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EDITORIAL

Acute type A aortic dissection reconsidered: it's all about the location of the primary entry tear and the presence or absence of malperfusion

Martin Czerny [1,2,*] and Bartosz Rylski[1,2]

[1]Department of Cardiovascular Surgery, University Heart Center Freiburg, Bad Krozingen, Germany; and [2]Faculty of Medicine, University of Freiburg, Freiburg, Germany

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This editorial refers to 'Determinants of outcomes following surgery for type A acute aortic dissection: the UK National Adult Cardiac Surgical Audit', by U. Benedetto *et al.*, https://doi.org/10.1093/eurheartj/ehab586.

The last decade has been characterized by a leap in understanding the natural course of acute type A aortic dissection, thereby enabling an amelioration of treatment approaches and finally improving results.[1–3] The article by Umberto Benedetto *et al.* in this issue of the *European Heart Journal* reports the outcome of surgical repair of acute type A aortic dissection in the UK National Adult Cardiac Surgical Audit dataset.[4] The main findings are that age, malperfusion, poor left ventricular ejection fraction, previous cardiac surgery, pre-operative mechanical ventilation, pre-operative resuscitation, and concomitant coronary artery bypass grafting (CABG) have been identified as independent predictors of outcome. Finally, a relationship between the individual case load and outcome could be identified.

These important findings can be—apart from the components of age, previous cardiac surgery, and the case load issue—condensed to one single surrogate, i.e. the presence or absence of malperfusion at the time of diagnosis and treatment. Despite the fact that malperfusion is an isolated parameter, all other surrogates such as poor left ventricular ejection fraction, pre-operative mechanical ventilation, pre-operative resuscitation, and CABG are usually closely correlated with and indicative of the presence of malperfusion.

Let's go into the details: it is the exception and not the rule that patients suffering from acute aortic syndromes have significant coronary artery disease; nature rarely combines dilatative and obliterative arteriopathy.[5] Poor left ventricular ejection fraction and also the need for CABG are very often a consequence of coronary malperfusion and not of native coronary artery disease, e.g. a frequent finding is functional obstruction of the right coronary ostium by the retrograde propagation of the dissection membrane. Pre-operative mechanical ventilation and the need for resuscitation are very often due to neurological issues in combination with functional obstruction of the supra-aortic vessels or pericardial tamponade—in other words, the effects of malperfusion.[6]

So the main question is: how can we analyse the disease status/clinical condition of a patient with acute type A aortic dissection in the emergency room on his way to the operating room and how can we provide at that time point an initial assessment of what has to be done to (i) prevent rupture and (ii) in, the case of its presence, revert malperfusion.

If we address this question adequately, the main component to be taken into account is that the primary aim of therapy in acute aortic dissection irrespective of type is the exclusion of the primary entry tear from the circulation either by surgical resection or by transcatheter techniques, and it is imperative for the understanding of the natural disease process that the location of the primary entry tear is the main determinant of the presence or absence of malperfusion and has a tremendous impact on the treatment strategy.[7,8]

