

Prevalence of the Metabolic Syndrome in Patients With Type B Aortic Dissection

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Research

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Abstract

Background/Objective: The aim of this study is to detect the prevalence of metabolic syndrome (MS) and its components in type B aortic dissection patients. This study assessed the association of MS and its component with type B aortic dissection in Chinese patients.

Methods: This cross-sectional prospective observation study consisted of 445 patients who were first diagnosed with type B aortic dissection. Demographic information, clinical symptoms and laboratory parameters were collected using a standard form.

Results: Among the 445 TBAD patients 38.4% had MS. Hypertension was present in 78.2% of all TBAD patients. Hypertension, high fasting glucose and obesity were the most common combination of metabolic abnormalities (93%, 79.5% and 63.2%) in the TBAD patients, and a same phenomenon was seen in acute TBAD patients. But among chronic TBAD patients the most frequent individual components were hypertension, hyper-triglyceride and high fasting glucose (92.6%, 75%, and 70.6%). Presence of two or more components of the metabolic syndrome was common: 22.7% had one component, 31.9% had two components, 24.9% had three components, 10.8% had four components and 3.1% had five components. In TBAD, hypertension, obesity, triglycerides and FBG (fasting blood-glucose) were main risk factors for MS.

Conclusion

This is the first study provided information on the prevalence and components of MS in the initial TBAD patients. Hypertension, high fasting glucose and obesity were the most common combination of metabolic abnormalities in TBAD patients.

Background

Aortic dissection (AD) is a life-threatening cardiovascular disease associated with high morbidity and mortality rates, and it remains a challenge to clear its causation. The anatomical classification is basis on the location of the dissection and/or origin of the intimal tear and the extent of the dissection, as Stanford type A aortic dissections (TAAD) involve the ascending aorta, and Stanford type B dissections (TBAD) involve the descending aorta. Acute AD is diagnosed within two weeks of onset of symptoms, and chronic phase is diagnosed after eight weeks, the middle period is defined subacute AD [1]. According to the International Registry of Acute Aortic Dissection (IRAD), 33% patients presented with type B aortic dissection (TBAD) and 63% were treated medically [2]. Influence factors associated with TBAD include hypertension, diabetes mellitus (DM), obesity, and hyperlipidemia, which are also common components of MS. As estimated, approximately 80% of patients who develop an aortic dissection have hypertension, 31% of patients have atherosclerosis [3–4]. Nevertheless, the role of association diabetes mellitus, obesity, triglyceride and high-density lipoprotein cholesterol in TBAD remains unclear with controversial or scarce research findings [5].

Metabolic syndrome (MS) is characterized by a cluster of metabolic risk factors including obesity, elevated blood pressure, hyperglycemia, high triglyceride and low high-density lipoprotein cholesterol [6]. However, there is no uniform definition of MS, even though several diagnostic criteria of MS were proposed in the past few years, including the World Health Organization criteria in 1998, the Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), and the CDS criteria by cooperation group of Chinese diabetes society in 2004, the International Diabetes Federation (IDF) in 2005 and so on [7–10].

These criteria generally share the similar components although they vary somewhat in some specific elements. For example, the CDS used body mass index (BMI) rather than waist circumference (WC) to define obesity and the cut-offs for other components are different from those in the revised NCEP ATP III except for the cut-off of triglycerides. The synergistic effect of the components of MS may cause or accelerate the progression of vascular dysregulation. Individuals with MS are at increased risk for developing cardiovascular related diseases, and the relevant had well documented. However, to data, limited information is available on the association of AD with MS and its components. This study collected a relative large sample to evaluate the correlation between MS and AD in TBAD patients.

Methods

Participants

For the present study, a cross-sectional evaluation, analyses were based on the screening period of 1 January 2016 to 31 December 2019. Inclusion criteria: patients were initial TBAD and whom complete data were available. Height, weight and blood pressure was measured at admission as well as laboratory test (fasting blood glucose [FBG], triglycerides [TG], total cholesterol [TC], high-density lipoprotein cholesterol [HDL-C] and low density lipoprotein cholesterol [LDC-C] and so on).

