IJPSR (2021), Volume 12, Issue 5 (Research Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 12 May 2020; received in revised form, 21 September 2020; accepted, 24 September 2020; published 01 May 2021

USE OF ATENOLOL AND OLMESARTAN AS AN ADD-ON THERAPY WITH CALCIUM CHANNEL BLOCKER IN HEMODIALYSIS PATIENTS FOR HYPERTENSION

Gokul Sampathkumar [*1], K. P. Athira [1], A. Infant Smily [1] and Ilangovan Veerappan [2]

RVS College of Pharmaceutical Sciences, Coimbatore, Affiliated to the Tamilnadu Dr. MGR Medical University, Chennai - 641402, Tamil Nadu, India.
KG Hospital and Postgraduate Medical Institute [2], Coimbatore - 641018, Tamil Nadu, India.

Keywords:

Beta-blockers, Antihypertensives, Atenolol, Olmesartan, Add-on therapy

Correspondence to Author:
Gokul Sampathkumar

Pharm D Intern,
RVS College of Pharmaceutical Sciences, Coimbatore, Affiliated to The Tamilnadu Dr. MGR Medical University, Chennai - 641402, Tamil Nadu, India.

E-mail: ggokul76@gmail.com

ABSTRACT: Background: Management of hypertension in hemodialysis patients was never the same in all and tends to involve a various classes of drugs with respect to their disease conditions, response to drug therapy, medication adherence, and many more. Atenolol and Olmesartan can be used as add-on therapy in managing hypertension with calcium channel blockers. **Methodology:** Blood pressure was monitored using Continous Ambulatory Blood pressure monitoring for 24 h and patients with blood pressure above 160 mm Hg and who are free from Atenolol or Olmesartan were included in the study. They were given with Atenolol or Olmesartan as an add-on drug to the existing other class of antihypertensive drugs. After a period of 2 weeks, their 24 h ambulatory blood pressure was measured again. A comparative data of both the blood pressure data was established. **Results:** The overall 24 hours ambulatory systolic blood pressure dropped from 179.32 ± 10.823 to 168.36 ± 13.991, and overall diastolic pressure dropped from 90.72 ± 13.743 to 81.32 ± 12.750. Similarly, the mean heart rate decreased from 83.00 ± 6.198 to 77.48 ± 6.795. In addition to it, Olmesartan was found to be effective in lowering blood pressure when compared to Atenolol. **Conclusion:** Atenolol and Olmesartan can be effectively used as add-on therapy on hemodialysis patients with calcium channel blockers to control hypertension. Appropriate monitoring and titration of Atenolol and Olmesartan doses can help in managing blood pressure and cardiac comorbidities.

INTRODUCTION: Hypertension, one of the evident factors that contribute a lot in the development of cardiovascular disease-causing morbidity and mortality in a significant population. Hypertension causes damage to all the vital organs such as the heart, kidney, blood vessels that lead to ischemic heart diseases, renal failure, congestive heart failure, and stroke.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.12(5).2920-25

This article can be accessed online on www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.12(5).2920-25

Hypertension, therefore, poses a major risk and concern in modern medical practice [1].

Staging of Hypertension: The latest guidelines of the Joint National Committee (JNC-8) states that patients of age 18-59 free from major comorbidities, and in patients 60 years older who is known as diabetic or CKD, the desired blood pressure level is <140/90 mmHg. It also states that the drugs to be used should be limited to 4 classes such as calcium channel blockers, ACE inhibitors, Thiazide diuretics, and Angiotensin Receptor Blockers [2]. The optimal blood pressure during pre and post-dialysis is defined by the USA End-stage renal disease indicators as <150/90 mmHg and <135/85 without therapy or an ambulatory

nighttime blood pressure <120/80 mmHg without therapy [3, 4]. In most patients, diastolic hypertension is not always seen, along with Systolic hypertension. The evident positive relation of the systolic pressure with the risks of Coronary diseases and stroke suggests that control of systolic pressure towards the baseline as preferred can prevent the aforementioned disease in both the hypertensive and non-hypertensive population [5].

