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Kidneys: The Victim Of Hypertension: Review

Islam Kamal*, Rehab Hamdy and Nourhan M.sayed
Kasr Alainy Faculty of Medicine, Cairo University, Egypt

Abstract

Background & objectives: Our review discuss the relation between hypertension and the renal system ,and show the cyclic effect of both hypertension and chronic kidney damage on each other, our objectives are to control the high blood pressure with minimal renal affection due to side effects of medications.

Materials & methods: many studies and trials compare between different antihypertensive drugs and their effects on kidneys which may decrease their efficiency.

Results: Angiotensin converting enzyme inhibitor (ACE-Is), angiotensin II receptor blocker (ARBs), Beta-blockers and calcium channel blockers are identified to be the second line of treatment of hypertension according to a network meta-analysis conducted in 2003, ACE-Is were found to show a significant effect in slowing the progression of nephrosclerosis and slower declining of GFR more than β-blocker or calcium channel blocker.

Conclusion: Kidney is indispensable organ in the body that we must protect it from the irreversible macroscopic and microscopic changes pathological as : macroscopic (small size, finely granular surface, adherent and difficulty stripped capsule, fibrotic, atrophic, not demarcated cortex on cut section, thick prominent arterioles and increased peripelvic fat) and microscopic (afferent and efferent arterioles show benign arteriosclerosis, gradual ischemic atrophy and fibrosis of the glomeruli, atrophy of non-functioning tubules related to atrophic glomeruli, may undergo compensatory cystic dilatation of tubule related to functioning glomeruli). ACE-Is is considered the drug of choice in hypertensive patients complicated with chronic kidney disease, In hypertensive patients that are refractory to medical treatment, renal sympathetic denervation is a safe alternative.

Keywords: Blood pressure dependency; Hypertension; Chronic renal failure; Renal denervation

Introduction

Normal blood pressure means the pressure that the blood affecting the normal body vessels and depends on many items like: cardiac output, vascular resistance and the total blood volume. In normal healthy people it should be below than 120 mmhg "systolic" and below than 80 mmhg "diastolic". When your blood pressure rises more than 140/90 it means that you are hypertensive [1]. Hypertension is one of the most leading causes of non-infectious death all over the world and considered one of the most common conditions that doctors can see in the primary care. Hypertension has many serious effects as coronary artery disease, chronic renal failure, myocardial infarction, cerebral stroke, aortic aneurysm and so on.

Kidneys are responsible for long term controlling blood pressure, except in hypotension, through the rennin angiotensin aldosterone system (RAAS) as follow (Figure 1): rennin is released form juxtaglomerular apparatus of the kidney which lead to cleavage of the angiotensinogen, secreted by the liver into blood, to form angiotensin1 and through angiotensin converting enzyme, produced by the lungs, which induce production of angiotensin2 from angiotensin1.

ACE has many actions through its effect on AT1 & AT2, but mainly on AT1:

On kidney: prevent natriuresis and cause vasoconstriction.

-On blood vessels: cause potent vasoconstriction.

-On adrenal cortex: increase release of aldosterone which stimulates sodium reabsorption from distal nephron.

-On brain: have vasopressor action when injected intraventricular [2]

Diabetes is the first cause of CKD then HTN is the second one [3,4] also increase age has a role in such disease, CKD is defined as persistent kidney damage accompanied by reduction GFR and presence of albuminuria, So the damaged kidney fail to filter the blood from wastes and fluid, lead to increase the blood volume which cause increase in blood pressure (HTN), HTN has been found to occur in 85% to 95% of patients with CKD (stages 3-5) [5].

The uncontrolled hypertensive patients have an increased intraglomerularal pressure that lead to damage of glomeruli & increase protein filtration, so this shows the relation between HTN and CKD, how both of them can cause the other Figure 2, and the importance of maintaining BP normal to decrease renal disease and cardiovascular morbidity and mortality [3].

Reno vascular hypertension reflects the relation between anatomically evident artero-occulosion disease and hypertension. Approximately two third of renovascular hypertension caused by atherosclerosis of renal artery and the other one third caused by fibro muscular disease and other congenital anomalies [6]. There are other clinical entities as: acute renal thrombosis, embolism, cholesterol embolic disease, aortic dissection and so on.