Definitions

The CDS criteria (Metabolic syndrome study cooperation group of Chinese diabetes society, 2004) was used to define MS in this study. Patients meeting three or more of the following conditions were defined as having the MS. Besides, patients took anti-hypertensive or antidiabetic drugs were considered to satisfy the criteria even though with normal blood pressure or FBG.

1. Obesity: BMI \geq 25 kg/m².
2. High blood pressure: SBP \geq 140 mmHg systolic or DBP \geq 90 mmHg diastolic.
3. Hyper-triglyceride: serum triglycerides \geq 1.70 mmol/l (150 mg/dl).
4. Low HDL-cholesterol: serum HDL-cholesterol < 1.0 mmol/l (40 mg/dl) in men or < 0.9 mmol/l (50 mg/dl) in women.
5. High fasting glucose: fasting serum glucose \geq 6.1 mmol/l (110 mg/dl).

Statistical analysis

Continuous variable was expressed as mean \pm SD, median and interquartile range according to its distribution. Student t test or nonparametric test were used to examine the difference between two groups. Categorical variable was shown as percentage, and the Chi-square test was used to examine the difference between groups. Multiple Logistic regression analysis was performed to identify the risk of metabolic syndrome development in TBAD patients. Statistical analyses were performed using IBM SPSS 23.0. The reported p-value was two-tailed, and $p < 0.05$ was considered to be statistically significant.

Results

Demographics and baseline characteristics of the study population are summarized in Table 1. A total of 445 patients with confirmed TBAD were included in this study. The overall prevalence of MS was 38.4%. 37.3% in acute TBAD and 40.2% in Chronic TBAD. The mean age was 60 ± 13.6 years, 59.98 ± 12.16 in MS group and 60.47 ± 14.44 in Non-MS group. The majority of the patients were male (78.7%). Chest-back pain was the most common syndrome (62.5%). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were higher in patients with MS than Non-MS ($P < 0.001$). The mean height and weight were significantly ($P < 0.001$) different between both groups. ($P = 0.006$). Among the MS group the value of lipid related indicators were higher than Non-MS, including total cholesterol, triglyceride, HDL-C and LDL-C. Fasting serum glucose significantly ($P < 0.001$) higher in patients with MS (7.1) than those without metabolic syndrome (5.7). Proportion of patients with elevated serum uric acid levels was significantly higher in MS group than in Non-MS ($P = 0.016$).

Table 2 displays the prevalence of the MS and its components in TBAD patients. Among those patients, a total of 171 (38.4%) were also diagnosed with MS, 103 (37.3%) in acute TBAD patients, and 68 (40.2%) in chronic TBAD patients. Hypertension was present in 78.2% of all TBAD patients, 69% and 93% in Non-MS and MS patients, respectively. Hypertension, high fasting glucose and obesity were the most common combination of metabolic abnormalities (93%, 79.5% and 63.2%) in the TBAD patients, and a same phenomenon was seen in acute TBAD patients. But among chronic TBAD patients the most frequent individual components were hypertension, hyper-triglyceride and high fasting glucose (92.6%, 75%, and 70.6%).

Presence of two or more components of the metabolic syndrome was common: 22.7% had one component, 31.9% had two components, 24.9% had three components, 10.8% had four components and 3.1% had five components. (Table 3) Multiple logistic regression showed that the MS was 1.131 times more common in acute phase compared to chronic phase (1.131 (0.764-1.674)). In TBAD, hypertension, obesity, triglycerides and FBG (fasting blood-glucose) were main risk factors for MS as Table 4 showed.

Discussion

This is the first cross-sectional study explore the relationship between MS and TBAD with a large sample size. The overall prevalence of MS was 38.4%. 37.3% in acute TBAD and 40.2% in Chronic TBAD. Presence of two or more components of the MS was common in the TBAD patients. Hypertension, high fasting glucose and obesity were the most common combination of metabolic abnormalities.

