CARACTERÍSTICAS CLÍNICO-PATOLÓGICAS DE LA PODOCITOPATÍA POR GLOMERULOESCLEROSIS FOCAL Y SEGMENTARIAPOR MICROSCOPIA ELECTRÓNICA EN LA REGIÓN CARIBE COLOMBIANA

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RESUMEN

Glomeruloesclerosis focal y segmentaria, también es llamada hialinosis focal y segmentaria, hace referencia a un patrón histológico, pero que indica un síndrome clínico patológico, siendo este una característica posiblemente de seis etiologías subyacentes distintas que como se ha venido mencionando lo característico que se va a observar es la cicatrización del glomérulo de forma progresiva, de tal forma que estas etiologías comparten un tema común de lesión y depleción de los podocitos, lo que se concluye no es una enfermedad única, sino un patrón morfológico de lesión que se desarrolla a partir de una amplia gama de etiologías.

Objetivo: Evaluar las características clínico-patológicas de la podocitopatía por glomeruloesclerosis focal y segmentaria por microscopia electrónica en la región caribe colombiana

Métodos: Se presentaron las variables cuantitativas como medianas y rangos intercuartílicos, mientras que las variables categóricas se describieron con frecuencias absolutas y relativas. El análisis incluyó pruebas como el test de Wilcoxon para las medianas según el sexo y la prueba exacta de Fisher para variables categóricas. Se empleó análisis de correspondencia múltiple para explorar relaciones entre hallazgos de microscopía y variables clínicas. La normalidad se evaluó con la prueba de Shapiro-Wilk, considerando $p < 0.05$ como significativo. Se utilizó el software R-CRAN versión 4.3.2 para los análisis estadísticos.

Resultados: En el estudio de 21 pacientes con podocitopatía GEFS, la mediana de edad fue 40 años, con predominio masculino (57%). Hipertensión arterial (33%) y enfermedad renal crónica (19%) fueron las comorbilidades más comunes. El síndrome nefrótico se presentó en el 86%, con hematuria en el 57%. Albúmina sérica fue menor en hombres ($p=0.03$), y la tasa de filtrado glomerular (TFG) fue más baja en mujeres ($p=0.0153$). Microscopía reveló esclerosis segmentaria (95%) y tubulopatía (58%). La microscopía electrónica destacó características como pérdida de pedicelos y depósitos subendoteliales/mesangiales (14%). El análisis de correspondencia múltiple sugiere asociación entre hematuria, esclerosis segmentaria y tubulopatía, proporcionando una caracterización integral de la podocitopatía GEFS y subrayando la relevancia de la evaluación diferencial por género y la interrelación de parámetros clínicos.

Conclusión: La comprensión detallada de las características clínico-patológicas sienta las bases para enfoques más efectivos en el diagnóstico y tratamiento de esta compleja podocitopatía.

Palabras clave: Glomeruloesclerosis focal y segmentaria, Microscopia electrónica; Rubulopatía

ABSTRACT

Focal segmental glomerulosclerosis, also known as focal and segmental hyalinosis, refers to a histological pattern indicating a clinical-pathological syndrome. This pattern is likely a characteristic of six distinct underlying etiologies. As previously mentioned, the common feature observed is progressive glomerular scarring. These etiologies share a common theme of podocyte injury and depletion, suggesting it is not a singular disease but a morphological pattern arising from a wide range of causes.

Objective: To evaluate Clinical-pathological characteristics of podocytopathy due to focal segmental glomerulosclerosis by electron microscopy in the Colombian Caribbean region.

Methods: Quantitative variables were presented as medians and interquartile ranges, while categorical variables were described using absolute and relative frequencies. Analysis included tests such as the Wilcoxon rank-sum test for medians by gender and Fisher's exact test for categorical variables. Multiple correspondence analysis explored relationships between microscopy findings and clinical variables. Data normality was assessed with the Shapiro-Wilk test, considering $p < 0.05$ as significant. Statistical analyses were performed using R-CRAN software version 4.3.2.

