Does an Open Distal Anastomosis Confer Prognostic Benefit in Acute Dissection Surgery?

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Abstract

Acute type A aortic dissection should in the present era be treated surgically with reconstruction of the ascending aorta in order to prevent rupture, tamponade and dissection of the coronary ostia and aortic valve. How to handle the rest of the aorta in general, and the distal aortic anastomosis in particular, is at the present time more diffuse and controversial. A mainstay of surgical technique has for years been to construct this anastomosis in an open fashion to promote a secure anchoring of the graft in the friable aortic tissue and to enable an inspection of the inner side of the aorta with a subsequently more extensive resection should the tear go beyond the planned anastomosis level. However, a careful review of published results cannot demonstrate a survival benefit, or theoretically possible adverse effect, from this technical solution. Such a critical evaluation of surgical results reveals that the methodological difficulties we face when assessing surgical techniques are substantial for life threatening and relatively rare diseases like acute aortic dissections.

Keywords

Acute aortic dissection • Surgical reconstruction • Open distal anastomosis

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What Is Proven (Evidence Based) Surgical Management of Acute Aortic Dissections?

Aortic dissection is one of many surgical diseases and therapies that do not easily lend themselves to randomized trials or other comparative studies. Through an analysis of the pathology and natural cause of the disease, DeBakey [1] and Shumway [2], among others, proposed surgical treatment of acute type A aortic dissections with the distinct aim to replace the ascending aorta with a vascular graft. This treatment soon became the accepted approach to the treatment of these severely ill patients with their very dismal prognosis. Figures from the International Registry of Acute Aortic Dissections (IRAD), using observational data, have shown the obvious benefit on survival by this surgical approach both in the first [3] and subsequent [4] eras of the database (Fig. 14.1).

As the surgical techniques and general management of these patients have improved, a number of other interventional approaches have been proposed, including arch reconstructions [5], surgery for uncomplicated B-dissections [6] and lately reimplantation of the aortic valves in completely resected roots [7] and finally combined stent-grafting of the descending aorta with arch and ascending replacement [5, 8]. In an era of increasing focus on best-evidence treatment, there is an ongoing concern on how to document and investigate the merits of these different surgical treatments for aortic dissections. Use of an open distal anastomosis during reconstruction of the aorta is one of the technical concepts that seems logical and potentially can improve the prognosis for patients with acute type A dissection.

The Open Distal Anastomosis: Why Should Such a Technique Improve Surgical Outcome?

Apart from the limited number of dissections confined to the ascending aorta alone (DeBakey type II morphology, [9]), most type A dissections affect the aorta from the ascending well into the descending aorta. As such, the upper part of the ascending aorta, the prevalent distal landing zone for the implanted graft in most operations, does not mark a logic natural site to truncate the reconstruction. The selection of this landing zone has emerged as a "compromise" between the pressing need to at least reconstruct the aorta within the pericardium (to avoid tamponade, coronary involvement and valve incompetence) and the limited invasiveness desirable in severely ill patients. From a morphological point of view, a more extensive approach including the arch in the reconstruction is logical [10], but there is a prize to pay for an extensively invasive procedure in these patients. Doing a large reconstruction, including the neck vessels and placing the distal landing zone in the descending aorta, puts increasing demand on brain protection and meticulous surgical technique to avoid neurological complications and bleeding problems from large anastomoses in friable tissue.

The thought of including part or the whole of the arch in the surgical resection emerged as deep hypothermia became commonplace [11]. By avoiding a clamp on the ascending aorta during reconstruction, a diagnostic inspection of the arch, arch vessels and proximal descending aorta is possible. In those cases where the primary tear is in the arch, a reconstruction that can remove this tear is possible. It is a general concept that removal of the entry tear can decompress the tension in the false lumen and thus reduce the risk of secondary rupture, dilatation and persistent flow in the false channel of the aortic wall. In addition, constructing the distal anastomosis in an open fashion i.e. with no clamp crowding the site of anastomosis, should make for a more secure and precise anastomosis. This should further reduce one of the most dreaded complications in dissection surgery; a difficult and at times uncontrollable bleeding from the distal anastomosis.

What Is the Documented Status for an Open Distal: Proven Benefit or "Suggestive and Hope-Driven"?

