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RESEARCH ARTICLE

Concordance of glomerular filtration rate with creatinine clearance in 24-hour urine and Schwartz and updated Schwartz formulas☆

María Luisa Salazar Gutiérrez, Cristina Ochoa Ponce, Juan Carlos Lona Reyes*, Sara Ivonne Gutiérrez Íñiguez

Departamento de Pediatría, Hospital Civil de Guadalajara Dr. Juan I. Menchaca, Guadalajara, Jalisco, Mexico

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KEYWORDS
Glomerular filtration rate;
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Abstract
Background: Reference methods for the quantification of the glomerular filtration rate (GFR) are difficult to use in clinical practice; formulas for evaluating GFR based on serum creatinine (SCr) and/or creatinine clearance are used. The aim of this study was to quantify the correlation and concordance of GFR with creatinine clearance in 24-hour urine (GFR24) and Schwartz and Schwartz updated formulas.
Methods: Cross-sectional study involving healthy pediatric patients and with chronic kidney disease (CKD) from 5 to 16.9 years. Linear correlation between GFR 24 and two formulas was evaluated with the Pearson correlation coefficient (r) and intraclass correlation coefficient (ICC).
Results: We studied 134 patients, of which 59.7% were male. Mean age was 10.8 years. The average GFR24 was 140.34 ml/min/1.73 m^2; 34.3% (n = 46) had GFR <90 ml/min/1.73 m^2. Moderate linear correlation between GFR24 and Schwartz (r= 0.63) and Schwartz updated (r= 0.65) formulas was observed. There was good concordance between the GFR24 and Schwartz (ICC= 0.77) and updated Schwartz (ICC= 0.77) formulas. Schwartz classical formula in patients with GFR24 $\geq$ 90 ml/min/1.73 m^2 estimated higher values, while Schwartz updated underestimated values.

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* Corresponding author.
E-mail addresses: carloslona5@hotmail.com, juancarloslonareyes@yahoo.com.mx (J.C. Lona Reyes).

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Conclusions: There is moderate correlation and good concordance between the GFR24 and Schwartz and Schwartz updated formulas. The concordance was better in patients with obesity and lower in women, patients with hyperfiltration and normal weight.

PALABRAS CLAVE
Tasa de filtración glomerular;
Insuficiencia renal;
Enfermedades del riñón

Concordancia de la tasa de filtración glomerular con depuración de creatinina en orina de 24 horas, fórmulas de Schwartz y Schwartz actualizada

Resumen
Introducción: Los métodos de referencia para cuantificar la tasa de filtración glomerular (TFG) son poco accesibles en la práctica clínica. Para evaluar la TFG se utilizan fórmulas basadas en la creatinina sérica y/o aclaramiento de creatinina. El objetivo de este estudio fue cuantificar la correlación y concordancia de la TFG con depuración de creatinina en orina de 24 horas (TFG24) y fórmulas de Schwartz y Schwartz actualizada.
Métodos: Estudio transversal analítico que incluyó pacientes de 5 a 16.9 años, sanos y con enfermedad renal crónica. Se evaluó la relación lineal entre la TFG24 y ambas fórmulas con el coeficiente de correlación de Pearson (r) y la concordancia con el coeficiente de correlación intraclase (CCI).
Resultados: Se estudiaron 134 pacientes, 59.7% de género masculino, la edad promedio fue 10.8 años. La TFG24 promedio fue 140.34 ml/min/1.73 m^2; el 34.3% (n = 46) presentaron TFG < 90 ml/min/1.73 m^2. Se observó moderada relación lineal entre la TFG24 y las fórmulas de Schwartz (r= 0.63) y Schwartz actualizada (r= 0.65). Hubo buena concordancia entre la TFG24 y fórmula de Schwartz (CCI= 0.77) y de Schwartz actualizada (CCI= 0.77). En pacientes con TFG24 $\geq$ 90 ml/min/1.73 m^2 la fórmula de Schwartz clásica estimó valores mayores de TFG, mientras que Schwartz actualizada subestimó los valores.
Conclusiones: Existe moderada correlación y buena concordancia entre la TFG24 y fórmulas de Schwartz y Schwartz actualizada. Con ambas fórmulas la concordancia fue mayor en pacientes con obesidad y menor en mujeres, pacientes con hiperfiltración y con peso normal.

1. Introduction

Chronic kidney disease (CKD) is defined as the abnormality of structure or renal function which persists for more than three months and has implications on health. The diagnosis is established by the presence of a decrease in the glomerular filtration rate (GFR) < 60 ml/min/1.73m^2; or the presence of one or more renal failure markers, such as albuminuria, abnormalities in the urine sediment, electrolyte imbalance due to tubular disorders, histological abnormalities, structural alterations or history of transplantation, irrespective of GFR level.[1]

The reference methods for the estimation of GFR use the renal clearance of exogenous substances such as insulin and chromium-51-ethylenediamine tetraacetic acid (51Cr-EDTA), iohexol iothalamate. However, they are invasive high-cost methods and difficult to implement in practice both in studies of scrutiny and monitoring of patients with CKD.[2–4]Different conditions such as gender, muscle mass, a high protein diet, intake of drugs or the presence of chemical interference (glucose, bilirubin) can influence the values of serum creatinine. Therefore, its accuracy to estimate GFR alone is not suitable given the heterogeneity of results and the variability in its ability to predict GFR.[1,5]

For the initial evaluation of GFR, it is recommended to use formulas based on serum creatinine SCr and patients with filtration rates of < 60 ml/min/1.73 m^2, and to confirm the results of additional measurements of clearance of cystatin C.[1,5,6] The quantification of SCr should be performed using tests that comply with international reference standards and that are comparable with the isotope dilution mass spectrometry (IDMS).[1,7]

Since 1976, Schwartz formula has been used to estimate GFR in patients under 18 years of age. However, due to the implementation of new methods that replaced the Jaffé reaction to quantify the SCr, the formula has been less used because it overestimates the GFR.[4,8–12] In 2009, Schwartz et al. proposed an updated formula to be used when the measurement of Scr is performed by enzymatic methods.[4]

Normal GFR values depend on the age, gender and height, and are approximately 126.5 $\pm$ 24 ml/min/1.73 m^2 in children from two to five years of age, and 116.7 $\pm$ 20.2 ml/min/1.73 m^2 in scholars and adolescents.[3,13] Quantified or estimated GFR could be classified as