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Evaluation of Laboratory Diagnostic Markers in Patients with Hypertension

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Abstract

Introduction: Hypertension is growing as a running title public health problem. It is one of the most important risk factors for various diseases including cardiovascular disease. The study of laboratory markers and early detection of complications can play an effective role in controlling the disease.

Materials and Methods: The present study was a descriptive-analytical cross-sectional one that was performed from March 21, 2020, to March 19, 2021, on patients referred to Abadan and Khorramshahr educational hospitals with hypertension. Information on age, sex, and laboratory diagnostic factors of patients with hypertension admitted to HIS were received. Data were analyzed using STATA software.

Results: The study population involved 1505 patients with hypertension admitted to Abadan and Khorramshahr educational hospitals; there were 487 males (32%) and 1018 females (68%). The average age of the patients was 61 (SD: 12). The highest frequency of patients with hypertension was in the age group of 64-55 years with a frequency of 420 (27.9%). The results showed that the mean of creatinine was higher than normal. The mean of CK-MB and INR was slightly higher than normal. The two sexes were significantly different in terms of the means of CK-MB, AST, ALT, Cr, Na, MCHC, HCT, HB, and RBC. According to the unadjusted and multiple logistic regression analysis, each 1 unit increase in BUN and K+ was associated with an increase in the odds of abnormal creatinine. Each 1 unit increase in RBC, HB, HCT, MCH, and MCHC was associated with a decrease in the odds of abnormal creatinine, and each 1 unit increase in PT was associated with an increase in the odds of abnormal creatinine.

Conclusion: The results of the present study showed that some laboratory markers in patients with hypertension were above the normal range including renal, cardiac, and coagulation diagnostic factors and some of which depend on age and sex; thus, it is important to pay attention to these markers in controlling high blood pressure in these patients. Future studies are warranted to examine the issue further.

Keywords: Cardiac diagnostic markers, Creatinine, Hypertension, Renal diagnostic markers.

1. Introduction

Due to considerable stress and extensive lifestyle changes, chronic diseases have been on the rise throughout the world. Chronic diseases such as hypertension cause many changes in all aspects of patients' lives. Hypertension accounts for many problems, often requiring long-term treatment. It is characterized by increased systolic artery pressure of more than 140/90 [1, 2]. It is noteworthy that every 20 ml of increased blood pressure is associated with a twofold increase in the risk of cardiovascular disease [3, 4].

Studies have shown that about half of Iranians aged 50 and over have high blood pressure. The prevalence of hypertension before the age of 45 is higher in men than women and is lower in Iran than in most neighboring countries and the Middle East. However, it is more widespread among Iranian women than those in other countries in the region [2, 5]. Blood pressure in Iran is higher than in industrialized countries, typically due to increased obesity, unhealthy eating habits, consumption of high-salt processed foods, and decreased physical activity. Nevertheless, high blood pressure is more common in developed countries like the United States and Germany. For example, there are 78 million hypertensive patients in the United States each year [2, 5, 6]. A meta-analysis study supposed that the prevalence rate of systolic blood pressure ≥ 140 mmHg is approximately 874 million adults [7].

About 70 % of women and 65 % of men over the age of 65 have high blood pressure, and about one billion people suffer from the disease worldwide [5]. Moreover, it accounts for seven million deaths annually. Hypertension, like smoking and diabetes, is a risk factor for cardiovascular disease, which causes a third of total death toll. Although 70% of patients with hypertension are aware of their disease and 60% of them receive treatment, but only 34% manage to control their disease [5, 8, 9].

