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Screening of Microalbuminuria and Estimated Glomerular Filtration Rate in Type 2 Diabetes Mellitus for Early Detection of Renal Dysfunction

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Monitoring patients with diabetes for microalbuminuria is now standard practice. The estimated glomerular filtration rate (eGFR) equations are based on serum creatinine level. The accuracy of these equations can be affected in certain populations such as extreme of age and body size, severe malnutrition or obesity, diseases of skeletal muscle, paraplegia or quadriplegia and vegetarian diet. The study was to find out the association between microalbuminuria and eGFR in type 2 diabetes mellitus. It was a cross-sectional, descriptive and analytic study. Urine, blood and body weight from 70 cases among type 2 diabetes mellitus patients from Diabetic Clinic, Yangon General Hospital were collected. Urine microalbumin was detected by immunometric method and eGFR was calculated by Cockcroft-Gault formula. If eGFR is less than 90 ml/min, diabetic patients will have increased risk of chronic kidney disease (CKD). With the normal urine volume, less than 20 mg/l of urine albumin was normoalbuminuria, and greater than or equal to 20 mg/l of urine albumin was microalbuminuria. Mean age of patients was 56(SD=11.2 years) and mean duration of diabetes was 7 years (SD=6.8 years). Thirty-five percent of patients had micro-albuminuria and they were in the risk of CKD, 19% had normoalbuminuria with risk of CKD, 19% had microalbuminuria with non-risk CKD. Normoalbuminuria and non-risk CKD patients were 27% of the study population. There was a statistical significant association between micro-albuminuria and eGFR (p=0.035). Patients in the CKD risk group had more risk 2.8 times (95% CI=062-7.437) to suffer microalbuminuria than non-risk CKD group.

Key words: Diabetes mellitus, Microalbuminuria, eGFR

INTRODUCTION

The World Health Organization estimated the global prevalence rate of diabetes is 9% among adults in 2014.[1] Diabetes was the 8th leading cause of death in 2012 causing 1.5 million deaths.[2] In 2014, prevalence of diabetes in Myanmar is 6.6%.[3] As the prevalence of diabetes is increasing, the complications of diabetes are important problems, especially diabetes nephropathy which accounts approximately one third of all cases of end-stage renal disease.[4] One of the earliest signs of impending glomerular nephropathy is microalbumin-uria. Monitoring patients with diabetes for microalbuminuria is now standard practice.[5] Although estimated glomerular filtration rate (eGFR) is feasible to use, the reliability is more or less questionable in other renal dysfunction. In the study of monitoring kidney function in type 2 diabetic patients from Demark, GFR is significantly under-estimated with predicted equations in micro-albuminuric patients.[6]

In a cross-sectional study done in India, results concluded that there was positive correlation between albumin excretion rate and estimated GFR in diabetic chronic kidney diseases.[7] This study was conducted

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to find out the association of microalbuminuria and estimated glomerular filtration rate using Cockcroft-Gault formula in type 2 diabetes mellitus for early detection of renal dysfunction.

MATERIALS AND METHODS

A laboratory-based, cross-sectional descriptive and analytic study was done from July 2015 to June, 2016 in Diabetic Clinic, Yangon General Hospital and Department of Medical Laboratory Technology, University of Medical Technology (Yangon). Random urine, whole blood samples and body weight from already diagnosed type 2 diabetes mellitus 70 cases, who had been consented, attending at Diabetic Clinic, Yangon General Hospital were collected. Urine samples with pus cells and red blood cells and haemolysed and lipaemic blood samples were excluded.

Urine microalbumin was measured with NycoCard U-Albumin immunometric assay. With a normal urine volume, <20 mg/l of urine albumin is normoalbuminuria and greater than or equal to 20 mg/l of urine albumin is microalbuminuria. Serum creatinine was determined by Jaffee's kinetic method and body weight was measured in kilogram. Estimated GFR was calculated by Cockcroft-Gault formula.

For male patients

$$\text{Estimated creatinine clearance}^{*} = \frac{(140\text{-age}) \times \text{BW (kg)}}{72 \times \text{Serum creatinine (mg/dl)}}$$

For female patients

$$\text{Estimated creatinine clearance}^{*} = \frac{(140\text{-age}) \times \text{BW(kg)}}{72 \times \text{Serum creatinine (mg/ dl)}} \times 0.85$$

(BW=Body weight, *= ml/min)

The risk of chronic kidney diseases (CKD) is defined by eGFR when the result is less than 90 ml/min and non-risk CKD is greater than or equal to 90 ml/min.[8]

Data entry and statistical analysis were done using Statistical Package for Social Science Software, version 20.0. The association was calculated by means of chi-square and 'p' value less than 0.05 was assumed as statistical significance. In order to assess the risk, odd ratio was calculated with 95% Confidence Interval.

