CARDIOVASCULAR SURGERY

Influence of concomitant coronary artery bypass graft on outcome of surgery of the ascending aorta/arch

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Heart 2007;93:232-237. doi: 10.1136/hrt.2006.090860

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Accepted 21 July 2006
Published Online First
16 August 2006

Background: Surgery of the ascending aorta with or without arch is being performed in an increasingly elderly population with risks of coexisting coronary artery disease.

Aim: To define specific groups requiring coronary artery bypass graft (CABG) and to analyse the influence of concomitant CABG on outcome.

Design: Over a 10-year period in a single institution, 296 consecutive procedures on the ascending aorta with or without arch were carried out in 291 patients. CABG was required in 42 (14.2%) procedures. In 24 (57%) patients, CABG was planned preoperatively and in 18 (43%) patients, on a salvage basis.

Results: In-hospital mortality for patients undergoing concomitant CABG was higher (21.4% v 11%, $p < 0.06$). Adjusting for baseline and operative characteristics, this was attributable to operative priority, and was not a consequence of concomitant CABG (adjusted OR 0.30, 95% CI 1.1 to 8.31; $p = 0.48$). However, in-hospital mortality was significantly higher when CABG was performed as salvage rather than as a planned procedure (38.9% v 8.9%, $p = 0.025$), and this difference remained after adjusting for confounding variables (adjusted OR 16.2, 95% CI 1.03 to >200 ; $p = 0.047$). The 3-year survival was significantly lower with concomitant CABG (59% v 81.9%, $p < 0.001$).

Conclusions: In association with surgery of the ascending aorta with or without arch planned concomitant CABG did not entail any added operative risk. However, salvage CABG, which occurred almost exclusively in association with emergency cases, was associated with a higher early mortality. Patients needing concomitant CABG had worse survival at 3 years compared with those requiring isolated surgery of the ascending aorta with or without arch.

Surgery of the thoracic aorta remains one of the more challenging areas in cardiac surgery. In recent years, it has been performed in an increasingly elderly population, with an incidence of coexisting coronary artery disease in 15–40%.¹ This means that preoperative coronary angiography is routinely indicated in elective patients, and concomitant coronary artery bypass graft (CABG) at the time of aortic reconstruction assumes increasing importance. In urgent/emergency cases with life-threatening aortic problems encompassing pathologies such as aortic dissection and leaking aneurysms, there is an ongoing dilemma between expeditious surgical treatment and the need to establish coronary anatomy by preoperative angiography. In the emergency group, problems arise either from damage to the coronary ostia from acute dissection, which may present preoperatively as established myocardial infarction, or where undiagnosed coronary artery disease may lead to myocardial ischaemia in the perioperative period. Therefore, there is a heterogeneous group of indications for CABG around the time of aortic surgery.

Data from other areas of cardiac surgery in adults show an additive mortality for combined procedures with CABG. In the UK, the overall mortality is 3.2% for isolated aortic valve procedures and 6.8% for aortic valve procedures with concomitant CABG.² Despite the advances in preoperative diagnosis, increased experience and improvement in postoperative management, surgery of the ascending aorta with or without arch still carries a significant mortality and morbidity. We may speculate that surgery of the ascending aorta with or without arch with concomitant CABG may similarly entail additive mortality.

In some of the bigger series of aortic reconstructions, the incidence of concomitant CABG has been reported between 11% and 25%,^{1–4} but there has been little information on the specific influence of this on early and late outcome after

surgery. The question of coronary disease has been dealt with most commonly in the context of the indications for coronary angiography or established myocardial infarction in patients with aortic dissection.^{3–6}

This observational study aims to establish the influence of concomitant CABG on clinical outcomes in patients undergoing surgery of the ascending aorta with or without arch.

PATIENTS AND METHODS

Patient selection

A consecutive series of patients undergoing surgery of the ascending aorta with or without arch over a period of 11 years was identified. Patients were grouped depending on whether they had an isolated aortic procedure (ascending aorta with or without arch) or concomitant CABG (ascending aorta with or without arch and CABG). The group undergoing concomitant CABG was further divided into two subgroups depending on whether the decision to carry out CABG was taken preoperatively (planned) or intraoperatively (salvage).