High blood pressure can damage blood vessels and organs, even leading to heart attack, stroke, aneurysm, heart failure, weakening and narrowing of blood vessels in the kidneys, thickening, narrowing, or rupture of blood vessels in the eye, metabolic syndrome, problems with memory, and dementia [10, 11]. Hypertension can also cause disorders in patients directly and indirectly. Liver cirrhosis is the fourth cause of death due to high blood pressure in adults in Western countries [12, 13]. Hypertension and related treatments can cause electrolyte imbalance, renal dysfunction, liver disorders, and can increase the level of inflammation in the body [14, 15]. Changes in potassium levels can lead to cardiac arrhythmias [16]. Alkaline phosphatase is a hydraulic enzyme that is found in large amounts in the liver and bone and in different forms in the blood. It is necessary to pay attention to its changes when blood pressure rises [17, 18]. Alanine aminotransferase is a specific liver enzyme that increases only in the liver. Also, aspartate aminotransferase (AST) is another liver enzyme that should be considered in the rise of blood pressure [18].

Objectives

According to the importance of blood pressure in society, we decided to examine its relationship with laboratory markers in people in Abadan and Khorramshahr hospitals.

2. Materials and Methods

This study was a descriptive-analytical cross-sectional one that was performed on patients referred to Abadan and Khorramshahr educational hospitals with hypertension from March 21, 2020, to March 19, 2021. The necessary permits from the Research Council and the Research Ethics Committee were fully obtained (Ethical approval ID: IR.ABADANUMS.REC.1399.168).

Patients' data records did not include their names and personal details. During the research, anonymous coding was used instead of mentioning the patients' names to classify the data. Attempts were made to comply with all religious, moral, and legal standards for all stages of the project. The study population involved 1505 patients with hypertension admitted to Abadan and Khorramshahr educational hospitals whose hypertension was diagnosed by a cardiologist and their information was available in HIS from March 21, 2020, to March 19, 2021. As far as the sample is concerned, 270 patients from the above-mentioned population were randomly selected to investigate laboratory markers. Blood, liver, and kidney markers, as well as the level of electrolytes and serum enzymes, were examined in terms of age and sex. Inclusion criteria involved diagnosis of hypertension in patients by a cardiologist whose tests were recorded in the HIS system, whereas exclusion criteria pertained to those whose tests were not registered in the HIS system.

The normality of quantitative data was checked by the Shapiro-Wilk test. Quantitative variables in gender groups were compared with the Mann-Whitney test. To evaluate the relationship between study factors and creatinine, the normal range of creatinine was used. Items above 1.3 were considered abnormal. First, the factors entered the univariate model individually. The relationships between different variables and abnormal creatinine were analyzed using logistic regression, and the association between each variable and abnormal creatinine was expressed as an odds ratio (OR) with 95% confidence intervals (CIs). Finally, the factors in the univariable model with p-value below 10% were included in the multiple logistic regression models. In order to adjust for confounding variables more effectively and increase the precision of the study, age and sex variables were included in the multiple logistic regression model. Data were analyzed using STATA 14 software.

3. Results

Demographic characteristics

The study population involved 1505 patients with hypertension admitted to Abadan and Khorramshahr educational hospitals; 487 were male (32%) and 1018 were female (68%). The mean (SD) age of the patients was 61[12]. The highest frequency of patients with hypertension was in the age group of 64-55 years with a frequency of 420 (27.9%) (Table 1).

In the present study, 270 patients with hypertension (i.e., the study sample) were randomly selected, including 87 males (32.22%) and 183 females (67.78%). The mean (95% CI) age of the patients was 60.89 (14.68) years, although the mean age of women (61.67 ± 14.17) was higher than that of men (59.09 ± 15.75). In terms of age, there were 12, 31, 38, 76, 58, and 55 people in the age ranges of 25-34 years (4.44%), 35-44 years (11.48%), 45-54 years (14.07%), 54 -64 years (28.15%), 64-74 years (21.48%), and over 75 years (20.37%), respectively.

Comparison of laboratory findings based on the normal range

Comparison of laboratory findings with normal ranges in this study showed that the mean of Cr (97/1 ±61/1) was higher than normal. The means of CK-MB (12.6 ± 25.2) and INR (51/0 ± 12/1) were slightly higher than normal. And the other variables were in the normal range (Table 2).

