Aortic dissection

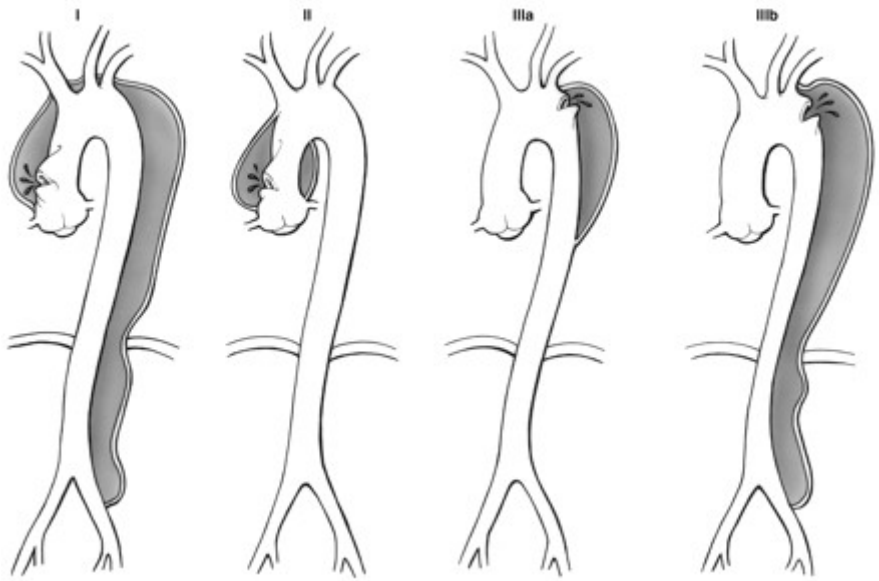
2009

Background

- first well-documented case of aortic dissection, when King George II of England died while straining on the commode, to the
- first successful operative repairs by DeBakey in 1955

Classification

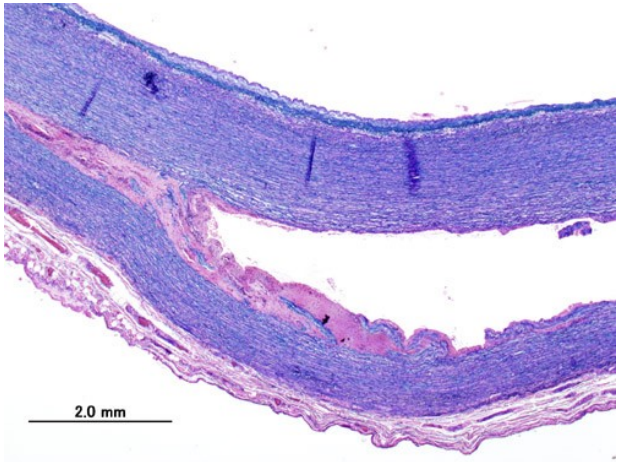
- Stanford
  - Type A
  - Type B
- DeBakey
  - Type I
  - Type II
  - Type III
    - IIIa
    - IIIb



Pathophysiology

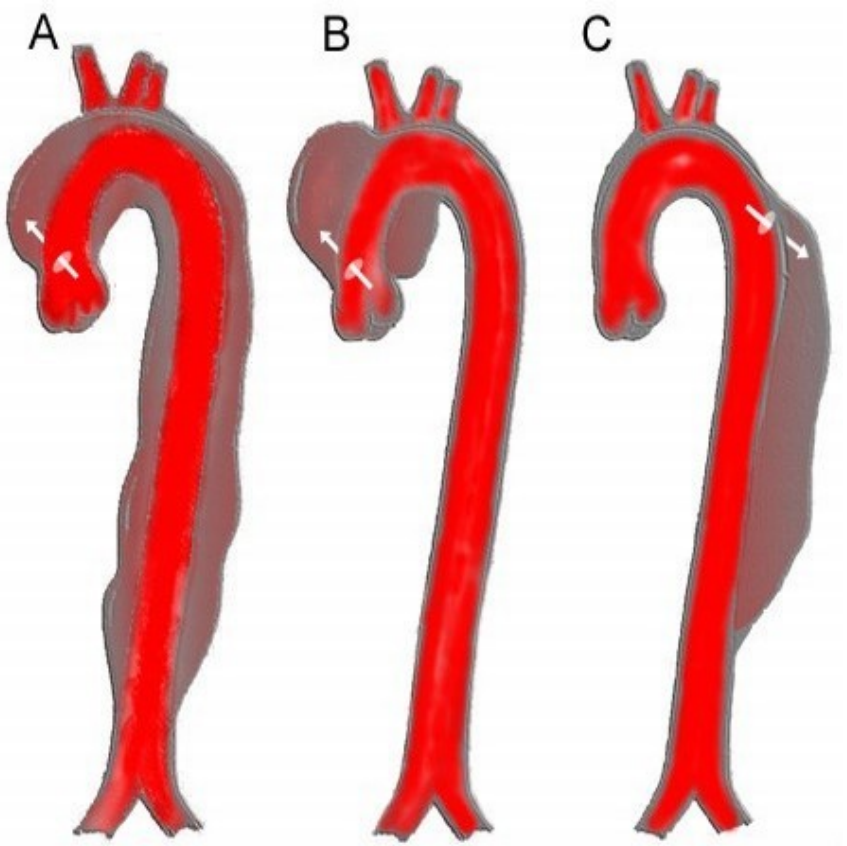
- A tear in the intimal layer, followed by formation and propagation of a subintimal hematoma.
- Cystic medial necrosis is the hallmark histologic change associated with dissection in those with Marfan syndrome.