Data collection

Demographics, preoperative, perioperative and postoperative data for procedures before April 1996 were abstracted from the operation notes. Since April 1996, data have been collected prospectively on all patients undergoing cardiac surgery, and entered into the Patient Analysis and Tracking System database (Dendrite Clinical Systems, London, UK). Deaths, after discharge from hospital, were identified from data on mortality provided by the National Health Service Strategic Tracing Service (NSTS). All patients were successfully matched to the NSTS database.

Abbreviations: CABG, coronary artery bypass graft; NSTS, National Health Service Strategic Tracing Service

Only those operations involving two or more distal anastomoses, one to the distal aorta and one or more aortic arch branches, were considered to be operations of the aortic arch. Definitions with respect to the operative priority, preoperative conditions and postoperative complications are those used in the National Adult Cardiac Database and accepted by the Society of Cardio-thoracic Surgeons of Great Britain and Ireland available at www.scts.org

Operative techniques

Surgical techniques

All the operations were performed through a median sternotomy incision; where extensive aortic arch reconstruction was required, the median sternotomy was extended as a T into the left fourth intercostal space. The detailed operative strategy, anaesthetic and perfusion techniques, neuroprotective and blood-conservation strategies practised have been described previously.⁷

Planned coronary artery bypass was carried out where indicated by coronary angiography. Salvage CABG was carried out either because of insurmountable technical problems encountered during coronary artery reimplantation or because of an intraoperative event indicative of myocardial ischaemia while weaning from cardiopulmonary bypass. The procedure carried out was adapted to the operative findings. LITA grafts were used where concomitant CABG was carried out as an elective, planned procedure. Saphenous vein grafts were used in emergent situations and where CABG was carried out as a salvage procedure.

Coronary angiography

Coronary angiography was performed in most elective procedures, and guided the choice of target vessels. Coronary angiography was also performed in a small proportion of patients in emergency situations where there was a clear history of angina or myocardial infarction and no signs of haemodynamic instability, pericardial effusion or pericardial tamponade, and where it did not cause significant delay to the operative procedure being performed.

Statistical analysis

Baseline and operative characteristics were compared using the χ^2 test or Fisher's exact test (categorical variables), or Wilcoxon's rank sum test (continuous variables).

As the number of adverse outcomes after surgery was few, particularly in the CABG group, the results were compared without adjustment for baseline and operative characteristics. Binary variables were compared using Fisher's exact test, and continuous variables were compared using Wilcoxon's rank sum test (stay in the intensive care unit) or the log rank test (stay in hospital and postoperative survival to 3 years).

In-hospital mortality and 3-year survival for surgery of the ascending aorta with or without arch with concomitant CABG was also compared between those operated on as an elective procedure and those carried out as an emergency. These analyses were adjusted for baseline and operative characteristics. Cox proportional hazards regression was used, and the validity of proportionality assumption was checked. Surviving patients were censored 2 months before the data were matched to the NSTS database (95% of deaths are logged with NSTS within 2 months) or at reoperation.

All analyses were carried out using Stata V.8.2.

RESULTS

Cohort

A total of 296 eligible patients were identified. Concomitant CABG with surgery of the ascending aorta with or without arch

was carried out in 42 patients. The number of concomitant CABG with surgery of the ascending aorta with or without arch has increased over time, from 3 during May 1992–March 1996 to 22 such procedures during April 2000–August 2003. However, taking the cohort as a whole, the operative mortality remained similar over the study period (Fisher's exact test, $p = 0.66$).

Baseline characteristics

Baseline characteristics were broadly similar across the two groups (table 1). A total of 21 of the 42 patients with concomitant CABG presented as an emergency. Salvage CABG was required in 19 patients, of which 18 had an emergency presentation.

In patients undergoing elective concomitant CABG with surgery of the ascending aorta with or without arch, coronary angiography had been performed in all the patients ($n = 21$). In the group undergoing isolated replacement of the ascending aorta with or without arch, coronary angiography had been performed in 115 of 136 (84.5%) patients.

In the emergency set-up, preoperative coronary angiography was performed in 27 patients. In the concomitant CABG group, 6 of 21 (26.8%) patients had coronary angiography as compared with 21 of 118 (17.7%), where only an isolated aortic procedure was performed. Table 2 gives the details of the indications for surgery.

