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TYPE B AORTIC DISSECTION - A SINGLE CENTER SERIES

Isabel Poleri[1], Marina Dias-Neto[1,2], João Rocha-Neves[1,2,3], Sérgio Sampaio[1,2].

[1]Faculty of Medicine, University of Porto, Portugal.
[2]Department of Angiology and Vascular Surgery, São João Hospital, Porto, Portugal.
[3]Department of Biomedicine – Unity of Anatomy, Faculdade de Medicina da Universidade do Porto, Portugal

***Contacto Autor:** marina_f_neto@hotmail.com

Abstract

Background: Type B aortic dissection (TBAD) is associated with high morbidity and mortality. The DISSECT classification aims to reunite clinical and anatomical characteristics of interest to clinicians involved in its management. This paper aims to characterize a cohort of patients admitted for type B aortic dissection in a tertiary institution.

Methods: This is a retrospective study that included all patients admitted to the hospital due to TBAD from 2006 to 2016. The computerized tomographic angiography that enabled the TBAD diagnosis were reevaluated using DISSECT classification.

Results: Thirty-two patients were included in this case series. As to DISSECT classification, 79.3% were acute (Duration), 66% had a primary Intimal tear location in aortic arch, the maximum aortic diameter was 44±13mm (Size), 60% extended from aortic arch to abdomen or iliac arteries (Segmental Extent), 28% presented with Complications, and 28% had partial Thrombosis of false lumen. Six patients underwent intervention during the follow-up period. At 12 months, overall survival was 75.4%±8.3% and survival free of aorta-related mortality was 87.0±6.1%. Survival free of aortic dilatation was 82.6±9.5%. In univariate analysis, the presence of complications and chronic kidney disease associated with increased overall and aorta-related mortality rates. Hypertension was associated with aortic dilatation.

Conclusions: The outcomes after TBAD in a Portuguese center are reported. All interventions in TBAD were performed due to complications. The presence of complications and chronic kidney disease was associated with overall mortality and aorta-related mortality and hypertension with aortic dilatation. DISSECT classification was possible to apply in all patients.

INTRODUCTION

Type B aortic dissection (TBAD) consists in a tear in the inner lining of aorta, causing the presence of a false lumen that allows blood circulation on the media layer.[1] Stanford classification divides this pathology, based on the anatomic involvement of the aorta, involving the ascending aorta (Type A), and distally to the left subclavian artery (Type B).[2] TBAD corresponds to 40% of all aortic dissections and has an estimated incidence between 2.9 and 3.5 per 100,000. This condition is associated with high morbidity and mortality.[3-6] Portuguese studies are scarce and mostly small cases series. Exceptions are reported outcomes of aortic dissection together with other thoracic pathologies undergoing TEVAR.[7,8]

The classic presentation consists in sudden and intense chest and interscapular pain associated with hypertension.[3,9] In fact, although the etiology of TBAD is multifactorial, hypertension is an important risk factor and is present in 80% of cases.[1,9] The clinical management of this patients has been highly controversial mainly since the development of endovascular techniques that allow the repair of the dissected aorta in a less invasive way.[10] The patients with complicated TBAD (malperfusion syndrome, aortic rupture, aneurismal dilatation, proximal or distal progression of the dissection, refractory pain and refractory hypertension) – about 20%, were classically treated with thoracotomy. However, European Society of Cardiology and the new guidelines of European Society for Vascular Surgery now recommend primary treatment with endovascular approach if anatomically fit.[1,5,9,11,12]

The management of uncomplicated TBAD is more complex. The classic treatment consists on pharmacologic management with antihypertensive drugs, being beta-blockers the first line choice.[13] However, the advance of thoracic endovascular aortic repair (TEVAR) has provided an alternative to the treatment of uncomplicated TBAD. Two randomized trials evaluated the possibility of using endovascular methods as first line therapy. The ADSORB (Acute Dissection Stentgraft OR Best Medical Treatment) trial[14] demonstrated, after a year of follow up, that TEVAR in addition to best medical treatment is safe and is related with aortic remodeling, false lumen thrombosis and reduction of its diameter

when compared with best medical treatment alone.[14] The INSTEAD-XL (Investigation of Stent Grafts in Aortic Dissection with extended follow-up) trial concluded that TEVAR in addition to best medical treatment allowed a 5-year improvement in aorta-related mortality.[11]

The natural history of uncomplicated TBAD and, especially, who are the patients that benefit of an interventive strategy is yet to be clarified. Thus, the evaluation of patients with TBAD treated with the different available modalities is needed.