Dissection sites

- 90% within 10 centimeters of the aortic valve.
- second most common site is just distal to the left subclavian artery.
- 5% - 10% of dissections do not have an obvious intima tear. These often are attributed to rupture of the aortic vasa vasorum as firs described by Krukenberg ir 1920



Aetiology

- Hypertension
- Atherosclerosis
- Connective tissue disorders (Marfan, Ehlers-Danlos)
- Congenital: Bicuspid aortic valve, coarctation
- Pregnancy
- Iatrogenic (catheterization, cross clamp, cannulation)
- crack cocaine use

Incidence

- Most estimates are based on autopsy studies
- 10-20/million
- Male:female 2:1-5:1
- 75% occur in those aged 40-70 years peak in the range of 50-65 years
- Blacks>whites>asians (frequency).

Presentation

- Sudden onset chest pain sensitivity 84%
- Maximal at onset (MI differentiation)
- some patients present with only mild pain
- painless in about 10% (neurologic complications, Marfan)

Correlation with anatomical site

- Anterior chest pain - Ascending aortic dissection
- Neck or jaw pain - Aortic arch dissection
- Interscapular tearing or ripping pain - Descending aortic dissection
- Chest pain
- Myocardial infarction
- Neurologic symptoms
- Syncope
- Stroke symptoms
- Altered mental status
- Limb paresthesias, pain, or weakness
- Hemiparesis or hemiplegia
- Horner syndrome
- Dysphagia
- Orthopnea
- Anxiety and premonitions of death
- Flank pain if renal artery is involved
- Dyspnea and hemoptysis if dissection ruptures into the pleura

Physical signs

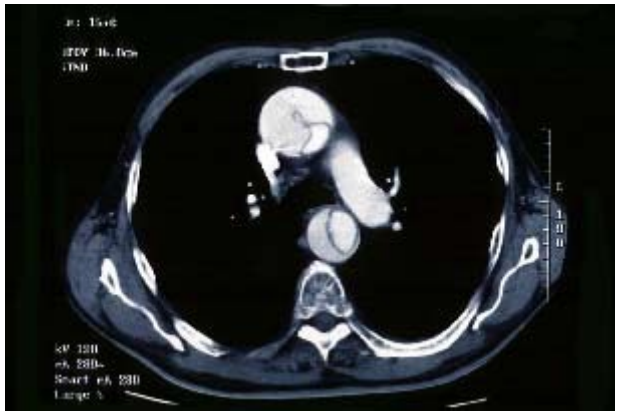
- BP
  - Hypertension: catecholamine surge or essential hypertension.
  - Hypotension excessive vagal tone, cardiac tamponade, or hypovolemia
  - BP differential of greater than 20 mm Hg should increase the suspicion of aortic dissection but is not proof. (20% normal).
- Neurologic deficits are a presenting sign in up to 20%.
- cardiac tamponade
- Haemothorax
- new diastolic murmur, asymmetrical pulses: carotid, brachial, and femoral pulses, progression of bruits or development of bruits.

Imaging

- Chest radiography: Findings are abnormal in 80%
  - Left apical cap
  - Tracheal deviation
  - Depression of left main stem bronchus
  - Esophageal deviation
  - Loss of the paratracheal stripe
  - only 25% presenting with widened mediastinum.
- over 12% normal.

Imaging

- CT: Prospective studies have shown a sensitivity of 83-94% with a specificity of 87-100%
- Echocardiography
  - TTE sensitivity 80% specificity 90%
  - TOE sensitivity 97-99% specificity 97-100%
- MRI 90% sensitivity 95% specificity
- Angiography





ECG

- More commonly, the ECG abnormality is ST depression.
- If the dissection involves the coronary ostia, it is the right coronary artery that is most commonly involved, leading to inferior ST-segment elevation pattern.

Medical management

- Resuscitation volume, inotropes if required.
- Analgesia
- Labetalol infusion syst. BP <120 mmHg
- GTN, SNP (tachycardia)

Indications for surgery

- Type A acute
  - Presence
- Chronic
  - Symptoms related to dissection (congestive heart failure, angina, aortic regurgitation, stroke, pain)
  - Malperfusion
  - Aneurysm

- Type B acute
  - Rupture
  - Malperfusion
  - Progressive dissection
  - Failure of medical
- Chronic
  - Symptoms related to dissection
  - Malperfusion
  - Aneurysm

Type A. Options

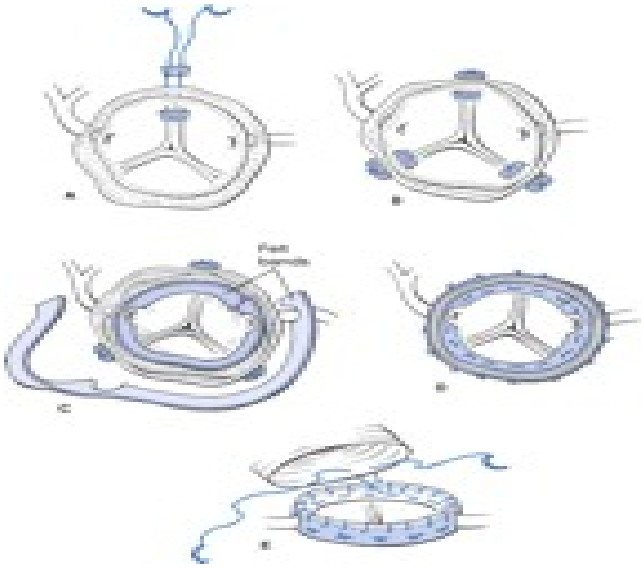
- Interposition graft of ascending aorta
  - ± resuspension of normal aortic valve
  - ± aortic valve replacement
- Aortic root replacement (coronary ostia involved)
- Valve sparing root replacement (Yacoub/David technique)