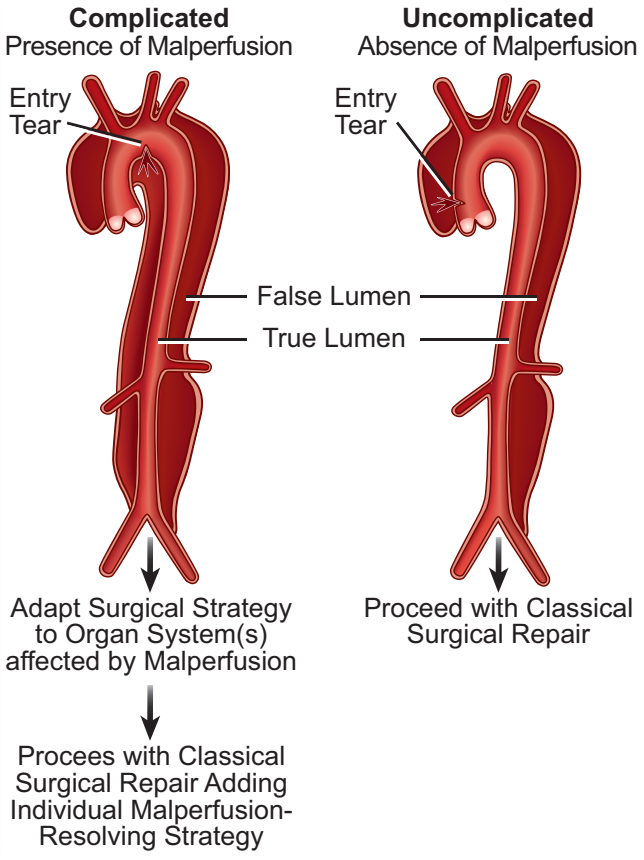
For this reason, a new classification system has been introduced, the TEM classification, being based on the oncological TNM classification, where T stands for the type of acute aortic dissection, either type A, type B, or the recently introduced subtype non-A–non-B; E stands for the location of the primary entry tear, with 0 (no entry tear visible; 1, entry tear within aortic root or ascending aorta; 2, entry tear within aortic arch; and 3, entry tear distal to the aortic arch; and M stands for malperfusion, and is categorized by its effect, with 0, no malperfusion present; 1; coronary malperfusion; 2, malperfusion of the supra-aortic branches; and 3, malperfusion of the spinal cord, viscerals, renals, lower extremities, or a combination of these. (+) is added if, in addition to radiographic malperfusion, clinical malperfusion is also present.[9] The *Graphical Abstract* depicts the basic scheme of the TEM system.

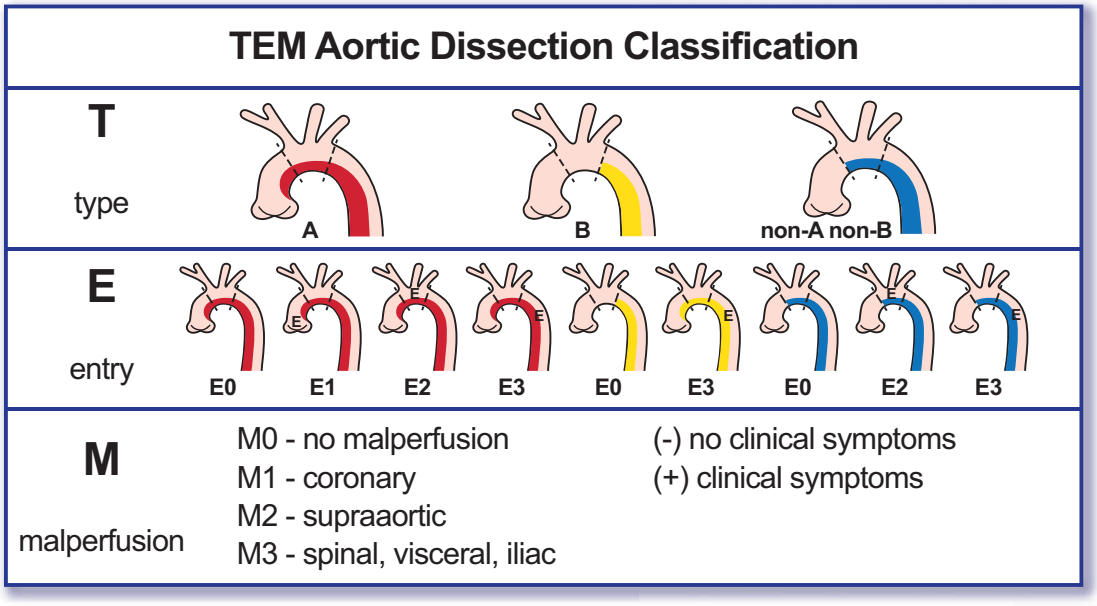
* Corresponding author. University Heart Center Freiburg, Bad Krozingen, University of Freiburg, Faculty of Medicine, Hugstetterstrasse 55, D-79106, Freiburg, Germany. Tel: +49 761 270 27740, Fax: +49 761 270 25500, E-mail: martin.czerny@universitaets-herzzentrum.de