Results: In the study of 21 patients with podocytopathy due to FSGS, the median age was 40 years, with a male predominance (57%). Arterial hypertension (33%) and chronic kidney disease (19%) were the most common comorbidities. Nephrotic syndrome occurred in 86%, with hematuria in 57%. Serum albumin was significantly lower in males ($p=0.03$), and glomerular filtration rate (GFR) was lower in females ($p=0.0153$). Light microscopy revealed segmental sclerosis (95%) and tubulopathy (58%). Electron microscopy highlighted features such as podocyte foot process effacement and subendothelial/mesangial deposits (14%). Multiple correspondence analysis suggested an association between hematuria, segmental sclerosis, and tubulopathy, providing a comprehensive characterization of podocytopathy due to FSGS and emphasizing the importance of gender-specific differential evaluation and the interrelation of clinical parameters.

Conclusion: A detailed understanding of clinical-pathological features lays the foundation for more effective approaches in the diagnosis and treatment of this complex podocytopathy.

Key Words: Focal segmental glomerulosclerosis; Electron microscopy; Tubulopathy.

REFERENCIAS BIBLIOGRÁFICAS

1. De Luis Román D, Bustamante J. Aspectos nutricionales en la insuficiencia renal. Nefrologia. 2008;28(3):333–42.
2. Gainza FJ. INSUFICIENCIA RENAL AGUDA. 2023;1–23.
3. Vaidya SR, Aeddula NR. Chronic Renal Failure. StatPearls. 2023.
4. Gyurászová M, Gurecká R, Bábíčková J, Tóthová Ľ. Oxidative Stress in the Pathophysiology of Kidney Disease: Implications for Noninvasive Monitoring and Identification of Biomarkers. Oxid Med Cell Longev. 2020;2020:5478708.
5. Rapa SF, Di Iorio BR, Campiglia P, Heidland A, Marzocco S. Inflammation and Oxidative Stress in Chronic Kidney Disease-Potential Therapeutic Role of Minerals, Vitamins and Plant-Derived Metabolites. Int J Mol Sci. 2019 Dec;21(1).
6. Panizo S, Martínez-Arias L, Alonso-Montes C, Cannata P, Martín-Carro B, Fernández-Martín JL, et al. Fibrosis in Chronic Kidney Disease: Pathogenesis and Consequences. Int J Mol Sci [Internet]. 2021 Jan 2;22(1). Available from: http://www.ncbi.nlm.nih.gov/pubmed/33401711
7. Martens CR, Kirkman DL, Edwards DG. The Vascular Endothelium in Chronic Kidney Disease: A Novel Target for Aerobic Exercise. Exerc Sport Sci Rev. 2016 Jan;44(1):12–9.
8. Risso MA, Sallustio S, Sueiro V, Bertoni V, Gonzalez-Torres H, Musso CG. The Importance of Tubular Function in Chronic Kidney Disease. Int J Nephrol Renovasc Dis [Internet]. 2019 Dec;2019(12):257–62. Available from: https://www.dovepress.com/the-importance-of-tubular-function-in-chronic-kidney-disease-peer-reviewed-article-IJNRD
9. Ma K, Gao W, Xu H, Liang W, Ma G. Role and Mechanism of the Renin-Angiotensin-Aldosterone System in the Onset and Development of Cardiorenal Syndrome. J Renin Angiotensin Aldosterone Syst. 2022;2022:3239057.