Haemodialysis Patients and their BP Variations: The blood pressure variation in patients during the multiple phases of haemodialysis is marked that it makes the treatment more complicated. The pressure readings can be measured in the dialysis unit just before dialysis, during, and after dialysis. Though definite evidence is not available yet, Some studies suggest that the systolic pressure measured before dialysis is overestimated by 10 mm Hg, and post dialysis systolic pressure is underestimated by 7 mmHg [6, 7]. Therefore in these patients, the blood pressure measured during interdialytic can best represent the actual BP variation and is considered to be the best indicator for chronic cardiovascular outcomes8.

Management of Hypertension in the patient on Haemodialysis :

Lifestyle Modifications: The typical lifestyle modifications such as low sodium intake, weight reduction, physical activity, fluid restriction, diet change should adhere to the prescribed level [9]. Another issue to be discussed is the tobacco use in haemodialysis patients, which increases the risk of development of congestive heart failure by 59%, development of peripheral vascular disease by 68 %, and overall mortality by 37% [10].

Dry Weight Maintenance: Dry weight may be defined as the lowest attainable weight at which patients are normotensive without antihypertensive medication and do not have symptoms of postural hypotension, intradialytic, or post-dialytic hypotension [11]. Dry weight is assessed with the criteria that the decrease in the blood pressure shall be in the range of <140/90 mmHg, and there should be an absence of peripheral oedema or pulmonary congestion [12, 13]. It is supported by the maintenance of sodium levels as they can directly lead to changes in blood pressure. For instance, a blood pressure changes of 4.2/2.0 mmHg to 5.2/3.7 mmHg and interdialytic weight gain of 1.25 kg can be achieved if the patient follows a two-gram sodium diet pattern [14, 15]. A 2.5 kg or more weight gain is associated with a significant rise in blood pressure [16, 17].

Anti-hypertensive Medications: Many randomized trials and meta-analyses showed that use of antihypertensive drugs has led to a decrease in cardiovascular morbidity and mortality in patients undergoing dialysis [18, 19]. Intravenous administration of loop diuretics causing negligible alterations in central hemodynamic parameters were proven by echocardiographic studies [20].

Angiotensin Receptor Blockers: The use of angiotensin receptor blockers has proven to not only reducing systolic blood pressure but also reduce cardiovascular events and mortality to a larger extent in haemodialysis patients and also improves the long-term prognosis [21, 22]. The cardiovascular outcomes were enhanced by improving pulse wave velocity and reducing left ventricular hypertrophy [23]. The markers of oxidative stress in haemodialysis patients can be markedly reduced by valsartan in combination with amlodipine [24, 25].

Calcium Channel Blockers: One of the most commonly prescribed antihypertensive in dialysis patients is calcium channel blockers [26, 27]. The acts by binding to alpha-1 subunit of L- type calcium channel and inhibits the calcium ion entry into the myocardial and vascular smooth muscles thereby decreasing the intracellular calcium [28]. The relaxation effect on the vascular smooth muscle of the coronary artery improves the systemic and pulmonary arterial circulation, leading to improved coronary blood flow, thereby reducing the oxygen demand of the cardiac cells [29].

Beta-Blockers: The kidney is richly supplied with sympathetic nerves. Patients with the end-stage renal disease with severe or moderate renal failure tend to show increased sympathetic activity [30]. The sympathetic activity level is an independent predictor of the total as well as cardiovascular mortality in patients with ESRD [31]. Beta-blocker is used to reduce cardiovascular morbidity and mortality in patients on chronic haemodialysis whenever the activity of the sympathetic nervous

system is increased [32]. Propranolol decreases glomerular filtration rate and renal blood flow by decreasing the cardiac output; thus, the increase in sympathetic activity raises systemic and renovascular resistance by reflex mechanisms. The chronic intake of propranolol leads to a reduction of renal blood flow and glomerular filtration rate [33].

Various types of patients, such as patients with normal renal function end-stage renal disease and hypertension along with diabetic nephropathy were given cardioselective beta-blockers that neither metoprolol nor atenolol produces any reduction in GFR or blood flow kidneys while lowering blood pressure in patients with essential hypertension, although both can increase renal vascular resistance [34, 35].

