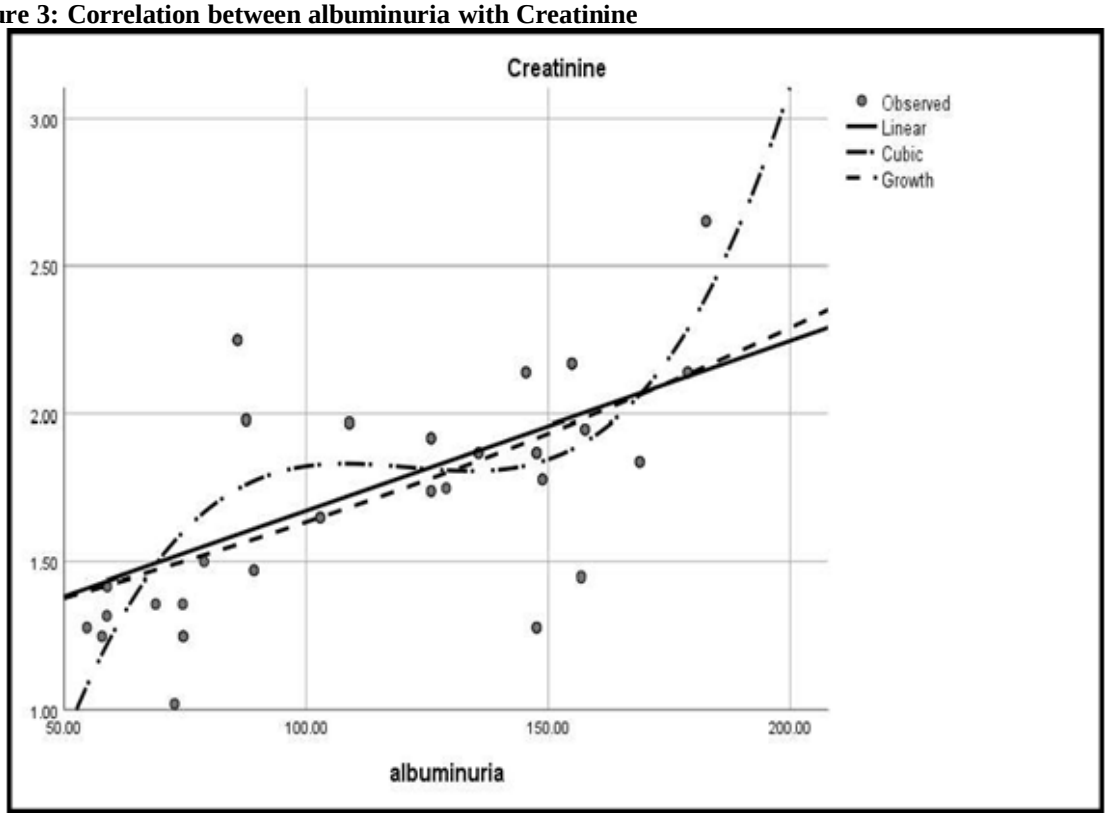


Figure 3: Correlation between albuminuria with Creatinine



DISCUSSION

Diabetes is characterized by metabolic abnormalities and long term microvascular and macrovascular complications. With the increase prevalence of diabetes, there is a significant increase in the microvascular complication like retinopathy,

nephropathy, neuropathy, coronary heart diseases and cerebrovascular accidents. These microvascular complications are linked to the duration of diabetes, poor glycemic control and increased BMI. Diabetic retinopathy is one of the leading causes of blindness in the world that increases the chances of losing sight by about 25 times as compared to normal individual.[7]

The finding of a significant relationship between albuminuria and fundus changes in Type 2 DM patients is consistent with several previous studies. A study by Pugliese et al[8] found that patients with albuminuria had a significantly higher prevalence of diabetic retinopathy compared to those with normo-albuminuria, and the severity of retinopathy increased with the severityof albuminuria. Similarly, another study by Geng W et al reported a significant association between albuminuria and the prevalence and severity of diabetic retinopathy.[9] The positive correlation between creatinine and albuminuria is consistent with previous studies. Albuminuria is a well-established risk factor for the development and progression of diabetic nephropathy, and increased albuminuria levels are associated with increased serum creatinine levels.[10,11]

Microalbuminuria (defined as urinary albumin excretion of 30-300 mg/day, or 20-200 µg/min) is an earlier sign of vascular damage. It is a marker of general vascular dysfunction and nowadays is considered a predictor of worse outcomes for both kidney and heart patients. There is a significant correlation between blood pressure and microalbuminuria.[12] The causes of microalbuminuria include short term hyperglycemia, exercise, urinary tract infections, marked hypertension, heart failure, acute febrile illness, dehydration. Some others condition that damage glomerulous causes microalbuminuria and then progress toward microalbuminuria to proteinuria. Such conditions are hypertension, diabetes, vasculitis etc.[13,14] Hence, the present study aimed to the prevalence of microalbuminuria among persons with Type 2 Diabetes Mellitus and evaluates its role as a risk factor for the presence of micro and macrovascular complications.

The present study found that relationship between albuminuria and kidney function parameters i.e., blood urea and serum creatinine levels and it was found to be significantly higher in the group A compareto group B (p value= <0.0001).