10. Cabrera SS. Definición y clasificación de los estadios de la enfermedad renal crónica . Prevalencia . de riesgo de enfermedad renal crónica. NEFROLOGIA. 2004;24(6):27–34.
11. Chen TK, Knicely DH, Grams ME. Chronic Kidney Disease Diagnosis and Management: A Review. JAMA [Internet]. 2019 Oct 1;322(13):1294–304. Available from: http://www.ncbi.nlm.nih.gov/pubmed/31573641
12. Nordheim E, Geir Jenssen T. Chronic kidney disease in patients with diabetes mellitus. Endocr Connect [Internet]. 2021 Apr 29;10(5):R151–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/33830068
13. Hovind P, Tarnow L, Rossing K, Rossing P, Eising S, Larsen N, et al. Decreasing incidence of severe diabetic microangiopathy in type 1 diabetes. Diabetes Care. 2003 Apr;26(4):1258–64.
14. Sica DA. The kidney and hypertension: causes and treatment. J Clin Hypertens (Greenwich). 2008 Jul;10(7):541–8.
15. Jara A, Mezzano S. [Vascular damage in chronic kidney disease]. Rev Med Chil. 2008 Nov;136(11):1476–84.
16. Taddei S, Nami R, Bruno RM, Quatrini I, Nuti R. Hypertension, left ventricular hypertrophy and chronic kidney disease. Heart Fail Rev. 2011 Nov;16(6):615–20.
17. Bidani AK, Griffin KA. Pathophysiology of Hypertensive Renal Damage. Hypertension. 2004 Nov;44(5):595–601.
18. Sun D, Wang J, Shao W, Wang J, Yao L, Li Z, et al. Pathogenesis and Damage Targets of Hypertensive Kidney Injury. J Transl Intern Med. 2020 Dec;8(4):205–9.
19. Akbar S, Bokhari SRA. Polycystic Kidney Disease. StatPearls. 2023.
20. Rishor-Olney CR, Hinson MR. Obstructive Uropathy. StatPearls. 2023.
21. Kazancioğlu R. Risk factors for chronic kidney disease: an update. Kidney Int Suppl. 2013 Dec;3(4):368–71.
22. Damtie S, Biadgo B, Baynes HW, Ambachew S, Melak T, Asmelash D, et al. Chronic Kidney Disease and Associated Risk Factors Assessment among Diabetes Mellitus Patients at A Tertiary Hospital, Northwest Ethiopia. Ethiop

J Health Sci. 2018 Nov;28(6):691–700.

23. Thomas R, Kanso A, Sedor JR. Chronic kidney disease and its complications. Prim Care. 2008 Jun;35(2):329–44, vii.
24. Hashmi MF, Benjamin O, Lappin SL. End-Stage Renal Disease. StatPearls. 2023.
25. Pergola PE, Pecoits-Filho R, Winkelmayer WC, Spinowitz B, Rochette S, Thompson-Leduc P, et al. Economic Burden and Health-Related Quality of Life Associated with Current Treatments for Anaemia in Patients with CKD not on Dialysis: A Systematic Review. PharmacoEconomics - open. 2019 Dec;3(4):463–78.
26. Darlington O, Dickerson C, Evans M, McEwan P, Sörstadius E, Sugrue D, et al. Costs and Healthcare Resource Use Associated with Risk of Cardiovascular Morbidity in Patients with Chronic Kidney Disease: Evidence from a Systematic Literature Review. Adv Ther. 2021 Feb;38(2):994–1010.
27. Hull KL, Adenwalla SF, Topham P, Graham-Brown MP. Indications and considerations for kidney biopsy: an overview of clinical considerations for the non-specialist. Clin Med. 2022 Jan;22(1):34–40.
28. Pugh D, Gallacher PJ, Dhaun N. Management of Hypertension in Chronic Kidney Disease. Drugs. 2019 Mar;79(4):365–79.
29. Gounden V, Bhatt H, Jialal I. Renal Function Tests. StatPearls. 2023.
30. Adejumo OA, Okaka EI, Okwuonu CG, Iyawe IO, Odujoko OO. Serum C-reactive protein levels in pre-dialysis chronic kidney disease patientsin southern Nigeria. Ghana Med J. 2016 Mar;50(1):31–8.
31. Bouvet BR, Paparella C V., Arriaga SMM, Monje AL, Amarilla AM, Almará AM. Evaluation of urinary N-acetyl-beta-D-glucosaminidase as a marker of early renal damage in patients with type 2 diabetes mellitus. Arq Bras Endocrinol Metabol. 2014 Nov;58(8):798–801.
32. Madalena LB, Facio ML, Bresciani PD, Fraind SA, Alejandre ME, Pandolfo M, et al. Excreción de proteínas de bajo peso molecular en pacientes con proteinuria a cadena liviana como marcadoras de disfunción renal. Acta Bioquim Clin Latinoam. 2004;38(1):17–22.