In 2004, we did a systematic survey of the literature addressing whether or not using an open distal no-clamp technique in the surgical treatment of acute type A aortic dissection could translate into an increased survival for the patients [12].

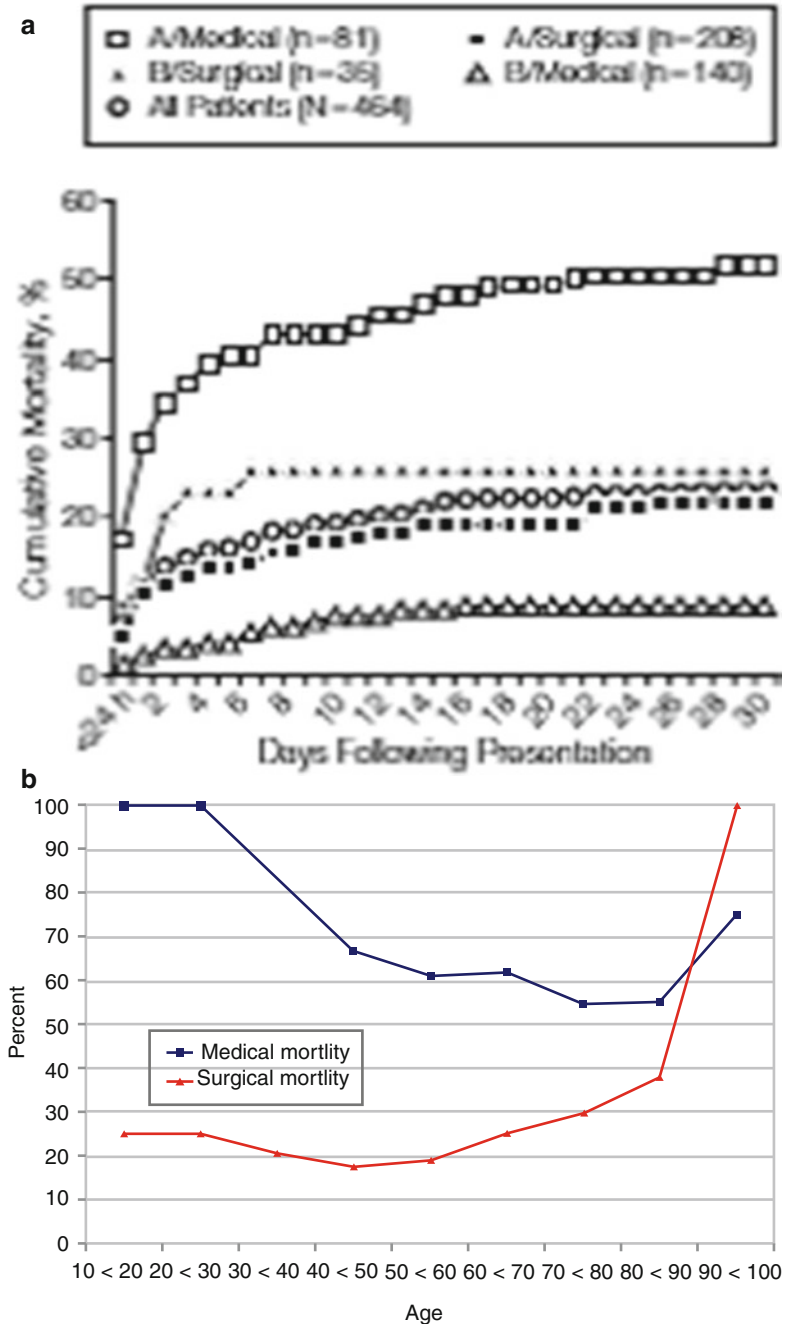

Fig. 14.1 Survival curves for patients with acute type A aortic dissections (Data from IRAD). (**a**) The first era of the database, published in 2000 (From Hagan et al. [3]; used with permission). (**b**) The recent era, published in 2011 (From Trimarchi et al. [4]; used with permission). Surgical treatment confers a survival benefit in all patient groups, maybe except for the very elderly patients

The design of the study was as a systematic literature review using the PubMed database with the search words "aortic dissection" and "treatment". The important selection criteria for inclusion of studies were a demand for inclusion of more than 20 patients, the study should be

performed after 1980, include a follow-up period of more than 1 year and allow a two-group comparison between an open distal and clamped anastomosis [12].