Operative details

Table 3 summarises the details of the surgical procedure and operative details. In over 80% of CABG procedures one or two grafts were done (mean 1.62). The left anterior descending coronary artery (LAD) was the most common target and was bypassed in 26 (62%) patients. The left internal thoracic artery (LITA) was used as a conduit to bypass the LAD in 14 (54%) patients and saphenous vein grafts in 12 (46%) patients.

Inhospital outcomes

In all, we found 37 (12.5%) in-hospital deaths, 9 (21.4%) in the CABG group (table 4). Of the in-hospital outcomes examined, reoperation rates for bleeding, the incidence of renal complications and lengths of stay in the intensive care unit and

Table 1 Baseline characteristics

	Isolated replacement of ascending aorta with or without arch (n = 254), n (%)	Concomitant CABG (n = 42), n (%)	p Value*
Age (years)	61 (48–69)	65 (56–71)	0.04†
Male patient	179 (70.5)	30 (71.4)	0.90
Parsonnet score	18 (10–27)	23 (17–28)	0.01†
Marfan's syndrome	38 (15.0)	5 (11.9)	0.60
Hypertension	125 (49.2)	25 (59.5)	0.22
Preoperative angiogram	138 (54.3)	27 (64.3)	0.23
Peripheral vascular disease	21 (8.3)	7 (16.7)	0.09‡
LV function			
Good	199 (78.3)	28 (66.7)	0.07‡
Moderate	50 (19.7)	11 (26.2)	
Poor	5 (2.0)	3 (7.1)	
Emergency procedure	118 (46.5)	21 (50.0)	0.67
Salvage procedure	—	19 (42.9)	

CABG, coronary artery bypass graft; LV, left ventricle.

Data are reported as number and percentage or median and interquartile range.

*Data are compared using a χ^2 test, unless indicated otherwise.

†Wilcoxon's rank sum test.

‡Fisher's exact test.

Table 2 Indications for operation

Aetiology	Elective procedure (n = 157)		Emergency procedure (n = 139)	
	Without CABG (n = 136, n (%))	With CABG (n = 21, n (%))	Without CABG (n = 118, n (%))	With CABG (n = 21, n (%))
Aneurysm	118 (86.7)	19 (90.5)	17 (14.4)	2 (9.5)
Dissection	12 (8.8)	2 (9.5)	95 (80.5)	19 (90.5)
Infection	8 (5.8)	—	9 (7.6)	—
Other	2 (1.5)	—	2 (1.7)	—

CABG, coronary artery bypass graft.
Some patients had more than one indication for operation.

postoperative stay were similar in the two groups. Major sternal wound complication rate was higher in the concomitant CABG group, but the overall incidence was small (six patients). The in-hospital death rate in the concomitant CABG group was almost twice that in the group with isolated replacement of ascending aorta with or without arch, but no neurological complications were reported ($p = 0.09$). Without adjustment for confounding variables, this difference in mortality was of borderline significance ($p = 0.06$). Adjusting for baseline and operative characteristics indicated that the increase in mortality was attributable to the operative priority and whether or not a salvage procedure was performed, and was not a consequence of the patient undergoing a concomitant CABG in itself (adjusted odds ratio (OR) 0.30, 95% confidence interval (CI) 0.1 to 8.31; $p = 0.48$).

Table 5 shows the outcomes for the concomitant CABG group subdivided according to whether the operation was a salvage procedure or not. As expected, complication rates were

generally higher in salvage group, although the numbers are small. In-hospital mortality was the only in-hospital outcome to vary significantly across the two subgroups (Fisher's exact test, $p = 0.025$), and this difference remained after adjusting for confounding variables (adjusted OR 16.2, 95% CI 1.03 to >200; $p = 0.047$).

Outcome at 3 years

The median follow-up of survivors was 3 years in the group undergoing isolated replacement of the ascending aorta with or without arch and 2.3 years in the group requiring concomitant CABG. There were 60 deaths in total over the 3 years; 50% occurred within 11 days of surgery. Overall, the 3-year survival was significantly lower in the concomitant CABG group than in the group undergoing isolated replacement of the ascending aorta with or without arch (log rank test, $p < 0.001$).