Comparison of laboratory findings by gender

Results showed that the two sexes were significantly different in some markers. Mann-Whitney test showed that the Rank Means of RBC, Hb, HCT, MCHC, ALT,

Table 1. Frequency distribution of patients with hypertension in study population

Basis of division		Frequency	Percentage	95% CI
Gender	Male	487	32	0.34-0.30
	Female	1018	68	0.65-0.69
Age(years)	15-24	7	0/05	0.002-0.009
	25-34	36	2.4	0.017-0.033
	35-44	131	8.7	0.073-0.102
	45-54	252	16.7	0.149-0.186
	55-64	420	27.9	0.257-0.302
	65-74	375	24.9	0.228-0.272
	75 ≤	282	18.7	0.168-0.208

Table 2. Laboratory findings based on the normal range in study sample

Variable		Normal Range	Mean((SD)
Electrolyte	K (mmol/L)	3.5-5.5	4.26 (0.60)
	Na (mmol/L)	135-145	140.94 (3.58)
Hematologic and Coagulation factors	WBC (/mm3)	4.5-11	8.55 (2.80)
	RBC (million/mm3)	M[a]: 4.3-5.9 F[b]:3.5-5.5	4.68 (0.27) 4.55 (0.19)
	HB (g/dL)	M:13.5-17.5 F:12-16	13.91 (0.86) 12.25 (0.52)
	HCT (%)	M:41-53 F:36-46	42.13 (1.57) 38.63 (0.72)
	PLT (mm^3)	150-400	240.76 (81.04)
	MCV (μm^3)	80-100	89.06 (42.94)
	MCH (pg/cell)	25.4-34.6	27.8 (3.04)
	MCHC (Hb/cell)	31-36	31 (2.89)
	INR	<1.1	1.12 (0.51)
	PT (s)	11-13	12.30 (3.02)
	PTT (s)	25-45	32.64 (10.43)
Renal factors	Cr (mg/dL)	0.6-1.3	1.61 (1.97)
	BUN (mg/dL)	7-20	18.51 (13.16)
Hepatic and Serum enzymes	ALP (IU/L)	60-306	225.3 (90.8)
	ALT (IU/L)	0-31	21.83 (13.51)
	AST (IU/L)	0-31	22.94 (10.96)
	Direct bilirubin (mg/dL)	0.1-0.3	0.15 (0.06)
	Total bilirubin (mg/dL)	0.3-1.2	0.46 (0.21)
Cardiac factor	CPK (IU/L)	22-198	122.3 (115.7)
	CK-MB (IU/L)	<24	25.2 (12.6)

a: male, b: female

AST, CK-MB, Cr, and Na were higher in men than women and these differences were statistically significant (P-Value <0.05). Also, the Rank Means of other factors (WBC, MCV, PLT, PT, PTT, INR, BUN, K, ALP, total bilirubin, direct bilirubin, and CPK) were not significantly different between men and women (P-Value> 0.05) (Table 3).

Relationship between creatinine and Electrolyte factors in unadjusted and multivariable logistic regression model

The unadjusted logistic regression analysis showed an association between k and abnormal creatinine. According to this model, each 1 unit increase in k was

Table 3. Comparison of the status of the studied parameters by patients based on gender in study sample