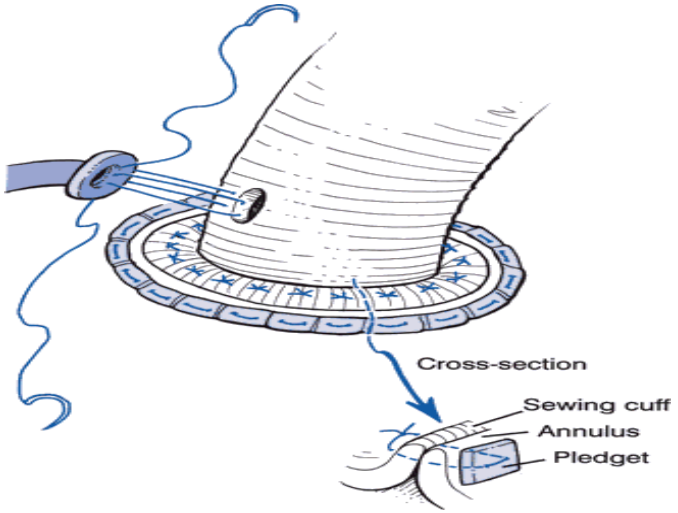
Key points

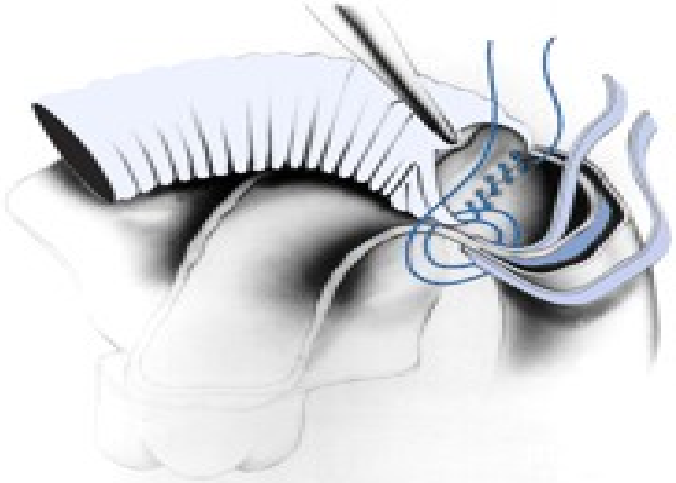
- Site of arterial cannulation. (True lumen)
  - Femoral
  - Axillary
  - Aorta
  - Transventricular
- Resuspend valve or replace the root
- Open or closed distal technique
- Should the arch be replaced

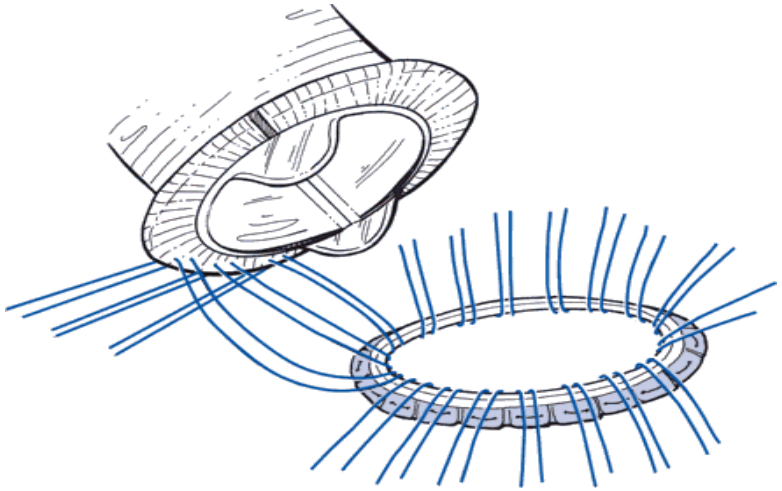
Main operative steps

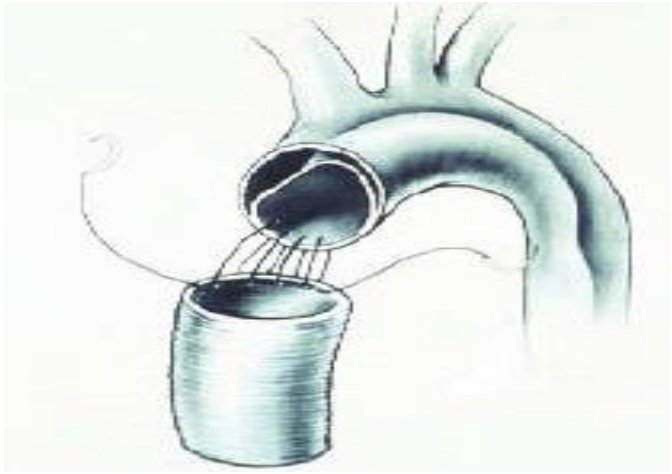
- Arterial cannulation
- Median sternotomy
- RA cannulation, on CPB, cooling
- Xclamp aorta, open, cardiolegia
  - If valve abnormal → root replacement
  - If valve normal → resuspend, repair proximal dissection (bioglue, Teflon collarsx2),Dacron graft
- Circulatory arrest
  - Deep hypothermia
  - Cerebral perfusion
    - Antegrade
    - Retrograde
- Inspect aortic arch, perform distal anastomosis, deair
- Restore circulation, rewarm.