Examining the effect of operative procedure, priority and salvage, after adjustment for baseline and operative characteristics, showed that emergency procedures carried a mortality risk almost four times that of an elective procedure (hazard ratio (HR) 3.69, 95% CI 1.67 to 8.08; $p = 0.001$) (fig 1). Mortality was higher for the group requiring concomitant CABG than for the group with isolated replacement of the ascending aorta with or without arch, particularly when the patient had not had an angiogram (HR 1.32, 95% CI 0.74 to >200; $p = 0.08$). The patients who had concomitant CABG after having angiography fared better than their counterparts who did not have a preoperative angiogram but needed concomitant CABG (HR 0.15, 95% CI 0.01 to 1.36; $p = 0.09$). Salvage operations, which were associated with an increased in-hospital mortality, ceased to be an independent risk factor for death within 3 years of surgery ($p = 0.32$).

The difference in survival between emergency and elective procedures was seen for both isolated replacement of ascending aorta with or without arch and for the group where concomitant CABG was performed, in so far as there was insufficient evidence to suggest that the effect of operative priority on survival for patients undergoing isolated replacement of the ascending aorta with or without arch was different from that where concomitant CABG was performed (test for differential effect, $p = 0.74$).

DISCUSSION

This study was undertaken to carry out a detailed analysis of CABG in association with surgery of the ascending aorta with or without arch. Few studies have specifically examined the incidence of concomitant CABG.

In our series, concomitant CABG was deemed necessary in 14.2% of patients who were classified into two distinct groups. The first group comprised patients with planned aortic reconstructions where coronary artery bypass was a planned procedure based on angiographic information. The second group comprised patients who underwent salvage operations carried out in an emergency setting where CABG was

Table 3 Operative characteristics

	Isolated replacement of ascending aorta with or without arch (n = 254, n (%))	Concomitant CABG (n = 42, n (%))	p Value*
Arch replacement	26 (10.2)	5 (11.9)	0.79†
Composite root replacement	117 (46.1)	22 (52.4)	0.45
Interposition graft	130 (51.2)	20 (47.6)	0.67
Without aortic valve replacement	58 (22.8)	5 (11.9)	
With valve suspended/replaced	72 (28.4)	15 (35.7)	
Mitral valve surgery	9 (18.4)	1 (6.9)	0.99†
Redo procedure	27 (10.6)	2 (4.8)	0.40†
Circulatory arrest	123 (48.6)	23 (54.8)	0.46
Circulatory arrest time	34 (26–43)	28 (22–41)	0.16‡
Bypass time (min)	157 (132–189)	188 (161–227)	<0.001‡
Cross clamp time (min)	96 (71–120)	111 (90–140)	0.004‡
Number of grafts			
1	—	23 (54.8)	
2	—	13 (30.9)	
3	—	5 (11.9)	
4	—	1 (2.4)	
Mean	—	1.62	
LAD graft	—	26 (61.9)	
LIMA to LAD graft	—	14 (33.3)	

CABG, coronary artery bypass graft; LAD, left anterior descending coronary artery; LIMA, left internal mammary artery.

Data are reported as number and percentage or median and interquartile range.

*Data are compared using a χ^2 test, unless indicated otherwise.

†Fisher's exact test.

‡Wilcoxon's rank sum test.

Table 4 Outcomes after surgery

	Isolated replacement of ascending aorta with or without arch (n = 254), n (%)	Concomitant CABG (n = 42), n (%)	p Value*
Reoperation for bleeding	20 (7.9)	3 (7.1)	0.99
Rewiring	3 (1.2)	3 (7.1)	0.04
Neurological complication	20 (7.9)	0 (0.0)	0.09
Transient	7 (2.8)	0 (0.0)	
Permanent	13 (5.1)	0 (0.0)	
Renal complication	17 (6.7)	5 (11.9)	0.22
In-hospital death	28 (11.0)	9 (21.4)	0.06†
ICU stay (days)	2 (1–4)	4 (2–7)	0.94‡
Postoperative hospital stay (days)	11 (9–16)	13 (10–23)	0.16§
Patient survival (%)¶ (95% CI)			
7 days	92.5 (88.5 to 95.2)	78.6 (62.8 to 88.2)	<0.001§
30 days	88.9 (84.4 to 92.2)	76.2 (60.2 to 86.4)	
1 year	82.4 (77.0 to 86.7)	59.0 (41.7 to 72.7)	
3 years	81.9 (76.4 to 86.2)	59.0 (41.7 to 72.7)	

CABG, coronary artery bypass graft; ICU, intensive care unit.

Data are reported as number and percentage, median and interquartile range or percentage and 95% confidence interval.