At that time point, no randomized trials had been done. Based on these selection criteria, six papers allowed a comparison between the two techniques (Table 14.1).

Of these six studies, one was a patient series and five were case-control studies with historical controls. The outcome is summarized in Table 14.1. A lower mortality was observed in the open-distal group in one of the studies. Importantly, no study had an observational period exceeding 5 years, and there were obvious shortcomings to all studies. For instance, the control groups were overall the eldest, and the open distal anastomoses were mostly done in the contemporary era. Due to the substantial development in surgical and anesthesiological techniques, this put a serious deficiency to the scientific quality of the studies. However, as there was no overall survival benefit to an open distal anastomosis, this historical fact, if anything, put forward the possibility that an open distal anastomosis gives an inferior result masked by the general improvement of treatment in the recent era.

It is obvious that the lack of statistical superiority from using an open distal technique in the various studies could be due to a statistical type-II error related to the low number of patients included in these overall single institutional series. Also, as the follow-up period was limited (mostly short, and not exceeding 5 years), a long term benefit from resecting more extensively the proximal part of the aorta may not appear until an extended observation period is possible. The overall conclusion from this review of the literature, was that the data available for supporting one or the other technique was clearly insufficient. However, as none of the authors could clearly demonstrate a benefit for an open distal anastomosis, the potential statistical difference cannot be substantial, and not approaching the level observed for medical vs surgical treatment for acute type A dissections.

For the purpose of an updated review, we have now done a new literature screening using the same criteria as those used in 2004. The new search again could not find any randomized trials and only two new studies [13, 14] were found based on our selection criteria (see Table 14.2). In this new table, however, we also have included a study by Pugliese and coworkers from 1998 [15]. This study is not assessing the effect of the open distal technique on survival, but the study is an analysis of factors influencing the need for reoperations after the primary surgery for type A dissections.

In essence, the new search has the same outcome as the 2004 search. There is no discernible difference between the two techniques. Therefore, we are still left with data that says these techniques are reasonably equal in securing patient survival after the primary operation for type A aortic dissection.

Current Recommendation for the Distal Anastomosis

We do not have surveys stating the preferred technique used to reconstruct the distal anastomosis in surgical treatment of acute type A aortic dissections. Thus, based on the documented results alone, the surgeon can decide for him or herself whether or not to clamp the aorta when constructing the distal anastomosis. However, the results obtained from surgery of the arch and related reconstructions are steadily improving [16], and the surgeon thus has more alternatives and liberties when performing such procedures. In the IRAD database, 96 % of procedures for type A aortic dissections are done with an open distal anastomosis [15], and our impression is that this trend is the prevailing one.