Variable		Gender	Mean	95% CI	P-value[a]
Electrolyte	K (mmol/L)	Male	4.38	3.91-4.84	P>0.05
		Female	4.23	3.96-4.49	
	Na (mmol/L)	Male	140.8	139.5-142.1	P<0.05*
		Female	140.5	139.4-141.6	
Hematologic and Coagulation factors	WBC (/mm3)	Male	10.01	7.16-12.84	P>0.05
		Female	8.35	7.02-9.69	
	RBC (million/mm3)	Male	4.68	4.11-5.26	P<0.05*
		Female	4.55	4.16-4.95	
	HB (g/dL)	Male	13.91	12.14-15.69	P<0.05*
		Female	12.26	11.18-13.33	
	HCT (%)	Male	42.14	38.99-45.28	P<0.05*
		Female	38.64	37.19-40.09	
	PLT (mm^3)	Male	252.5	223.5-281.5	P>0.05
		Female	248.6	218.4-278.8	
	MCV (μm^3)	Male	114.65	57.67-171.64	P>0.05
		Female	86.79	83.77-89.80	
	MCH (pg/cell)	Male	29.00	27.21-30.79	P>0.05
		Female	27.04	25.50-28.58	
	MCHC (Hb/cell)	Male	33.25	31.08-35.42	P<0.05*
		Female	31.11	29.88-32.34	
	INR	Male	4.90	0.94-8.85	P>0.05
		Female	5.41	2.06-8.75	
	PT (s)	Male	11.88	11.41-12.34	P>0.05
		Female	11.87	11.44-12.20	
	PTT (s)	Male	29.63	26.95-32.30	P>0.05
		Female	31.44	26.68-36.19	
Renal factors	Cr (mg/dL)	Male	1.65	0.83-2.47	P<0.05*
		Female	2.16	0.63-3.69	
	BUN (mg/dL)	Male	17.53	14.53-20.53	P>0.05
		Female	20.12	15.03-25.20	
Hepatic factors	ALP (IU/L)	Male	224.6	183.2-306.1	P>0.05
		Female	220.9	171.8-270.1	
	ALT (IU/L)	Male	30.20	22.34-38.06	P<0.05*
		Female	20.01	12.96-27.04	
	AST (IU/L)	Male	30.8	24.06-37.54	P<0.05*
		Female	20.81	16.26-25.36	
	Direct bilirubin (mg/dL)	Male	0.13	0.07-0.19	P>0.05
		Female	0.16	0.10-0.22	
	Total bilirubin (mg/dL)	Male	0.39	0.19-0.59	P>0.05
		Female	0.45	0.28-0.62	
Cardiac factors	CPK (IU/L)	Male	134.2	105.9-162.5	P>0.05
		Female	126.4	73.70-179.1	
	CK-MB (IU/L)	Male	26.75	20.49-32.99	P<0.05*
		Female	24.67	20.14-29.19	

a: Based on Mann-Whitney test, *: *P*-value<0.05, statistically significant.
ALP: indicates alkaline phosphatase; ALT: alanine transaminase; AST: aspartate transaminase

associated with a 13.46-fold increase in the odds of abnormal creatinine (OR=13.46, 95% CI: 6.33-28.61) (Table 4). According to the multiple logistic regression analysis, each 1 unit increase in k was associated with a 13.58-fold increase in the odds of abnormal creatinine (OR=13.58, 95% CI: 6.31-29.24). (Table 5).

Relationship between creatinine and Hematologic and Coagulation factors in unadjusted and multivariable logistic regression model

According to the unadjusted logistic regression analysis, each 1 unit increase in RBC was associated with a .51 decrease in the odds of abnormal creatinine (OR=0.49, 95% CI: 0.32-0.76). Each 1 unit increase in HB was associated with a .20 decrease in the odds of abnormal creatinine (OR=0.8, 95% CI: 0.69-0.93).

Each 1 unit increase in HCT was associated with a .08 decrease in the odds of abnormal creatinine (OR=0.92, 95% CI: 0.87-0.97). Each 1 unit increase in MCH was associated with a .10 decrease in the odds of abnormal creatinine (OR=0.9, 95% CI: 0.7-1.14); however, this association was not statistically significant. Each 1 unit increase in MCHC was associated with a .07 decrease in the odds of abnormal creatinine (OR=0.93, 95% CI: 0.78-1.10), yet this association was not statistically significant. Each 1 unit increase in PT was associated with a .07 increase in the odds of abnormal creatinine (OR=1.07, 95% CI 0.94-1.21). For every unit increase in PT, an Odds Ratio of creatinine abnormality increases by 7% (OR=1.07, 95% CI: 0.94-1.21), but this association was not statistically significant (Table 4).

