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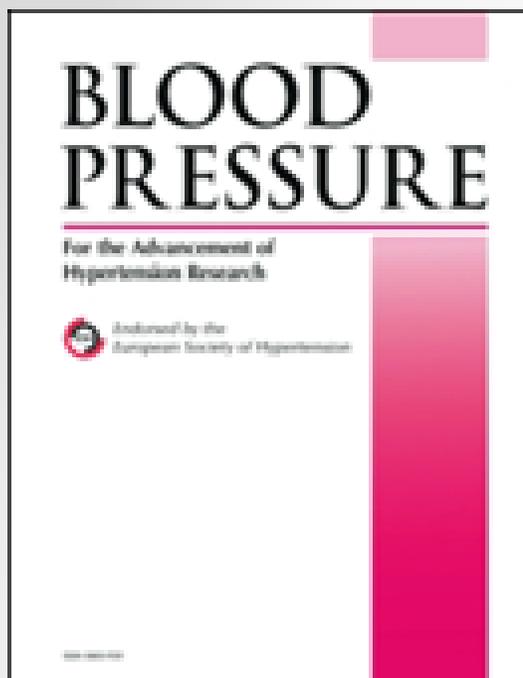
# Association of Morning Blood Pressure Surge with Carotid Intima-media Thickness and Cardiac Dysfunction in patients with Cardiac Syndrome-x

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## Blood Pressure

ISSN: 0803-7051 (Print) 1651-1989 (Online) Journal homepage:  
<http://www.tandfonline.com/loi/lblo>

Association of morning blood pressure surge with carotid intima-media thickness and cardiac dysfunction in patients with cardiac syndrome-X

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To cite this article: Ragab A. Mahfouz, Mohammad Goda, Islam Galal & Mohamed S. Ghareb (2018): Association of morning blood pressure surge with carotid intima-media thickness and cardiac dysfunction in patients with cardiac syndrome-X, Blood Pressure, DOI: 10.1080/08037051.2018.1476056

- Cardiac syndrome X, is characterized by typical angina chest pain, objective evidence of ischemia, associated with normal coronary angiography.
- The pathophysiology of cardiac syndrome X is multifactorial. Coronary micro-vascular dysfunction was suggested to be the underlying pathophysiologic mechanism. Moreover, endothelial dysfunction and pre-capillary arteriolar shear stress have been implicated as important contributing factors.

- It was suggested that morning blood pressure surge, is a good risk parameter for increased prevalence of cardiovascular events occurring in the morning. The association between morning blood pressure surge with carotid intima media thickness, and cardiac function in patients with cardiac syndrome X was not clearly studied.

- this study was designed to investigate the relationship between morning blood pressure surge with carotid intima-media thickness and cardiac function, in patients with cardiac syndrome X

# Patients And Methods

# Inclusion Criteria

- Patients should meet the diagnosis of cardiac syndrome X based on the presence of typical exercise-induced angina pectoris associated with transient ischemic ST segment depression ( $\geq 1$  mm) during the treadmill exercise test and consequent normal or nearly normal coronary angiogram.

# Exclusion Criteria

- significant arrhythmia,
- sick sinus syndrome,
- left bundle branch block,
- valvular heart disease, mitral valve prolapse,
- myocardial infarction, unstable angina,
- cardiomyopathy, congestive heart failure,
- pulmonary disease,
- stroke and other neurological disorders,
- musculoskeletal or collagen vascular disease.

- 70 subjects presented with chest pain, and had a negative exercise electrocardiogram and normal coronary angiography were recruited and served as a control group.

# Data Collection

## All patients were Subjected to:

- Complete history taking.
- General and local examination.
- Resting electrocardiography.
- Ambulatory blood pressure monitoring.
- Echocardiography.
- Carotid ultrasound assessment to measure carotid intima media thickness.

# Ambulatory blood pressure monitoring

- Blood pressure was measured and recorded first in the clinic, after the patients had rested for at least 5 minutes in the sitting position. Blood pressure and heart rate were monitored for 24 hour using a non-invasive, portable device (Spacelabs 90217, Spacelabs Healthcare, Issaquah, WA) Recordings of blood pressure were programmed to be obtained automatically every twenty minutes for the 24 hours.