Renal artery stenosis (RAS) is one of the commonest causes of renovascular hypertension, its prevalence increases by aging and many risk factors especially smoking but doesn't depend on race [6],

RAS is characterized by narrow arterial lumen by formation of atherosclerotic plaque due to increase the permeability of plasma macromolecules as LDL and increase of cells as macrophages, smooth muscle cells & endothelial cells, which lead to this lesion when these

***Corresponding author:** Islam Kamal, Medical Student, Kasr Alainy Faculty of Medicine, Cairo University, Egypt, Tel: 20 10 60 55056; E-mail: Islam.k.hamouda@students.kasralainy.edu.eg

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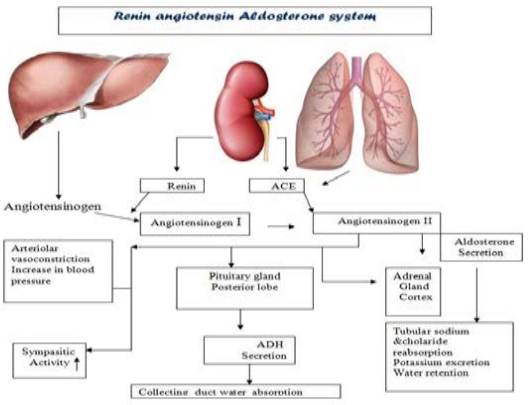


Figure 1: Illustrating the renal mechanism in controlling blood pressure.

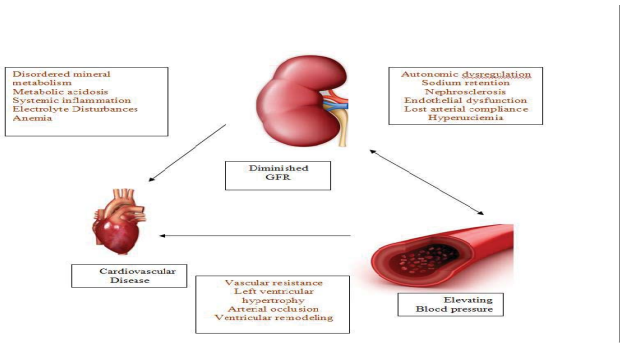


Figure 2: Cyclic relation between CKD and HTN

cells and lipoprotein become greater than certain level [6,7]. Figure 3 which will need early diagnosis and effective therapeutic management, it is better to be screened by contrast enhanced ultrasound which is a non-invasive procedure, then diagnosed by traditional echo color Doppler, So the cardiovascular complications can be found earlier.

RAS leads to HTN due to decrease in renal blood flow leading to reduction of renal perfusion followed by renal tissue damage and hypoplasia, also by activation of Renin angiotensin system [8] Figure 4. In case of unilateral renal ischemia: initiation of hyper secretion of rennin from this kidney that can be suppressed by the unaffected non stenotic kidney because it lack the same ischemic stimulus. But when the two kidneys are affected the hyperreninemia persists and blood pressure remains elevated because of angiotensin2 induced vasoconstriction of the vessels Figure 5.

In Reno vascular hypertension, the kidney undergoes serious changes such as reducing glomerular filtration rate, the surface become granular, and high protein loss and so on Table 1.

Discussion

In our review we studied the impact of long standing hypertension on renal system and how can the renal system affect the patients' blood pressure. Although hypertensive nephropathy isn't the most common complication of high blood pressure unlike cardiovascular disorders. Yet, high blood pressure is reported to be the second leading cause of end-stage renal disease.

Previously physicians thought that the tight control of hypertension

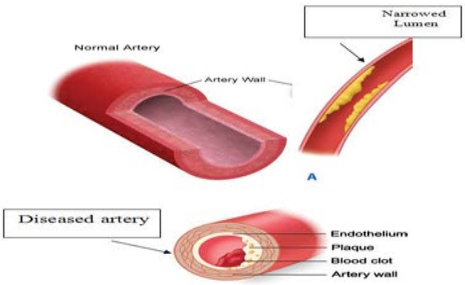


Figure 3: Show atherosclerotic plaque.

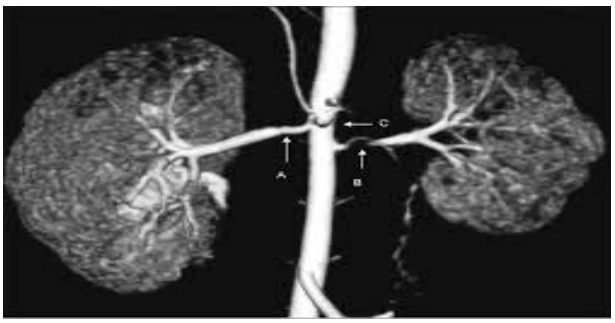


Figure 4: Show RAS.

