Review

Classification of acute type a dissection: focus on clinical presentation and extent


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Summary

Recent advances in the management of acute Stanford type A dissection have highlighted the clinical importance of clinical presentation and extent of dissection. The Penn classification of type A clinical presentations is based on ischemic profiles that not only determine mortality but also influence management options. The extent of type A dissection as summarized by the DeBakey classification significantly determines the role of endovascular intervention in this important disease. We propose an integration of these three classifications of acute type A dissection as a framework for future advances in diagnosis, intervention and prognosis.

Keywords: Type A dissection; Stanford classification; DeBakey classification

1. Introduction

A major consideration in the classification of acute aortic dissection is the presence of ascending aortic involvement because this represents an indication for urgent surgery. This important consideration is at the heart of the management-driven Stanford classification: type A dissection involves the ascending aorta, whereas type B does not [1—3]. This distinction remains important, but does not completely integrate the evolving management of acute aortic dissection due to the outcome importance of clinical presentation and the advances in thoracic endovascular aortic repair (TEVAR) [4—8].

Recently, these two advances have merged to offer alternatives in the management of acute type A dissection. The first consideration is that malperfusion on presentation of acute type A dissection is not only a major outcome determinant but also may require percutaneous restoration of perfusion with intimal fenestration and/or branch vessel stenting, followed by delayed central aortic reconstruction [9,10]. The second consideration is that TEVAR in acute type A dissection offers alternatives for thoracic aortic repair both related to the proximal and distal extent of the dissection: these endovascular techniques may not only be combined with standard techniques in central aortic reconstruction but may, in selected cases, also be the sole therapy [7,11,12].

In the current era of TEVAR, the heterogeneity in type A dissection based on clinical presentation and extent increasingly influences management strategies and outcomes, both in the short term and long term. The purpose of this review is to characterize these advances in acute type A dissection and propose a management-driven classification of type A dissection based on clinical presentation and extent. A management-driven extension of the Stanford classification could provide a common framework essential for outcome comparison and for future trial design.

2. The clinical presentation of type A dissection

Although the clinical presentation of type A dissection is heterogeneous, it may be understood in terms of four ischemic profiles proposed by the thoracic aortic research group at the University of Pennsylvania (Table 1) [14,15]. The first ischemic profile, classified as Penn presentation class a, is characterized by the ‘absence’ of ischemia in which the patient is hemodynamically stable with no branch vessel malperfusion. The second ischemic profile, classified as Penn presentation class b, is characterized by ‘branch’ vessel malperfusion that results in localized organ ischemia to cause...
the following: stroke; paraplegia; renal dysfunction; mesenteric ischemia; and/or an ischemic extremity.

The third ischemic profile, classified as Penn presentation class c, is characterized by circulatory collapse that produces generalized ischemia as a result of cardiac tamponade, coronary dissection, acute aortic regurgitation, and/or aortic rupture. The fourth ischemic profile, classified as Penn presentation class b and c, is characterized by both regional ischemia from 'branch' vessel malperfusion and generalized ischemia from 'circulatory collapse'. At the University of Pennsylvania, hospital mortality for type A dissection (N = 276; 1994—2008), the presence of any malperfusion syndrome on presentation of type A dissection (Penn presentation class b) almost trebled operative mortality for type A dissection (33% vs 12%; P = 0.0001); multivariate mortality predictors in this series included hypotension (odds ratio (OR) 7.4; P = 0.003), myocardial ischemia (OR 5.8; P = 0.03), neurological deficits (OR 7.7; P = 0.0001), and, acute renal failure (OR 3.9; P = 0.0001) [16].

The type A dissection outcome data from the International Registry of Acute Aortic Dissection (IRAD) further support the single-center data from around the world [17,18]. The independent predictors of mortality in type A dissection derived from the IRAD database (N > 650; 1995—2009) highlight the outcome importance of ischemic profile as outlined in the Penn classification: hypotension on presentation (OR 3.23; 95% confidence interval (CI) 1.95—5.37: a feature of Penn class c and class b and c), myocardial ischemia on presentation (OR 1.76; 95% CI 1.02—3.03: a feature of Penn class c or class b and c); any pulse deficit on presentation (OR 1.75; 95% CI 1.06—2.88: a feature of Penn class b or class b and c); and, renal failure on presentation (OR 4.77; 95% CI 1.80—12.6: a feature of Penn class b or Penn class b and c) [17]. Furthermore, recent IRAD data (N = 126: 18.7% of cohort) have demonstrated that cardiac tamponade on presentation in type A dissection (features of Penn class c or Penn class b and c) more than doubled hospital mortality (54% vs 24.6%; P < 0.0001), even after baseline risk adjustment [18]. The outcome importance of hypotension on presentation in acute type A dissection persists independent of patient age [19].