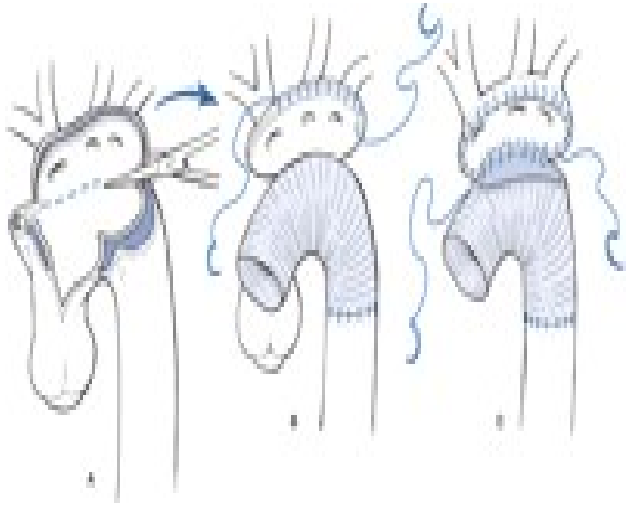


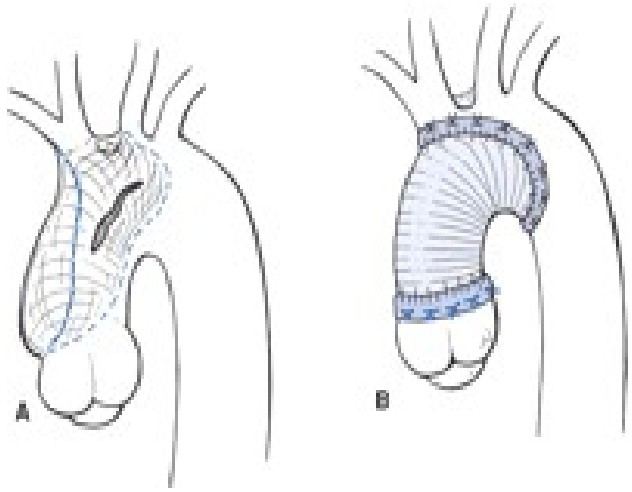

Cross-section
Sewing cuff
Annulus
Pledget

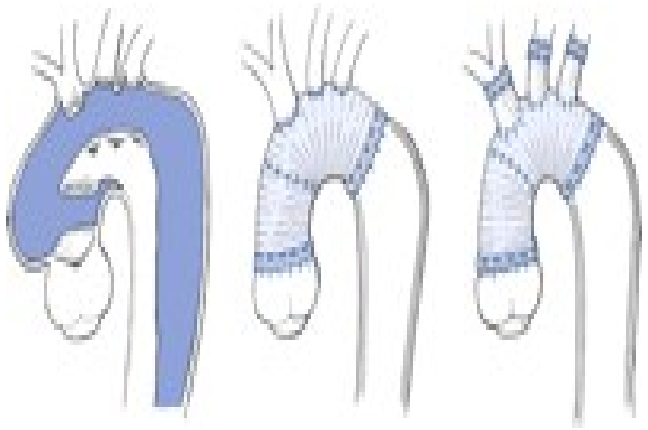









A
B

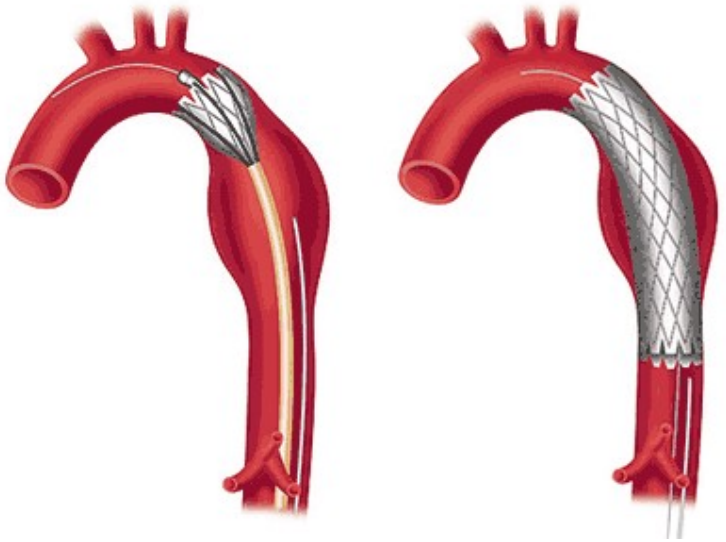


Prognosis Follow up

- 80-90% perioperative survival
- >90% have persistent distal false lumen prone to dilatation, lifelong follow up indicated (CT/MRI)

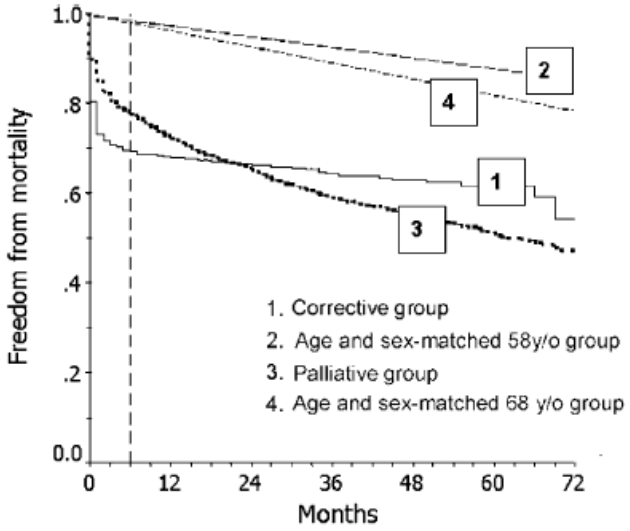
Type B

- Majority of patients with Type A die within 48 hours without surgery
- Majority of patients with Type B survive with appropriate medical management
- Options:
  - Medical
  - Endovascular
  - Surgical



Literature search 2009-1999

Late outcome of patients with aortic dissection: study of a national database *Eur J Cardiothorac Surg* 2004;25:683-690



	1M	6M	12M	24 M	36M	48 M	60M	72 M
Palliative	89.5±0.5%	78.4±0.6%	72.1±0.7%	64.9±0.8%	58.4±0.8%	54.4±1.0%	50.4±1.3%	46.1±1.3%
(Case No)	(4641)	(4098)	(3397)	(2808)	(1991)	(1347)	(825)	(397)
Corrective	80.4±1.3%	69.0±1.5%	66.1±1.5%	64.5±1.6%	62.6±1.6%	61.1±1.7%	59.9±1.9%	56.5±2.9%
(Case No)	(1013)	(813)	(630)	(552)	(402)	(256)	(148)	(65)

Annual attrition rate in groups 1~4 were 2.3%, 2.3%, 5.8%, and 3.7%, respectively.

