MORPHOLOGIC PREDICTORS OF IN HOSPITAL MORTALITY IN ACUTE TYPE III AORTIC DISSECTION

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Introduction: In-hospital mortality of acute aortic type III dissection ranged about 12%. Complicated dissections represent about 18% of all cases, and require open surgery or TEVAR. More morphological predictors of in hospital mortality are needed to differentiate patients who should be selected for immediate, surgical or endovascular intervention.

Methods: From January 2009 to December 2014, 74 patients with acute aortic type III dissection were enrolled at Clinic of Vascular and Endovascular Surgery in Belgrade Serbia and retrospectively analyzed. Every MSCT was observed in regard to morphologic characteristics of dissection.

Results: By analyzing morphologic parameters in patients between survival and non-survival group only localization of intimal tear showed statistical significance (p=0,020). The size of the intimal tear didn't reach statistical significance with the tendency of doing so in a larger sample of patients (p=0,063) with the cut-off value of 9.55mm. The shape of the true lumen was on the border of statistical significance (p=0,053).

Conclusion: Inner curvature intimal tear localization, huge intimal tear as well as elliptic shape of the true lumen together should raise awareness to a subgroup at risk for in hospital mortality. More liberal endovascular treatment in this subgroup of patients is advocated.

Key words: *pacute type III aortic dissection, multi-slice computed tomography, in-hospital mortality.*

INTRODUCTIONS

Acute aortic type III dissection is one of the most catastrophic events followed by in hospital mortality ranged between 10–12 % [1]. The majority of patients are treated medicaly, but complicated dissections, which represent 15% to 20% of cases, require surgical or interventional therapy, and Thoracic endovascular aortic repair (TEVAR) has generally replaced open surgery or fenestration as the treatment of choice for this clinical problem. According to IRAD study factors influencing increased in hospital mortality are: increasing age, hypotension/shock, periaortic hematoma, descending aortic diameter >55mm, acute renal failure, and limb ischemia [2]. To improve our results (overall mortality of 27.02%) and to lower in-hospital mortality more specific diagnostic parameters beside clinical symptomatology are warranted. Therefore, beside clinical symptoms, more morphological predictors of in hospital mortality are needed to differentiate patients who should be selected for immediate, surgical or endovascular intervention. The purpose of this study was to evaluate morphological predictors of in-hospital mortality.

METHODS

Patients

From January 2009 to December 2014, 74 patients with acute aortic type III dissection (within 14 days of the onset) were enrolled at Clinic of Vascular and Endovascular Surgery in Belgrade, Serbia and retrospectively analyzed. Every MSCT was observed in regard to morphologic characteristics of dissection; segment of the aorta affected (whether it is above or below the diaphragm), type of dissection (static, dynamic or combined), localization of the entry (convexity or concavity), size of the entry tear (expressed in mm), the maximum diameter of the aorta (expressed in mm), the state of false lumen (patent, thrombosed and partially trombosed), the existence of the reentry (without reentry, with one or more reentry), the shape of true lumen (elliptic or circular). Patients with Penetrating atherosclerotic ulcer (PAU) and Aortic intramural hematoma (IMH) were excluded from the study.

Definition

The diagnosis was established based on the findings of MSCT on admission in all of the patients. Our imaging

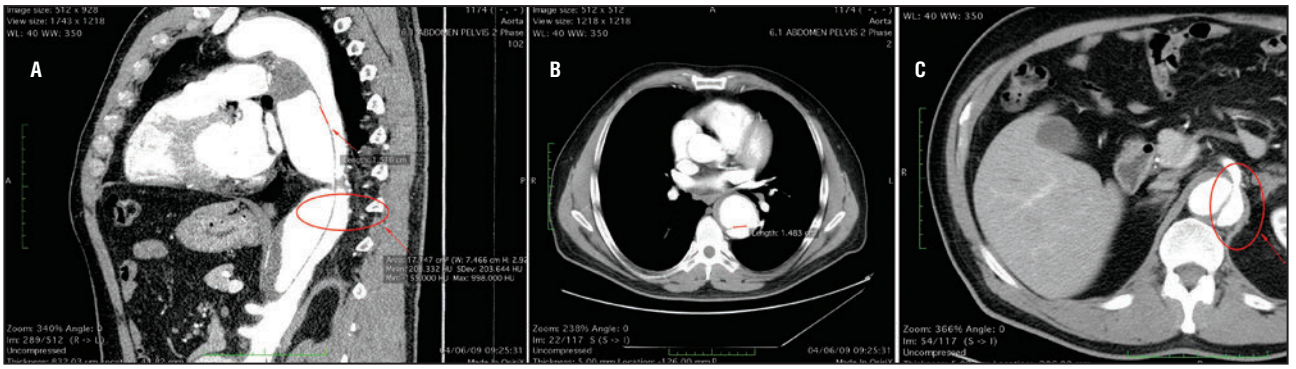

Fig. 1. a – The sagittal cross-section of the acute aortic dissection type III, with inner curve of the entry localization, retrograde dissection and partially thrombosis of the false lumen; b – The axial cross-section of the acute aortic dissection type III, with inner curve localization of the entry and the size of entry tear more than 9,55 mm; c – The axial cross-section of the acute aortic dissection type III, with elliptic shape of true lumen at the level of celiac trunk.

