Bahrain Medical Bulletin, Vol. 36, No. 3, September 2014

Blood Pressure Control and Predictors of Uncontrolled Hypertension

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ABSTRACT

Background: Improving blood pressure control requires the identification of covariates associated with uncontrolled hypertension.

Objective: To evaluate blood pressure control and predictors for uncontrolled hypertension.

Design: A Cross-Sectional Study.

Setting: Cardiology Out-patient Department, Salmaniya Medical Complex.

Method: We documented personal factors, comorbidities, blood pressure measurements and the use of anti-hypertensive medications in 371 hypertensive patients from 1 January 2012 to 30 April 2012. Ordinal logistic regression was used to identify factors associated with poor blood pressure control.

Result: The mean age of the patients was 54.6 ± 11.8 years. Two hundred forty-six (66.3%) patients had a mean blood pressure of <140/90; the rest had a mean blood pressure of >140/90. Age group 45-65 years, multidrug regimen, and poorly controlled diabetes were independent predictors of poor blood pressure control. Three hundred thirty-eight (91.1%) patients were on polytherapy receiving an average of three medications. The poorest blood pressure control was among diabetics, 207 (55.8%) and renal impairment patients 67 (18.1%).

Conclusion: The rate of BP control could be improved in the Cardiology Secondary Care Ambulatory Department. Most of the patients were on triple combination therapy. Diabetes and renal impairment are the main risk factors for poor blood pressure control.

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INTRODUCTION

Systemic hypertension represents a global burden for health care systems and societies worldwide causing morbidity and mortality in affected patients[1,2]. The cardiovascular risks of systemic hypertension are of particular importance as most hypertensive patients have other additional cardiovascular risk factors. Diabetes mellitus, dyslipidemia and obesity are the classical companions[3-5]. In Bahrain, cardiovascular disease accounts for 21.1% of total mortality according to 2012 Ministry of Health statistics[6].

Data about the prevalence of various cardiovascular risk factors in Bahrain are sparse. Hypertension is a classic example because it often remains undiagnosed[7].

Despite advances in diagnostic modalities and diverse pharmacological and non-pharmacological treatments for hypertension, the rate of blood pressure control remains low[8-14]. In the United States, only 50% of patients in the hypertensive population achieve their target blood pressure[10]. Studies on hypertension control in Bahrain are primarily conducted in primary health care settings[15-17]. To date, no data are available about the magnitude of blood pressure control in secondary care.

The aim of this study is to evaluate the blood pressure control and predictors for uncontrolled hypertension in the Ambulatory Department of Cardiology unit.

METHOD

The study was performed at the Cardiology Outpatient Department of Salmaniya Medical Complex. Hypertensive patients above the age of 18 years and on medications within the last six months were enrolled in the study. Patients' confidentiality was maintained throughout the study.

The study was performed from 1 January 2012 to 30 April 2012. Height, weight and blood pressure were recorded. The blood pressure was measured twice within a 5-minute interval from both arms. Diastolic blood pressure was recorded upon the disappearance of Korotkoff sounds (phase V). Blood pressure values were estimated as the mean of the two readings. Personal data, systolic and diastolic blood pressure, body mass index, comorbidities and the use of medications were recorded. The duration of diabetes was documented using the latest HBA1c measurement.

Controlled blood pressure readings were identified as <140/90 mmHg for non-diabetics and <130/85 mmHg for diabetics or patients with renal impairment[18,19]. According to recent European Society of Hypertension Guidelines, patients older than 80 years should have a target BP of <150/90 mmHg and patients with chronic kidney disease and micro albuminuria should have a target BP of <130/80 mmHg[20]. Patients' enrollment had been before the release of these guidelines.

Eighth Joint National Committee (JNC 8) recommends a blood pressure control of <140/90 mmHg for all patients above 18 years including diabetic and renal impaired patients. For patients older than 60 years, the target blood pressure is <150/90 mm Hg[21].

American Society of Hypertension (ASH) guidelines recommended a similar target blood pressure of <140/90 mmHg for all patients above 18 years including diabetic and chronic kidney disease patients.

In this study, the older definitions of blood pressure control based on Seventh Joint National Committee (JNC 7) and European Society of Hypertension (ESH) guidelines were adopted[19].