The aim of this paper is to characterize a cohort of patients admitted for type B aortic dissection in a tertiary institution from 2006-2016.

METHODS

This paper consists in a retrospective study that included all patients with TBAD admitted to a tertiary hospital with a referral area of about 0.7 million habitants, in the period from march of 2006 to the end of 2016.

The sample was obtained from the analysis of all patients codified with aortic dissection in ICD9 (4441 – Aneurysm and Aortic Dissection; 44100 - Aortic Dissecting Aneurysm, site non-specified; 44101 – Thoracic Aortic Dissecting Aneurysm; 44102 – Abdominal Aortic Dissecting Aneurysm; 44103 – Thoraco-abdominal Aortic Dissecting Aneurysm). Demographic characteristics, comorbidities such as diabetes, hypertension, hyperlipidemia, carotid disease, coronary disease, chronic kidney disease, pulmonary disease, heart failure, history of coronary treatment (percutaneous transluminal coronary angioplasty and coronary artery bypass surgery), peripheral artery disease, history of heart surgery and usual medication of all patients were collected from clinical registries. For each patient, the computerized tomographic (CT) angiography that enabled the TBAD diagnosis was classified using the DISSECT classification. The date of the first CT scan was considered the inclusion date. The DISSECT classification, proposed by Dake *et al*[15], is a new mnemonic based approach on the evaluation of aortic dissections that aims at standardizing the imaging and clinical classification of this patients. This classification includes the analysis of six variables that influence the therapeutic decision: Duration of dissection, (primary) Intimal tear location within the aorta, Size based on the maximum trans-aortic diameter (true lumen), aortic involvement Segmental extent from proximal to distal boundary, Clinical complications related to dissection and aortic false lumen Thrombosis. While a recent consensus document on aortic pathology recommends that arch involvement either by the most proximal tear or by retrograde extension to be referred to as non-A-non-B aortic dissection[16], the DISSECT classification for TBAD do not address this question directly and contemplates the arch as a possible location for the primary entry tear in TBAD.

The primary outcomes of this paper were defined as overall mortality, aorta-related mortality and aortic dilatation (>3 mm). The need for aortic surgery after TBAD diagnosis was also analyzed.

Table 1 **Demographic characteristics and comorbidities of 32 patients with type B aortic dissection. Legend: MI – myocardial infarction**

	No. or mean	%
Gender		
Male	27	84
Female	5	16
Age	60±13	
Tobacco		
No	14	534
Ex-smoker	5	19
Smoker	7	27
Diabetes Mellitus		
No	28	88
Diet or oral medication controlled	13	9
Insulin dependent	1	3
Hypertension		
No	5	16
Regulated by monotherapy	25	78
Regulated by 2 drugs	2	6
Regulated by > 2 drugs	0	0
Carotid disease		
No	28	88
Asymptomatic significant stenosis	0	0
History of transient ischemic attack	1	3
Ischemic stroke	3	9
Coronary disease		
No	29	91
Stable Angina	0	0
Unstable Angina	0	0
MI > 1 year	0	0
MI <1 year	3	9
Chronic kidney disease		
No	21	66
Mild increased serum creatinine <210μmol/L	7	22
Severe increased serum creatinine 220-250μmol/L	2	6
Serum creatinine >250μmol/L or dialysis/ kidney transplantation dependent)	2	6

The statistical analyses were performed using SPSS (IBM Corp., released 2017. IBM SPSS Statistics for Windows, version 25.0, Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) when normally distributed and as median and interquartile range (IQR) when skewed. Categorical variables were presented as percentages. Overall mortality rates and aorta-related mortality rates were estimated using Kaplan-Meier method. Univariate analyses for predictors of overall mortality, aorta-related mortality and aortic dilatation was undertaken using Log-Rank test. In order to adjust for multiple comparisons, p value was considered significant if <0.017.