protocol was based on a 4 slice helical CT-scanner. For the evaluation of patients with suspected AAS, we use 4x2,5 mm collimation technique with 5 mm axial reconstructions and coronal, sagittal and oblique MPRs. The acquired MSCT data sets were transferred to a 3Mensio vascular workstation for analysis. Aortic dissections were morphologically classified De Bakey classification (III a, III b). Static type of dissection is defined as malperfusion caused by static extension of the dissection flap directly into a visceral or lower limb artery. Dynamic type of dissection is defined as malprefusion caused by dissection flap prolapsing into the vessel origin. Combination type of dissection is defined as a combination of static and dynamic type in same patient [3]. The largest diameter of the dissecting aorta measured was defined as the maximum aortic diameter (mm). The baseline MSCT was used to assess multiple morphologic characteristics of the dissection. The false lumen (FL) was classified as patent or a partially or completely thrombosed. A partially thrombosed FL was defined as the presence of thrombus at any level in the FL. Transverse, coronal, sagittal or multiplanar reconstructions were used to investigate whether side branches of the aorta were involved on the baseline MSCT scan. An intimal tear was defined as a continuity of contrast between the true lumen TL and FL. The location of the intimal tear was classified as being on the inner or the outer curvature of the aortic arch. The configuration of the TL was classified as elliptic or circular. Elliptical shape is defined as a curve on a plane surrounding two focal points such that the sum of the distances to the two focal points is constant for every point on the curve. Circular shape is defined as a set of points in a plane that are at an almost same distance from a given point. Two experienced radiologists performed aortic measurement analysis with interobserver agreement of 97%, and all morphological parameters were assessed based on consensus between both radiologists.

Treatment

With regard to antihypertensive therapy, patients with acute aortic dissection received ß-blockers by continuous intravenous infusion immediately after admission to our hospital with additional continuous intravenous infusion of nitric acid agents in some cases. In addition, surgery or endovascular treatment was performed in patients with complications such as rupture or impending rupture, an

Table 1

Morphologic characteristics of patients with acute type III dissection in relation to the outcome of hospital treatment

MSCT findings		The outcome of hospital treatment		p value
		Dead patients	Survived patients	
Affected aortic segment	Above the diaphragm	17 (85,0%)	52 (96,3%)	0,231*
	Below the diaphragm	3 (15,0%)	2 (3,7%)	
Type of dissection	Static	2 (10,0%)	4 (7,4%)	0,698*
	Dynamic	17 (85,0%)	44 (81,5%)	
	Combined	1 (5,0%)	6 (11,1%)	
Localization of the intimal tear	Concavity	5 (25,0%)	2 (3,7%)	0,020*
	Convexity	15 (75,0%)	52 (96,3%)	
Size of the intimal tear (mm); SV±SD		13,65±8,68	9,61±6,40	0,063**
Maximum diameter of the aorta (mm); SV±SD		44,16±24,31	42,15±23,05	0,903**
State of false lumen	Patent	14 (70,0%)	37 (68,5%)	0,696*
	Thrombosed	1 (5,0%)	6 (11,1%)	
	Partially trombosed	5 (25,0%)	11 (20,4%)	
Rentry	No	5 (25,0%)	6 (11,1%)	0,325*
	One	5 (25,0%)	15 (27,8%)	
	More	10 (50,0%)	33 (61,1%)	
The shape of true lumen	Circular	5 (25,0%)	29 (53,7%)	0,053*
	Elliptic	15 (75,0%)	25 (46,3%)	

**– chi-square test ; **– Mann-Whitney U test; SV– mean value; SD– standard deviation; p – statistical significance.*

increased aortic diameter, visceral ischemia, and lower limb ischemia.

Statistics

Complete statistical data analysis was performed in a statistical computer program PASW Statistics version 18. All attribute variables presented in the form of the frequency of certain categories, and statistical significance between the individual categories are tested by chi-square test. All continuous variables are presented as mean values ± standard deviation. For differences in continuous variables Student's t test for independent samples or Man–Whitney U test were used, depending on the normality of distribution that are tested based on the Kolmogorov–Smirnov test . The relationship between morphologic parameters and outcomes are evaluated by univariate logistic regression, and expressed as odds ratio (OR) with 95% confidence interval. All analyzes are assessed at the level of statistical significance of $p<0.05$. Principles of ICH Good Clinical Practice were strictly followed and ethical approval No 1358/8 from the Ethics Committee of Clinical Center of Serbia was obtained.

