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http://dx.doi.org/10.1016/j.jacc.2015.10.041

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Reconsidering the Impact of Pre-Operative Malperfusion on Acute Type A Dissection

The Modified Penn Classification

We read with great interest the recent article reported by Czerny et al. (1) who performed an analysis of a large database to address an important issue showing that malperfusion remained a severe clinical condition with strong potential for adverse outcomes in patients of acute type A aortic dissection (ATAAD) undergoing surgery while the impact differed substantially in accordance with the number and the type of organ malperfusion involved. Therefore, they proposed a classification system of "complicated" and "uncomplicated" ATAAD to help predict risk of outcomes. We want to congratulate the investigators for shedding light on the important issue of the impact of malperfusion on operative mortality risk for patients with ATAAD. The investigators provided valuable scientific evidences which confirmed and extended the viewpoint of ischemic consequences of organ malperfusion and end-organ dysfunction that compromised survival (2,3), although some investigators still argued that generalized ischemia in ATAAD predicted early surgical outcomes only (4). The issue of generalized ischemia caused by circulatory collapse, distinct from localized organ ischemia, is a very well taken point to be emphasized as the most important predictor of outcome after surgical repair of ATAAD and associated with the highest in-hospital mortality regardless of treatment strategy (3-5). In 2009, Augoustides et al. (2) reported an observational study of mortality risk stratification by ischemic presentation in patients with ATAAD, so-called Penn classification, which has been validated by subsequent investigators (see references 1 and 5 in Chien et al. [5]) and has shown merit to be a useful risk assessment system in predicting ATAAD-related in-hospital mortality (4,5). Nevertheless, Penn classification might still underestimate the surgical risk of ATAAD in the setting with critical organ-specific ischemia (including mesenteric ischemia, sustained major cerebral ischemia, and coronary malperfusion). From this point of view, we have proposed to modify the original Penn classification and suggested to divide the Penn class Ab into subclasses Ab-1 and Ab-2 (Table 1) (5). Based on this consideration, we studied the relationship of ischemic presentations to 30-day mortality after surgical repair in 179 patients from 1997 to 2014 (mean age, 59 ± 12 years; 124 men; classes Aa [n = 60], Ab-1 [n = 44], Ab-2 [n = 27], Ac [n = 10], and Abc [n = 38]). It was found that subclass Ab-2 had much higher mortality rate than that of subclass Ab-1 (22.2% vs. 2.3%), however, without statistical significance (p = 0.175). One possible explanation is the small number of our patients suffered from localized malperfusion (Ab-1 or Ab-2). Nevertheless, we do think that subclass Ab-2 remains a surgical challenge and is

TABLE 1 Modified Penn Classification of Ischemic Presentations in Patients With Acute Type A Aortic Dissection

Class	Definition
Penn Class Aa	Absence of branch vessel malperfusion or circulatory collapse
Penn Class Ab	Branch vessel malperfusion with localized malperfusion
Subclass Ab-1	Localized malperfusion without involving critical organs of subclass Ab-2
Subclass Ab-2	Major cerebral, mesenteric, and coronary malperfusion
Penn Class Ac	Generalized malperfusion because of circulatory collapse
Penn Class Abc	Both localized and generalized malperfusion

associated with adverse outcomes following surgical repair (3) (see references 2, 8, and 12 in Chien et al. [5]). Of note, class Aa + Ab-1 (odds ratio [OR]: 0.17, 95% confidence interval [CI]: 0.064 to 0.444; $p < 0.001$) and class Ab-2 + Ac + Abc (OR: 5.94, 95% CI: 2.251 to 15.671; $p < 0.001$) were respectively relieving and exacerbating independent factors for 30-day mortality (5.8% vs. 26.7%, $p < 0.001$). Thus, it seems that a mixed group of modified Penn Ab-2 + Ac + Abc is more similar to the meaning of "complicated" ATAAD and the mixed group of modified Penn Aa + Ab-1 is closer to the meaning of "uncomplicated" ATAAD. In short, we think the validation of modified Penn classification could be easier to apply and more adequately point out patients with higher risk of in-hospital mortality after surgical repair.

Notably, a prevalence of 20% to 35% of patients with ATAAD with shock (defined as generalized ischemia) was reported by a number of investigators. Nevertheless, Czerny et al. (1) did not describe if they included this major confounder, hemodynamic shock, and have not included it as variable in the multivariate analysis. This was a serious problem because hemodynamic shock is strongly related to post-repair in-hospital mortality. This flaw calls into question the methodology of investigation and its subsequent results. Thus, the in-hospital mortality of patients with organ-specific malperfusion might be overestimated or underestimated during statistical analysis, depending on whether the hemodynamic shock is presented or not in patients with organ-specific malperfusion. Finally, since generalized malperfusion is the strongest risk factor of post-repair in-hospital mortality in patients with ATAAD by many investigators (2,4) (see references 1, 3, and 5 in Chien et al. [5]), we strongly recommend the investigators consider the impact of generalized malperfusion as a major confounder of pre-operative malperfusion on the operative mortality risk for patients with ATAAD in future analyses.

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http://dx.doi.org/10.1016/j.jacc.2015.09.102

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REPLY: Reconsidering the Impact of Pre-Operative Malperfusion on Acute Type A Dissection

The Modified Penn Classification

We thank Dr. Li and colleagues for their interest in our paper (1). The genuine rationale for classifications is to simplify complexity and, as the investigators state, the Penn classification is an excellent risk stratification tool to predict mortality on the ischemic pattern at clinical presentation (2). However, any sub-segmentation — despite that it might be justified and may fit — does not always help to make complex issues easier to understand and does not always direct the focus of a physician on a clinical path where the diagnostic and therapeutic aim is reached more rapidly. In general, a classification has to be easy to understand and self-explanatory, as we are well aware that not all variations of a highly dynamic process can be mapped. This is also the case when