Fig. 2. Kaplan–Meier survival curve for all aortic dissection cases, grouped by treatment mode, and compared to that of age- and sex-matched grou

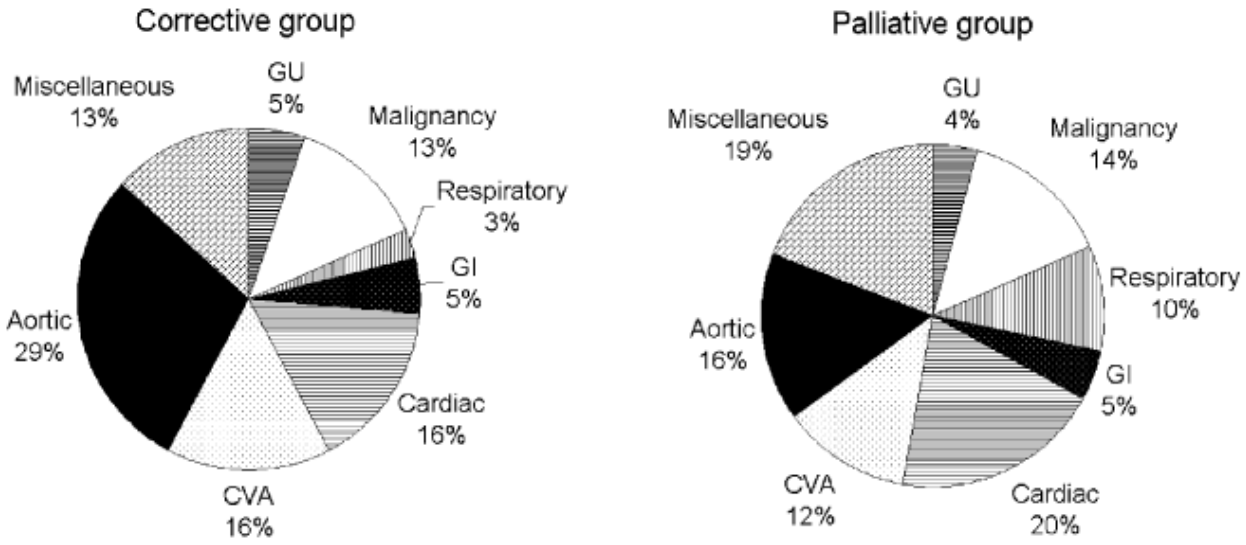


Fig. 3. Causes of late mortality for patients in each group surviving more than 6 months.

Perioperative Risk Factors for Mortality in Patients With Acute Type A Aortic Dissection *Ann Thorac Surg* 2002;74:2034-2039

- **In multivariate analysis, predictors of mortality were presence of rupture, renal failure, and intestinal malperfusion, duration of cardiopulmonary bypass >200 minutes, blood loss>500 mL, and transfusion of blood >4 units.**

Is Extended Arch Replacement for Acute Type A Aortic Dissection an Additional Risk Factor for Mortality? *Ann Thorac Surg* 2003;76:1209-1214

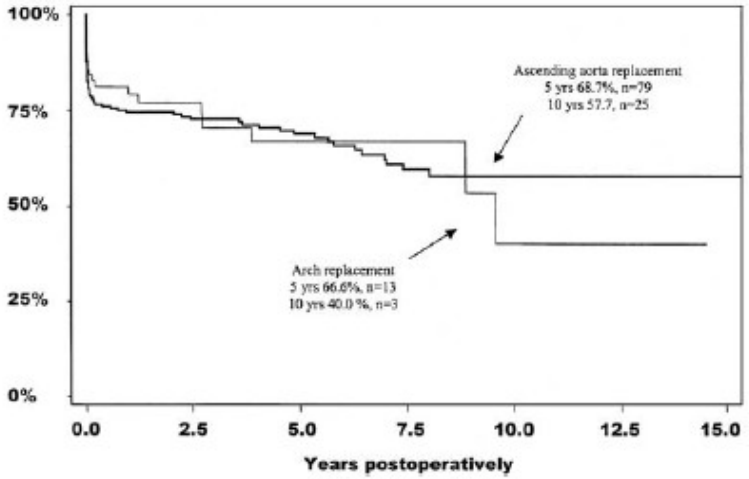


Fig 2. Cumulative survival (p = *0.96*).

Simple Risk Models to Predict Surgical Mortality in Acute Type A Aortic Dissection: The International Registry of Acute Aortic Dissection Score

Ann Thorac Surg 2007;83:55-61

Table 5. Preoperative Prediction Model

Variable	Overall Type A (%)	% Among Survivors	% Among Death	Coefficient	Score Assigned	*p* Value	Death OR (95% CI)
Age ≥ 70 y	27.3	24.1	37.4	0.68	0.7	<0.01	1.98 (1.19–3.29)
History aortic valve replacement	4.5	3.8	6.6	1.44	1.5	<0.01	4.21 (1.56–1.34)
Presenting hypotension, shock, or tamponade	28.8	22.4	49.0	1.17	1.2	<0.01	3.23 (1.95–5.37)
Migrating chest pain	13.8	12.1	19.3	0.88	0.9	<0.01	2.42 (1.32–4.45)
Preoperative cardiac tamponade	15.5	11.7	28.2	0.97	1.0	<0.01	2.65 (1.48–4.75)
Any pulse deficit	28.6	25.7	37.8	0.56	0.6	0.03	1.75 (1.06–2.88)
ECG infarct, new Q waves, ST elevation, or ischemia	21.1	18.7	29.3	0.57	0.6	0.04	1.76 (1.02–3.03)

CI = confidence interval; ECG = electrocardiogram; OR = odds ratio.