According to the multiple logistic regression analysis, each 1 unit increase in RBC was associated with a .37 decrease in the odds of abnormal creatinine (OR=0.62, 95% CI: 0.35-1.11), yet this association was not statistically significant.

Each 1 unit increase in HB was associated with 0.15 decrease in the odds of abnormal creatinine (OR=0.85, 95% CI: 0.66-1.09); however, this association was not statistically significant. Each 1

Table 4. Association between creatinine and laboratory diagnostic factors in the univariable model

Variable	OR[a]	95% CI[b] for OR		*P*-value*
		Lower	Upper	
Demographic				
Age	1.10	.90	1.30	0.3
Sex	.79	.44	1.43	0.4
Renal				
BUN (mg/dL)	1.30	1.20	1.39	0.00*
Electrolyte				
Na (mmol/L)	0.90	0.84	0.98	0.01*
K (mmol/L)	13.46	6.33	28.61	0.00*
Hematologic and Coagulation				
WBC (/mm3)	0.99	0.90	1.10	0.93
RBC (million/mm3)	0.49	0.32	0.76	0.00*
HB (g/dL)	0.80	0.69	0.93	0.00*
HCT (%)	0.92	0.87	0.97	0.00*
PLT (mm³)	0.99	0.99	1.00	0.56
MCV (μm³)	0.99	0.98	1.00	0.61
MCH (pg/cell)	0.90	0.70	1.14	0.39
MCHC (Hb/cell)	0.93	0.78	1.10	0.41
INR	1.00	0.96	1.03	0.91
PT (s)	1.07	0.94	1.21	0.25
PTT (s)	1.01	0.98	1.04	0.23
Hepatic and Serum enzymes				
ALP (IU/L)	0.99	0.98	1.00	0.45
ALT (IU/L)	0.99	0.92	1.06	0.80
AST (IU/L)	1.03	0.95	1.11	0.36
Cardiac enzymes				
CPK (IU/L)	1.00	0.99	1.00	0.71
CK-MB (IU/L)	0.99	0.96	1.02	0.82

a: odds ratio; *b:* confidence interval, c: *P*-value<0.05, statistically significant
ALP: indicates alkaline phosphatase; ALT: alanine transaminase; AST: aspartate transaminase

Table 5. Association between creatinine and electrolyte factors in multivariable logistic regression model:

Variable	OR[a]	95% CI[b] for OR		*P*-value*
		Lower	Upper	
Demographic				
Age	1.03	0.80	1.31	0.81
Sex	0.62	0.30	1.26	0.19
Electrolyte				
Na (mmol/L)	0.90	0.82	0.99	0.03*
K (mmol/L)	13.58	6.31	29.24	0.00*

a: odds ratio; *b:* confidence interval, *: *P*-value<0.05, statistically significant

Table 6. Association between creatinine and Hematologic and Coagulation factors in multivariable logistic regression model:

Variable	OR[a]	95% CI[b] for OR		*P*-value*
		Lower	Upper	
Demographic				
Age	1.13	0.92	1.40	0.22
Sex	0.52	0.26	1.01	0.05
Hematologic factors				
RBC (million/mm3)	0.62	0.35	1.11	0.11
HB (g/dL)	0.85	0.66	1.09	0.20
HCT (%)	0.98	0.91	1.06	0.69

a: odds ratio; *b:* confidence interval, *: *P*-value<0.05, statistically significant

unit increase in HCT was associated with 0.02 decrease in the odds of abnormal creatinine (OR=0.98, 95% CI: 0.91-1.06), but this association was not statistically significant (Table 6)

Relationship between creatinine and BUN in univariable and multivariable logistic regression model

According to the multiple logistic regression analysis, each 1 unit increase in BUN was associated with 0.3 increase in the odds of abnormal creatinine (OR=1.30, 95% CI: 1.20-1.39), (Table 4). Moreover, each 1 unit increase in BUN was associated with 0.30 increase in the odds of abnormal creatinine (OR=1.30, 95% CI: 1.21-1.40). In the multivariable modelIn the multivariable model, BUN despite matching other confounding variables, increases an Odds Ratio of creatinine becoming abnormal (Table 7).