Acute type A aortic dissection reconsidered - TEM classification and GERAADA score determine the surgical strategy

Age:	50
Sex:	Male
Resuscitation before surgery:	No
Previous cardiac surgery:	No
Intubation/ventilation at referral:	No
Catecholamines at referral:	No
Aortic valve regurgitation:	No
Preoperative organ malperfusion:	
☑	No
☐ coronary malperfusion	
☐ visceral malperfusion	
☐ peripheral malperfusion	
☐ unknown or other	
Preoperative hemiparesis:	No
Extension of dissection:	
☐ aortic arch	
☐ supraaortic vessels	
☐ descending or further downstream	
☑ unknown or other	
Location of primary tear	
within aortic arch:	No

Calculate risk





Graphical Abstract

With this simple system, an initial thorough analysis of the disease status can be made and an initial treatment strategy can be defined. In a first example, i.e. type A, E1, M0, an acute type A with the primary entry tear in the ascending aorta without malperfusion—namely the ideal type A patient—this issue will be solved by ascending and hemiarch replacement, in other words a standard procedure. In another example, type A, E3, M3 (+), this is complex as in this type A aortic dissection, the primary entry tear is located in the descending aorta (in other words, a retrograde type A aortic dissection is present which started as a type B and then advanced to the ascending aorta), and there is clinical malperfusion of the viscerals and renals. This patient needs extensive surgery as ascending aortic replacement will prevent rupture but will not solve visceral and renal malperfusion. This requires extensive surgical repair by the application of the frozen elephant trunk (FET) technique to exclude the primary entry tear from the circulation, otherwise malperfusion will persist and no effect is achieved.

Another component is anticipating risk by scoring systems. Until recently, scores have been applied which have not been developed for this pathology, such as the EuroSCORE and STS score. Despite the fact that an approximation could be achieved, these scores are inadequate for this pathology. Recently, the first web-based score predicting 30-day mortality in acute type A aortic dissection has been developed, the GERAADA score (https://www.dgthg.de/de/GERAADA_Score) where, according to easily retrievable radiographic and clinical parameters, 30-day mortality risk can be predicted.[10] This tool is the first of its kind, selectively addressing the need for prediction in acute type A aortic dissection; further analyses have already validated this score and we expect more to come.[11]

The final important finding of this analysis is the relationship between the individual case load and outcome. This has been shown in several cardiovascular procedures and further underlines the need for centralization.[7] This remains a political decision and our task, i.e. to name the issue and to provide data supporting this direction, has already been fulfilled.

So if we condense the results of this excellent analysis and harmonize them with the TEM system and the GERAADA score, we can conclude that results of surgical treatment of acute type A aortic dissection have been steadily improving in the last decades and several refinements regarding the conceptual approach have been implemented. The major determinant of outcome remains the absence or presence of malperfusion and its reversal by the surgical strategy. The TEM system (the Syntax score of acute type A aortic dissection) allows for a quick and straightforward initial estimation of the clinical situation by the diagnostic CT scan, and thereby allows establishment of a disease process-oriented treatment strategy; adding the GERAADA (the EuroSCORE of acute type A aortic dissection) score helps in anticipating risk for 30-day mortality.

Summarizing, it's all about the location of the primary entry tear as well as the presence or absence of malperfusion. This knowledge, together with the routine application of the TEM classification and the GERAADA score, mirrors the development of acute aortic dissection to the archetype of personalized aortic medicine and will help in further refinement of therapeutical strategies leading to better outcome in the years to come.

Conflict of interest: M.C. and B.R. are consultants to Terumo Aortic and shareholders of Ascense Medical. M.C. is consultant to Medtronic, Endospan, and NEOS, received speaking honoraria from Cryolife-Jotec and Bentley, and is a shareholder of TEVAR Ltd.

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