RESULTS

We included 32 patients, ascertaining a TBAD rate of approximately 5 per 1.000.000 in the last 10 years. The median follow up time was 38 months (95% confidence interval of 8-68 months). The majority were male (84%) with a mean age of 60±13 years; 84% presented hypertension, 46% were ex-smokers or active smokers, 13% had diabetes and 9% had myocardial infarction in the previous year (Table 1).

DISSECT classification

Regarding DISSECT classification, 79% were acute, 66% had a primary intimal tear location in the aortic arch (non-A non-B aortic dissection), the maximum aortic diameter was 44±13mm, 60% extended from aortic arch to abdomen or iliac arteries, 28% presented with complications, being rupture (16%) and branch vessel malperfusion (9%) the most frequent, and 28% had partial false lumen thrombosis (versus 66% with permeability of false lumen). DISSECT classification among patients is represented in Table 2.

Aortic Intervention

Six patients underwent surgery, 3 of them in acute phase, 1 of them in subacute phase and 2 of them in chronic phase. All patients that underwent surgery did so due to complications of TBAD. In the acute phase, TEVAR was performed due to branch vessel malperfusion (1) or aortic rupture (3). In the subacute phase, an open correction of abdominal aortic aneurysm was performed in a patient with TBAD due to abdominal aortic rupture. Two additional patients were treated in the chronic phase due to aortic valve insufficiency and ascending aorta aneurysm (1) and due to abdominal aorta aneurysm (1). Three of these patients died, all of them with aortic-related deaths.

Mortality and Aortic dilatation

Thirty days survival and survival free of aorta-related mortality was, respectively, 87.5±5.8% and 90.6±5.2%. At 12 months, overall survival was 75.4%±8.3% and survival free of aorta-related mortality was 87.0%±6.1% (Figure 1 A and B). Mortality causes are reported in Table 3. Univariate analysis identified the presence of complications and chronic kidney disease (CKD) as risk factors of overall mortality and

Table 2 **DISSECT classification in patients of type B aortic dissection**

	No. or mean	%
Duration		
Acute - < 2 weeks from onset of symptoms	23	79
Subacute - 2 weeks to 3 months after symptom onset	1	3
Chronic - > 3 months from initial symptoms	5	17
Intimal tear location		
Ascending aorta	0	0
Aortic arch	21	66
Descending aorta	11	34
Abdominal aorta	0	0
Unknown	0	0
Aortic size		
maximum trans-aortic diameter	22.7±10.8 43.7±13.2	
Segmental extent		
Aortic Arch to Abdominal Aorta	10	30
Aortic Arch to Iliac	11	33
Descending exclusively	5	15
Descending to abdominal Aorta	1	3
Descending to iliac	5	15
Complications		
Aortic valve involvement	0	0
Cardiac tamponade	1	3
Rupture	5	16
Branch vessel malperfusion	3	9
Progression of aortic involvement with proximal or distal extension of dissection	0	0
Other	0	0
None	23	72
False lumen thrombosis		
Patent aortic false lumen	21	66
Complete thrombosis	2	6
False thrombosis	9	28