33. Wu M-T, Lam K-K, Lee W-C, Hsu K-T, Wu C-H, Cheng B-C, et al. Albuminuria, proteinuria, and urinary albumin to protein ratio in chronic kidney disease. J Clin Lab Anal. 2012 Feb;26(2):82–92.
34. Moreno JA, Sevillano Á, Gutiérrez E, Guerrero-Hue M, Vázquez-Carballo C, Yuste C, et al. Glomerular Hematuria: Cause or Consequence of Renal Inflammation? Int J Mol Sci. 2019 May;20(9).
35. Inoue K, Streja E, Tsujimoto T, Kobayashi H. Urinary albumin-to-creatinine ratio within normal range and all-cause or cardiovascular mortality among U.S. adults enrolled in the NHANES during 1999-2015. Ann Epidemiol. 2021 Mar;55:15–23.
36. Shaikh H, Hashmi MF, Aeddula NR. Anemia of Chronic Renal Disease [Internet]. StatPearls. 2023. Available from: http://www.ncbi.nlm.nih.gov/pubmed/4975372
37. Arnold R, Issar T, Krishnan A V, Pussell BA. Neurological complications in chronic kidney disease. JRSM Cardiovasc Dis [Internet]. 2016;5:2048004016677687. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27867500
38. Kaw D, Malhotra D. Platelet dysfunction and end-stage renal disease. Semin Dial [Internet]. 2006;19(4):317–22. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16893410
39. Espi M, Koppe L, Fouque D, Thaunat O. Chronic Kidney Disease-Associated Immune Dysfunctions: Impact of Protein-Bound Uremic Retention Solutes on Immune Cells. Toxins (Basel) [Internet]. 2020 May 6;12(5). Available from: http://www.ncbi.nlm.nih.gov/pubmed/32384617
40. Fevrier-Paul A, Soyibo AK, Mitchell S, Voutchkov M. Role of Toxic Elements in Chronic Kidney Disease. J Heal Pollut [Internet]. 2018 Dec;8(20):181202. Available from: http://www.ncbi.nlm.nih.gov/pubmed/30560001
41. Warrens H, Banerjee D, Herzog CA. Cardiovascular Complications of Chronic Kidney Disease: An Introduction. Eur Cardiol [Internet]. 2022 Feb;17:e13. Available from: http://www.ncbi.nlm.nih.gov/pubmed/35620357
42. Sahadevan M, Kasiske BL. Hyperlipidemia in kidney disease: causes and

consequences. Curr Opin Nephrol Hypertens [Internet]. 2002 May;11(3):323–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11981263

43. Spoto B, Pisano A, Zoccali C. Insulin resistance in chronic kidney disease: a systematic review. Am J Physiol Renal Physiol [Internet]. 2016 Dec 1;311(6):F1087–108. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27707707
44. Rosenstein K, Tannock LR. Dyslipidemia in Chronic Kidney Disease [Internet]. Endotext. 2000. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23067652
45. Dialysis in chronic kidney disease [Internet]. Institute for Quality and Efficiency in Health Care (IQWIG). Colonia, Alemania; 2018. Available from: //www.ncbi.nlm.nih.gov/books/NBK492979/
46. Carminatti M, Tedesco-Silva H, Silva Fernandes NM, Sanders-Pinheiro H. Chronic kidney disease progression in kidney transplant recipients: A focus on traditional risk factors. Nephrology (Carlton) [Internet]. 2019 Feb;24(2):141–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/30159972
47. Ghanta M, Jim B. Renal Transplantation in Advanced Chronic Kidney Disease Patients. Med Clin North Am [Internet]. 2016 May;100(3):465–76. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27095639
48. Hole B, Hemmelgarn B, Brown E, Brown M, McCulloch MI, Zuniga C, et al. Supportive care for end-stage kidney disease: an integral part of kidney services across a range of income settings around the world. Kidney Int Suppl [Internet]. 2020 Mar;10(1):e86–94. Available from: http://www.ncbi.nlm.nih.gov/pubmed/32149013
49. Sultan S, Nasir K, Qureshi R, Dhrolia M, Ahmad A. Assessment of the Nutritional Status of the Hemodialysis Patients by Anthropometric Measurements. Cureus [Internet]. 2021 Oct;13(10):e18605. Available from: http://www.ncbi.nlm.nih.gov/pubmed/34765364
50. Lordsleem A, Gueiros APS, Gueiros JE de B, Markman Filho B, Victor EG.