Type A aortic dissection: Has surgical outcome improved with time? *J Thorac Cardiovasc Surg* 2008;136:1172-1177

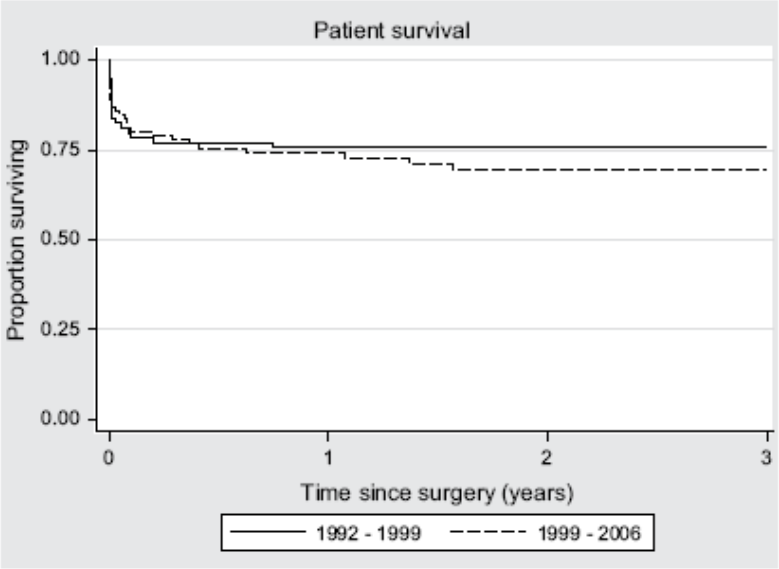
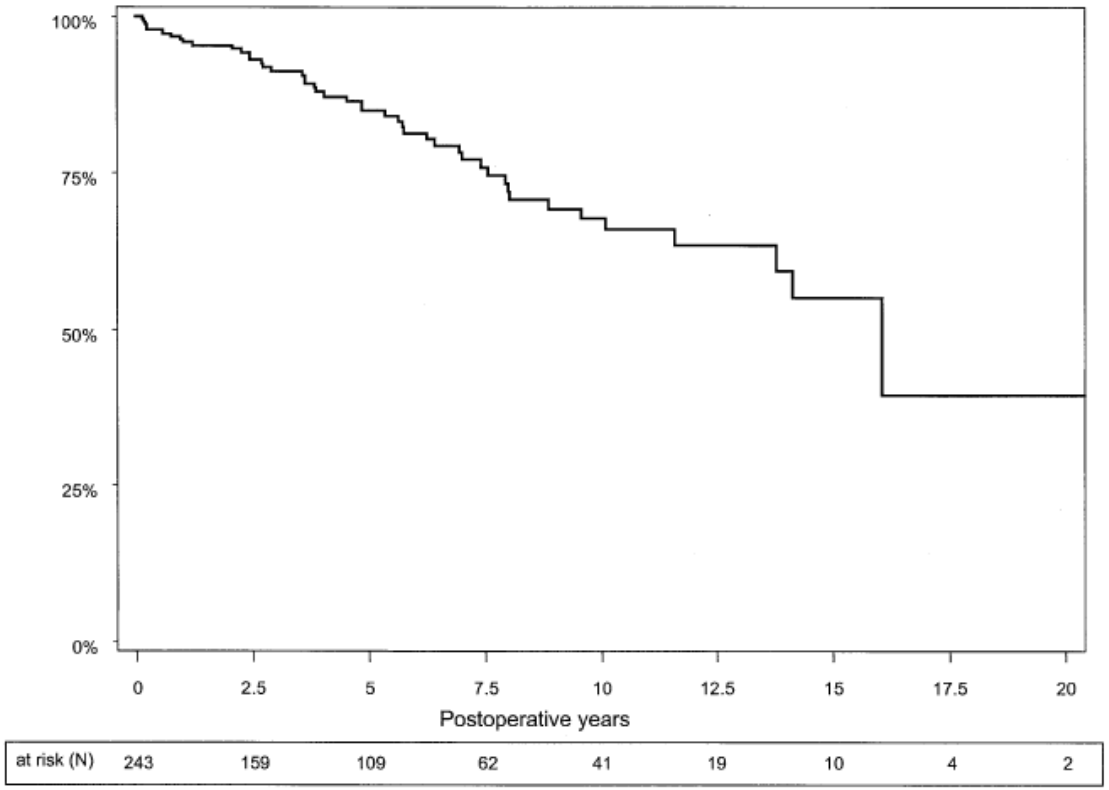


FIGURE 1. Kaplan–Meier survival estimates by era.

Long-Term Results After 27 Years of Surgical Treatment of Acute Type A Aortic *Ann Thorac Surg* 2005;80:523-529

Fig 1. Survival of operative survivors.



Can the principles of evidence-based medicine be applied to the treatment of aortic dissections? *Eur J Cardiothorac Surg* 2004;25:236-242

- (1) Is the use of routine circulatory arrest and an ‘open distal’ anastomosis technique better than traditional aortic cross clamping?
- (2) Does a persistent false lumen in the distal aorta wall have an adverse influence on long-term event-free survival? and
- (3) Is primary surgical or medical treatment of patients with Stanford acute type B dissections preferable in terms of long-term event-free survival?
- no conclusive evidence exists favoring use of an open distal anastomosis in patients with acute type A dissections or complete elimination of flow in the distal aortic false lumen; similarly, medical therapy of patients with acute type B aortic dissections has no proven advantage over surgical treatment.

Does aortic cross clamping during the cooling phase affect the early clinical outcome of acute type A aortic dissection? *J Thorac Cardiovasc Surg* 2008;136:1536-1540

- aortic crossclamping or noclamping, may be used during the induction of deep hypothermia to repair acute type A aortic dissections with similar early clinical outcome.

Emergency Surgery for Acute Type A Aortic Dissection in Octogenarians *Ann Thorac Surg* 2006;82:554-559

age 80 or greater was not an independent risk factor of hospital death.