Table 14.1 Effect of an open distal technique on surgical outcome

Study	Design	Patients	Results	Comments
Baylor College of Medicine (Crawford) 1992 [10]	Retrospective patient series Multivariable risk factor analysis. Open distal not entered in analysis (circulatory arrest serve as substitute)	*N*=82 (1968–1992) Routine HCA and open anastomosis used from 1981	Circulatory arrest not significant factor in predicting surgical outcome	Continuing improvement of results during the period with no direct evidence of benefit of open distal technique. Multiple factors altered during the period
University of Philadelphia (Bavaria) 1996 [11]	Retrospective case-control design (historical controls) Comparing selective HCA[a] (group 1) with routine open distal technique (group 2)	*N*=41 (group 1) (1987–1995); *N*=19 (group 2) (1993–1995)	60-day mortality; group 1, 29 % (12/41); group 2, 5 % (1/19); *P*=0.04 CVA: group 1, 26 % (10/38); group 2, 0 % (0/19); *P*=0.02	Selection criteria unclear. Multiple alterations in protocol concomitant with open distal (use of retrograde cerebral perfusion, EEG, TEE, drug alterations, more use of composite grafts)
Kobe University (Yamashita) 1997 [12]	Retrospective case-control design (historical controls) Comparing cross-clamped ascending repair (group 1) with routine open distal technique (group 2)	*N*=27 (group 1) (1986–1991); *N*=16 (group 2) (1991–1996)	Operative mortality: group 1 19 % (5/27); group 2, 19 % (3/16) Persistent false lumen: group 1,50 % (9/18); group 2, 13 % (2/13); *P*<0.05	Unequal graft techniques between groups. Most persistent false lumens found in patients operated with ring grafts (16/18 ring grafts used in group 1). Short follow-up in group 2. Effect on long-term survival uncertain
University of Berne (Nguyen) 1999 [13]	Retrospective case-control design (historical controls) Comparing cross-clamped ascending repair (group 1) with routine open distal without (group 2) or with (group 3) use of glue	*N*=20 (group 1); N=16 (group 2); *N*=18 (group 3)	Operative mortality: group 1, 13 % (3/23); group 2, 15 % (3/20); group 3, 18 % (4/22) Long-term distal aneurysm: group 1, 20 % (4/20); group 2, 13 % (2/16); group 3, 11 % (2/18); *P*<0.05 (1 vs. 3)	No information on exact year of operation or whether or not the follow-up time was different in the three groups (probable difference, deducted from discussion). No details of aneurismal development (diameter, rupture, survical effect)
University of Toronto (David) 1999 [14]	Retrospective case-control design (historical controls) Comparing selective HCA (group 1) with routine open distal technique (group 2)	*N*=55 (group 1); *N*=54 (group 2) (1979–1996, time period separating the two groups not given)	Operative mortality: group 1, 20 % (11/55); group 2, 9 % (5/54); *P*=0.1 Strokes: group 1, 15 % (8/55); group 2, 4 % (2/54); *P*=0.05 A non-significant tendency towards less persistent false lumens and longer survival was observed in group 2	Time point discriminating the two groups and detailed operative protocols (including other potentially altered factors) not given

(continued)

Table 14.1 (continued)

Study	Design	Patients	Results	Comments
Stanford University (Lai) 2002 [15]	Retrospective case-control design (historical controls); subgroup analysis using propensity scoring	*N*=121 (group 1); *N*=186 (group 2) (1967–1999)	Survival overall: 30-day, 81±2 %; 1-year, 74±3 %; 5-year, 63±3 %	Long time period with concomitant time-related changes in surgical methods (historical controls)
	Comparing profound hypothermic circulatory arrest (PHCA, group 1) with patients were no PHCA was used (group 2)	Subgroup propensity: *N*=113, PHCA; *N*=39, no PHCA	No difference between PHCA and no-PCHA in any groups	Large series of patients with careful statistical approach, but unequal and small numbers in propensity-matched groups

CVA cerebrovascular accident, *EEG* electro-encephalogram, *TEE*, transesophageal echocardiogram
Table includes studies found in the literature where this has been addressed as a separate issue. Open distal technique, the use of routinely hypothermic circulatory arrest and construction of the distal anastomosis without aortic clamp
[a]Selective HCA (hypothermic circulatory arrest), HCA used when intimal tear extended to arch (20 of 41 patients in group 1)

Table 14.2 Effect of an open distal technique on surgical outcome – update 2013

Study	Design	Patients	Results	Comments
University of Verona (Pugliese) 1998 [15]	Retrospective patient series Univariate analysis of factors influencing reoperations	N = 178 (1979–1996)	15 factors influencing reoperations; 8/95 (8 %) with open distal and 11/46 (24 %) with clamp	Open distal only from 1990
Washington University (Zierer) 2007 [13]	Retrospective analysis of consecutive patient series Multivariate analysis of reoperations, mortality and aortic dilatation	N = 201 (1984–2006) 56 patients (28 %) operated with cross-clamp	Surgical technique did not influence any end points	These surgeons have been using clamped aortas also in the recent era
St. Louis/Boston/University of South Carolina Charlotte (Stamar) 2011 [14]	Retrospective patient series Univariate comparisons between two groups with survival curves	N = 124 (2000–2008) N = 42 (group 1, cross-clamp) N = 82 (group 2, DHCA, open distal)	Five year survival: group 1, 73 %; group 2, 74 %, ns. Reoperations: group 1, 34 %; group 2, 20 %, ns Stroke: group 1, 24 %; group 2, 16 %, ns	Relatively concomitant between treatments. Unequal patient numbers

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