Cardiac evaluation of patients with chronic kidney disease: what lessons? J Bras Nefrol [Internet]. 2012 Mar;34(1):8–15. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22441176

51. McKercher CM, Venn AJ, Blizzard L, Nelson MR, Palmer AJ, Ashby MA, et al. Psychosocial factors in adults with chronic kidney disease: characteristics of pilot participants in the Tasmanian Chronic Kidney Disease study. BMC Nephrol [Internet]. 2013 Apr 12;14:83. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23586969
52. Ahmed S, Mothi SS, Sequist T, Tangri N, Khinkar RM, Mendu ML. The Kidney Failure Risk Equation Score and CKD Care Delivery Measures: A Cross-sectional Study. Kidney Med [Internet]. 2022 Jan;4(1):100375. Available from: http://www.ncbi.nlm.nih.gov/pubmed/35072040
53. Felipe Inserra, María Lía Torres, Alberto Alles CB. Evaluación de la función renal para la detección y seguimiento de la enfermedad renal crónica. Documento multidisciplinario de consenso 2021. Especial atención sobre situaciones clínicas específicas. FABA. 2022;56.
54. Gómez-Carracedo A, Arias-Muñana E, Jiménez-Rojas C. Enfermedad renal crónica - Progesión de la IRC. Nefrol al dia [Internet]. 2016;36(1):[48-55]. Available from: https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S0211-69952016000500048&lng=es&nrm=iso&tlng=es
55. Kwek JL, Pang HQJ, Li H, Lim WWL, Choo JCJ, Choong HL, et al. Validation of the kidney failure risk equation in predicting the risk of progression to kidney failure in a multi-ethnic Singapore chronic kidney disease cohort. Singapore Med J [Internet]. 2022 Jun;63(6):313–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/36043308
56. Grams ME, Brunskill NJ, Ballew SH, Sang Y, Coresh J, Matsushita K, et al. The Kidney Failure Risk Equation: Evaluation of Novel Input Variables including eGFR Estimated Using the CKD-EPI 2021 Equation in 59 Cohorts. J Am Soc Nephrol [Internet]. 2023 Mar 1;34(3):482–94. Available from: http://www.ncbi.nlm.nih.gov/pubmed/36857500

57. Hundemer GL, Tangri N, Sood MM, Ramsay T, Bugeja A, Brown PA, et al. Performance of the Kidney Failure Risk Equation by Disease Etiology in Advanced CKD. Clin J Am Soc Nephrol. 2020 Oct;15(10):1424–32.
58. Matsushita K, Mahmoodi BK, Woodward M, Emberson JR, Jafar TH, Jee SH, et al. Comparison of risk prediction using the CKD-EPI equation and the MDRD study equation for estimated glomerular filtration rate. JAMA [Internet]. 2012 May 9;307(18):1941–51. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22570462
59. Coca SG, Zabetian A, Ferket BS, Zhou J, Testani JM, Garg AX, et al. Evaluation of Short-Term Changes in Serum Creatinine Level as a Meaningful End Point in Randomized Clinical Trials. J Am Soc Nephrol [Internet]. 2016 Aug;27(8):2529–42. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26712525
60. Gómez-Carracedo A, Arias-Muñana E, Jiménez-Rojas C. Enfermedad renal crónica - Progesión de la IRC. Nefrol al dia. 2016;36(1):[48-55].
61. López CAN. Predicción de progresión de enfermedad renal crónica en pacientes diabéticos por la fórmula Kidney Failure Risk Equation (KFRE) en población mexicana. Tecnologico de Monterrey. 2 Instituto Tecnológico y de Estudios Superiores de Monterrey Escuela de Medicina y Ciencias de la Salud; 2020.
62. Bhachu HK, Fenton A, Cockwell P, Aiyegbusi O, Kyte D, Calvert M. Use of the kidney failure risk equation to inform clinical care of patients with chronic kidney disease: a mixed-methods systematic review. BMJ Open. 2022 Jan;12(1):e055572.
63. Carrero JJ, Hecking M, Chesnaye NC, Jager KJ. Sex and gender disparities in the epidemiology and outcomes of chronic kidney disease. Nat Rev Nephrol. 2018 Mar;14(3):151–64.
64. Kovesdy CP. Epidemiology of chronic kidney disease: an update 2022. Kidney Int Suppl. 2022 Apr;12(1):7–11.
65. Lewandowski MJ, Krenn S, Kurnikowski A, Bretschneider P, Sattler M, Schwaiger E, et al. Chronic kidney disease is more prevalent among women

