Chemistry Research Journal, 2021, 6(2):151-156

Available online www.chemrj.org

Research Article

ISSN: 2455-8990
CODEN(USA): CRJHA5

Comparison of Urinary micro-albumin analysis: Precision testing on two separately operated Cobas chemistry analyzers c501

Ishrat Sultana, Junaid Mahmood Alam, Sarah Sughra Asghar, Mahwish Amin, Afsheen Sardar

Department of Biochemistry lab services and Chemical Pathology, Liaquat National Hospital and Medical College, Karachi. Pakistan. 1Department of Anatomy, Sir Syed Institute of Medical Sciences, Karachi-Pakistan (Corresponding address; dr_jmalam@hotmail.com)

Abstract *Background:* Urinary micro-albumin is parameter which is considered as an early indicator of glomerular insufficiency, which leads to renal failure, if remains untreated, thus requires accurate and precise estimation. *Aim*: Present study described precision analysis of TINA-QUANT urinary micro-albumin on two separately operated Cobas c 501 chemistry analyzers to assess accuracy and reproducibility of both instruments, analytical skills of variable set of staff that is performing the test and stability of kits. *Materials and Methods*: Confirmed cases of diabetes mellitus from both genders were selected for the present study during Dec 2020 to March 2021. Patients' with micro-albuminuria in diabetes mellitus with renal disease (n = 70) and hypertension (n = 70), sub classified as males and females with n = 35 patients each. Micro-albumin was performed in samples received as per 2nd morning urine collected from all patients and co-morbid groups. All samples were processed and in duplicate using both Cobas c501 chemistry analyzers tagged as A and B. *Results:* Precision via regression analysis R^2 values were between 0.981 (female diabetics) to 0.942 (male Renal disease), which was 94.2% to 98.1% accurate between the runs on two separately operated instruments. *Conclusion:* Regression correlation data showed precision of 94% to 98% which is highly appreciable keeping in view the fact that both set of Cobas c501 were operated by two separate sets of staff, suggesting efficiency, accuracy and efficacy of the system and operations.

Keywords Urinary micro-albumin analysis, Cobas chemistry, TINA-QUANT

Introduction

Quality parameters are one of the main milestones of any clinical laboratory for precise, accurate, time-bound, reproducible results for better and thorough clinical decisions by physicians and off-course patient's satisfaction. In last two decades, many international and regional regulatory associations initiated quality control and assurance programs for clinical laboratories to evaluate, maintain and sustain their services, most importantly for those operational 24/7, and tertiary care [1,2]. Special emphasis was also given to those particular test parameters that can detect end stage diseases, debilitating clinical conditions and/or chronic metabolic derangements. Urinary micro-albumin is one of such parameter which is considered as an early indicator of glomerular insufficiency, which leads to renal failure, if remains untreated. Interestingly, excretion of urinary micro-albumin of less than 30 mg/24 hours still reflects risk factor for deterioration of metabolic pathways and sometimes development of cardiovascular incongruity. Present study described precision analysis of TINA-QUANT urinary micro-albumin on two separately

operated Cobas c 501 chemistry analyzers to assess accuracy and reproducibility of both instruments, analytical skills of variable set of staff that is performing the test and stability of kits. Previously we have reported correlation of urinary micro-albumin in diabetes and hypertension and precision analyses on Cobas 6000 series versus conventional Hitachi 912 chemistry analyzer with more than 90% accuracy and regression analysis of R^2 0.90 in all runs [3,4].

Materials and Methods

Patients Selection

Confirmed cases of diabetes mellitus from both genders were selected for the present study which was conducted at Department of Biochemistry Lab services & Chemical Pathology, Liaquat National Hospital and Medical College during Dec 2020 to March 2021. Patients' with micro-albuminuria in diabetes mellitus with renal disease (n = 70) and hypertension (n = 70), sub classified as males and females with n = 35 patients each. By definition, renal insufficiency was considered significant when protein to creatinine ratio was greater than 1.0; and patients were categorized as diabetic where fasting was greater than 125 mg/dl or HbA1c greater than 8.0%. The patients were considered hypertensive that manifested blood pressure equal or higher than 140/90 mmHg. The average ages of patients in groups and sub-groups were renal insufficiency: F = 35-78 yrs, M = 35-84 yrs; diabetics F = 34-79 yrs, M = 35-86 yrs and hypertensive: F = 35-75 yrs and M = 34-79 yrs.