# Morning surge

- *Sleep blood pressure* was defined as the average of blood pressure readings from the time when the patient went to bed until the time he or she got out of bed.
- awake blood pressure was defined as the average of blood pressure readings recorded during the rest of the day.
- **Morning surge** in blood pressure defined as mean of blood pressure during the first two hours after waking (eight blood pressure readings), minus the mean BP during the night (as the average blood pressure of three readings centered on the lowest nighttime reading).

# Results

# Demographic characteristics of patients with cardiac Syndrome X compared with control subjects

Variable	Cardiac Syndrome X N=70	Controls N=70	p value
Age (year)	47.0±5.3	48.1±6.1	0.33
Sex (female/male)	42/28	39/31	0.42
Body mass index (kg/m <sup>2</sup> )	26±4	25±4	0.39
Cigarette smoking n(%)	22 (36%)	13 (33.3%)	0.51
Heart rate (bpm)	79 ± 6	72 ± 7	0.13
Hypertension (%)	27 (38.6)	17 (35.4)	0.44
Diabetes mellitus (%)	23 (32.9%)	15 (31.3)	0.59
Total cholesterol mmol/L	5.25±0.85	5.04±0.69	0.25
Triglycerides mmol/L	1.84±0.89	1.72±0.92	0.22
Low density lipoprotein cholesterol mmol/L	3.34±0.8	3.13±0.59	0.26
High density lipoprotein cholesterol mmol/L	1.24±0.23	1.32±0.21	0.34
Serum creatinine umol/L	84.88±9.73	80.46±10.61	0.37
hs-C reactive protein (nmol/L)	<b>15.43±4.95</b>	<b>6.95±0.48</b>	<b>&lt;0.001</b>
Carotid intimal-medial thickness (mm)	<b>0.93±0.06</b>	<b>0.74±0.05</b>	<b>&lt;0.01</b>

# Blood pressure (BP) variables in patients with cardiac Syndrome X and controls

Variable	Cardiac syndrome X N=70	Controls N=70	p value
<b>Clinic</b>			
Systolic blood pressure SBP (mmHg)	135 ± 15	132 ± 16	0.34
Diastolic blood pressure DBP (mmHg)	82 ± 9	80 ± 7	0.42
<b>Morning (mean 6 to 10 AM)</b>			
Systolic blood pressure SBP (mmHg)	<b>168 ± 7</b>	<b>145 ± 5</b>	<b>&lt;0.003</b>
Diastolic blood pressure DBP (mmHg)	<b>112 ± 4</b>	<b>96 ± 3</b>	<b>&lt;0.003</b>
<b>Day (mean 10 AM to 10 PM)</b>			
Systolic blood pressure SBP (mmHg)	142 ± 6	138 ± 4	0.15
Diastolic blood pressure DBP (mmHg)	86 ± 5	83 ± 3	0.32
<b>Night (mean 10 PM to 6 AM)</b>			
Systolic blood pressure SBP (mmHg)	131 ± 6	129 ± 5	0.52
Diastolic blood pressure DBP (mmHg)	85 ± 3	83 ± 3	0.33
<b>Morning surge</b>			
Systolic blood pressure SBP (mmHg)	<b>37 ± 4</b>	<b>16 ± 3</b>	<b>&lt;0.001</b>
Diastolic blood pressure DBP (mmHg)	<b>27 ± 2</b>	<b>13 ± 2</b>	<b>&lt;0.001</b>

## A. Demographic and echocardiographic characteristics of patients with exaggerated morning blood pressure surge (MBPS) versus patients with normal morning blood pressure surge (MBPS)

Variable	Group I N=42	Group II N=28	P value
Age (year)	47.3±4.7	46.5±4.9	0.285
Sex (female/male)	24/18	15/13	0.64
Body mass index (kg/m <sup>2</sup> )	26±3	25.7±2	0.55
Cigarette smoking (%)	13 (31%)	9 (32%)	0.66
Heart rate (bpm)	87 ± 11	74±8	<0.05
Hypertension (%)	16 (38%)	11 (39.2%)	0.61
Diabetes mellitus (%)	14 (33.3%)	9 (32%)	0.42
Total cholesterol mmol/L	5.35±1	5.22±1	0.46
Triglycerides mmol/L	1.86±0.94	1.81±1.08	0.34
Low density lipoprotein cholesterol mmol/L	3.44±0.91	3.34±0.96	0.37
High density lipoprotein L-cholesterol mmol/L	1.22±0.28	1.24±0.34	0.43
Serum creatinine umol/L	87.54±11.49	84±7.07	0.26
hs-C reactive protein nmol/L	20±3.62	11.43±3.33	<0.01