Microalbuminuria could be taken also, as an indicator of insulin resistance and of the increased renal and cardiovascular risk associated with metabolic syndrome. Renal involvement is a pivotal development in diabetes and microalbuminuria is generally the first clinical sign of renal dysfunction in diabetics. It is demonstrated that cardiovascular and renal risk is elevated even in the high normal range of microalbuminuria (below 30 mg/day). [12]

Ninomiya T et al[15] also reported that high albuminuria and kidney function independently predict cardiovascular and renal outcomes among patients with type 2 diabetes. Diabetic nephropathy occurs in as many as 30% of type I diabetes mellitus patients and 25% of type II diabetes mellitus patient. It is a dreaded disease with progressive and continuous deterioration in glomerular function. In the early phase of diabetic nephropathy, there is a rise in urinary excretion of albumin i.e., microalbuminuria which is detectable only by use of sensitive assay for urinary albumin. At this stage, urine is negative for macroalbumin and renal function is normal by standard clinical tests. The presence of microalbuminuria precedes the development of overt diabetic nephropathy by 10 to 15 years. It is at this stage that one can hope to reverse diabetic microvascular complications and prevent its progression. In type 2 diabetic patients, 20-40% with microalbuminuria progress to overt nephropathy and 20 years later, approximately 20% develop end stage renal failure.[16].Diabetic Retinopathy is responsible for 4.8% of the 37 million cases of blindness throughout the world.[7] The concordance of microalbuminuria and diabetic retinopathy has well reported in type 1 diabetes; however, for type 2 diabetes, there is paucity of data.

CONCLUSION

The correlation analysis showed a strong positive correlation between creatinine and albuminuria. Overall, these findings emphasize the importance of early detection and management of albuminuria in patients with type 2 diabetes, as it may indicate the development of diabetic nephropathy and other complications such as retinopathy.

REFERENCES

1. Zheng Y, Ley SH, Hu FB. Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. Nat Rev Endocrinol. 2018 Feb;14(2):88-98.
2. Nathan DM, Cleary PA, Backlund JY, et al. (December 2005). "Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes". *The New England Journal of Medicine*. **353** (25): 2643 53.
3. Diabetes Control and Complications Trial Research Group. The effect of intensive diabetes therapy on the development and progression of neuropathy. Annals of Internal Medicine. 1995 Apr 15;122(8):561-8.
4. Mogenson CE. Preventing end stage renal disease. Diabetes Med. 1998;15:S51-6
5. Ritz E, Orth SR. Nephropathy in patients with type 2 diabetes. N Engl J Med. 1999;341:1127-33.
6. Shukla UV, Tripathy K. Diabetic Retinopathy. [Updated 2023 Feb 22]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-.
7. Parving HH, Gall MA, Skott P, Jorgensen HE, Lokkegaard H, Jorgensen F et al. Prevalence and causes of albuminuria in non-insulin- dependent diabetic patients. Kidney Int. 1992;41:758- 62.
8. Pugliese G, Solini A, Bonora E, Orsi E, Zerbini G, Fondelli C, Gruden G, Cavalot F, Lamacchia O,

Trevisan R, Vedovato M. Distribution of cardiovascular disease and retinopathy in patients with type 2 diabetes according to different classification systems for chronic kidney disease: a cross-sectional analysis of the renal insufficiency and cardiovascular events (RIACE) Italian multicenter study. Cardiovascular Diabetology. 2014 Dec;13:1-1.

9. Geng W, Du Y, Jin W, Wei W, Hu Y, Li J. Gesture recognition by instantaneous surface EMG images. Scientific reports. 2016 Nov 15;6(1):36571.
10. Afkarian M, Zelnick LR, Hall YN, Heagerty PJ, Tuttle K, Weiss NS, de Boer IH. Clinical manifestations of kidney disease among US adults with diabetes, 1988-2014. Jama. 2016 Aug 9;316(6):602-10.
11. Al-Rubeaan K, Al-Manaa H, Khoja T, Ahmad N, Al-Sharqawi A, Siddiqui K, AlNaqeb D, Aburisheh K, Youssef A, Al-Batil A, Al-Otaibi M. The Saudi abnormal glucose metabolism and diabetes impact study (SAUDI-DM). Annals of Saudi medicine. 2014 Nov;34(6):465-75.
12. Koroshi A. Microalbuminuria, is it so important?. Hippokratia. 2007 Jul;11(3):105.
13. Pearson ER, RJ M. Davidson's Principles and Practice of Medicine. 22nd edn. Vol. 21.
14. Parving HH, Mauer M, Ritz E. Brenner and Rector's the Kidney. Diabetic Nephropathy, 7th, BM Brenner. WB Saunders, BostonUSA. 2004:1777-818.
15. Ninomiya T, Perkovic V, De Galan BE, Zoungas S, Pillai A, Jardine M, Patel A, Cass A, Neal B, Poulter N, Mogensen CE. Albuminuria and kidney function independently predict cardiovascular and renal outcomes in diabetes. Journal of the American Society of Nephrology. 2009 Aug 1;20(8):1813-21.
16. McPherson RA, Ben-Ezra J (2007) Basic Examination of Urine. In: Mcment by Laboratory Methods, (21st edn.), Elsevier, New Delhi, India.