*Data are compared using Fisher's exact test, unless indicated otherwise.

† χ^2 test.

‡Wilcoxon's rank sum test.

§Log rank test.

¶Estimated using the Kaplan–Meier method.

performed because of destruction of the tissues around the coronary ostia by aortic dissection or perioperative myocardial ischaemia with no preoperative angiogram, where the haemodynamic or electrocardiographic instability was considered to be potentially due to undiagnosed coronary disease.

Coronary ischaemia and concomitant CABG have been previously reported to be risk factors for mortality.^{8,9} Although mortality in patients undergoing concomitant CABG has been reported to be as high as 62.5% in a series of emergency cases,⁵ in general, concomitant CABG is thought to be a safe, worthwhile procedure that has no significant effect on in-hospital mortality.^{1,4}

In our experience, the overall risk of early death was higher in patients undergoing concomitant CABG (21.4% v 11%). However, with adjustment for differences in baseline and operative variables, the additional mortality was attributable to the operative priority rather than to the addition of CABG.

Emergency procedures have been reported to carry a much higher risk of mortality,¹⁰ and in our study, the risk was almost four times that of an elective procedure. It was also not surprising that the addition of CABG led to poorer outcome at 3 years, which was probably due to a combination of factors, the older patients with ischaemic heart disease coupled with the need for salvage CABG.

The subgroup of patients designated to undergo salvage CABG almost exclusively occurred in the emergency group. In these patients, the range of problems included extensive destruction of the coronary ostia, particularly the right coronary by acute dissection. Some of these patients presented with preoperative clinical myocardial ischaemia and were already, as a consequence of this, at increased operative risk. Myocardial infarction has previously been shown to be the only predictor of in-hospital mortality in patients undergoing emergency aortic surgery.⁴ The more common involvement of the right coronary artery in cases of acute dissection due to compression, destruction or disruption is well documented.^{11,12} The incidence of coronary malperfusion due to type A aortic dissection has been reported at 5–11%, is rapidly fatal and can be difficult to evaluate. Another small group of patients who had undergone operations for aortic emergencies showed some evidence of myocardial ischaemia in the perioperative period, usually while weaning from bypass, either in the form of haemodynamic instability, with or without electrocardiographic abnormalities, or with the detection of wall motion abnormalities with intraoperative transoesophageal echocardiogram. This was presumed to be caused by undiagnosed coronary disease as well as by the fact that coronary malperfusion due to coronary dissection may at times present only when flow is re-established after aortic declamping.^{11–13} Mortality owing to unrecognised myocardial ischaemia and salvage CABG for myocardial ischaemia after aortic repair have both been reported.¹³ In these circumstances, in the absence of preoperative angiography, target vessel revascularisation was undertaken; although in this small subgroup, in-hospital mortality was high at 38.9%, it was possible to salvage 60% of such patients. With regards, to the surgical strategy for management

Table 5 Outcomes after surgery (concomitant coronary artery bypass graft procedures only)

	Non-salvage (n = 23), n (%)	Salvage (n = 19), n (%)
Reoperation for bleeding	1 (4.4)	2 (10.5)
Rewiring	2 (8.7)	1 (5.3)
Neurological complication		
Renal complication	2 (8.7)	3 (15.8)
In-hospital death	2 (4.4)	7 (42.1)
ICU stay	3 (2–5)	4.5 (1.5–11)
Postoperative hospital stay	13 (10–17)	15 (11–28)
Patient survival (%) (95% CI)		
7 days	95.7 (72.9 to 99.4)	57.9 (33.2 to 76.3)
30 days	91.3 (69.5 to 97.8)	57.9 (33.2 to 76.3)
1 year	75.0 (49.4 to 88.9)	40.9 (19.1 to 61.8)
3 years	75.0 (49.4 to 88.9)	40.9 (19.1 to 61.8)

ICU, intensive care unit.

Data are reported as number and percentage, median and interquartile range or percentage and 95% confidence interval.

*Estimated using the Kaplan–Meier method.

Figure 1 Mortality risk of emergency procedures compared with elective procedures.

of associated coronary artery dissection, although Neri *et al*¹² favour reconstruction and reimplantation, we favour supplementary CABG in addition. We share the view of Kawahito *et al*¹³ that although local repair may have a role in selected cases, CABG is simple to perform and effective in managing these cases, particularly where any doubt exists with respect to the adequacy of coronary perfusion after reconstruction.