Analysis of urinary micro-albumin on Cobas c 501 chemistry analyzers

Analysis of Micro-albumin was performed in samples received as per 2^{nd} morning urine collected from all patients and co-morbid groups. All samples were processed and in duplicate using both Cobas c501 chemistry analyzers tagged as A and B. Both analyzers were operated by two different sets of trained technologists, 24/7, as per need of turn around time. Cobas c501A and B are operated by set of Medical technologists, Assistant Medical Technologists and certified technicians working as per their duty rota. Kit was TINA-QUANT of urinary albumin methodology (Roche-Diagnostics, Pakistan and Basil) and processed according to manufacturer's advices.

Statistical analysis

Data presented as mean ± standard deviation and statistically compared with $P < 0.05$. Regression correlation analysis was performed by comparing data generated by Cobas c501 A and B on X axis Y axis, respectively.

Results:

Results are summarized in Figures 1 to 6. Data exhibited considerable linearity when sample results of urinary micro-albumin from Females and Males, diabetic, hypersensitive and renal insufficient were compared between two separately operated Cobas c501 chemistry analyzer designated as A and B. Both Cobas c501 (Roche Diagnostics, Basil) A and B are operated by different set of Medical technologists, Assistant Medical Technologists and certified technicians working as per their duty rota in morning, evening and night shifts. TINA-QUANT kit of urinary albumin (Roche-Diagnostics, Pakistan and Basil) was used and processed according to manufacturer's advices. Precision via regression analysis R^2 value was between 0.981 (Fig 6) (female diabetics) to 0.942 (Fig 4) (male Renal disease), which was 94.2% to 98.1% accurate between the runs on two separately operated instruments. Data of all precision comparison and analytical runs exhibited linear, considerably good regression, thus confirming, accuracy of kit, reproducibility, efficiency of staff and maintained working status of both instruments.

Discussion

Of all the measurable chemical parameters in cases of kidney insufficiency or hypertension or uncontrolled diabetes mellitus, micro-albumin is one of the most significant markers to detect, assess and determine extent of severity, pathogenesis and prognosis [5-7]. Albumin is documented to be very carefully regulated biochemical components, hemostasis of which depends on renal efficiency and metabolic efficacy [6].

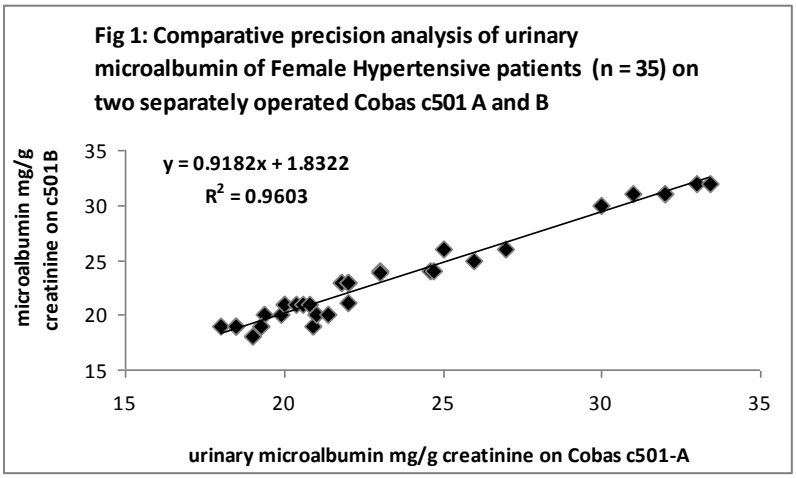

Fig 1: Comparative precision analysis of urinary microalbumin of Female Hypertensive patients (n = 35) on two separately operated Cobas c501 A and B