Table 7. Association between creatinine and renal factor in multivariable logistic regression model:

Variable	OR[a]	95% CI[b] for OR		*P*-value*
		Lower	Upper	
Demographic				
Age	1.28	0.96	1.71	0.08
Sex	0.77	0.35	1.72	0.54
Renal factor				
BUN (mg/dL)	1.30	1.21	1.40	0.00*

a: odds ratio; *b:* confidence interval, *: *P*-value<0.05, statistically significant

4. Discussion

In the present study, 1505 patients with hypertension admitted to Abadan and Khorramshahr educational hospitals; they included 487 males (32%) and 101۸ females (68%). The mean age of the patients was 60.89 (14.68) years, while the mean age of women was 61.67(14.17) years and was higher than that of men (59.09 (15.75)). Also, the highest frequency of patients was seen in the age groups of 54-64 years (28.15%), 64-74 years (21.48%), and over 75 years (20.37%).

In the study conducted by McCallum et al. (2015), most of the patients in their research were women (53%). In their study, the average age of patients was 50/88(14/6) years; besides, the average age of women (51/79±15/48) was higher than that of the studied men (49/87±13/28). Their findings were consistent with those of the present study in terms of distribution and having older women than men [19]. High blood pressure is a major concern in women and has a role at risk of difficulty, mortality, and in causing cardiovascular disease, heart attack, and stroke. The risk of developing high blood pressure increases with aging [20]. In the study of Rahman and colleagues (2020) in Bangladesh, most of the patients studied were male (63%) and also the mean age of the subjects was 23.9 (98.28) years; these are not consistent with the current study [21]. The reason for this difference could be due to the sample size or the statistical population.

The study of hematological parameters in the present study showed that all CBC parameters were within the normal range. On the other hand, the levels of Hb, HCT, RBC, and MCHC in men were significantly higher than those in women ($P < 0.05$). Regarding other hematological parameters, no statistically significant difference was observed between the two sexes and across the different age groups.

The result of Jacob and colleagues' study (2018) showed that average markers of RBC, HB, HCT in men were significantly higher than those in women. This finding is in line with that of the present study [22].

The study of coagulation tests in the present study showed that PT and PTT were in the normal range and INR was slightly above the normal range. On the other hand, these tests did not show any difference between the two sexes and across the different age groups.

In their study conducted in Pakistan, Plunge-Rhule et al. (2017) found that all coagulation parameters including INR in the group of hypertensive patients were higher than those in the control group showing that they were sensitive to coagulation and hemostatic abnormalities [23]. The study by Tkachyshyn and colleagues (2021) in Ukraine showed that in the case group (i.e., patients with hemorrhagic stroke and hypertension in the last 6 months) compared to the control group (i.e., individuals with normal blood pressure), the internal pathway of coagulation homeostasis reduced and all patients had at least one of the coagulation factors outside the normal range and were prone to bleeding [24]. Adaeze and colleagues (2014) in Calabar, Nigeria, reported that the average of PT and APPT in the patients with hypertension was higher compared to people with normal blood pressure. The results of all these studies are in line with those of the present study [25]. However, the research results of HU and colleagues [2017) showed that the ratio PT/INR in pregnant female patients was related to different close blood pressure groups and did not have significant differences [26]. In their study conducted in Nigeria, Nwovu et al. (2017) found no significant difference between prothrombin time and platelet count. Differences in the results of these studies are dependent on differences in numbers of research samples, taking drugs which affect blood clotting, and so on [27].