Aims and Objectives: To reduce the BP to less than 160 mmHg units in dialysis patients using Atenolol or Olmesartan as add-on therapy with Calcium Channel Blockers for patients undergoing haemodialysis. The objectives include i) To monitor the BP changes in patients who are in CCBii) To commence the drugs of interest for patients with systolic BP >160 mmHg iii) to evaluate the effectiveness of Atenolol or Olmesartan as add-on therapy with calcium channel blocker in dialysis patients for hypertension iv) To monitor heart rate in Atenolol group

Methodology: This is a prospective, non-randomized study and was conducted for a period of 6 months. The study was conducted in the Nephrology Department in a tertiary care hospital among 25 patients. The inclusion criteria include patients on maintenance HD for >6 months, patients whose Systolic BP is ≥160 mmHg, patients who are prescribed with a CCB, patients who do not take Olmesartan or Atenolol along with CCB.The study was approved by the Institutional Ethics Committee, and an ethical clearance certificate was issued. After obtaining Informed consent, the demographic data, past medical, medication, family, and dialysis history were collected. The patients were divided into two groups based on their heart rate and serum potassium level for appropriate drug therapy with Atenolol and Olmesartan. The paired t-tests and meant calculations were carried using SPSS software v 2.0 by IBM.

Baseline Measurement and Assessment: Eligible patients were checked for their Systolic and Diastolic BP in three categories as Asleep period, Awake period, and Overall BP using Continuous Ambulatory Blood Pressure Monitoring (CABP). Eligible patients were checked for their recent laboratory reports for their serum potassium level. Only those whose value near to the baseline are considered eligible for drug therapy with Angiotensin Receptor Blockers. Other comorbidities which can get worsen when the drugs of interest are prescribed as also assessed, such as Asthma, Hypothyroidism, Congestive Heart Failure, other pulmonary and cardiac comorbidities. By-standers were also interviewed for detailed information about the patients for their medication compliance, food habits, smoking/ alcohol habits, occupation, and other symptoms experienced during non-dialysis days in a week.

Diagnosis of Hypertension and Prescription of Atenolol or Olmesartan: Patients were initially screened for their BP changes over time using the dialysis log records, and those with systolic blood pressure more than 160 mmHg were picked for 24 h (CABP) monitoring. Heart rate and serum potassium were also assessed. Patients were divided into two groups such as Atenolol group and the Olmesartan group, respectively. In addition to calcium channel blockers like Amlodipineor Nifedipine, Atenolol or Olmesartan was prescribed as an add-on therapy and was asked to take drugs for two weeks. At the end of 14 days, patients were measured for 24 h ambulatory monitoring again. The ambulatory monitoring device provides data such as BP during the asleep period, awake period, overall value, and heart rate during the entire day. The first two weeks when BP fluctuations were monitored without any change in the prescription is considered as the control period, whereas the two weeks when the drugs were taken by the patient is considered as the test period.

The screening session involved 100 dialysis patients for their inclusion, and out of those, 25 were recruited to the study. All of them were diagnosed with hypertension with systolic blood pressure ≥of 160 mmHg. They were divided into two groups for drug therapy based on their updated prescription, heart rate, and serum potassium.

TABLE 1: DEMOGRAPHICAL CHARACTERISTICS OF THE STUDY POPULATION

Parameters	Values
Age in years	47 ± 9.826*
Number of males	15 out of 25
Number of females	10 out of 25
Predialysis weight (kg)	92.0 ± 28.24*
Post dialysis weight (kg)	88.1 ± 26.5*

*All data are means and standard deviations

TABLE 2: BLOOD PRESSURE DATA OF PATIENTS

	Parameters	Time	Mean ± std.dev	Mean difference	T value	Significance level
Night time	Systolic BP	Control period	179.16 ± 12.164	18.160	14.751	P<0.005
		Test Period	161.00 ± 10.004			
	Diastolic BP	Control period	94.64 ± 13.025	15.360	5.987	P<0.005
		Test Period	79.28 ± 11.816			
Day time	Systolic BP	Control period	181.84 ± 12.378	18.160	14.751	P<0.005
		Test Period	159.04 ± 10.322			
	Diastolic BP	Control period	98.48 ± 14.694	11.560	10.138	P<0.005
		Test Period	86.92 ± 11.131			
Overall	Systolic BP	Control period	179.32 ± 10.823	10.960	4.339	P<0.005
		Test Period	168.36 ± 13.991			
	Diastolic BP	Control period	90.72 ± 13.743	9.400	4.077	P<0.005
		Test Period	81.32 ± 12.750			