A patient was considered to have diabetes if two readings of fasting blood glucose, taken on separate occasions, exceeded 7 mmol/L, if symptoms of diabetes occurred with casual plasma glucose concentration ≥200 mg/dl (11.1 mmol/L), or if the 2-hour post-load glucose level was ≥200 mg/dL (11.1 mmol/L) during an oral glucose tolerance test (OGTT)[22,23]. Dyslipidemia (hypercholesterolemia) was diagnosed if the total cholesterol level exceeded 200 mg/dL[24]. Renal impairment was diagnosed when the estimated glomerular filtration rate (GFR) was <90 mL/min/1.73 m^2 [25]. WHO defines overweight as BMI 25-30; class I obesity which is moderately obese (30-35), class II obesity which is severely obese (35-40) and class III obesity which is very severely obese >40[26].

Chi-square test was used. Multivariate analyses were conducted using logistic regressions. All statistical analyses were performed using SPSS 20 and a P-value of less than 0.05 was considered significant.

RESULT

Data from 371 subjects were collected; the mean age of the subjects was 54.6 ± 11.8 years. Two hundred forty-nine (67%) were males, and 122 (33%) were females. The mean BMI among the study group was 30.6, see table 1.

Table 1: Characteristics of Patients

Characteristics	Number and Percentage
Age in years, mean ± SD	54.6 ± 11.8
Gender	
Male	249 (67)
Female	122 (33)
Nationality	
Bahraini	272 (73.3)
Non-Bahraini	99 (26.7)
Body mass index (BMI), mean ± SD	30.6 ± 6.6
Normal	80 (21.6)
Overweight	129 (34.8)
Obese I	71 (19.1)
Obese II	51 (13.7)
Obese III	40 (10.8)

Comorbidities	
Diabetes Mellitus	207 (55.8)
HBA1c < 53mmol/mol	98 (26.4)
HBA1c >53mmol/mol	109 (29.4)
Dyslipidemia	287 (77.4)
Ischemic heart disease	128 (34.5)
Heart Failure	37 (10)
Renal Impairment	67 (18)
Peripheral vascular disease	13 (3.5)
Smoking	45 (12)

Two hundred eighty-seven (77.4%) had dyslipidemia, and 207 (55.8%) were diabetics. The mean diabetes duration was 6 (±6.6) years. The HbA1c measurement was greater than 53 mmol/mol in 109 (53%) of the diabetic patients.

One hundred twenty-eight (34.5%) patients had ischemic heart disease, 67 (18%) patients had chronic kidney diseases. Thirty-seven (10%) patients had congestive heart failure. Three hundred forty-eight (93.8%) patients were prescribed angiotensin-converting enzyme inhibitors (ACEI) or angiotensin receptors blockers (ARBs). Beta-blockers were the second agent prescribed in 258 (69.5%) patients. The use of antihypertensive classes is presented in table 2. Two hundred fifty-eight (69.5%) patients were prescribed beta-blockers.

Table 2: Antihypertensive Agents Used

Antihypertensive Medication class	Number of Patients and Percentage
ACEi	118 (31.8)
Perindopril	95 (80.5)
Enalapril	9 (7.6)
Cilazapril	7 (6)
Lisinopril	7 (6)
ARB	230 (62)
Valsartan	200 (87)
Irbesartan	28 (12)
Others	2 (1)
β- Blockers	258 (69.5)
Bisprolol	138 (53.5)
Carvedilolol	66 (25.6)
Metoprolol	29 (11.2)
Atenolol	25 (9.7)
Diuretics	256 (69)
Thiazide	209 (81.6)
Spironolactone	28 (10.9)
Furosemide	13 (5.1)
Others	6 (2.4)
CCB	202 (54.4)
Amlodipine	111 (55)
Nifedipine	53 (26.2)
Felodipine	13 (6.4)
Non-dihydropyridine	25 (12.4)
Others	25 (6.7)

ACEI: Angiotensin converting enzyme inhibitor; ARB: angiotensin receptors blockers; CCB: calcium channel inhibitors.

Three hundred thirty-eight (91.1%) patients were prescribed more than one blood pressure-lowering medication. One hundred thirty-seven (37%) patients were on three medications, whereas 96 (26%) were on four and 84 (22.6%) were prescribed on two medications, see figure 1.