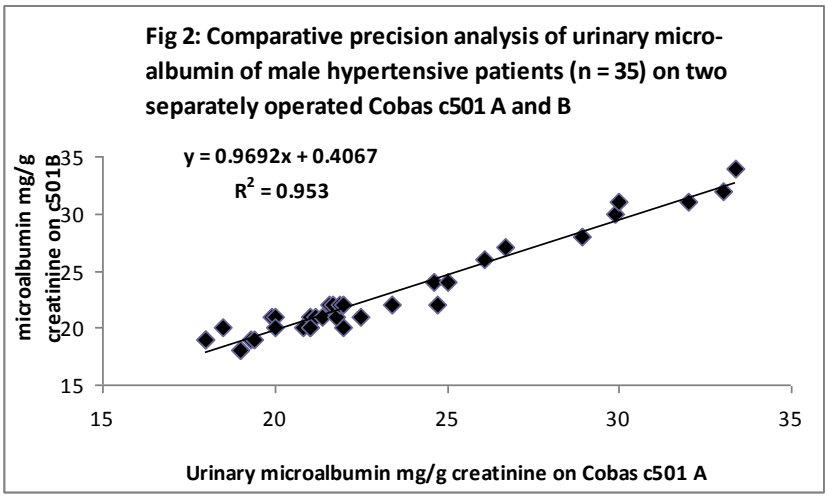

Fig 2: Comparative precision analysis of urinary micro-albumin of male hypertensive patients (n = 35) on two separately operated Cobas c501 A and B

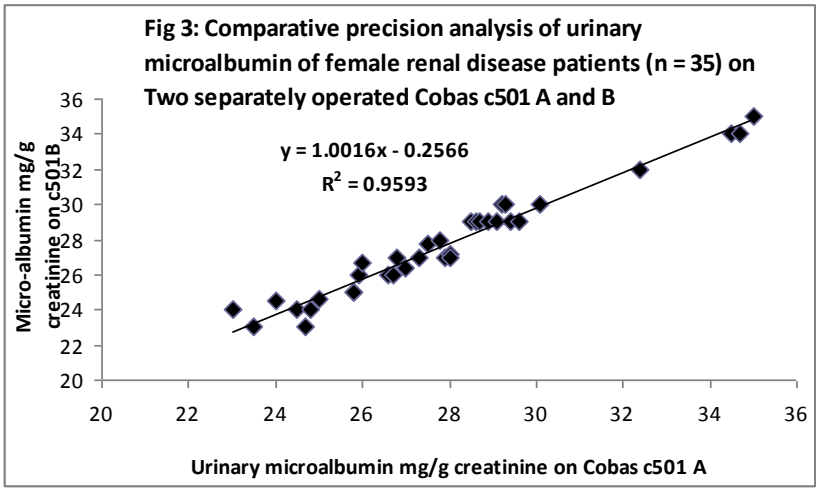

Fig 3: Comparative precision analysis of urinary microalbumin of female renal disease patients (n = 35) on Two separately operated Cobas c501 A and B

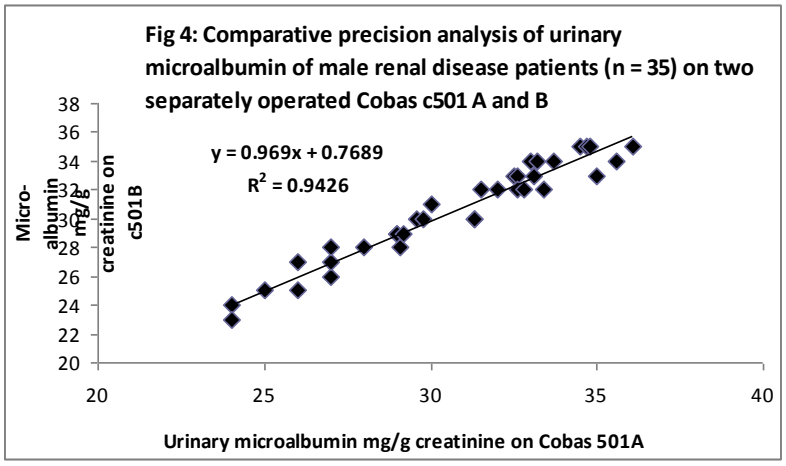
Fig 4: Comparative precision analysis of urinary microalbumin of male renal disease patients (n = 35) on two separately operated Cobas c501 A and B
y = 0.969x + 0.7689
R2 = 0.9426
Micro-albumin mg/g creatinine on c501B
Urinary microalbumin mg/g creatinine on Cobas 501A