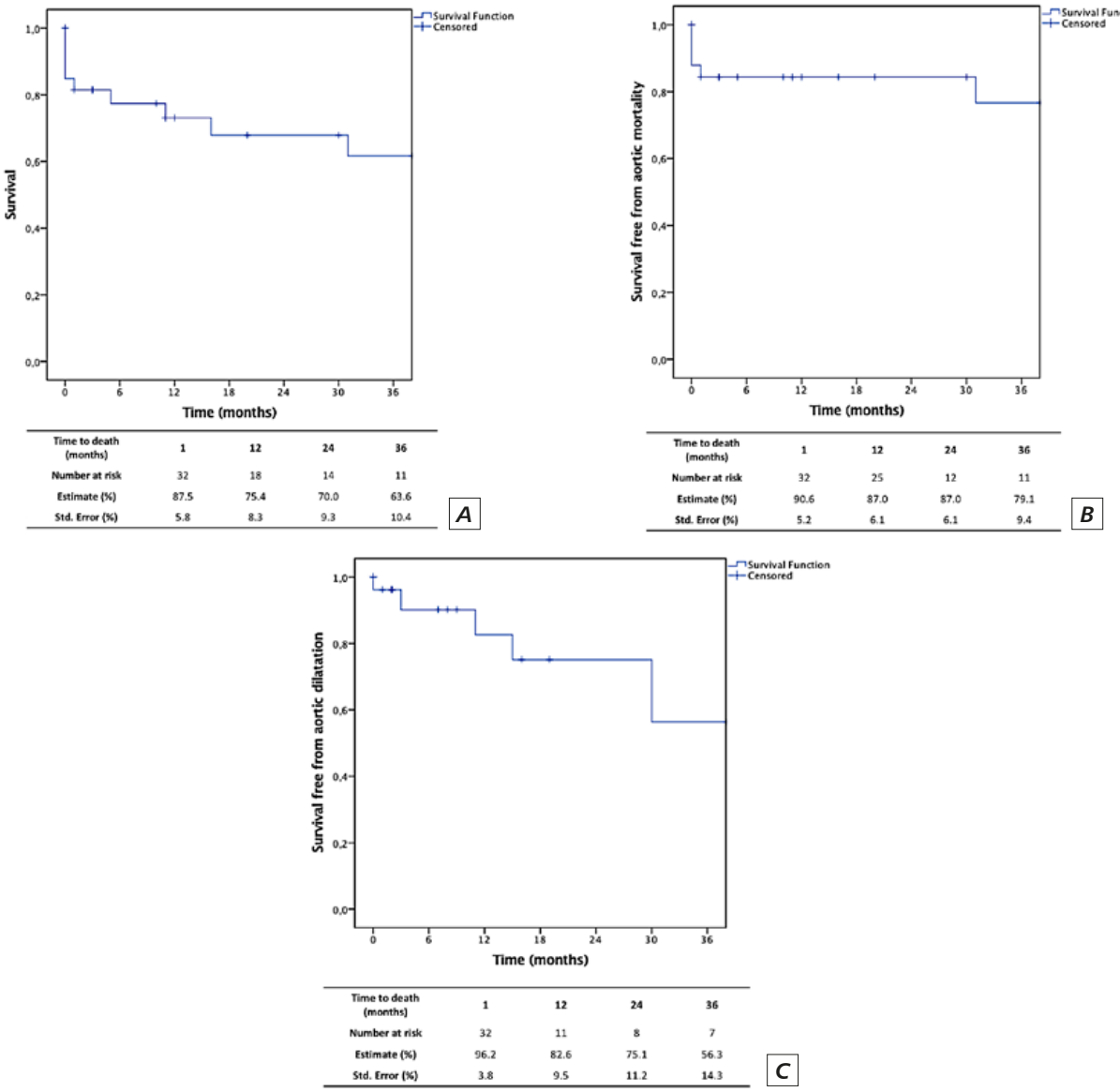

Figure 1 *Overall survival (**A**), survival free of aorta-related mortality (**B**) and survival free of aortic dilatation of 32 patients with TBAD (**C**).*

Table 3 **Causes of mortality in patients with type B aortic dissection**

Time between inclusion and death (days)	Cause of death
1	Ventricular fibrillation
8	Aortic rupture
10	Aortic rupture
13	Aortic rupture
21	Aortic rupture
50	Aortic rupture
344	Intracerebral hemorrhage
513	Septic shock
965	Aortic rupture

aorta-related mortality. Other two variables included in the DISSECT classification presented association with mortality (acute presentation, p=0.046) and with aortic-related mortality (intimal tear location, p=0.045), but this statistical significance was lost after adjustment for multiple comparisons.