The prevalence of the metabolic syndrome in abdominal aortic aneurysm (AAA) patients was 45% in study conducted by Jobien et al [11]. In their study, MS was diagnosed according to the Adult Treatment Panel III criteria. Individual variability and the use of different diagnostic criteria for the MS are, at least in part, reasons for differences in prevalence rate. The incidence of MS has regional and demographic characteristics, and we believe that the Chinese standard is more suitable for Chinese population [12–14].

Hypertension is an established risk factor of aortic dissection, as estimated that about 80% aortic dissection patients had hypertension, that's why hypertension was the most common component in MS group [15]. The role of associated diabetic conditions in aortic dissection is controversial [16]. Approximate 80% of the patients with type 2 diabetes mellitus, the MS was present. Our results showed FBG was the second frequent component among TBAD patients, which suggested the relationship between diabetes mellitus and TBAD [17]. Several studies showed obesity was related to the prognostic of AD, however limit information about the relationship between TBAD and obesity [18–19].

Majority of TBAD patients present two or more components of the metabolic syndrome. Only a limited number of patients displayed the full cluster of metabolic. The link between TBAD and MS has suggested a possible role of multiple metabolic syndrome has been suggested a possible role of

MS risk factors in the development of AD. A similar relationship was found in studies about abdominal aortic aneurysm and MS [20–21].

MS were responsible for the endothelial dysfunction, which share similar mechanism with AD [22]. The combination of risk factors comprising the metabolic syndrome interacts synergistically causing or accelerating the progression of AD.

This study was, however, subject to several limitations. This is a cross-sectional retrospective study that can't draw causal conclusions. In the present study, only taking anti-hypertension and anti-diabetic were included and lipid-lowering drugs was not evaluated. As a result, this may lower the rate of MS in TBAD patients.

Conclusion

This study aimed at the evaluation of the presentation of MS on TBAD patients from a single center admission records. The present study provided the information on the prevalence and components of MS in the initial TBAD patients. The prevalence of MS in the present study was 38%. Previous study showed MS was a risk factor of AAA. The present study observations suggest that hypertension, diabetes mellitus, hypertriglyceridemia, hyperuricemia, and reduced HDL were prominently associated with the increased risk of developing metabolic syndrome in patients with TBAD.

Abbreviations

Aortic dissection [AD]; Stanford type A aortic dissections [TAAD]; Stanford type B dissections [TBAD]; Metabolic syndrome [MS]; Diabetes mellitus [DM]; Chinese diabetes society [CDS]; Body mass index [BMI]; Waist circumference [WC]; Fasting blood glucose [FBG]; Total cholesterol [TC]; Triglycerides [TG]; High-density lipoprotein cholesterol [HDL-C]; Low density lipoprotein cholesterol [LDL-C]

Uric acid [UA]; White blood cell [WBC]; Lymphocyte neutrophil ratio [NLR]

Declarations

Ethics approval and consent to participate

The study was approved by the Changhai Hospital medical ethic committee, affiliated to Navy Medical University. The study was a retrospective study, samples involved in this study had discharged from our hospital. Then verbal consent was obtained from each subject by telephone consultation and was approved by the Changhai Hospital medical ethics committee.

Consent for publication

Not applicable

Availability of data and materials

All data generated or analyzed during this study are included in the article.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

SSL analyzed data and wrote the manuscript. JD and JY contributed to data collection. RLG and RF contributed to the data analysis. JZ and ZPJ contributed to the design and revised the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1 Demographics and baseline characteristics of the study population