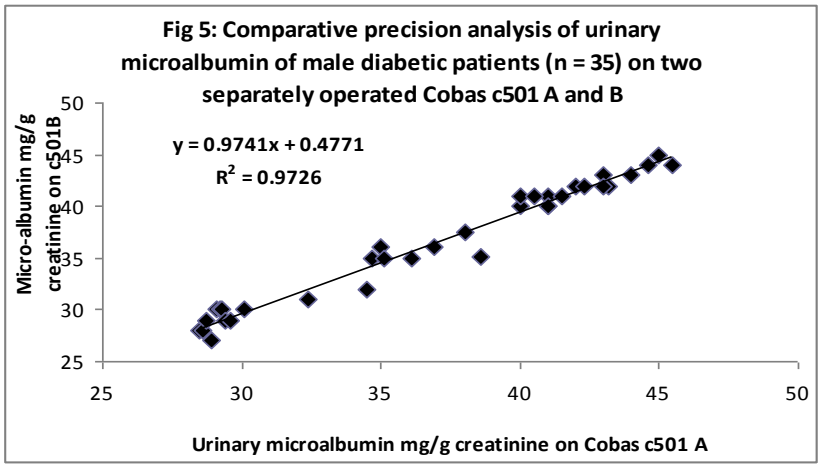
Fig 5: Comparative precision analysis of urinary microalbumin of male diabetic patients (n = 35) on two separately operated Cobas c501 A and B
y = 0.9741x + 0.4771
R2 = 0.9726
Micro-albumin mg/g creatinine on c501B
Urinary microalbumin mg/g creatinine on Cobas c501 A

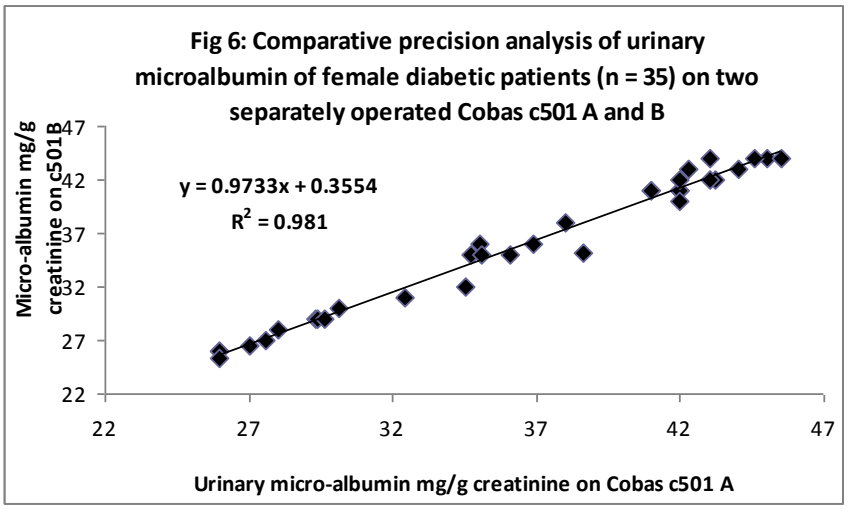
Fig 6: Comparative precision analysis of urinary microalbumin of female diabetic patients (n = 35) on two separately operated Cobas c501 A and B
y = 0.9733x + 0.3554
R2 = 0.981
Micro-albumin mg/g creatinine on c501B
Urinary micro-albumin mg/g creatinine on Cobas c501 A