The study of liver parameters and cardiac markers, such as CK-MB, in this piece of enquiry showed that the means of ALT, AST, ALP, total bilirubin, and direct bilirubin were in the normal range and the mean of CK-MB was slightly above the normal range. On the other hand, ALT, AST, and CK-MB levels in men were significantly higher than those in women; however, there was no significant difference between other liver parameters (direct and total bilirubin) and serum enzymes in both sexes.

Cardiac biomarkers such as creatine kinase isoenzyme (CK- MB), TroponinI, and lipid profile are important in assessing people with high blood pressure. In another research which was done by Emokpae and colleagues (2017) in Nigeria, the results showed that the average activity of CK-MB in people with high blood pressure was more than those with normal blood pressure and the average of CK MB in women with high blood pressure was significantly higher than that of their male counterpart [28]. The results of a study by Mulani and colleagues in 2017 in India showed that the average of CK-MB in patients with high blood pressure was more than that of the healthy individuals [29]. Also in another study which was done by Sorokina et al. (2019), the results showed that the amount of CK-MB in women with high blood pressure was more than that of the normal blood pressure group [30]. In a study by Amin EA and colleagues which was done on 30 patients with hypertension, serum CK-MB levels were found to be higher than normal. The results of all these studies were consistent with those of the present study [31]. In their study, McCallum et al. (2015) found that the levels of liver enzymes AST, ALT, GGT, and bilirubin in men with high blood pressure were significantly higher those in women. However, the amount of ALP did not show a significant difference between the two sexes. These results are similar to those of the present study in terms of gender [19].

The results of kidney function tests showed that the mean of creatinine was higher than normal and the mean of BUN was in the normal range. On the other hand, the creatinine level in men was significantly higher than that of women ($p<0.05$). However, there was no significant difference between BUN levels in male and female groups ($P> 0.05$). Each 1 unit increase in BUN was associated with 0.30 increase in the odds of abnormal creatinine (OR=1.30, 95% CI: 1.21-1.40). In the multivariable model, such as the univariable bun, despite matching on other confounding variables, In the multivariable model, BUN despite matching other confounding variables, increases an Odds Ratio of creatinine becoming abnormal. According to the unadjusted and multiple logistic regression analysis, each 1 unit increase in RBC, HB, HCT, MCH, and MCHC was associated with a decrease in the odds of abnormal creatinine and each 1 unit increase in PT was associated with an increase in the odds of abnormal creatinine. Dupont et al. (2013) reported that in patients with ADHF, lowering blood pressure was related to lower creatinine levels [32]. High blood pressure is a major risk factor for cardiovascular disease and kidney disease. These results are consistent with those of the present study [33]. Also, Lee and colleagues (2013) found that Urinary sodium creatinine ratio is related to high blood pressure and its increase [34]. In a study by Pandya and colleagues in 2016 in India, the results showed that serum creatinine level in patients with hypertension was higher than in healthy people [35]. Park and colleagues in Korea also showed in their research that creatinine ratio was significantly related to hypertension in men [36]. Yadav et al.'s (2016) study in Korea revealed that this ratio was related to blood pressure in women [37]. In a study by Yang and colleagues (2020) in China, the results showed that the amount of BUN and creatinine in men with high blood pressure was higher than that in female patients; these findings are in agreement with those of the current study [38].

5. Conclusion

The results showed that some laboratory markers in patients with hypertension are higher than normal including renal, cardiac and coagulation diagnostic factors, and some markers are dependent on age and sex; in a similar vein, it is important to pay attention to these markers in controlling high blood pressure in individuals.

Ethical Considerations

Compliance with ethical guidelines

This study was approved (Ethical approval ID: IR.ABADANUMS.REC.1399.168) by the Ethics Committee of Abadan University of Medical Sciences (Direct link: http://ethics.research.ac.ir).

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Conflict of interest

The authors declare no conflict of interests.

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