With regard to the assessment of the effect of coronary angiography, there is little argument that in older patients undergoing planned aortic reconstruction, preoperative coronary angiography should be performed and appropriate revascularisation undertaken. In a study carried out on 192 patients undergoing elective thoracic aortic surgery, Ueda *et al*¹⁴ concluded that complete revascularisation of major coronary arteries with significant stenoses is essential to reduce postoperative cardiac events.

In the emergency group, it is difficult to draw meaningful conclusions from observational data. Several authors have previously dealt with this question and arrived at broadly similar conclusions to those that we adhere to.^{1 3-5 15} In stable patients with a history of ischaemic heart disease or a strong clinical suspicion of coronary artery disease, preoperative coronary angiography should be carried out.¹ Despite concerns about poor visualisation of the coronary anatomy due to flow obstruction and technical issues with regard to catheterisation of a dissected aorta, coronary angiography can be safely performed¹⁶ in these patients and is helpful. However, in patients where there is a pressing need to undertake surgery and there are obvious contraindications, the inherent delays in undertaking angiography should be avoided.^{3-5 15} Intraoperative coronary angioscopy¹⁵ and intraoperative angiography have been reported as other options¹⁷ to assess atherosclerotic coronary artery disease. It is possible that as non-invasive imaging develops, the use of computed tomography or magnetic resonance imaging to image the proximal coronary anatomy will develop to such an extent that angiography will become irrelevant in this situation; however, at present, the stage of development of these imaging modalities does not currently allow this.

Overall, we can conclude that CABG can be undertaken in association with aortic reconstruction without any evidence of increased risk in elective patients, and preoperative coronary angiography should be used to guide this. In emergency cases, where coronary angiography has often not been performed, revascularisation as a salvage procedure may be necessary as a consequence of several clinical scenarios. Despite these patients being at high risk of death after surgery, a large number can be salvaged with reasonable prospects of medium-term survival.

Limitations

This is an observational study with two groups (concomitant CABG *v* isolated aortic surgery), which are quite heterogeneous with respect to baseline characteristics, nature of presentation and operative procedures. However, these variables have been adjusted for to achieve a meaningful comparison.

The sample size is small, particularly for the concomitant CABG group, and with the low incidence of postoperative complications in both groups, the power to detect statistically significant differences in outcome is low. Taking renal complications as an example, to detect a 5% difference in complication rate between the two groups (12% in the group with concomitant CABG *v* 7% in the group with isolated aortic surgery) with 80% power (assuming a ratio of 1:6 patients in the two groups) would require a study of about 2000 patients.

Although there are some inherent limitations in terms of study design and heterogeneity of the study population, a proper randomised controlled trial in the setting of acute dissections is impractical and virtually impossible to carry out.

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Competing interests: None declared.

REFERENCES

- 1 Creswell LL, Kouchoukos NT, Cox JL, *et al*. Coronary artery disease in patients with type A aortic dissection. *Ann Thorac Surg* 1995;**59**:585-90.
- 2 Keogh BE, Kinsman R. UKCSR: miscellaneous operations for acquired heart disease financial year 2003. In: Keogh BE, eds. *Fifth National Adult Cardiac Surgical Database Report 2003*. Oxfordshire: Dendrite Clinical Systems, 2004:46.
- 3 Miller JS, Lemaire SA, Coselli JS. Evaluating aortic dissection: when is coronary angiography indicated? *Heart* 2000;**83**:615-16.
- 4 Penn MS, Smedira N, Lytle B, *et al*. Does coronary angiography before emergency aortic surgery affect in-hospital mortality? *J Am Coll Cardiol* 2000;**35**:889-94.
- 5 Motallebzadeh R, Batas D, Valencia O, *et al*. The role of coronary angiography in acute type A aortic dissection. *Eur J Cardiothorac Surg* 2004;**25**:231-5.
- 6 Islamoglu F, Atay Y, Can L, *et al*. Diagnosis and treatment of concomitant aortic and coronary disease: a retrospective study and brief review. *Tex Heart Inst J* 1999;**26**:182-8.
- 7 Narayan P, Caputo M, Rogers CA, *et al*. Early and mid-term outcomes of surgery of the ascending aorta/arch: is there a relationship with caseload? *Eur J Cardiothorac Surg* 2004;**25**:676-82.
- 8 Chirillo F, Marchiori MC, Andriolo L, *et al*. Outcome of 290 patients with aortic dissection. A 12-year multicentre experience. *Eur Heart J* 1990;**11**:311-19.
- 9 Crawford ES, Kirklin JW, Naftel DC, *et al*. Surgery for acute dissection of ascending aorta. Should the arch be included? *J Thorac Cardiovasc Surg* 1992;**104**:46-59.