Diabetic vascular complications and related physiological and physical dysfunctions are hallmark of untreated or chronic diabetes, manifested by micro-albuminuria, in addition to other parameters. Earlier studies recognized albuminuria as the most sensitive marker for dysfunctional kidneys and Hermann Senator suggested its estimation for the same as early as 19th century [7,8]. Significance of urinary micro-albumin can be ascertain by the fact that diabetic nephropathy stages are correlated with how much urinary micro-albumin excreted such as Stage I Diabetic nephropathy is characterized by micro-albumin level of 30-300 mg/24-hr urine. Nonetheless, estimation of 24 hr albumin level is considered as gold standard to assess urinary microalbuminuria associated with diabetes [5,6].

Previously, mostly during one and half decades of 1999-2013, dipstick, or semi-quantitative or semi automatic methods were used to assess urinary micro-albumin [1,2,9]. Even now in hundreds of lab, Point of care testing (POCT) facilities, use of semi-automatic or semi quantitative methods are common, 1st due to its easy accessibility and 2nd due to unavailability of high technology instruments and gadgetry [9-12] Thus many countries and via approval from regulatory authorities, POCT for micro-albumin are used for screening and/or even early diagnosis of chronic kidney diseases with morbid and evident micro-albuminuria, producing fair sensitivity and good negative predictive values [13-17]. However, with continuous demands for more and better accuracy, efficient turn around time, and reproducibility of results, technology gurus, tech companies and clinical lab diagnostic entities came up robust methods using artificial intelligence, proteomics, protein separation technology, biological mass spectrometry, protein interaction and bioinformatics to asses, estimate and analyze blood parameters, more importantly urinary micro-albumin for diabetic kidney disease [18]. Previously we have documented precision analysis of urinary microalbumin on Cobas 6000 series versus conventional Hitachi 912 chemistry analyzer with more than 90% accuracy and regression analysis of R^2 0.90 in all runs [3,4], suggesting efficient staff performance, sustainable accuracy and maintainable reproducibility, which ultimately benefits end-users and patients.

Conclusion

Precision analysis was performed on two separately operated Cobas c501 chemistry analyzers designated as A and B to assess accuracy, efficiency and reproducibility of both or either because both are operated by different sets of staff, 24/7 as per rota. Precision via regression analysis R^2 value was between 0.981 (female diabetics) to 0.942 (male Renal disease), which was 94.2% to 98.1% precise comparatively.

References

[1]. Alam JM, Sherwani SK, Hussain A, Matinuddin S, Kausar R, Ahmed A and Ansari MA. (2014a). Comparative assessment of analytical performance of conventional chemistry analyzer and modular Cobas 6000 system using Routine Chemistry parameters. Middle- East Journal of Scientific Research, 21(8): 1283-1287

[2]. Alam JM, Sherwani SK, Islam Z, Kausar R, Naureen S and Sultana I. (2014b) Performance evaluation of thyroid hormones and thyroid stimulating hormones (TSH) assays by conventional and modular electro-chemi Luminescence (ECL) systems. World Journal of Medical Sciences, 11(3): 315-319.

[3]. Alam JM, Ali HH, Sultana I, Amin M, Mahmood SR (2015). Clinical Significance of Urinary Microalbumin Estimation in Diabetic Patients with Co-Morbid of Hypertension and Renal Insufficiency. International Journal of Current Research, Vol. 07, issue, 05, pp-16242-16245.

[4]. Alam JM, Ali HH, Baig JA, Ahmed A Matinuddin S (2015). Precision analysis of urinary micro-albumin on convevtional Hitachi 912 and modular cobas 6000 c501 analyzers. International Journal of Current Research, Vol, 07, issue, 05, pp- 16379-16382.

