

Protective Effects of Metformin on Renal Tubular Cells

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Received: April 19, 2013; **Revised:** September 19, 2013; **Accepted:** February 12, 2014

Keywords: Metformin; Kidney; Toxicity

Dear Editor,

Recently, we conducted a preclinical investigation to find the ameliorative properties of metformin on renal biochemical and histologic alterations of gentamicin-induced kidney damage in male Wistar rats (1). In this investigation, attenuation of gentamicin-induced acute kidney injury was found. Likewise, Taheri et al. conducted a study on the effects of metformin on renal tubular cells after unilateral ischemia reperfusion in rats' kidney. They observed that metformin provided kidney protection against ischemia and reperfusion-induced injury (2). They concluded that metformin has tissue-protective effect through activation of adenosine monophosphate-activated protein kinase (AMPK) and endothelial nitric oxide synthase (2). More recently we conducted a study on 70 male Wistar rats to test the efficacy of coadministering garlic extract and metformin in prevention of gentamicin-induced renal tubular damage in Wistar rats (3). The result of this study showed that metformin, garlic juice, or their combination had both curative and protective effects on gentamicin-induced kidney injury. In addition, Kim et al. conducted a study using metformin for diabetic rats for 17 weeks and found that treatment of diabetic rats with metformin had restored podocyte loss. They suggested that diabetes-induced podocyte loss in diabetic nephropathy could be suppressed by metformin through the repression of oxidative injury. They proposed that diabetes-induced podocyte loss in diabetic nephropathy could be reduced by metformin (4). Kim et al. found that the phosphorylation of adenosine monophosphate-activated protein kinase (AMPK) was decreased in the kidney of diabetic rats and metformin could restore its modification (4). Diabetic nephropathy is one of the most important complications of diabetes mellitus (5-11) and metformin has been broadly used for the treatment of type 2 diabetes (12). Thus, the suggestion of Baradaran et al. further attests our results and those by

Taheri et al., which stated metformin protects against tubular injury by restoring the biochemical alterations and modulation of oxidative stress on the tubules (2, 3). Furthermore, according to the study of Kim et al. metformin protects podocytes in diabetic nephropathy (4). On the other hand, there is also tubular cell injury in diabetic nephropathy due to glycosuria (12-18). These findings can more potentiate the clinical use of metformin in the prevention of diabetic nephropathy. Previously, Morales et al. showed that gentamicin-induced renal tubular damage was attenuated by metformin (17). It is evident that metformin treatment significantly attenuates the increase in malondialdehyde and total reactive oxygen species generation and restores both enzymatic and nonenzymatic antioxidants to their physiologic levels (18, 19). These findings advocate the use of metformin in diabetes due to its protective effect on kidney beyond its blood regulatory effects. In fact, it is reasonable to illuminate three different actions of metformin including blood sugar regulatory property, renal tubular cell protection by acting as an effective antioxidant, and finally, protective effect on diabetic nephropathy through saving the podocytes (4, 18, 19). Hence, patients with diabetes might benefit from all of these three distinct protective properties (4, 18, 19). In this regard, more experimental or clinical studies are recommended to improve our knowledge regarding the kidney protective properties of metformin.

Acknowledgements

Hereby we express our thanks to Shahrekord University of Medical Sciences for financial support of this work.

Authors' Contributions

Mahmoud Rafeian Kopaei prepared the primary draft and Azar Baradaran completed and edited it.

Funding/Support

Research Deputy of Shahrekord University of Medical Sciences financially supported the study.

References

1. Amini FG, Rafieian-Kopaei M, Nematbakhsh M, Baradaran A, Nasri H. Ameliorative effects of metformin on renal histologic and biochemical alterations of gentamicin-induced renal toxicity in Wistar rats. *J Res Med Sci*. 2012;17(7):621-5.
2. Taheri N, Azarmi Y, Neshat M, Garjani A, Doustar Y. Study the effects of metformin on renal function and structure after unilateral ischemia-reperfusion in rat. *Res Pharm Sci*. 2012;7(5):S77.
3. Baradaran A, Rafieian-kopaei M. Histopathological study of the combination of metformin and garlic juice for the attenuation of gentamicin renal toxicity in rats. *J Renal Inj Prev*. 2012;2(1):15-21.
4. Kim J, Shon E, Kim CS, Kim JS. Renal podocyte injury in a rat model of type 2 diabetes is prevented by metformin. *Exp Diabetes Res*. 2012;2012:210821.
5. Baradaran A. Lipoprotein(a), type 2 diabetes and nephropathy; the mystery continues. *J Nephropathol*. 2012;1(3):126-9.
6. Tolouian R, T. Hernandez G. Prediction of diabetic nephropathy: The need for a sweet biomarker. *J Nephropathol*. 2013;2(1):4-5.
7. Tavafi M. Protection of renal tubules against gentamicin induced nephrotoxicity. *J Renal Inj Prev*. 2012;2(1):5-6.
8. Tavafi M. Diabetic nephropathy and antioxidants. *J Nephropathol*. 2013;2(1):20-7.
9. Nasri H. Acute kidney injury and beyond. *J Renal Inj Prev*. 2012;1(1):1-2.
10. Hajivandi A, Amiri M. World Kidney Day 2014: Kidney disease and elderly. *J Parathyroid Dis*. 2014;2(1):3-4.
11. Hundal RS, Krssak M, Dufour S, Laurent D, Lebon V, Chandramouli V, et al. Mechanism by which metformin reduces glucose production in type 2 diabetes. *Diabetes*. 2000;49(12):2063-9.
12. Tavafi M. Inhibition of gentamicin-induced renal tubular cell necrosis. *J Nephropathol*. 2012;1(2):83-6.
13. Nasri H, Rafieian-Kopaei M. Metformin improves diabetic kidney disease. *J Nephroparmacol*. 2012;1(1):1-2.
14. Kari J. Epidemiology of chronic kidney disease in children. *J Nephropathol*. 2012;1(3):162-3.
15. Tamadon MR, Beladi-Mousavi SS. Erythropoietin; a review on current knowledge and new concepts. *J Ren Inj Prev*. 2013;2(4):119-21.
16. Rafieian-Kopaei M. Medicinal plants and the human needs. *J HerbMed Pharmacol*. 2013;1(1):1-2.
17. Morales AI, Detaille D, Prieto M, Puente A, Briones E, Arevalo M, et al. Metformin prevents experimental gentamicin-induced nephropathy by a mitochondria-dependent pathway. *Kidney Int*. 2010;77(10):861-9.
18. Sun YM, Su Y, Li J, Wang LF. Recent advances in understanding the biochemical and molecular mechanism of diabetic nephropathy. *Biochem Biophys Res Commun*. 2013;433(4):359-61.
19. Herrington WG, Nye HJ, Aung T. Metformin use in chronic kidney disease: new evidence to guide dosing. *QJM*. 2013;106(11):1059-61.