- 10 **Bachet JE**, Termignon JL, Dreyfus G, *et al.* Aortic dissection. Prevalence, cause, and results of late reoperations. *J Thorac Cardiovasc Surg* 1994;**108**:199–205.
- 11 **Pêgo-Fernandes PM**, Stolf NAG, Hervoso CM, *et al.* Management of aortic dissection that involves the right coronary artery. *Ann Thorac Surg* 2003;**76**:1471–6.
- 12 **Neri E**, Toscano T, Papalia U, *et al.* Proximal aortic dissection with coronary malperfusion: presentation, management, and outcome. *J Thorac Cardiovasc Surg* 2001;**121**:552–60.
- 13 **Kawahito K**, Adachi H, Murata S, *et al.* Coronary malperfusion due to type a aortic dissection: mechanism and surgical management. *Ann Thorac Surg* 2003;**76**:1471–6.
- 14 **Ueda T**, Shimizu H, Shin H, *et al.* Detection and management of concomitant coronary artery disease in patients undergoing thoracic aortic surgery. *Jpn J Thorac Cardiovasc Surg* 2001;**49**:424–30.
- 15 **Rizzo RJ**, Aranki SF, Aklog L, *et al.* Rapid noninvasive diagnosis and surgical repair of acute ascending aortic dissection. Improved survival with less angiography. *J Thorac Cardiovasc Surg* 1994;**108**:567–74.
- 16 **Israel DH**, Sharma SK, Ambrose JA, *et al.* Cardiac catheterization and selective coronary angiography in ascending aortic aneurysm or dissection. *Cathet Cardiovasc Diagn* 1994;**32**:232–7.
- 17 **Neri E**, Massetti M, Sassi C. Bypassing a dilemma: intraoperative coronary angiography in acute aortic dissection. *Eur J Cardiothorac Surg* 2002;**21**:363–4.

IMAGES IN CARDIOLOGY

doi: 10.1136/hrt.2006.090753

Coronary artery–left atrial fistula caused by feeding artery rupture in cardiac myxoma

An 81-year-old woman with atrial fibrillation and a history of amaurosis fugax was admitted to our hospital for diagnosis and therapy. Her vital signs and laboratory data were normal on admission. No fresh ischaemic lesions in the brain or organic stenosis of the head and neck arteries were observed on a magnetic resonance imaging scan. Although transthoracic echocardiography did not show any thrombus in the cardiac chambers, a cardiac tumour (5 × 4 cm) was detected in the left atrium (LA). Multiplane transoesophageal echocardiography (TOE) interpreted it as a multilocular tumour with heterogeneous echodensity; the tumour was attached to the interatrial septum. These findings were suggestive of myxoma (panel A). Colour Doppler images showed an intratumour blood flow and blood stream spurting from the tumour (arrow in panel B and video 1; to view video footage visit the *Heart* website—<http://www.heartjnl.com/supplemental>). Conventional coronary angiography (CAG) revealed the presence of a feeding artery from the proximal portion of the left circumflex branch to the LA. The tumour was remarkably enhanced, like a bunch of grapes, by the contrast media, which

spouted out into the LA (video 2), as well as by the TOE images. At surgery, the diagnosis of left atrial myxoma was made. The internal elastic lamina of the artery near the tumour stalk was partially destroyed, and it was associated with fibrous thrombus; this indicated artery rupture. This must have been the cause of the coronary artery–left atrial fistula through the myxoma, which was observed by TOE and CAG; however, its causal relationship with the history of amaurosis fugax was not clear.

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To view video footage visit the *Heart* website—<http://www.heartjnl.com/supplemental>

(A): Multiplane transoesophageal echocardiography showing a multilocular cardiac tumour attached to the interatrial septum in the left atrium, with heterogeneous echodensity. (B): Colour Doppler images showing an intratumour blood flow and blood stream (arrow) spurting from the tumour.