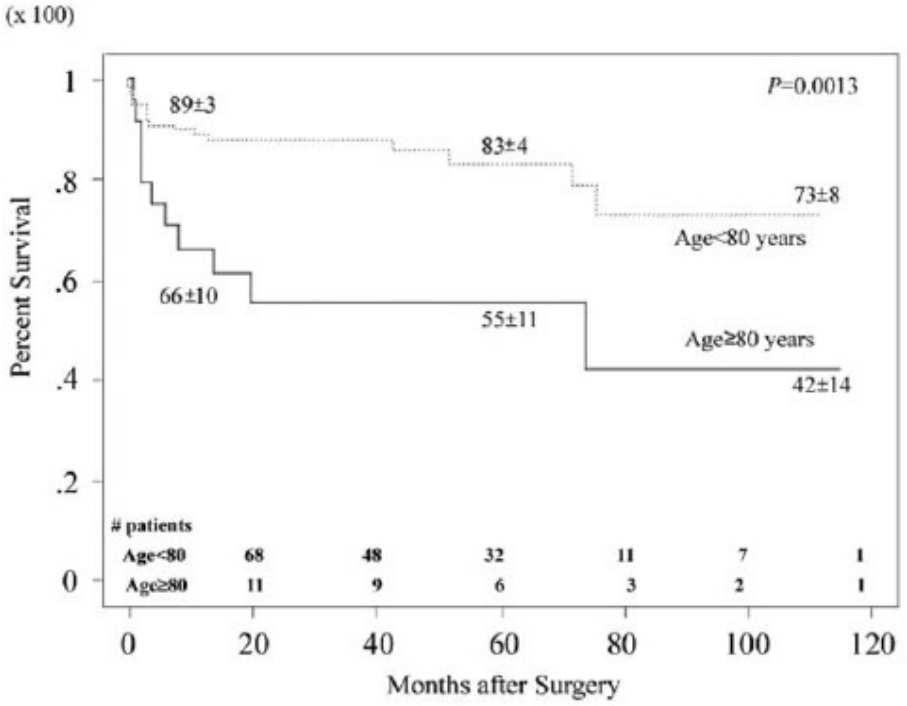


Fig 1. Actuarial survival curve for the two age groups (80 years or older, and younger than 80 years) after emergency surgery for acute type A aortic dissection.

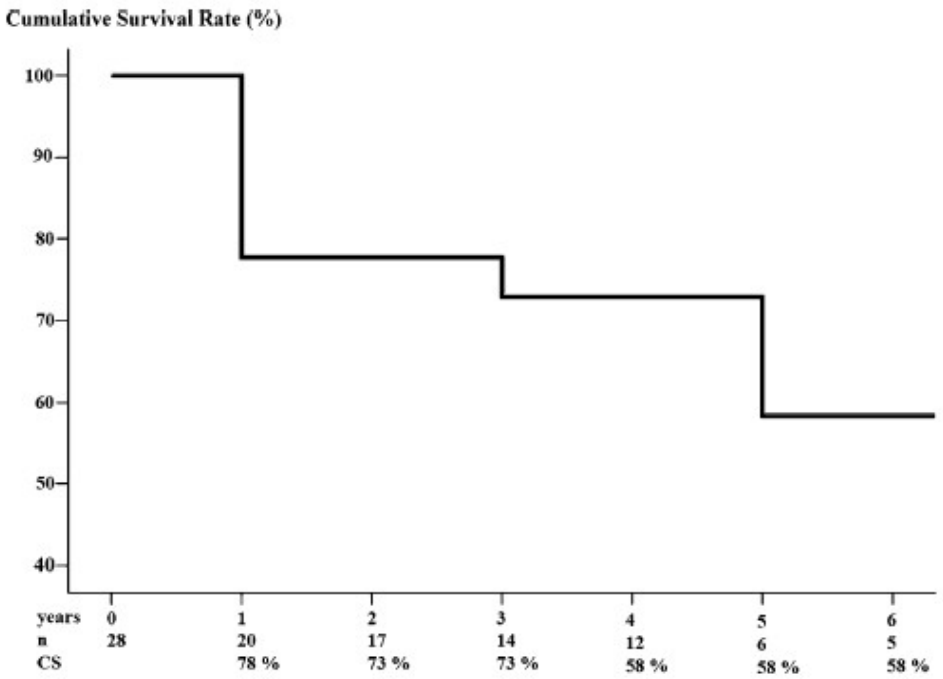
Survival and quality of life after repair of acute type A aortic dissection in patients aged 75 years and older justify intervention
Eur J Cardiothorac Surg 2006;29:386-391

- Overall results for emergency repair of acute type A aortic dissection in the elderly justify intervention, particularly in uncomplicated cases.
- Expeditious referral and intervention by lowering pre-operative dissection-related complications and comorbidities might help to improve results. Survivors show functional status and quality of life similar to contemporary individuals.

Less invasive quick replacement for octogenarians with type A acute aortic dissection *J Thorac Cardiovasc Surg* 2008;136:489-493

- During open distal anastomosis with a rectal temperature of 28C without any cerebral perfusion, circulating blood in the cardiopulmonary bypass circuit was warmed to 40C accompanied by warming of the patient's body by a heating mat. As soon as the distal anastomosis was completed, rapid rewarming was initiated by 40C blood perfusion.

Serious complications following endovascular thoracic aortic stent-graft repair for type B dissection
European Journal of Cardio-thoracic Surgery 33 (2008) 58—63



Complicated acute type B aortic dissection: Midterm results of emergency endovascular stent–grafting *J Thorac Cardiovasc Surg* 2008;136:424-430

- With follow-up to 9 years, endovascular stent–grafting for patients with complicated acute type B aortic dissection conferred benefit. Consideration of emergency stent–grafting may improve the dismal outlook for these patients; future refinements in stent–graft design and technology and earlier diagnosis and intervention should be associated with improved results.