RESULTS

The study group included 57 men and 17 women with an average age of 63.1±9.9 years (range: 45–72 years. There were 61(82.4%) patients with uncomplicated dissection and 13(17.5%) with complicated dissection. The overall mortality was 27.02% (20 patients). By analyzing morphologic parameters in patients between survival and non-survival group only localization of intimal tear (inner curvature) showed statistical significance (chi-square test, p=0,020). The size of the intimal tear didn't reach statistical significance with the tendency of doing so in a larger sample of patients (Mann–Whitney, p=0,063) with the cut-off value of 9.55mm.The shape of the true lumen (elliptic) was on the border of statistical significance (chi-square test, p=0,053) (Table 1). After all, Univariate linear regression analysis was performed and showed that entry inner curvature localization, the size of the intimal tear and the elliptic shape of the true lumen were associated with increased mortality (95% CI, 1,525–49,255; P=0,015), (95% CI, 0,868–0,996, P=0.038), (95% CI, 0,091–0,903, P= 0.033) (Table 2).

Table 2

Morphological predictors of in-hospital mortality in linear logistic regression analysis

Variable	Univariate linear regression	
	OR (95% CI)	p value
Segment of the aorta affected	4,588 (0,706-29,803)	0,111
Type of dissection:		
static	0,720 (0,121–4,273)	0,718
dynamic	0,776 (0,190–3,169)	0,724
combined	2,375 (0,268–21,065)	0,437
Intimal tear localization	8,667 (1,525–49,255)	0,015*
Size of the intimal tear	0,927 (0,868–0,996)	0,038*
Aortic diametar	0,996 (0,975–1,018)	0,739
False lumen:		
patent	0,933 (0,306–2,846)	0,903
thrombosed	2,375 (0,268–21,065)	0,437
partial thrombosed	0,767 (0,229–2,572)	0,668
Rentry:		
No	2,000 (0,500–7,997)	0,327
one	1,154 (0,357–3,734)	0,811
more	1,571 (0,559–4,416)	0,391
The shape of true lumen	0,287 (0,091–0,903)	0,033*

*p – Statistical significance; * – statistically significant predictors; OR (95% CI) – odds ratio (95% confidence interval).*

DISSCUSION

The optimal indication for and timing of surgery in patients with acute type III aortic dissection with complications has been already established. The incidence is reported to be 10–18% [4]. Since the incidence of complicated type III aortic dissection might be underreported due to several reasons (the absence of clinical signs of complications, such as malperfusion, hemodynamic compromise and pain) we have tried to detect morphological predictors, which could help us to select the group of patients who are under higher risk for in-hospital mortality. If it were possible to identify the patients with morphological predictors of dissection-related complications requiring surgery or endovascular treatment at the time of onset the therapeutic outcome for patients with type III aortic dissections would be expected to improve. The median age of our cohort corresponded well to recently published series [5, 6]. The incidence of complicated acute type B aortic dissection was the same as in the recent literature [7]. A recent study reported that patients with intimal tear located in the inner curvature are more prone to develop complications [8]. According to our results majority of patients with intimal tear localization in the inner aortic arch curvature died. The most probable reason is the retrograde dissection due to lack of anatomical supraaortic branches which could have stopped the proximal progression of the disease (Fig. 1a). An elliptic configuration of the true lumen was also found to be one of the significant predictor of in-hospital mortality. Such a configuration is a consequence of the high FL pressure, compromising TL leading to malperfusion, which could be manifested, or not depending of the pressure value (Fig. 1b). Another issue which should be discussed is the size of the intimal tear. We have found that the intimal tear size over 9.55 mm could be a significant predictor of mortality (Fig. 1c). Other studies showed that a large intimal tear over 10 mm is a predictor of a long term aortic complications. Probably that neither one of these factors could not predict mortality by its own, but rather their combination. Due to huge intimal tear, pressurization of the false lumen can leads to elliptic formation of the true lumen followed by malperfusion or retrograde dissection if the intimal

tear is located in the inner curvature. According to these results it seems prudent to suggest liberal endovascular or open surgery treatment in patients with these morphological predictors with purpose of preventing very high mortality percentage risk. It is clear that these findings have no additive value in a patient being referred with already sustained complications, but it helps to select those with these morphological characteristics and to create awareness of this subgroup at risk.

This study evaluated multiple morphologic predictors of mortality in patients with acute type III dissection, but the results must be interpreted within the study limitations. It is a retrospective study, and a number of patients are too small to make some definite conclusions.

CONCLUSION

Morphologic characteristics appear to predict in-hospital mortality in patients with acute aortic type III dissection. Inner curvature intimal tear localization, huge intimal tear as well as elliptic shape of the true lumen together should raise awareness to a subgroup at risk for in hospital mortality. More liberal endovascular treatment in this subgroup of patients is advocated.

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