	Total	Non-MS	MS	<i>P value</i>
Patients(n)	445	274	171	*
Age(years)	60±13.6	60.47±14.44	59.98±12.16	0.715
Male (n,%)	350(78.7)	212(77.3)	138(80.7)	0.404
Symptom (n,%)				
Asymptomatic	62(13.9)	38(13.9)	24(14)	0.922
Chest-back pain	278(62.5)	174(63.5)	104(60.8)	
Abdominal pain	52(11.7)	30(10.9)	22(12.9)	
Others	53(11.9)	32(11.7)	21(12.3)	
Kidney disease(n,%)	26(5.8)	19(6.9)	7(4.1)	0.214
Cardiac disease(n,%)	28(6.3)	19(6.9)	9(5.3)	0.48
Surgery history(n,%)	130(29.2)	82(29.9)	48(28.1)	0.675
Smoking(n%)	159(35.7)	91(33.2)	68(39.8)	0.16
Alcohol(n%)	110(24.7)	65(23.7)	45(26.3)	0.537
Hypertension(n%)	348(78.2)	189(69)	159(93)	0.001
SBP(mmHg)	150±11	125±11	156±12	0.001
DBP(mmHg)	95±10	83±9	100±10	0.001
Height(m)	168±6.57	168±6.53	169±6.64	0.84
Weight(kg)	69.44±11.41	66.23±9.81	74.53±11.94	0.001
BMI (kg/m ²)	24.4±3.48	23.27±2.98	26.20±3.46	0.001
TC(mmol/l)	4.43(3.84-5.12)	4.32(3.69-4.99)	4.59(4.04-5.28)	0.004
TG (mmol/l)	1.32(0.95-1.78)	1.16(0.85-1.42)	1.8(1.26-2.15)	0.001
HDL-C(mmol/l)	1.11(0.9-1.36)	1.2(0.98-1.43)	0.96(0.85-1.22)	0.001
LDL-C (mmol/l)	2.53(2.06-3.12)	2.54(2.08-3.10)	2.44(2.04-3.20)	0.79
FBG(mmol/l)	6.1(5.3-7.8)	5.7(5.1-6.7)	7.1(6.1-9.1)	0.001
Albumin(g/L)	38(35-41)	38(35-41)	38(35-42)	0.965
WBC(x10 ⁹ /L)	8.23(6.43-10.79)	7.75(6.24-10.6)	8.47(6.58-11.4)	0.041
Lymphocyte(x10 ⁹ /L)	15.75(9.33-23.68)	16.9(10.02-24.32)	14.4(8.7-22.6)	0.06
Neutrophil(x10 ⁹ /L)	73.6(64.58-82.4)	72.1(63.7-81.1)	75.2(65.9-83.8)	0.03
NLR(x10 ⁹ /L)	4.31(2.66-8.20)	4.19(2.60-8.06)	4.93(2.94-9.51)	0.078
D-dimer(ug/ml)	1.59(0.65-3.32)	1.48(0.60-2.84)	1.81(0.68-4.01)	0.056
Uric acid(mol/L)	0.34(0.25-0.41)	0.34(0.24-0.40)	0.36(0.26-0.45)	0.016

*present no relevant data

Table 2 displays the prevalence of the MS and its components in TBAD patients. *present no relevant data

	Total			Acute TBAD			Chronic TBAD			P value
	N(%)	Non-MS	MS	N(%)	Non-MS	MS	N(%)	Non-MS	MS	
MS	171(38.4)	*	*	103(37.3)	*	*	68(40.2)	*	*	
Hypertension	348(78.2)	189(69)	159(93)	210(76.1)	114(65.9)	96(93.2)	138(40.6)	75(74.3)	63(92.6)	0.167
Obesity	152(34.2)	44(16.1)	108(63.2)	112(40.6)	37(21.4)	75(66.9)	40(23.7)	7(6.9)	33(48.5)	□ 0.001
FBG	232(52.1)	96(35)	136(79.5)	156(56.5)	68(39.3)	88(85.4)	76(45)	28(27.7)	48(70.6)	0.018
Hyper-triglyceride	130(29.2)	26(9.5)	104(60.8)	71(25.7)	18(10.4)	53(51.5)	59(34.9)	8(7.9)	51(75)	0.039
Low HDL-C	116(26.1)	36(13.1)	80(46.8)	60(21.7)	20(11.6)	40(38.8)	56(33.1)	16(15.8)	40(58.8)	0.008

P value was calculated by χ^2 test and represented statistic difference between acute TBAD and chronic TBAD patients.