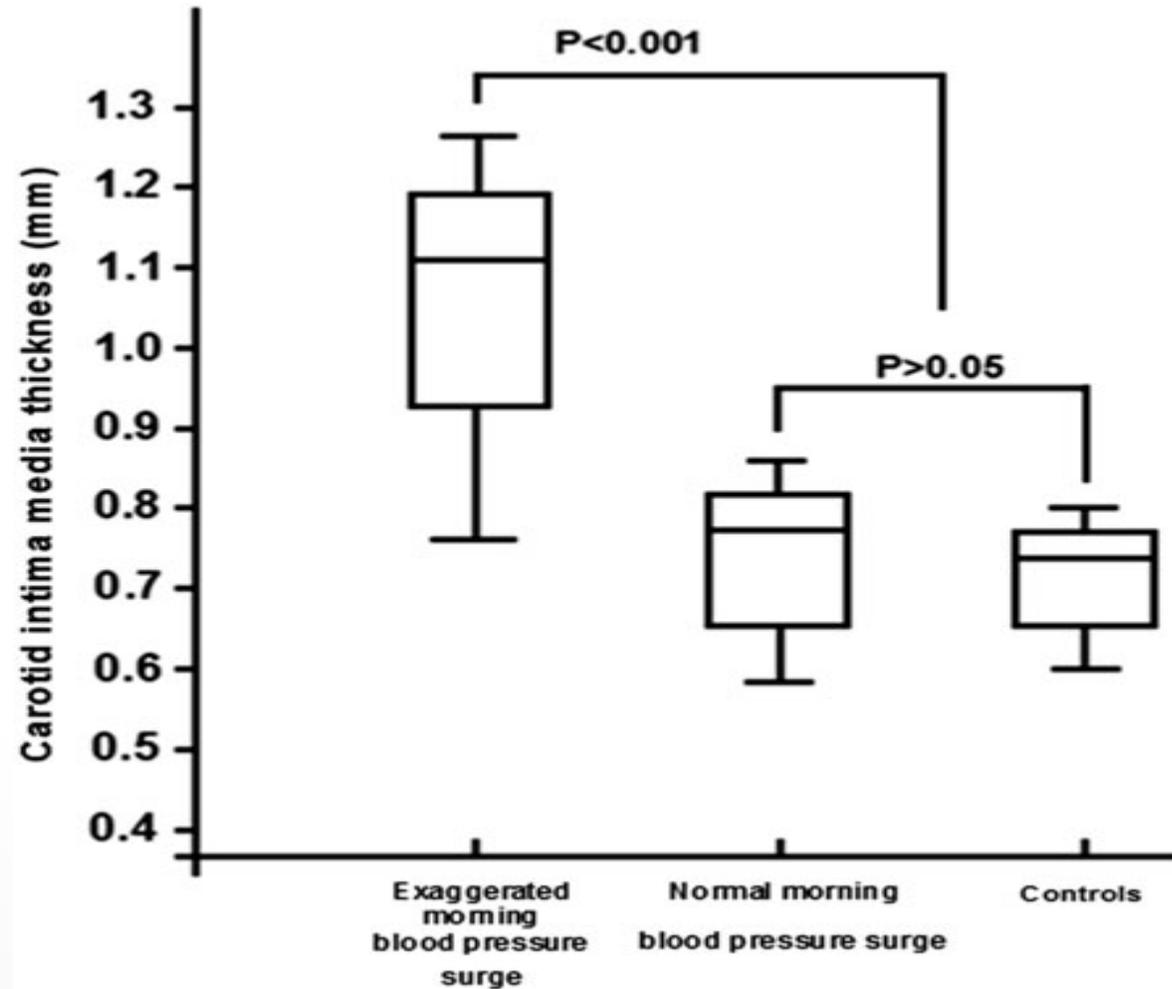
## B. Demographic and echocardiographic characteristics of patients with exaggerated morning blood pressure surge (MBPS) versus patients with normal morning blood pressure surge (MBPS)