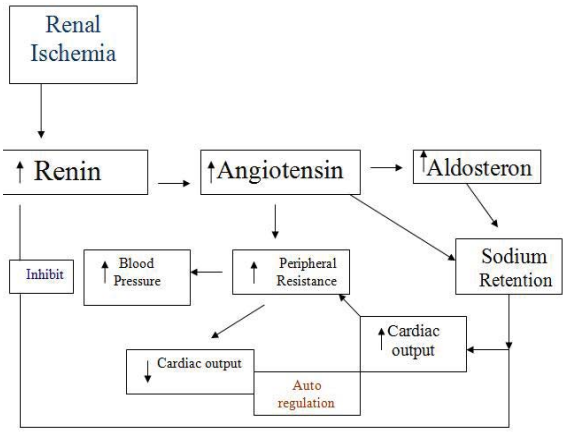


Figure 5: Shows mechanism of kidney in hypertension.

and the aggressive decline in blood pressure values contribute to renal dysfunction and rising of creatinine levels as a result of antihypertensive agents, so doctors used to decrease the dose of antihypertensive drugs in order to reach the normal baseline of creatinine level. Recently it is proved that this method is not optimal for the long term control of the disease including the renal affection as the benefits of the proper control of blood pressure outweigh the benefit of keeping a normal creatinine level. It's believed now that lowering blood pressure to the levels of current guidelines using the appropriate treatment plays an important role in decreasing the progression of renal affection [9].

Therefore, a lot of studies were performed to compare the effect of several types of drugs used on treatment of high blood pressure. Using

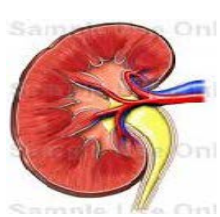
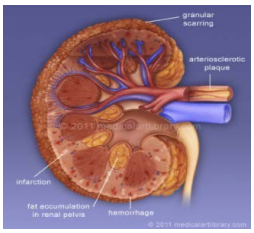
Items	Physiological kidney	Pathological hypertensive kidney
Picture		
Size	Normal	reduced
Surface	Smooth	Granular "bumpy"
Function	Healthy	reduced
Protein loss	Low	High
Renal artery	Non stenotic	stenotic
Hemorrhage	No he	May petechial hge
Endothelial	Normal	injured
Urine	No sugar content	May contain sugar due to damaged tubules
GFR	Normal	Low

Table 1: The difference between physiological and Pathological hypertensive kidney.

Diuretics as the first line of treatment of uncomplicated hypertensive patients plays a great role in decreasing the co-morbidity of hypertension. A low dose of thiazide Diuretics may be used as a combination with angiotensin converting enzyme inhibitor in hypertensive patients with kidney disease without the fear of changes in the renal function [9,10].

Angiotensin converting enzyme inhibitor (ACE-Is) , angiotensin II receptor blocker (ARBs), Beta-blockers and calcium channel blockers are identified to be the second line of treatment of hypertension according to a network meta-analysis conducted in 2003, however, further data are needed to compare between the second line drugs. In the HOPE randomized trial conducted on 980 patients with mild renal insufficiency , ACE-Is were found to show a significant effect in slowing the progression of nephrosclerosis and slower declining of GFR more than β-blocker or calcium channel blocker [10]. ACE-Is like ramipril used as a monotherapy is considered now the drug of choice in hypertension with kidney affection. The African American study of kidney disease and hypertension (AASK) recommended in a huge trial that intensive lowering of blood pressure below the current guidelines does not reduce the progression of nephropathy [9]. Their results supported that Angiotensin converting enzyme inhibitors are superior to calcium channel blockers and β-blockers. However, β-blockers may be more effective than CCBs in patients with kidney disease [9].

The failure of the mentioned drugs in treating hypertension made renal sympathetic denervation an optimal safe treatment for resistant hypertension. Renal sympathetic nerves have been an important pillar in the pathophysiology of hypertension. Many studies were conducted to show the degree of reduction of blood pressure and for follow up of postprocedure period. In Simplicity HTN 1,2 trials around 84% of patients underwent renal denervation had a reduction rate of ≥10 mmHg for 24 month in comparison to controls without any harm to the renal vasculature or deterioration of renal function [11]. This procedure can be done through a catheter or by radiofrequency ablation without major complication and was done by many case control studies that show a significant lowering of blood pressure in addition to preventing a lot of hypertension co-morbidities including chronic kidney disease. In simplicity trial 1 they suggested that the benefit from denervation that increases the glomerular filtration rate override the benefit of reducing blood pressure only, however, a controlled trial conducted in 2014 contradicted the previous studies outcomes and contributed those results to the patient compliance to treatment during the trial duration [4,5,12].

On reviewing further studies, there were new studies suggesting new lines of treatment like a clinical trial done last year working on inhibition of galectin-3 which is involved in the pathophysiology of renal damage in hypertension. They suggest that drugs that can block the effect of galectin-3 may be a good prevention tool of hypertensive nephropathy.