At 12 months, survival free of aortic dilatation was 82.6±9.5% (Figure 1 C). Hypertension was identified as a risk factor of aortic dilatation. No significant differences were found in the remaining groups. Univariate analyses for predictors of overall mortality, aorta-related mortality and aortic dilatation are presented in Table 4.

DISCUSSION

Management of aortic dissection has been challenged by recent evidence both in the diagnostic and in the

Table 4 **Univariate analyses for predictors of overall mortality, aorta-related mortality and aortic dilatation. *P value was considered significant if <0.017***

Variables	Overall mortality (P-value)	Aorta-related mortality (P-value)	Aortic dilatation (P-value)
Demographics and comorbidities			
Male gender	0.546	0.546	0.179
Smoker	0.899	0.384	0.728
Diabetes	0.500	0.750	0.210
Hypertension	0.585	0.186	<0.001
Carotid disease	0.575	0.110	0.072
Coronary disease	0.835	0.406	0.637
Chronic Kidney disease	0.002	0.002	0.454
Heart failure	0.749	0.515	0.391
Peripheral arterial disease	0.240	0.703	0.690
DISSECT classification			
Duration of presentation	0.046	0.052	0.469
Intimal tear location	0.276	0.045	0.768
Complications	<0.001	<0.001	0.052
False lumen thrombosis	0.399	0.255	0.955

therapeutic fields. Due to the absence of Portuguese publications dedicated to this topic, it is not known whether these developments are affecting the real practice and in what extent. In this paper, a low rate of admissions due to TBAD was reported and most interventions were performed due to acute complications. The presence of complications and CKD were associated with overall mortality and aorta-related mortality and hypertension with aortic dilatation. DISSECT classification was possible to apply in all patients and demonstrated association with mortality and aortic-related mortality.

Regarding the Portuguese literature about TBAD, a study reviewed all patients that underwent TEVAR (n=52) from 2007 to 2017. Chronic TBAD was the second most frequent surgical indication, being performed in 18 patients. In-hospital mortality was 3.9% and survival at 1, 2 and 5 years was 87.9%, 85.6% and 71.5%, respectively.[7] Another study assessed 27 patients who were eligible to TEVAR, 3 of them due to TBAD complicated with rupture. Thirty days and 24 months global mortality for the whole group were, respectively, 4% and 13% but specific mortality due to TBAD was not available.[8] Like in this paper, the sample size of these series was small, despite including similar time frames. Even though these studies provide some background on TEVAR as a strategy to treat thoracic aorta diseases, none of them approaches TBAD as the main topic of debate.

In this series most patients had acute TBAD (79%) and TEVAR was performed mostly in the acute phase and in the presence of complications. In the literature, in-hospital survival in complicated TBAD patients treated conservatively is about 50%. Technical success of complicated TBAD patients treated with TEVAR ranged from 95% to 99%, and hospital mortality ranged from 2.6% to 9.8%.[9] The global mortality obtained in this case series was comparable, being of 12.5% at 30 days.

The randomized trials that compare the endovascular with standard medical treatment[10,14] lead to the general recommendation that, to prevent aortic complications in uncomplicated acute type B aortic dissection, early thoracic endografing may be considered selectively (Class IIb, Level of evidence B).[9] Despite this evidence, no patients were treated due to isolated non-complicated TBAD in this series. It is worth of note that the cited guidelines were published only in 2017 based on randomized trials from 2014. It would of interest to compare this case series with recent cohorts to assess in what extent the recent guidelines are changing the indications for intervention in TBAD and its prognosis.