Results of a New Surgical Paradigm: Endovascular Repair for Acute Complicated Type B Aortic Dissection *Ann Thorac Surg* 2008;86:87-94

- **Endovascular repair of acute complicated type B aortic dissection is associated with low morbidity and mortality and has emerged as the surgical therapy of choice.**
- **35 PATIENTS**

Treatment of type B aortic dissection: endoluminal repair *Eur J Cardiothorac Surg* 2005;27:826-830

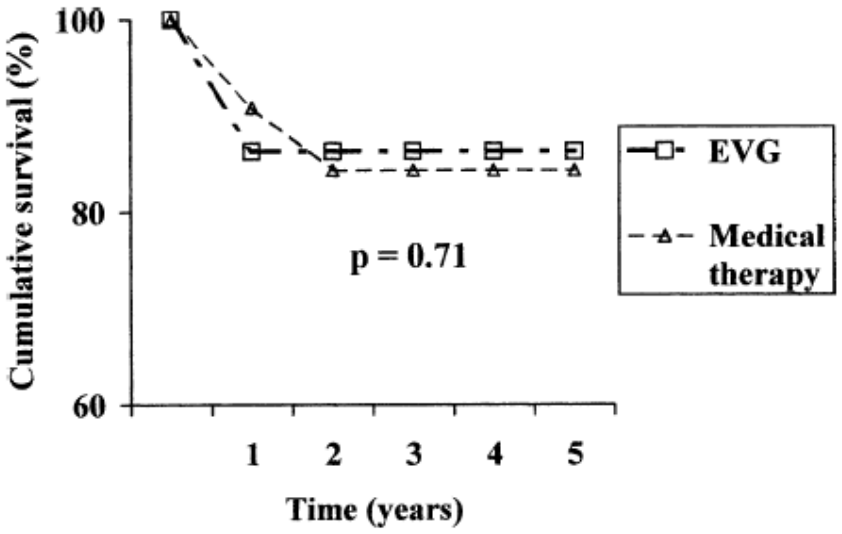


Fig. 1. Actuarial survival estimates according to treatment group.

Endovascular treatment achieved a
better mid-term fate of the descending thoracic aorta than medical therapy alone, even in patients with worse preoperative conditions.

Outcome of Endovascular Treatment of Acute Type B Aortic Dissection *Ann Thorac Surg* 2008;86:1707-1712

- **Endovascular treatment of complicated acute type B aortic dissection seems to provide favorable initial outcomes and would seem to be a great addition to the treatment options for this condition. Further study of long-term outcomes is required. REVIEW ARTICLE**

Axillary Artery Cannulation Improves Operative Results for Acute Type A Aortic Dissection *Ann Thorac Surg* 2005;80:77-83

- **Achievement of greater success in the surgical treatment of acute type A dissection will require axillary artery cannulation and measures to prevent visceral malperfusion. 106 patients**

Ascending aortic cannulation in acute aortic dissection type A: the Hannover *Eur J Cardiothorac Surg* 2008;34:792-796

The role of coronary angiography in acute type A aortic dissection
Department of Cardiac Surgery, St George's Hospital and Medical School, Blackshaw Road, London SW17 0QT, UK
Eur J Cardiothorac Surg 2004;25:231-235

- We have shown that coronary angiography did not affect the occurrence of CABG and was not associated with improved hospital survival. Furthermore, there is a considerable delay to surgery caused by angiography. Therefore in this setting coronary angiography is not recommended.74 PATIENTS RETROSPECTIVE

Aortic Dissection in Pregnancy: Analysis of Risk Factors and Outcome *Ann Thorac Surg* 2003;76:309-314

- **We found that aortic root enlargement (> 4cm) or an increase of aortic root size during pregnancy in patients with BAVD, and Marfan syndrome is associated with a considerable risk for the occurrence of Type A dissection.**

Antegrade Cerebral Perfusion for Acute Type A Aortic Dissection in 120 Consecutive Patients *Ann Thorac Surg* 2008;85:465-469

- **Antegrade cerebral perfusion in combination with mild hypothermia (30) offered sufficient neurologic protection in our patient cohort, provided adequate distal organ protection, and reduced perioperative complications in surgery for type A dissection.**

Aortic Enlargement and Late Reoperation After Repair of Acute Type A Aortic Dissection Ann Thorac Surg 2007;84:479–87

- **Optimal long-term outcome of patients with acute type A dissection demands rigorous antihypertensive therapy and lifelong radiographic follow-up because aortic enlargement can begin more than a decade postoperatively**

REPLACEMENT OF THE AORTIC ROOT IN PATIENTS WITH MARFAN'S SYNDROME N Engl J Med 1999;340:1307-13

- Because nearly half the adult patients with aortic dissection had an aortic root diameter of 6.5 cm or less at the time of operation, it may be prudent to undertake prophylactic repairof aortic aneurysms in patients with Marfan's syndrome when the diameter of the aorta is well below that size.

Late Complications of Gelatin-Resorcin-Formalin Glue in the Repair of Acute Type A Aortic Dissection *Ann Thorac Surg* 2007;83:1621-1626

- **Five patients developed an aortic pseudoaneurysm at the anastomotic site and underwent a late reoperation. All of these patients had been treated with gelatin-resorcin-formalin glue during the previous operation.**
- **Histologic examination of the resected aortic wall after the reoperation revealed tissue necrosis, severe local inflammation, and organization of old thrombi at the site of the glue application.**
- ***Conclusions.*** **Late complications after the use of gelatin-resorcin-formalin glue may occur with a certainamount of risk, suggesting its toxicity for aortic tissue.Therefore, proper use of this glue and close follow-up ofthe patients are strictly required.**

Is Surgery Always Mandatory for Type A Aortic Dissection? *Ann Thorac Surg* 2006;82:1658-1664

- **Our large, single-center experience allowed us to develop a mathematical model to predict30-day mortality for type A acute aortic dissection. When the expected mortality is 58% or less, surgery is always indicated.**
- **When the predicted mortality is greater than 58%, the possibility of survival is similar, according to International Registry of Aortic Dissections data, for surgery and medical treatment. In such cases surgery can no longer be considered mandatory, and a careful evaluation of the individual patient is recommended to choose the more suitable strategy.**