These presentation categories also may significantly determine management in type A dissection. Although circulatory compromise in type A dissection is considered an indication for immediate surgery, the timing of central aortic repair in the presence of branch vessel malperfusion remains controversial [20]. The proposal from the University of Michigan is that operative aortic repair be delayed until after revascularization with intimal fenestration and after resolution of the ischemia—reperfusion injury [9,20,21]. On the other hand, this delayed approach is countered by the proposal from centers such as the University of Pennsylvania and Harvard University that immediate central aortic repair achieves acceptable operative outcomes [4,22,23]. Although the optimal timing of central aortic repair remains to be determined in class b type A dissection, the branch vessel ischemia can be percutaneously relieved and remains a major determinant of final outcome [24—26].

### Table 1. University of Pennsylvania class of clinical presentations in acute type A dissection.

<table>
<thead>
<tr>
<th>Clinical presentation</th>
<th>Definition of clinical presentation class</th>
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<tbody>
<tr>
<td>Class a</td>
<td>Clinical presentation characterized by Absence of branch vessel malperfusion or circulatory collapse</td>
</tr>
<tr>
<td>Class b</td>
<td>Clinical presentation characterized by Branch vessel malperfusion with ischemia e.g. stroke; ischemic extremity</td>
</tr>
<tr>
<td>Class c</td>
<td>Clinical presentation characterized by Circulatory collapse with or without Cardiac involvement</td>
</tr>
<tr>
<td>Class b and c</td>
<td>Clinical presentation characterized by both Branch vessel malperfusion and Circulatory collapse</td>
</tr>
</tbody>
</table>

3. The extent of type A dissection

The gold standard for treatment of acute type A dissection is emergency open replacement of the ascending aorta with extension to the aortic root and aortic arch as indicated. This management approach has been associated with excellent results both in the short term and the long term [27—32]. An integrated management approach has further enhanced perioperative outcome [23—27]. Although the optimal technique for cerebral protection during open arch repair is debated, the clinical efficacy of the established techniques has rendered aortic arch repair a routine consideration in operative repair for type A dissection [15,33].

The distal extent of acute type A dissection remains a major risk factor for adverse long-term outcomes due to the patency of the false lumen in the descending thoracic aorta [12]. This distal false lumen can be obliterated with antegrade stent deployment in the descending thoracic aorta at the time of open aortic arch repair (‘frozen elephant trunk’) [34—37]. This use of TEVAR for more complete thoracic aortic reconstruction in acute type A dissection with DeBakey type I extent is not only feasible but also significantly improves distal aortic outcomes [13,34—37]. At the University of Pennsylvania, this approach (N = 78; 2005—2008) did not increase operative risk, and decreased the risk of subsequent open distal aortic intervention (0% vs 11%; P = 0.083) [13]. In a recent series from Japan, the frozen elephant trunk TEVAR technique, as compared with standard open repair (N = 120: 1997—2008), significantly improved long-term survival (95.3% vs 69.0%; P = 0.03; mean follow-up 67 months), and the 5-year freedom from thoracic aortic events (95.7% vs 73.0%; P = 0.01) [36]. In both series, distal false lumen obliteration was achieved in the vast majority of the frozen elephant trunk cohort (80% and 100%, respectively). In both these series, standard open repair included hemiarch and not total aortic arch repairs.

The safety of the TEVAR elephant trunk approach has recently been demonstrated in conjunction with total aortic
arch replacement in acute type A dissection [37]. In this series from China (N = 107: 2003—2007), the 30-day mortality was 3.74% with a distal false lumen obliteration rate of 95% around the stent graft and 69% distal to the stent graft at the level of the diaphragm. These investigators concluded that a more aggressive thoracic aortic repair is warranted in acute type A dissection (with DeBakey type I extent) because it is associated with low operative mortality. In the TEVAR era, the therapeutic options for acute type A dissection have multiplied and will likely be individualized based on type of clinical presentation and dissection extent. Further clinical trials are indicated to delineate the complementary role of TEVAR in the operative management paradigm for acute type A aortic dissection.

4. Towards an integrated classification of type A dissection

Given the outcome and therapeutic consequences of clinical presentation (Penn presentation classes) and dissection extent (DeBakey I vs DeBakey II), we propose that the Stanford classification of proximal thoracic aortic dissection should be extended to address these cardinal clinical considerations. Our classification proposal is summarized in Table 2: it integrates the type A dissection concept (Stanford classification) with the concepts of presentation class (Penn classification) and dissection extent (DeBakey classification). This integrated classification organizes the clinical heterogeneity in acute type A dissection into discrete categories that further drive contemporary management based on outcome risk and therapeutic alternatives. This integrated approach may provide a lingua franca for the contemporary clinical approach to type A dissection in the guidance of treatment decisions, evaluation of interventions, assessment of prognosis, and patient stratification for future clinical trials.

5. Conclusion

In summary, recent progress in the management of acute type A dissection has ushered in a paradigm shift in the future clinical approach to this important disease. We propose the Penn integrated classification of acute type A dissection as a framework for facilitating future advances in diagnosis, intervention, and prognosis. We hope that this integrated classification will become widespread in the aortic community to benefit our patients.

References