Another clinical trial suggested that a fatty acid called N-palmitoylethanolamide may lower blood pressure and protect against glomerulosclerosis and interstitial fibrosis through decreasing the production of 20-HETE that contributes to the oxidative stress, vascular reactivity to stress hormones and endothelial dysfunction. Thus, it may be used as a good treatment to suppress the pro-inflammatory systems in the kidney [12-14].

Another randomized trial compared using revascularization to medical treatment in renal artery stenosis cases found that revascularization does not have a great benefit with respect to renal function or blood pressure in comparison to medical treatment [11].

Conclusion

Finally, we should follow the rule says " Prevention is better than cure" because the kidney is indispensable organ in the body that we must protect it from the irreversible macroscopic and microscopic changes pathological as: macroscopic (small size, finely granular surface, adherent and difficulty stripped capsule, fibrotic, atrophic, not demarcated cortex on cut section, thick prominent arterioles and increased peripelvic fat) and microscopic (afferent and efferent arterioles show benign arteriosclerosis, gradual ischemic atrophy and fibrosis of the glomeruli, atrophy of non-functioning tubules related to atrophic glomeruli, may undergo compensatory cystic dilatation of tubule related to functioning glomeruli).

We should prevent also the precipitating factors as diet (high residue diet), sedentary life style and occupational hazards as over exposure to some medication and toxins. So, we need further research about alternating renal function and structure and how to be prevented.

References

1. Armstrong C; Joint National Committee (2014) JNC8 guidelines for the management of hypertension in adults. Am Fam Physician 90: 503-504.
2. Crowley SD, Gurley SB, Herrera MJ, Ruiz P, Griffiths R, et al. (2006) Angiotensin II causes hypertension and cardiac hypertrophy through its receptors in the kidney. Proc Natl Acad Sci U S A 103: 17985-17990.
3. Rao MV, Qiu Y, Wang C, Bakris G (2008) Hypertension and CKD: Kidney Early Evaluation Program (KEEP) and National Health and Nutrition Examination Survey (NHANES), 1999-2004. Am J Kidney Dis 51: S30-7.
4. Esler MD, Krum H, Sobotka PA, Schlaich MP, Schmieder RE, et al. (2010) Renal sympathetic denervation in patients with treatment-resistant hypertension (The Symplicity HTN-2 Trial): a randomised controlled trial. Lancet 376: 1903-1909.

5. Bhatt DL, Kandzari DE, O'Neill WW, D'Agostino R, Flack JM, et al. (2014) A controlled trial of renal denervation for resistant hypertension. N Engl J Med 370: 1393-1401.

6. Jazrawi A, Darda S, Burke P, Daccarett M, Stehlik J, et al. (2009) Is race a risk factor for the development of renal artery stenosis? Cardiol Res Pract 2009: 817987.

7. Jennings CG, Houston JG, Severn A, Bell S, Mackenzie IS, et al. (2014) Renal artery stenosis-when to screen, what to stent? Curr Atheroscler Rep 16: 416.

8. Lee JJ, Pai KS, Shin JI, Park SJ (2014) Renovascular hypertension treated by renal artery embolization. Yonsei Med J 55: 273-275.

9. Wright JT Jr, Bakris G, Greene T, Agodoa LY, Appel LJ, et al. (2002) Effect of blood pressure lowering and antihypertensive drug class on progression of hypertensive kidney disease: results from the AASK trial. JAMA 288: 2421-2431.

10. Cachofeiro V, Goicochea M, de Vinuesa SG, Oubiña P, Lahera V, et al. (2008) Oxidative stress and inflammation, a link between chronic kidney disease and cardiovascular disease. Kidney Int Suppl : S4-9.

11. Esler MD, Krum H, Schlaich M, Schmieder RE, Böhm M, et al. (2012) Renal sympathetic denervation for treatment of drug-resistant hypertension: one-year results from the Symplicity HTN-2 randomized, controlled trial. Circulation 126: 2976-2982.

12. Mattace Raso G, Simeoli R, Russo R, Santoro A, Pirozzi C, et al. (2013) N-Palmitoylethanolamide protects the kidney from hypertensive injury in spontaneously hypertensive rats via inhibition of oxidative stress. Pharmacol Res 76: 67-76.

13. ASTRAL Investigators, Wheatley K, Ives N, Gray R, Kalra PA, et al. (2009) Revascularization versus medical therapy for renal-artery stenosis. N Engl J Med 361: 1953-1962.

14. Ciccone MM, Cortese F, Fiorella A, Scicchitano P, Cito F, et al. (2011) The Clinical Role of Contrast-Enhanced Ultrasound in the Evaluation of Renal Artery Stenosis and Diagnostic Superiority as Compared to Traditional Echo-Color-Doppler Flow Imaging. Int Angiol 30: 135-139.