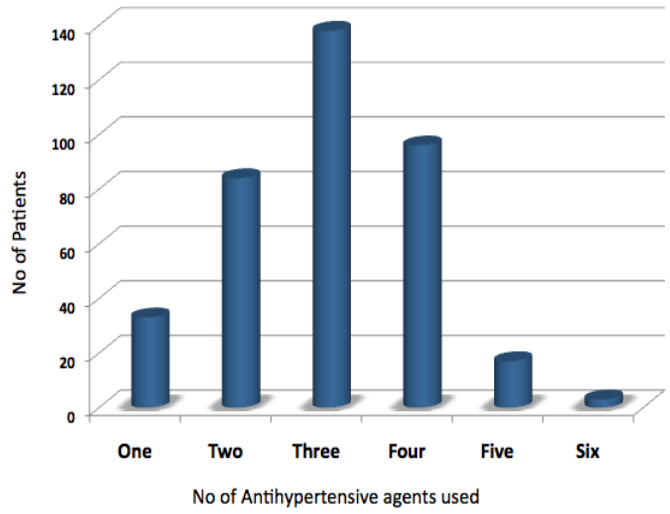

Figure 1: Distribution of Patient's According to the Number of Antihypertensive Agents

The most prescribed combination included ACEI or ARB, beta-blocker, calcium channel blocker and a diuretic. The remainder of the combination prescription is presented in table 3. Unfortunately, none of these combinations displayed superiority in terms of blood pressure control.

Table 3: Frequency of Anti-hypertensive Medication Combination Regimens

Combination regimen	Frequency
ACEI/ARB+ BB+ CCB+ Di	27%
ACEI/ARB+ BB+ Di	20%
ACEI ARB+ CCB+ Di	12.60%
ACEI /ARB+ BB	10.70%
ACEI /ARB+ Di	8%
ACEI /ARB+BB+CCB	5%
ACEI /ARB+CCB	3%
BB+CCB	2.60%
BB+ CCB+ Di	0.20%
CCB+ Di	0.20%

Blood pressure of <140/80 mmHg was observed in 246 (66.3%) patients. Uncontrolled hypertension (P value 0.001) and poorly controlled diabetes (HbA1c >53 mmoL/moL) (P value

0.006) were associated with multiple blood pressure lowering agents. Logistic regression identified diabetes mellitus, renal impairment, obesity, age (45-65 years) and multiple blood lowering agents as variables related to poor blood pressure control.

The blood pressure control rate was best achieved among patients with no co-morbidities 44 (12%), and the poorest control was observed among patients with diabetes mellitus and renal impairment 207 (55.8%) and 67 (18%), respectively. Subjects with ischemic heart disease and heart failure had better blood pressure control (128 (34.5%), 37 (10%), see figure 2.

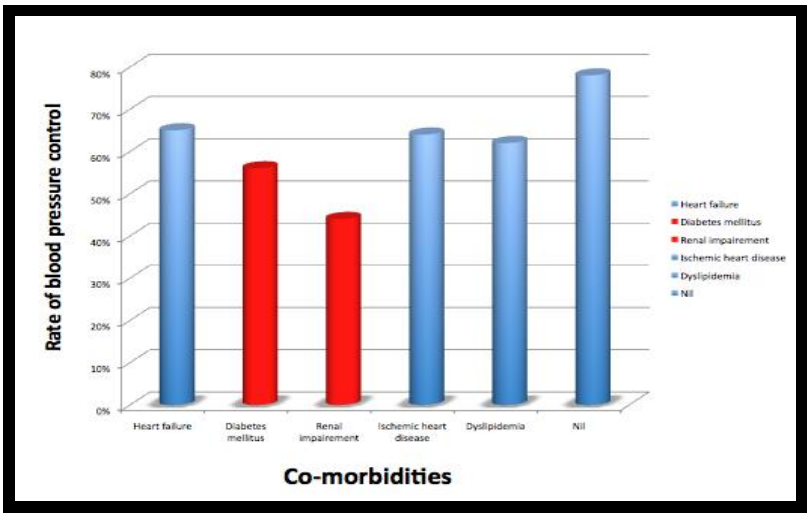

Figure 2: Rate of Blood Pressure Control across the Comorbidities Groups

DISCUSSION

The majority of the current guidelines for the treatment of hypertension lack data representing Gulf populations[18-21]. In the European Society of Hypertension Guidelines, observational and population studies have gained recognition[19].

Only 80 (21.6%) patients had a normal body mass index (BMI). The degree of blood pressure control was inversely related to elevated BMI and in particular type II and III obesity. One hundred four (85%) females had elevated BMI compared to 187 (75%) males. Obesity was higher in females compared with males (59% versus. 36.1%). The prevalence of obesity among the adult population in Bahrain is estimated to be 32.6% for both genders[26]. In our study, 162 (43.6%) patients were obese. Obesity and hypertension usually coexist[27-29].