[5]. Kiggundu T, Kalyesubula R, Andia-Biraro, Makanga G, Byakika-Kibwika P. (2020) Prevalence of microalbuminuria and associated factors among HIV − infected ART naïve patients at Mulago hospital: across-sectional study in Uganda BMC Nephrology (2020) 21:440 https://doi.org/10.1186/s12882-020-02091-2

[6]. Raja P, Maxwell AP, Brazil DP (2020) The Potential of Albuminuria as a Biomarker of Diabetic Complications. Cardiovascular Drugs and Therapy. https://doi.org/10.1007/ s10557-020-07035-4

[7]. Gansevoort RT, Ritz E. (2008) Hermann senator and albuminuria— forgotten pioneering work in the 19th century. Nephrol Dial Transplant. 24:1057–62.

[8]. Warren AM, Knudsen ST, Cooper ME (2019). Diabetic nephropathy: an insight into molecular mechanisms and emerging therapies. Expert Opin Ther Targets England. 2019; 23:579–91.

[9]. Currin, S.D., Gondwe, M.S., Mayindi, N.B. *et al.* (2021) Diagnostic accuracy of semiquantitative point of care urine albumin to creatinine ratio and urine dipstick analysis in a primary care resource limited setting in South Africa. *BMC Nephrol* **22,** 103. https://doi.org/10.1186/s12882-021-02290-5

[10]. McTaggart MP, Price CP, Pinnock RG, Stevens PE, Newall RG, Lamb EJ (2012). The diagnostic accuracy of a urine albumin-creatinine ratio point-of-care test for detection of albuminuria in primary care. Am J Kidney Dis, 60(5):787–94. https://doi.org/10.1053/j.ajkd.2012.05.009.

[11]. Graziani MS, Gambaro G, Mantovani L, et al (2009). Diagnostic accuracy of a reagent strip for assessing urinary albumin excretion in the general population. Nephrol Dial Transplant, 24(5):1490–4. https://doi.org/10.1093/ndt/gfn639.

[12]. Guy M, Newall R, Borzomato J, Kalra PA, Price C (2009). Diagnostic accuracy of the urinary albumin: creatinine ratio determined by the CLINITEK microalbumin and DCA 2000+ for the rule-out of albuminuria in chronic kidney disease. Clin Chim Acta, 399(1–2):54–8. https://doi.org/10.1016/j.cca.2008.09.006.

[13]. Le Floch JP, Marre M, Rodier M, Passa PH. (2001). Interest of clinitek® microalbumin in screening for microalbuminuria: results of a multicentre study in 302 diabetic patients. Diabetes Metab, 27(1):36–9.

[14]. Croal BL, Mutch WJ, Clark BM, et al (2001). The clinical application of a urine albumin: Creatinine ratio point-of-care device. Clin Chim Acta, 307(1–2):15–21. https://doi.org/10.1016/S0009-8981(01)00450-8.

[15]. Meinhardt U, Ammann RA, Flück C, Diem P, Mullis PE (2003). Microalbuminuria in diabetes mellitus - efficacy of a new screening method in comparison with timed overnight urine collection. J Diabetes Complicat;17(5):254–7. https://doi.org/10.1016/S1056-8727(02)00180-0.

[16]. Nah EH, Cho S, Kim S, Cho HI (2017) . Comparison of urine albumin-to-creatinine ratio (ACR) between ACR strip test and quantitative test in prediabetes and diabetes. Ann Lab Med. 37(1):28–33. https://doi.org/10.3343/alm.2017.37.1.28.

[17]. Oyaert M, Delanghe JR. (2019) Semiquantitative, fully automated urine test strip analysis. J Clin Lab Anal. 33(5):1–7. https://doi.org/10.1002/jcla.22870

[18]. Lin S, Guo Y. (2021). Value Analysis of Using Urinary Microalbumin in Artificial Intelligence Medical Institutions to Detect Early Renal Damage in Diabetes", *Journal of Healthcare Engineering*, vol. Article ID 6678454, 13 pages, 2021. https://doi.org/10.1155/2021/6678454