Variable	Group I N=42	Group II N=28	P value
Morning surge mmHg			
• Systolic blood pressure (mmHg)	53 ± 9	18 ± 2	<0.001
• Diastolic blood pressure (mmHg)	36 ± 7	15 ± 2	<0.001
Left Atrial volume index (ml/m <sup>2</sup> )	35.8±3.1	24.6±2.1	<0.01
Left ventricular mass index (gm/m <sup>2</sup> )	159±27.5	162±22.7	0.19
Left ventricular ejection fraction%	72±5	73±5	0.43
E/A ratio	1.0±1	1.2±0.2	0.09
E/e' ratio	9.7±0.5	5.1±3	<0.01
Mitral annular (Sm) wave	0.82±1.1	0.85±0.9	0.06
Carotid intima-media thickness, mm	1.16±0.07	0.78±0.05	<0.001
Plaque n (%)	19 (45.2%)	2 (7.1%)	<0.005

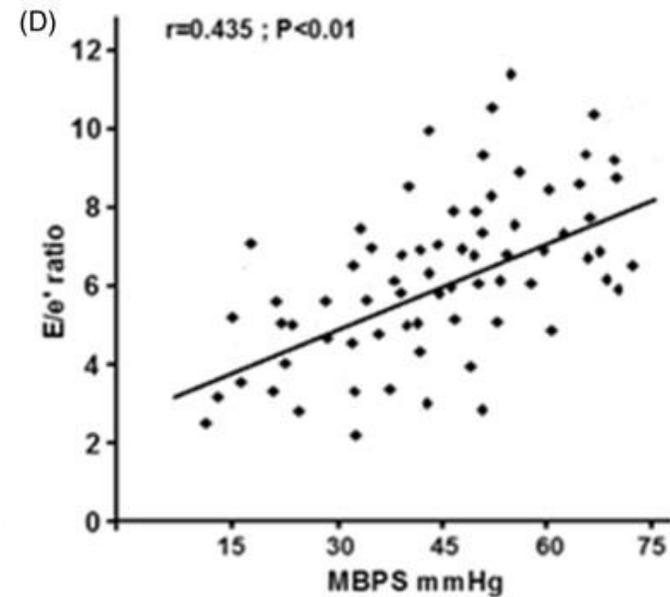
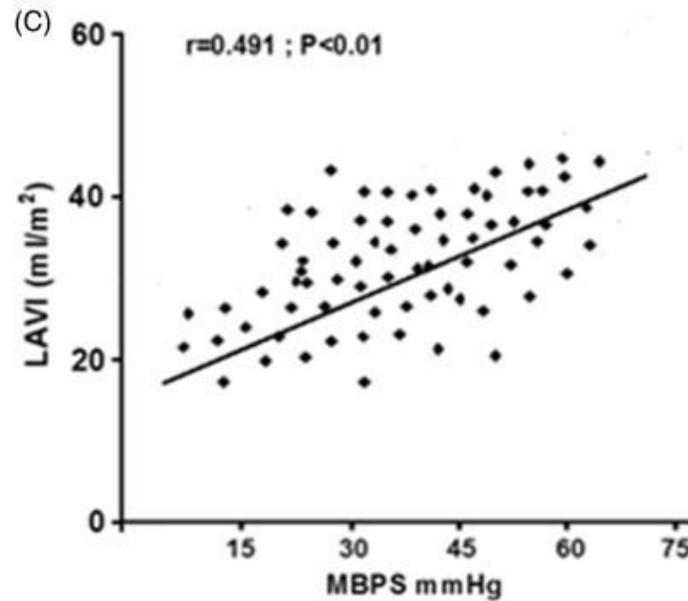
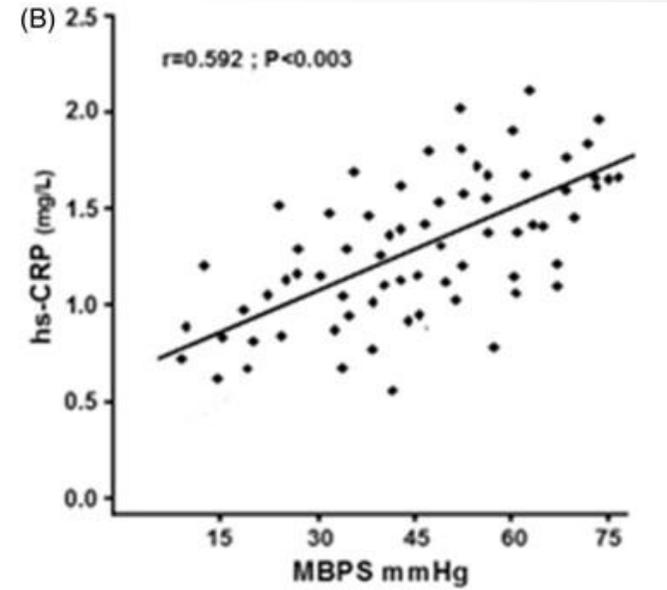
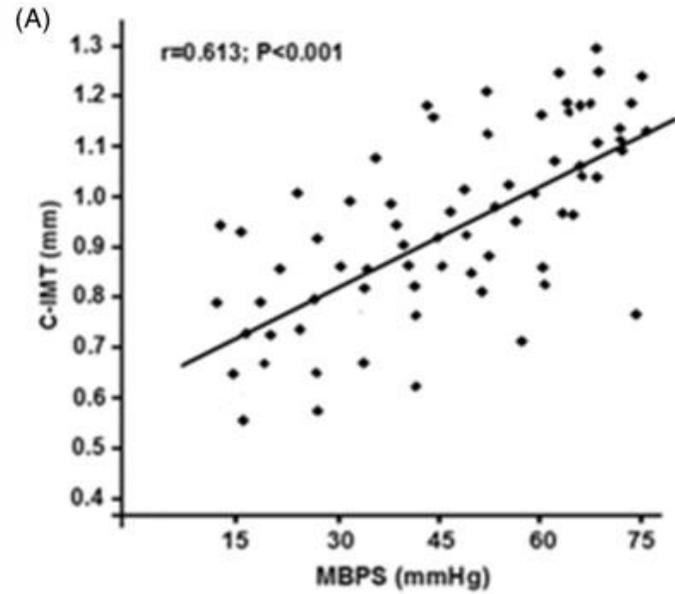
## Multivariate analysis of predictor variables for increased carotid intimal-medial thickness and E/e' in subjects with cardiac Syndrome X.