TABLE 3: HEART RATE OF PATIENTS DURING VARIOUS TIME PERIODS

Time		Mean ± std.dev	Mean difference	T value	Significance level
Asleep	Control period	78.72 ± 8.003	2.520	3.011	P<0.005
	Test Period	76.20 ± 5.993			
Awake	Control period	83.72 ± 6.407	4.000	6.576	P<0.005
	Test Period	79.72 ± 5.542			
Overall	Control period	83.00 ± 6.198	5.520	4.738	P<0.005
	Test Period	77.48 ± 6.795			

TABLE 4: BLOOD PRESSURE CHANGES IN PATIENTS TAKING ATENOLOL AND OLMESARTAN

Drug	Parameters	Time	Mean ± std.dev	Mean difference	T value	Significance level
Atenolol	Systolic BP	Control period	176.39 ± 9.657	9.217	5.534	P<0.005
		Test Period	167.17 ± 9.340			
	Diastolic BP	Control period	90.04 ± 12.323	10.000	6.022	P<0.005
		Test Period	80.04 ± 9.688			
Olmesartan	Systolic BP	Control period	179.15±10.136	16.667	6.125	P<0.005
		Test Period	162.48±15.902			
	Diastolic BP	Control period	89.78 ± 12.302	7.444	4.553	P<0.005
		Test Period	82.33 ± 12.655			

DISCUSSION: Our study aimed to evaluate the outcomes of blood pressure of dialysis patients when a Calcium channel blocker is supported by a beta-blocker or an Angiotensin receptor blocker as an add-on therapy. Calcium channel blockers are the most commonly prescribed drugs in dialysis patients for hypertension. These drugs are always given in combinations with other drugs [36]. As our study hypothesized that when these drugs are combined with a beta-blocker or an ARB can effectively reduce the BP provided that other factors involved in increasing BP are merely corrected and are maintained near the respective baselines. CABP Monitoring, being a gold standard method in assessing the BP at various time periods, fetched a bulk of data, including the patient's heart rate [37]. Though 48 h CABP is able to produce a detailed report on BP, the study was decided to proceed with 24 h CABP because of the time limitations [38]. The demographics showed that the ratio of male CKD is higher than the female population, which complies with the statistics [39]. Out of 25, most patients were identified to be in the age group of 41 to 50 years.

This represents the maximum percentage of people in the total study population, comprising about 36%. It also showed that the consecutive next big population lies in the age group of 31-40 with 26%. Atenolol, one of the dialysable drugs was not taken by the patients before the dialysis in the morning time. Atenolol, even in low doses, exhibited excellent bioavailability and effective in lowering blood pressure. Though there is a slight change of half-life in renal failure patients a good correlation between the peak concentration and pharmaco-dynamic response is good, as measured by a reduction in heart rate and systolic BP [40]. The level of significance attained using Paired t-test clearly denoted the significant changes at night. The mean blood pressure during daytime again proves the effectiveness of add-on therapy during daytime. The overall mean systolic BP reduced from 177.88 ± 9.915 mmHg to 164.64 ± 13.376 mmHg, and mean diastolic BP reduced from 90.16 ± 12.326 mmHg to 81.28 ± 8.792 mmHg. Similarly, the overall mean heart rate has reduced from 82.86 ± 5.966 b/min to 76.74 ± 5.924b/min with a mean difference of 6.120. No bradycardia has been observed in any single patient which complies with the study protocol.

Patients with variable dry weights during the study period were counseled to maintain adequate weight with respect to their fluid volume, age, and dialysis history. Patients were checked for their serum electrolytes level once a month. The data obtained through the clinical laboratory reports were assessed, and no tests were done exclusively for the study. As per those reports, serum potassium levels for the month of initiation of the study and the report of the previous month were analyzed. Once the therapy was initialized, the consecutive lab reports were also followed up for any changes seen.

CONCLUSION: This study aimed to prove the effectiveness of Atenolol or Olmesartan as add-on therapy with calcium channel blocker in dialysis patients for hypertension. Add-on therapy was provided, and a change in the BP values was very evident within 2 weeks. When compared to the usage CCB with other antihypertensives such as vasodilator, centrally acting antihypertensive, alpha-blocker and even diuretics, the best possible outcomes were obtained when it is combined with a beta-blocker or an ARB.