The univariate analyses demonstrated an association between the presence of complications and CKD on overall mortality and aorta-related mortality. Hypertension was identified as a risk factor of aortic dilatation. Some independent risk factors for mortality in TBAD have been described in literature (Table 5). These include age and some other clinical co-morbidities, as acute renal injury, coronary heart disease or pulmonary disease as independent predictors of mortality.[4,6,17-22] Other studies have been carried to evaluate image determinants in non-complicated TBAD to determinate the patients that would benefit from

Table 5 Predictors of mortality in type B aortic dissection

Glower. 1990[15]	Presenting complication of dissection Age Rupture
Umaña. 2002[16]	Shock Visceral ischemia Arch extension Rupture Stroke Previous sternotomy Coronary artery disease Pulmonary disease
Suzuki. 2003[17]	Branch vessel involvement Lack of chest/back pain Hypotension/shock
Tsai. 2006[18]	Female gender History of prior aortic aneurysm History of atherosclerosis In-hospital renal failure Pleural effusion on chest radiograph In-hospital hypotension/shock
Jonker. 2013[4]	Age ≥ 70 years Descending aortic diameter ≥ 5.5 cm Hypotension/shock Visceral ischemia Acute renal failure
Ray. 2016[19]	Aortic diameter >44 mm Age>60 years
Matsushita. 2017[20]	Initial aortic diameter >40mm False-lumen diameter > true-lumen diameter
Guo. 2017[21]	Maximum diameter of the affected aorta

an endovascular procedure as first line therapy. Schwartz et al, evaluated 254 patients with medical treatment and concluded that an aortic diameter >40mm, an entry tear >10mm and patency of true lumen are associated with an increased risk of subsequent aortic intervention and recommend treatment with TEVAR in these cases.[23] Also, a false lumen >22mm and an aortic diameter >44mm are predictors of intervention.[20] A study conducted by Sailer *et al*[24] demonstrates that the presence of connective tissue disease and 4 morphological features identified by CT scan (false lumen circumferential coverage, maximum aortic diameter, false lumen outflow volume and number of intercostals arteries) are independently associated with late adverse events. These types of studies aim at the development of a risk-prediction model that allows to calculate the individual risk of adverse events after an initially uncomplicated TBAD, identifying patients who would benefit of an endovascular intervention at an early stage.

The two classical classifications of TBAD (DeBakey and Stanford) are based mostly on anatomic characteristics and have been used to allow the division of the patients in two groups: those who will benefit from surgical treatment and those who will be submitted to medical treatment alone. However, these classifications are too simplistic and not validated for the complex demand of the treatment of TBAD where endovascular techniques may play an important role. In this decision, factors such as duration of the disease, presence of complications or false lumen thrombosis need to be considered and the previously referred classic methods do not take them into account. Another difficulty in the patient selection for endovascular treatment is the heterogeneity in the reports of cases of TBAD. The DISSECT classification was proposed to address these problems. Being a mnemonic--based method, it is easy to apply and takes into consideration a group of characteristics of interest in contemporary therapeutic decision of patients with aortic dissection, particularly those with TBAD. This classification allows an easy interaction between anatomical and clinical aspects that are relevant to assist the decision of contemporary treatment of patients with TBAD, in which endovascular techniques are emerging.[15] The classification was suitable and feasible as it was easily applied to all patients in this cases series and some of its variables associated with the studied outcomes.

LIMITATIONS

One of the most intriguing results of this paper is the verified rate of TBAD that was lower than in previous reports.[3] This low rate might reflect a lower prevalence of the disease in the North of Portugal or the lack of an appropriate diagnose. Since there is no codification that corresponds directly to patients with TBAD, miscoding of patients with this pathology might have happened. Absolute numbers of incidence of TBAD reported in this study are thus of limited value and deserve further studies. The small sample size obtained did not allow for multivariate analysis, so complications, CKD and hypertension could not be tested as independent prognostic factors.

CONCLUSION

TBAD is an entity whose best approach to patients is yet to be clarified. DISSECT classification is valuable in the staging and decision making of these patients. New trends in the treatment of patients with TBAD show endovascular techniques as a viable option for their treatment, especially in those which clinical and anatomic characteristics whom predict later intervention. Referral centers may improve decision making of low incidence diseases such as TBAD. Notwithstanding, further studies are needed to characterize TBAD in Portugal.

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