The majority of the studied patients had additional cardiovascular risk factors and to elevated blood pressure[3-5]. Blood pressure control is often difficult in patients with multiple risk factors[30-32].

Among the medications used, beta-blockers had a great preference. Ischemic heart disease and heart failure were commonly encountered among the studied subjects. Beta-blockers markedly modify the prognosis of these patients and hence were commonly prescribed[32-35]. The remainder of the blood pressure lowering agents was consistent with those reported in the literature[11,36,37].

The average number of blood pressure lowering agents prescribed was three, and 31.3% of patients were administered more than three medications. Among the diuretics, spironolactone ranked second after thiazides. The use of spironolactone as an add-on therapy complies with the suggested approach to treat resistant hypertension[19]. In contrast to what has been observed in similar studies, our physicians had the initiative to modify the medications if the guidelines' targets for blood pressure were not met[38].

In high cardiovascular risk patients, antihypertensive treatment strategies differ from those implemented in lower risk subjects. A similar strategy was implemented in our patients[19].

The most commonly prescribed combination consists of RAS blockers (ACEI or ARB) combined with β-blockers, calcium channel blockers and diuretics. The long-term cardiovascular protection of these regimens is yet to be determined.

The rate of blood pressure control in our study was 65%. Navar-Boggan et al recently presented a variable rate of blood pressure control among hypertensive patients[38]. Among the variables associated with blood pressure control was the private medical insurance cover, which indicates easier access to the medical facility and dispensing of relatively expensive medications[39]. The small geographic area of Bahrain with easy access to free medical service contributed to the high rate of blood pressure control in the studied subjects.

Diabetes and its duration, age group of 45-65 years, and an increased number of blood pressure medications were correlated with uncontrolled hypertension in regression analysis. These observations were almost consistent with other studies[31,40,41].

Patients with heart failure and ischemic heart disease appear to be more adherent to their medications because of close follow-up clinic visits; therefore, they are able to achieve blood pressure within the target range[40]. Navar-Boggan et al demonstrated that an increased number of medications were associated with better blood pressure control[39]. This implies to all classes of medications rather than confined merely to blood pressure lowering agents. Medications prescribed for other diagnoses, such as heart failure or ischemic heart diseases were included[39]. Patients with diabetes and renal failure had the lowest blood pressure control[41,42]. In our study, we defined blood pressure target in those patients according to the previous difficult bar of <130/80. Applying the new lenient definition of blood pressure control to 140/90 will help clinicians to achieve the recommended blood pressure in these high-risk groups[20,21].

Uncontrolled ambulatory blood pressure is one of the known risk factors for the development of hypertensive crisis[42-45]. Hypertensive crisis carries high mortality and morbidity. Diabetics are at an increased risk to develop acute left ventricular failure and acute myocardial infarction during hypertensive crisis[44]. The risk is amplified if diabetes and hypertension coexist. The negative influence is exacerbated if either condition or both are uncontrolled[46].

As a cross-sectional analysis, the rate of blood pressure control is studied at a single time point rather than during an extended follow-up period. The high-risk population does not reflect the entire group of treated patients with elevated blood pressure in Bahrain. The efficacy of the various blood pressure-lowering medications used in relation to long-term cardiovascular

outcome has yet to be determined. The latter can be attained by following the studied subjects for a longer period.

CONCLUSION

This study revealed that the rate of blood pressure control is satisfactory in the sample studied. Yet, various interventions could be implemented to improve the degree of blood pressure control. The advantage of limited geographic area of Bahrain and well-established family medicine network should be exploited.

Comprehensive plan that overcomes various barriers should be implemented. Those barriers could be patients-related or physician-related or health care system. Encouraging patients to self-monitor blood pressure and encourage clinical inertia among physicians could help bridge the gap between guidelines and implementation.

Author Contribution: All authors share equal effort contribution towards (1) substantial contribution to conception and design, acquisition, analysis and interpretation of data; (2) drafting the article and revising it critically for important intellectual content; and (3) final approval of manuscript version to be published. Yes.

Potential Conflicts of Interest: None.

Competing Interest: None. **Sponsorship:** None.

Submission Date: 21 May 2014. **Acceptance Date:** 10 July 2014.

Ethical Approval: Approved by the Secondary Care of the Research Committee, Salmaniya Medical Complex.