but more men than women are under nephrological care : Analysis from six outpatient clinics in Austria 2019. Wien Klin Wochenschr. 2023 Feb;135(3–4):89–96.

66. Mallappallil M, Friedman EA, Delano BG, McFarlane SI, Salifu MO. Chronic kidney disease in the elderly: evaluation and management. Clin Pract (Lond). 2014;11(5):525–35.
67. Hamrahian SM, Falkner B. Hypertension in Chronic Kidney Disease. Adv Exp Med Biol. 2017;956:307–25.
68. Georgianos PI, Agarwal R. Hypertension in chronic kidney disease—treatment standard 2023. Nephrol Dial Transplant. 2023 Jun;
69. Abraham HMA, White CM, White WB. The comparative efficacy and safety of the angiotensin receptor blockers in the management of hypertension and other cardiovascular diseases. Drug Saf. 2015 Jan;38(1):33–54.
70. Bravo-Zúñiga J, Saldarriaga EM, Chávez-Gómez R, Gálvez-Inga J, Valdivia-Vega R, Villavicencio-Carranza M, et al. Effectiveness of adherence to a renal health program in a health network in Peru. Rev Saude Publica. 2020 Aug;54:80.
71. Li PK-T, Garcia-Garcia G, Lui S-F, Andreoli S, Fung WW-S, Hradsky A, et al. Kidney health for everyone everywhere - from prevention to detection and equitable access to care. Brazilian J Med Biol Res = Rev Bras Pesqui medicas e Biol. 2020;53(3):e9614.
72. Kattah AG, Garovic VD. Understanding sex differences in progression and prognosis of chronic kidney disease. Ann Transl Med. 2020 Jul;8(14):897.
73. Prasad R, Jha RK, Keerti A. Chronic Kidney Disease: Its Relationship With Obesity. Cureus. 2022 Oct;14(10):e30535.
74. Bello AK, Alrukhaimi M, Ashuntantang GE, Basnet S, Rotter RC, Douthat WG, et al. Complications of chronic kidney disease: current state, knowledge gaps, and strategy for action. Kidney Int Suppl. 2017 Oct;7(2):122–9.
75. Abcar AC, Chan L, Yeoh H. What To Do for the Patient with Minimally Elevated Creatinine Level? Perm J. 2004;8(1):51–3.
76. O'Seaghdha CM. A Risk Score for Chronic Kidney Disease in the General

Population. HHS Author Manuscripts. 2013;

77. Kamath CC, Dobler CC, Lampman MA, Erwin PJ, Matulis J, Elrashidi M, et al. Implementation strategies for interventions to improve the management of chronic kidney disease (CKD) by primary care clinicians: protocol for a systematic review. BMJ Open. 2019 Aug;9(8):e027206.
78. Ameh OI, Ekrikpo U, Bello A, Okpechi I. Current Management Strategies of Chronic Kidney Disease in Resource-Limited Countries. Int J Nephrol Renovasc Dis. 2020;13:239–51.
79. García GG, Iyengar A, Kaze F, Kierans C, Padilla-Altamira C, Luyckx VA. Sex and gender differences in chronic kidney disease and access to care around the globe. Semin Nephrol. 2022 Mar;42(2):101–13.