Disease Markers 2018 vol.2018

Urinary clusterin is upregulated in nephropathia epidemica

Tazetdinova L., Valiullina A., Khaiboullina S.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2018 Ekaterina V. Martynova et al. Kidney insufficiency is a hallmark of nephropathia epidemica (NE). Little is known about the mechanisms of the NE kidney pathology, with current knowledge mainly based on findings in postmortem tissue. We have analyzed kidney damage biomarkers in urine collected from early- and late-phase NE using Bio-Plex kidney toxicity panels 1 and 2. To determine the disease specificity, kidney damage biomarkers were also analyzed in urine samples from patients diagnosed with gout, type 2 diabetes, systemic lupus erythematosus, and chronic kidney insufficiency. Analysis of 12 biomarkers suggests damage to the kidney proximal tubule at the onset of NE. Also, upregulation of biomarkers of inflammation and leukocyte chemotaxis were detected in NE urine. Furthermore, increased clusterin levels were found in early- and late-phase NE urine. Comparative analysis revealed that clusterin is a biomarker, upregulated in NE urine.

http://dx.doi.org/10.1155/2018/8658507

References

[1] J. Mustonen, S. Mäkelä, T. Outinen et al., "The pathogenesis of nephropathia epidemica: new knowledge and unanswered questions," Antiviral Research, vol. 100, no. 3, pp. 589-604, 2013.

[2] J. Li, J. Chen, G. Yang et al., "Case-control study of risk factors for human infection with avian influenza A (H7N9) virus in Shanghai, China, 2013," Epidemiology and Infection, vol. 143, no. 09, pp. 1826-1832, 2015.

[3] S. B. Garanina, A. E. Platonov, V. I. Zhuravlev et al., "Genetic diversity and geographic distribution of hantaviruses in Russia," Zoonoses and Public Health, vol. 56, no. 6-7, pp. 297-309, 2009.

[4] R. Yanagihara, H. L. Amyx, and D. C. Gajdusek, "Experimental infection with Puumala virus, the etiologic agent of nephropathia epidemica, in bank voles (Clethrionomys glareolus)," Journal of Virology, vol. 55, no. 1, pp. 34-38, 1985.

[5] G. Diglisic, C. A. Rossi, A. Doti, and D. K. Walshe, "Seroprevalence study of Hantavirus infection in the community based population," Maryland Medical Journal, vol. 48, no. 6, pp. 303-6, 1999.

[6] S. F. Khaiboullina, E. V. Martynova, Z. L. Khamidullina et al., "Upregulation of IFN-γ and IL-12 is associated with a milder form of hantavirus hemorrhagic fever with renal syndrome," European Journal of Clinical Microbiology & Infectious Diseases, vol. 33, no. 12, pp. 2149-2156, 2014.

[7] D. Ferluga and A. Vizjak, "Hantavirus nephropathy," Journal of the American Society of Nephrology, vol. 19, no. 9, pp. 1653-1658, 2008.

[8] Z. Bi, P. B. Formenty, and C. E. Roth, "Hantavirus infection: a review and global update," Journal of Infection in Developing Countries, vol. 2, no. 1, pp. 3-23, 2008.

[9] T. M. Cosgriff, "Mechanisms of disease in Hantavirus infection: pathophysiology of hemorrhagic fever with renal syndrome," Reviews of Infectious Diseases, vol. 13, no. 1, pp. 97-107, 1991.

[10] J. Mustonen, H. Helin, K. Pietilä et al., "Renal biopsy findings and clinicopathologic correlations in nephropathia epidemica," Clinical Nephrology, vol. 41, no. 3, pp. 121-126, 1994.

[11] J. Groen, J. A. Bruijn, M. N. Gerding, J. G. Jordans, A. Moll van Charante, and A. D. Osterhaus, "Hantavirus antigen detection in kidney biopsies from patients with nephropathia epidemica," Clinical Nephrology, vol. 46, no. 6, pp. 379-383, 1996.

[12] M. Temonen, J. Mustonen, H. Helin, A. Pasternack, A. Vaheri, and H. Holthöfer, "Cytokines, adhesion molecules, and cellular infiltration in nephropathia epidemica kidneys: an immunohistochemical study," Clinical Immunology and Immunopathology, vol. 78, no. 1, pp. 47-55, 1996.

[13] A. F. Bren, S. K. Pavlovčič, M. Koselj, J. Kovač, A. Kandus, and R. Kveder, "Acute renal failure due to hemorrhagic fever with renal syndrome," Renal Failure, vol. 18, no. 4, pp. 635-638, 1996.

[14] S. Makela, I. Ala-Houhala, J. Mustonen et al., "Renal function and blood pressure five years after Puumala virus-induced nephropathy," Kidney International, vol. 58, no. 4, pp. 1711-1718, 2000.

[15] D. Turcinov, I. Puljiz, A. Markotiá, I. Kuzman, and J. Begovac, "Clinical and laboratory findings in patients with oliguric and non-oliguric hantavirus haemorrhagic fever with renal syndrome: an analysis of 128 patients," Clinical Microbiology and Infection, vol. 19, no. 7, pp. 674-679, 2013.

[16] E. I. Germash, V. S. Timokhov, Zagidullin ShZ, I. M. Zagidullin, and S. N. Ozhgikhin, "The pathogenetic therapy of patients with a severe form of hemorrhagic fever and acute kidney failure," Terapevticheskiĭ Arkhiv, vol. 69, no. 11, pp. 26-30, 1997.

[17] T. F. Tsai, "Hemorrhagic fever with renal syndrome: clinical aspects," Laboratory Animal Science, vol. 37, no. 4, pp. 419-427, 1987.