REFERENCES

1. Perkovic V, Huxley R, Wu Y, et al. The Burden of Blood Pressure-Related Disease: A Neglected Priority for Global Health. Hypertension 2007; 50(6): 991-7.
2. Kearney PM, Whelton M, Reynolds K, et al. Global Burden of Hypertension: Analysis of Worldwide Data. Lancet 2005; 365(9455): 217-23.
3. Haffner SM, Miettinen H, Gaskill SP, et al. Metabolic Precursors of Hypertension. The San Antonio Heart Study. Arch Intern Med 1996; 156(17): 1994-2001.
4. Smith NL, Savage PJ, Heckbert SR, et al. Glucose, Blood Pressure, and Lipid Control in Older People with and Without Diabetes Mellitus: The Cardiovascular Health Study. J Am Geriatr Soc 2002; 50(3): 416-23.
5. Cohen HW, Hailpern SM, Alderman MH. Glucose-Cholesterol Interaction Magnifies Coronary Heart Disease Risk for Hypertensive Patients. Hypertension 2004; 43(5): 983-7.
6. Ministry of Health, Health Information Directorate: Health Statistics 2012. March 15, 2014. Available at: http://www.moh.gov.bh/PDF/Publications/statistics/HS2012/hs2012_e.htm. Accessed

on 15 March 2014.
7. Musaiger A, Al-Roomi K. Prevalence of Risk Factors for Cardiovascular Diseases among Men and Women in an Arab Gulf Community. Nutr Health 1997; 11(3): 149-57.
8. Wolf-Maier K, Cooper RS, Banegas JR, et al. Hypertension Prevalence and Blood Pressure Levels in 6 European Countries, Canada, and the United States. JAMA 2003; 289(18): 2363-9.
9. Fletcher RD, Amdur RL, Kolodner R, et al. Blood Pressure Control among Us Veterans: A Large Multiyear Analysis of Blood Pressure Data from the Veterans Administration Health Data Repository. Circulation 2012; 125(20): 2462-8.
10. Egan BM, Zhao Y, Axon RN. US Trends in Prevalence, Awareness, Treatment, and Control of Hypertension, 1988-2008. JAMA 2010; 303(20): 2043-50.
11. Gu Q, Burt VL, Dillon CF, et al. Trends in Antihypertensive Medication Use and Blood Pressure Control among United States Adults with Hypertension: The National Health and Nutrition Examination Survey, 2001 to 2010. Circulation 2012; 126(17): 2105-14.
12. Grasssi G, CifkovaI R, Laurent S, et.al. Blood Pressure Control and Cardiovascular Risk Profile in Hypertensive Patients from Central and Eastern European Countries: Results of the BP-CARE Study. Eur Heart J 2011; 32(2): 218-25.
13. Ong KL, Cheung BMY, Man YB, et al. Prevalence, Awareness, Treatment, and Control of Hypertension Among United States Adults 1999-2004. Hypertension 2007; 49(1): 69-75.
14. Joffres M, Falaschetti E, Gillespie C, et al. Hypertension Prevalence, Awareness, Treatment and Control in National Surveys from England, the USA and Canada, and Correlation with Stroke and Ischaemic Heart Disease Mortality: A Cross-Sectional Study. BMJ Open 2013; 3(8): e003423.
15. Al Khaja KA, Sequeira RP, Damanhori AH. Treatment of Hypertension in Bahrain. Ann Pharmacother 2003; 37(10): 1511-7.
16. Habib M. Management of Hypertension in Local Health Centers in Bahrain. Bahrain Med Bull. 2003; 25(2); 84-5.
17. Sequeira RP, Jassim KA, Damanhori AH, et al. Prescribing Pattern of Antihypertensive Drugs by Family Physicians and General Practitioners in the Primary Care Setting in Bahrain. J Eval Clin Pract 2002; 8(4): 407-14.
18. Chobanian AV, Bakris GL, Black HR, et al. Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension 2003; 42(6): 1206-52.
19. Mancia G, Fagard R, Narkiewicz K, et al. 2013 ESH/ESC Guidelines for the Management of Arterial Hypertension: The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). Eur Heart J 2013; 34(28): 2159-219.
20. Weber MA, Schiffrin EL, White WB, et al. Clinical Practice Guidelines for the Management of Hypertension in the Community a Statement by the American Society of Hypertension and the International Society of Hypertension. J Hypertens 2014; 32(1): 3-15.
21. James PA, Oparil S, Carter BL, et al. 2014 Evidence-Based Guideline for the Management of High Blood Pressure in Adults: Report from the Panel Members