Ethical consideration

This study was submitted and approved by Ethical Review Committee of University of Medical Technology (Yangon).

RESULTS

Samples from 70 cases among type 2 diabetic patients were assessed. Mean age of the study population was 56 years, minimum was 25 years and maximum was 81 years (SD=11.2 years). Mean duration of diabetes was 7 years (SD=6.8 years). Table 1 shows the demographic data of the study population.

Table 1. Demographic data

	N	Percentage
Sex		
Male	16	23
Female	54	77
Age (years)		
56 and above	36	51
Less than 56	34	49
Duration of DM (years)		
7 and over	33	47
Less than 7	37	53
Antihypertensive drug taking		
Yes	47	67
No	23	33
Race		
Myanmar	40	57
Other	30	43

Table 2. Urine albumin and eGFR

		Urine albumin, N (%)		Total N (%)
		Micro-albuminuria	Normo-albuminuria	
eGFR	Risk CKD	25(35)	13(19)	38(54)
	Non-risk CKD	13(19)	19(27)	32(46)
Total		38(54)	32(46)	70(100)

Thirty-eight patients (54%) had microalbuminuria and 32 patients (46%) had normoalbuminuria. In the case of eGFR calculated by Cockcroft-Gault formula, 38 patients (54%) were in the CKD risk group and 32 patients (46%) were in the CKD non-risk group. Thirty-five percent of the study population had both risk CKD and

microalbuminuria, while 27% had non-risk CKD and normoalbuminuria. Nineteen percent had normoalbuminuria with risk CKD, 19% had microalbuminuria with non-risk CKD. There was a statistical significant association of eGFR and microalbuminuria (p=0.035). Odd ratio of eGFR to micro-albuminuria was 2.8(95% CI=1.062-7.437).

DISCUSSION

In this study, the levels of urine micro-albumin were detected from type 2 diabetes mellitus with immunometric method and eGFR was calculated using Cockcroft-Gault formula. In terms of demographic data, 47% of the study population had disease for more than 7 years, 67% was taking antihyper-tensive drugs and 57% was Myanmar race.

In the study population, out of 70 cases, 38(54%) showed microalbuminuria. Among 38 cases, 25 participants had the risk of CKD. For normoalbuminuria group, there were 32 cases (46%), in which 13 participants had the risk of CKD.

Microalbuminuria is an indicator of incipient diabetic nephropathy.[9, 10] It is an early component in a continuum of progressive increased urinary albumin excretion and characterizes diabetic CKD.[11] However, 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. Therefore, detection of microalbuminuria should be repeated in type 2 diabetes mellitus to determine the overt nephropathy.[8, 12]

In this study, the CKD risk group had 38 cases (54%). Among them, 25 participants had microalbuminuria. In the CKD non-risk group, there were 32 cases (46%), in which 13 participants had micro-albuminuria.

For calculation of eGFR, several equations can be used, such as Cockcroft-Gault, MDRD and CKD-EPI formulae which are estimated based on serum creatinine levels. Estimated GFR using Cockcroft-Gault formula depends on age, body weight, serum creatinine level and sex of the patient.

Saha, *et al*.[7] proved that Cockcrock-Gault formula is more reliable than MDRD formula. It is feasible to calculate the GFR compared to measuring it. However, the precision and accuracy of eGFR equations were unacceptable in the study of Lauritsen, *et al*.[13]due to a synchronous decrease of plasma creatinine (PCr) and measured GFR in their study population. Estimates by Cockcroft-Gault equation tend to be higher than true GFR.[14] As creatinine is excreted via renal tubules, the estimated GFR with serum creatinine level may slightly increase compared to true GFR. And if the patient has large adipose tissue and edema, the calculation of weight in Cockcroft-Gault equation may overestimate the GFR. However, the estimated GFR was more reliable than serum creatinine level in patients with reduced renal function.[15]

In the study done by Saha, *et al*.[7] they found that there was a good positive correlation between microalbuminuria and eGFR in type 2 diabetes. But, the study of Rossing, *et al*.[6] showed eGFR was unacceptable and underestimated in their study population of which patients were type 2 diabetic mellitus already with incipient and overt diabetic nephropathy.

In this cross-sectional study, the patients were apparently healthy. Most of them made regular visits to the Out-patient Department of Diabetic Clinic, Yangon General Hospital. In that population, eGFR using Cockcroft-Gault formula had a significant association with microalbu-minuria (p=0.035) and risk of CKD group has 2.8 times to suffer microalbuminuria than non-risk CKD group (odd ratio=2.8, 95% CI=1.062-7.437).

Conclusion

In apparently healthy type 2 diabetes mellitus patients, eGFR using Cockcroft-Gault formula is reliable compared to microalbuminuria for early detection of renal dysfunction. Patients with risk of CKD

have more chance to have microalbuminuria 2.8 times than non-risk CKD group.

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