	Carotid intimal-medial thickness			E/e'		
	OR	95% (CI	<i>p</i>	OR	95% (CI	<i>p</i>
Age	1.012	0.982- 1.042	0.75	0.955	0.917- 1.005	0.59
Sex	1.596	0.935–2.042	0.28	1.474	1.003–1.945	0.34
Body mass index (kg/m <sup>2</sup> )	1.063	0.911–1.215	0.29	1.103	0.922–1.285	0.39
Basal heart rate (beats/minute)	1.319	0.725–1.972	0.24	1.372	0.713-2.041	0.38
Total cholesterol mmol/L	1.175	0.814-1.533	0.15	1.019	0.814-1.225	0.27
hs-C reactive protein (nmol/L)	1.873	1.13–2.61	<0.01	1.382	0.938–1.861	0.09
Morning blood pressure surge	<b>2.379</b>	<b>1.55–3.19</b>	<b>&lt;0.001</b>	<b>2.464</b>	<b>1.437–3.511</b>	<b>&lt;0.001</b>

Carotid intima-media thickness in patients with exaggerated morning blood pressure surge, normal morning blood pressure surge and control subjects.



Correlations  
of MBPS with  
different  
variables



# Conclusion

- We found a significant association between an exaggerated morning blood pressure surge and increased carotid intima-media thickness, diastolic dysfunction and increased left atrial volume index in patients with cardiac syndrome X.
- Likewise hs-C reactive protein was correlated with both morning blood pressure surge and carotid intima-media thickness.

- These findings suggest that the "cardiac syndrome X" could be explained, in part by morning blood pressure surge and/or hypertensive vascular changes.
- **SO,** morning blood pressure surge might serve as a useful clinical marker of cardiac syndrome X.

*Thank You*