Appointed to the Eighth Joint National Committee (JNC 8). JAMA 2014; 311(5): 507-20.
22. Executive summary: Standards of Medical Care in Diabetes--2009. Diabetes Care. 2009; 32 Suppl 1:S6-12.
23. Stone NJ, Robinson J, Lichtenstein AH, et al. 2013 ACC/AHA Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2013 pii: S0735-1097 (13) 06028-2.
24. National Kidney Foundation. K/DOQI Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification, and Stratification. Am J Kidney Dis 2002; 39(2 Suppl 1): S1-266.
25. World Health Organization (2006). Global Database on Body Mass Index. BMI Classification. Available at: http://apps.who.int/bmi/index.jsp?introPage=intro_1.html. Accessed on 15 March 2014.
26. World Health Organization. Obesity. Available at: www.who.int/topics/obesity/en/. Accessed on 15 March 2014.
27. Haslam DW, James WP. Obesity. Lancet. 2005; 366(9492): 1197-209.
28. Narkiewicz K. Obesity and Hypertension--The Issue is more Complex than we Thought. Nephrol Dial Transplant 2006; 21(2): 264-7.
29. Mancia G, Grassi G. Systolic and Diastolic Blood Pressure Control in Antihypertensive Drug Trials. J Hypertens 2002; 20(8): 1461-4.
30. Wang TJ, Vasan RS. Epidemiology of Uncontrolled Hypertension in the United States. Circulation 2005; 112(11): 1651-62.
31. McMurray JJ, Adamopoulos S, Anker SD, et al. ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012: The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2012 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association (HFA) of the ESC. Eur Heart J 2012; 33(14): 1787-847.
32. Yancy CW, Jessup M, Bozkurt B, et al. 2013 ACCF/AHA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2013; 62(16): e147-239.
33. Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS guideline for the diagnosis and management of patients with stable ischemic heart disease: executive summary: a report of the American College of Cardiology Foundation/American Heart Association task force on practice guidelines, and the American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. Circulation 2012; 126(25): 3097-137.
34. Task Force Members, Montalescot G, Sechtem U, et al. 2013 ESC Guidelines on the Management of Stable Coronary Artery Disease: The Task Force on the Management of Stable Coronary Artery Disease of the European Society of Cardiology. Eur Heart J 2013; 34(38): 2949-3003.

35. Gu Q, Paulose-Ram R, Dillon CF, et al. Antihypertensive Medication Use among US Adults with Hypertension. Circulation. 2006; 113(2): 213-21.
36. Nelson CR, Knapp DA. Trends in Antihypertensive Drug Therapy of Ambulatory Patients by US Office-Based Physicians. Hypertension 2000; 36(4): 600-3.
37. Fine LJ, Cutler JA. Hypertension and the Treating Physician: Understanding and Reducing Therapeutic Inertia. Hypertension 2006; 47(3): 319-20.
38. Navar-Boggan AM, Boggan JC, Stafford JA, et al. Hypertension Control among Patients Followed by Cardiologists. Circ Cardiovasc Qual Outcomes 2012; 5(3): 352-7.
39. Knight EL, Bohn RL, Wang PS, et al. Predictors of Uncontrolled Hypertension in Ambulatory Patients. Hypertension 2001; 38(4): 809-14.
40. Borzecki AM, Wong AT, Hickey EC, et al. Hypertension Control: How Well are we Doing? Arch Intern Med 2003: 163(22): 2705-11.
41. Agarwal R, Nissenson AR, Batlle D, et al. Prevalence, Treatment, and Control of Hypertension in Chronic Hemodialysis Patients in the United States. Am J Med 2003; 115(4): 291-7.
42. Tisdale JE, Huang MB, Borzak S. Risk Factors for Hypertensive Crisis: Importance of Outpatient Blood Pressure Control. Fam Pract 2004; 21(4): 420-4.
43. Al-Bannay R, Husain AA. Hypertensive Crisis. Clinical Presentation, Comorbidities, and Target Organ Involvement. Saudi Med J 2010; 31(8): 916-20.
44. Al Bannay R, Husain A. Hypertensive Crisis: Comparison between Diabetics and Non-Diabetics. Int J Cardiol 2012; 154(2): 198-200.
45. Al Bannay R, Böhm M, Husain A. Heart Rate Differentiates Urgency and Emergency in Hypertensive Crisis. Clin Res Cardiol 2013; 102(8): 593-8.
46. Tedesco MA, Natale F, Di Salvo G, et al. Effects of Coexisting Hypertension and Type II Diabetes Mellitus on Arterial Stiffness. J Hum Hypertens 2004; 18(7): 469-73.