Multiple trials have demonstrated the reduction in mortality rate with ARB usage in CKD and hypertension. In addition to that, beta-blockade can provide secondary prophylaxis of coronary artery disease in high-risk patients. Though drugs are not the only factor that determines the blood pressure of CKD patients, other factors such as smoking and dietary habits, fluid and sodium intake, lifestyle modifications, and even medication adherence should be directed towards the goal of reducing the high blood pressure. This study thus concluded that addition Atenolol or Olmesartan to the standard pharmacotherapy helps in improving the quality of life of patients by improving their BP in long-term management. Clinical pharmacists shall actively participate in designing patient-specific antihyper-tensive regimens, daily patient review, and counsel on the importance of medication adherence in dialysis patients in improving their health outcomes.

ACKNOWLEDGEMENT: Nil

CONFLICTS OF INTEREST: Nil

REFERENCES:

1. Tripathi KD: Essentials of Medical Pharmacology. 7th edition. New Delhi: Jaypee Pvt. Ltd; 2014; 558.
2. Schwenk TL: New Hypertension guidelines, Joint National Committee guidelines seventh revision 2003.
3. Ahmad R, Habib A and Rehman S: International Journal of Advance Medicine 2016; 3(4): 790-98.
4. Rahman M, Griffin V, Kumar A and Manzoor F: A comparison of standardized versus “usual” blood pressure measurements in haemodialysis patients. Am J Kidney Dis 2002; 39(1): 1226-30.
5. Neaton JD, Kuller L and Stamler J: Impact of systolic and diastolic blood pressure on cardiovascular mortality. Diagnosis, and Management. 2 ed. New York: Raven Press 1995; 127(1): 144.
6. De Paula FM, Peixoto AJ and Pinto LV: Clinical consequences of an individualized dialysate sodium prescription in haemodialysis patients. Kidney Int 2004; 66(1): 1232-8.
7. Sinha AD: Cardiovascular protection with anti-hyper-tensive drugs in dialysis patients: Systematic review and meta-analysis. Nephrol dial transplant 2009; 53: 860-66.
8. Foley RN, Herzog CA and Collins AJ: Smoking and cardiovascular outcome in dialysis patients. Kidney Int 2003; 63(4): 1462-7.
9. Agarwal R: Cardiovascular protection with anti-hyper-tensive drugs in dialysis patients: Systematic review and meta-analysis. Nephrol dial transplant 2009; 53: 860-66.
10. Folly: Mechanism of Hypertension. American Journal of Kidney Disease 1996; 28(2): 257-61.
11. He FJ and MacGregor GA: Effect of modest salt reduction on blood pressure: A meta-analysis of randomized trial. Implications for public health. J Hum Hypertens 2002; 16: 761-70.