Table 3 Odd Ratios and 95% Confidence Intervals for TBAD According to Metabolic Syndrome

Vasriable	Adjusted OR	95%CI
Sex(male)	1.21	0.78-1.95
Age	0.99	0.98-1.02
Hypertension	25.45	7.48-28.58
BMI	1.37	1.24-1.52
TG	8.90	4.44-10.86
TC	1.17	0,82-1.66
FBG	1.97	1.62-2.40
HDL	0.06	0.018-0.20
UA	0.68	0.05-0.945
WBC	1.03	0.98-1.08
Lymphocyte	0.99	0.96-1.02
Neutrophil	1.01	0.97-1.02
NLR	1.02	0.99-1.05

Figures

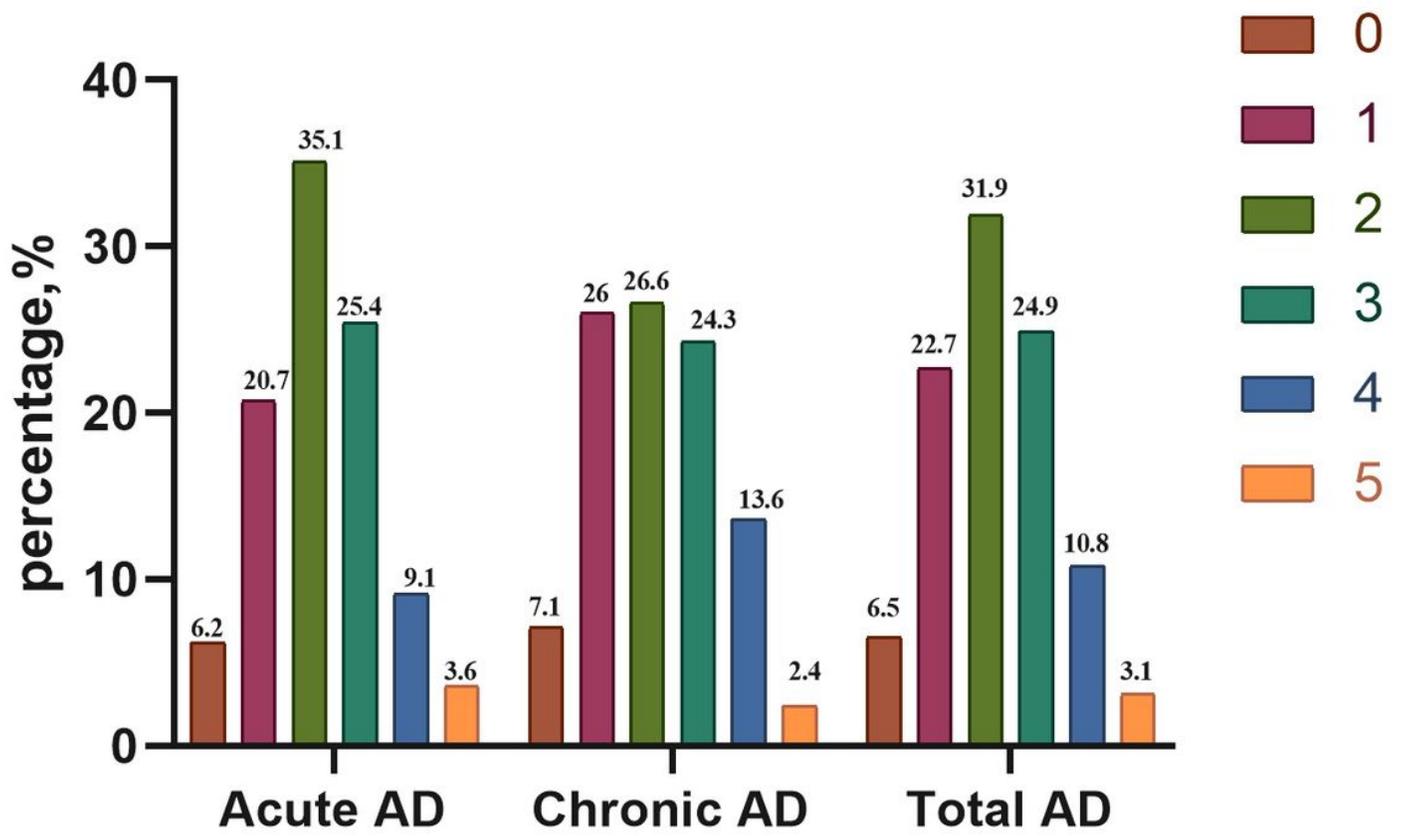


Figure 1

Prevalence of the number of components of the metabolic syndrome in TBAD

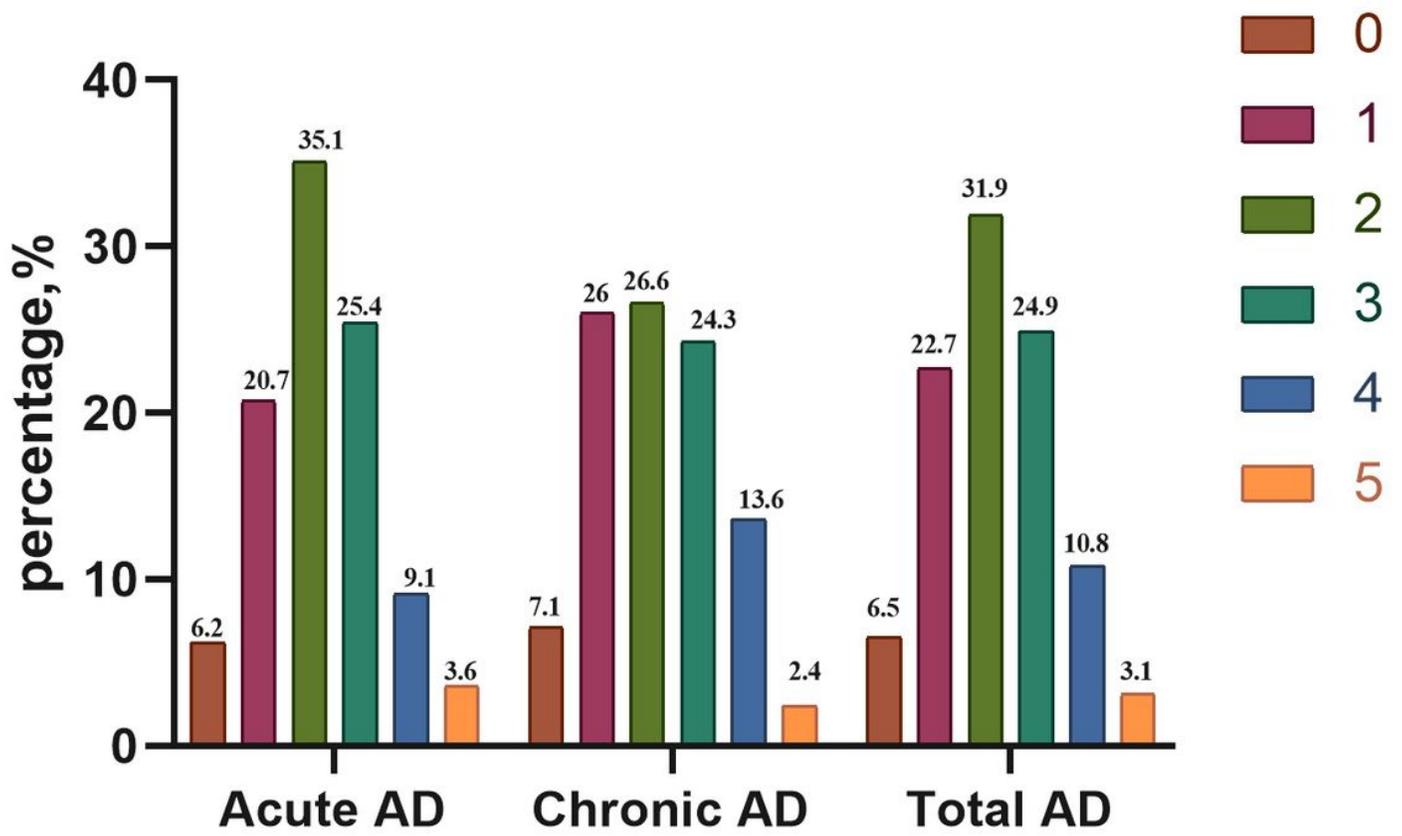


Figure 1

Prevalence of the number of components of the metabolic syndrome in TBAD