[18] J. Mishra, Q. Ma, A. Prada et al., "Identification of neutrophil gelatinase-associated lipocalin as a novel early urinary biomarker for ischemic renal injury," Journal of the American Society of Nephrology, vol. 14, no. 10, pp. 2534-2543, 2003.

[19] W. K. Han, V. Bailly, R. Abichandani, R. Thadhani, and J. V. Bonventre, "Kidney injury molecule-1 (KIM-1): a novel biomarker for human renal proximal tubule injury," Kidney International, vol. 62, no. 1, pp. 237-244, 2002.

[20] W. E. Carson, J. E. Dierksheide, S. Jabbour et al., "Coadministration of interleukin-18 and interleukin-12 induces a fatal inflammatory response in mice: critical role of natural killer cell interferon-gamma production and STAT-mediated signal transduction," Blood, vol. 96, no. 4, pp. 1465-1473, 2000.

[21] J. Dvergsten, J. C. Manivel, R. Correa-Rotter, and M. E. Rosenberg, "Expression of clusterin in human renal diseases," Kidney International, vol. 45, no. 3, pp. 828-835, 1994.

[22] M. E. Rosenberg and M. S. Paller, "Differential gene expression in the recovery from ischemic renal injury," Kidney International, vol. 39, no. 6, pp. 1156-1161, 1991.

[23] M. A. Harding, L. J. Chadwick, V. H. Gattone II, and J. P. Calvet, "The SGP-2 gene is developmentally regulated in the mouse kidney and abnormally expressed in collecting duct cysts in polycystic kidney disease," Developmental Biology, vol. 146, no. 2, pp. 483-490, 1991.

[24] R. Correa-Rotter, M. E. Ibarra-Rubio, G. Schwochau et al., "Induction of clusterin in tubules of nephrotic rats," Journal of the American Society of Nephrology, vol. 9, no. 1, pp. 33-37, 1998.

[25] G. S. Jung, M. K. Kim, Y. A. Jung et al., "Clusterin attenuates the development of renal fibrosis," Journal of the American Society of Nephrology, vol. 23, no. 1, pp. 73-85, 2012.

[26] N. Kim, J. C. Yoo, J. Y. Han et al., "Human nuclear clusterin mediates apoptosis by interacting with Bcl-XL through Cterminal coiled coil domain," Journal of Cellular Physiology, vol. 227, no. 3, pp. 1157-1167, 2012.

[27] M. R. Wilson and S. B. Easterbrook-Smith, "Clusterin binds by a multivalent mechanism to the Fc and Fab regions of IgG," Biochimica et Biophysica Acta (BBA)-Protein Structure and Molecular Enzymology, vol. 1159, no. 3, pp. 319-326, 1992.

[28] L. E. French, J. Tschopp, and J. A. Schifferli, "Clusterin in renal tissue: preferential localization with the terminal complement complex and immunoglobulin deposits in glomeruli," Clinical and Experimental Immunology, vol. 88, no. 3, pp. 389-393, 1992.

[29] N. H. Choi, T. Mazda, and M. Tomita, "A serum protein SP40,40 modulates the formation of membrane attack complex of complement on erythrocytes," Molecular Immunology, vol. 26, no. 9, pp. 835-840, 1989.

[30] N. H. Choi, Y. Nakano, T. Tobe, T. Mazda, and M. Tomita, "Incorporation of SP-40,40 into the soluble membrane attack complex (SMAC, SC5b-9) of complement," International Immunology, vol. 2, no. 5, pp. 413-417, 1990.

[31] J. R. Saunders, A. Aminian, J. L. McRae, K. A. O'Farrell, W. R. Adam, and B. F. Murphy, "Clusterin depletion enhances immune glomerular injury in the isolated perfused kidney," Kidney International, vol. 45, no. 3, pp. 817-827, 1994.

[32] T. Ichimura, J. V. Bonventre, V. Bailly et al., "Kidney injury molecule-1 (KIM-1), a putative epithelial cell adhesion molecule containing a novel immunoglobulin domain, is upregulated in renal cells after injury," The Journal of Biological Chemistry, vol. 273, no. 7, pp. 4135-4142, 1998.

[33] V. S. Vaidya, S. S. Waikar, M. A. Ferguson et al., "Urinary biomarkers for sensitive and specific detection of acute kidney injury in humans," Clinical and Translational Science, vol. 1, no. 3, pp. 200-208, 2008.

[34] O. Liangos, M. C. Perianayagam, V. S. Vaidya et al., "Urinary N-acetyl-beta-(D)-glucosaminidase activity and kidney injury molecule-1 level are associated with adverse outcomes in acute renal failure," Journal of the American Society of Nephrology, vol. 18, no. 3, pp. 904-912, 2007.

[35] F. M. Rasche, B. Uhel, R. Ulrich et al., "Thrombocytopenia and acute renal failure in Puumala hantavirus infections," Emerging Infectious Diseases, vol. 10, no. 8, pp. 1420-1425, 2004.

[36] G. M. Bernier and M. E. Conrad, "Catabolism of human beta-2-microglobulin by the rat kidney," American Journal of Physiology-Legacy Content, vol. 217, no. 5, pp. 1359-1362, 1969.

[37] A. Sundberg, E. L. Appelkvist, G. Dallner, and R. Nilsson, "Glutathione transferases in the urine: sensitive methods for detection of kidney damage induced by nephrotoxic agents in humans," Environmental Health Perspectives, vol. 102, Supplement 3, pp. 293-296, 1994.

[38] D. J. Harrison, R. Kharbanda, D. S. Cunningham, L. I. McLellan, and J. D. Hayes, "Distribution of glutathione S-transferase isoenzymes in human kidney: basis for possible markers of renal injury," Journal of Clinical Pathology, vol. 42, no. 6, pp. 624-628, 1989.