12. Agarwal R and Sinha AD: Cardiovascular protection with antihypertensive drugs in dialysis patients: Systematic review and meta-analysis. Nephrol Dial Transplant 2009; 53: 860-66.
13. HeerspinkHJ, Ninomiya T, Zoungas S, de Zeeuw D, Grobbee DE, Jardine MJ, Gallagher M, Roberts MA, Cass A, Neal B and Perkovic V: Effect of lowering blood pressure on cardiovascular events and mortality in patients on dialysis: A systematic review and meta-analysis of randomised controlled trials. Lancet 2009; 373: 1009-15.
14. Hayashi SY, Seeberger A, Lind B, Gunnes S, Alvestrand A and Brodin LA: Acute effects of low and high intravenous doses of furosemide on myocardial function in anuric haemodialysis patients: A tissue Doppler study. Nephrol Dial Transplant 2008; 23: 1355-61.
15. Ichihara A, Hayashi M and Kanisitro Y: Low doses of Losartan and Trandolapril improved arterial stiffness in haemodialysis patients. Am J Kidney Dis 2005; 45: 866-74.
16. Agarwal R, Nissenson AR and Battle D: prevalence treatment and control of hypertension in chronic haemodialysis patient in the United States. Am J Med 2003; 115: 291-7.
17. Kungys G, Naujoks H and Wanner C: Pharmacokinetics of Amlodipine in hypertensive patients undergoing haemo-dialysis. European Journal of Clinical Pharmacology 2003; 59: 291-5.
18. Zachariah PK, Moyer TP, Theobald. The pharmaco-kinetics of racemic verapamil in patients with impaired renal function. J Clin Pharmacol 1991; 31: 45-53.
19. Satosker RS, Nirmala NR and Bhardarkar SD: Pharmaco-logy and pharmacotherapeutics 24th edition 2015; 406-7.
20. Tepel M, Hopfenmueller W, Scholze A and Maler A: Effect of Amlodipine on cardiovascular events in hypertensive haemodialysis patients. Nephrol Dial Transplant 2008; 23: 2605-12.
21. Kestenbaun B, Gillen DL and Sherrard: Calcium channel blocker use and mortality among patients with end-stage renal disease. Kidney Int 2002; 61: 2157-64.
22. London GM, Pannier B and Guerin AP: Cardiac hypertrophy, aortic compliance, peripheral resistance and wave reflection in end-stage renal disease. Comparative effects of ACE inhibition and calcium channel blockade. Circulation 1994; 90: 2786-96.
23. Doyle GD, Donohue J, Carmody M and Laher M: Pharmacokinetics of amlodipine in renal impairment. Eur J Clin Pharmacol 1989; 36(2): 205-8.
24. Whelton PK, Watson AJ and Kone B: Calcium channel blockade in dialysis patients with left ventricular hypertrophy and well-preserved systolic function. J CardiovPharmacol 1987; 10: 185-7.
25. Zoccali C, Mallamaci F and Parlongo S: Plasma norepinephrine predicts survival and incident cardio-vascular events in patients with end-stage renal disease. Circulation 2002; 105: 1354-9.
26. Epstein M and Oster JR: Beta blockers and renal function: a reappraisal. J Clin Hypertens 1985; 1: 85-99.
27. Sugino G and Barg AP: Renal perfusion is preserved during cardioselective beta-blockade with metoprolol in hypertension. Am J Kidney Dis 1984; 3: 357-61.
28. Ljungman S and Wikstrand J: Effects of long-term anti-hypertensive treatment and aging on renal function and albumin excretion in primary hypertension. Am J Hypertens 1993; 6: 554-63.
29. Seiler KU and Schuster KJ: The pharmacokinetics of metoprolol and its metabolites in dialysis patients. Clin Pharmacokinet 1980; 5: 192-8.
30. Branten AJ, Hilbrands LB and Van Hamersvelt HW: Renal and systemic effects of atenolol and tertalol in renal transplant recipients on cyclosporine. Nephrol Dial Transplant 1998; 13: 423-6.
31. Agarwal R: Supervised atenolol therapy in the management of haemodialysis hypertension. Kidney Int. 1999; 55: 1528-35.
32. Alborzi: Home blood pressure monitoring is of greater prognostic value than haemodialysis units recordings. CJASN. 2007;2:1228-34.
33. Luther JM: Relationship between BP and mortality in dialysis patients. Kidney Int 2008; 73: 667-8.
34. Inrig JK, Oddone EZ and Hasselblad: Association of intradialytic blood pressure changes with hospitalization and mortality rates in prevalent ESRD patients. Kidney Int. 2007; 71: 454-61.
35. Shoji T, Tsubakihara Y, Fujii M and Imai E: Haemo-dialysis-associated hypotension as an independent risk factor for two-year mortality in haemodialysis patients. Kidney Int 2004; 66: 1212-20.
36. Huerta C, Castellsaque J, Varas C and Garcia LA: Nonsteroidal anti-inflammatory drugs and risk of ARF in the general population. Am J Kidney Dis 2005; 45(3): 531-9.
37. Davenport: Patients achieving pre- and post-dialysis UK RA blood pressure targets. Kidney International. 2008; 73: 759-4.
38. Kalantar-Zadeh: Association between BP and 15-month CV death in MHD patients. Hypertension. 2005;45:811-7.
39. Agarwal R. Hypertension in chronic kidney disease and dialysis: Pathophysiology and management. Cardiol Clin 2005; 23: 237-48.
40. Campese VM, Stein D and De Quattro V: Treatment of severe hypertension with minoxidil: advantages and limitations. The J of Clinical Pharmaco 1979; 19: 231-2.

How to cite this article:
Sampathkumar G, Athira KP, Smily IA and Veerappan I: Use of atenolol and olmesartan as an add-on therapy with calcium channel blocker in hemodialysis patients for hypertension. Int J Pharm Sci & Res 2021; 12(5): 2920-25. doi: 10.13040/IJPSR.0975-8232.12(5). 2920-25.