Combined coronary artery bypass surgery and abdominal aortic aneurysm repair

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The proper management of patients with asymptomatic abdominal aortic aneurysms and significant coexistent coronary artery disease is still debatable. The most common approach has been to perform the coronary artery bypass surgery some weeks before the abdominal aortic aneurysm repair in the hope of reducing the cardiac morbidity and mortality. We report our initial experience of three consecutive elective cases where the coronary artery bypass surgery and the abdominal aortic aneurysm repair were performed at one operation by the same operating surgeon.

INTRODUCTION

Many patients with infra-red abdominal aortic aneurysms have coexistent coronary artery disease. Cardiac ischaemia, especially if associated with impaired left ventricular function, is an important determinant of operative risk and cardiac complications are the commonest cause of death following elective abdominal aortic aneurysm repair. Standard teaching has been that coronary revascularization be performed 3–6 months prior to abdominal aortic aneurysm repair in the hope of reducing cardiac morbidity and mortality. Although there have been reports in the literature of combined procedures, most have been reserved for symptomatic aneurysms that have been considered to be at risk of imminent rupture. These abdominal aneurysms have usually been repaired immediately following coronary revascularization after weaning from cardiopulmonary bypass. We report our initial experience of three consecutive elective cases (Table 1)

| Table 1 Summary of operative and post operative data |
| Case 1 | Case 2 | Case 3 |
| Cardiac crossclamp time (min) | 33 | 38 | 28 |
| Abdominal aortic crossclamp time (min) | 40 | 30 | 32 |
| Total CPB time (min) | 199 | 128 | 120 |
| Hours on ITU | 29 | 29 | 37 |
| In patient stay (days) | 13 | 13 | 7 |
| Outcome | Alive and well | Alive and well | Alive and well |
| Follow-up (months) | 14 | 12 | 5 |

CPB=cardiopulmonary bypass; ITU=intensive care unit

where repair of the abdominal aortic aneurysm was undertaken at the same time as coronary artery bypass surgery using cardiopulmonary bypass and discuss its merits.

CASE 1

A 65-year-old man was investigated following the sudden death of his brother from a ruptured abdominal aortic aneurysm. He had been a lifelong heavy smoker until 5 years previously but had no other cardiac risk factors. He had no cardiac symptoms. Clinical examination confirmed the presence of an 8 cm abdominal aortic aneurysm: all his distal pulses were palpable and there were no signs of cardiac failure. His exercise test was strongly positive at low work load and he therefore underwent left heart cardiac catheterization. This demonstrated severe three vessel coronary arterial disease and impaired left ventricular function. An abdominal ultrasound and computerized tomography (CT) scan revealed the aneurysm to be infra-renal with dilation of the right common iliac artery.

He underwent combined coronary artery bypass surgery and repair of his abdominal aneurysm. Median sternotomy was performed and the incision extended in the midline to just above the symphysis pubis which provided excellent access. Following harvesting of both internal mammary arteries he was heparinized and cardiopulmonary bypass was instituted between the right atrium and ascending aorta. The patient was cooled on bypass to 30°C and after aortic cross-clamping crystalloid cardioplegia was infused into the aortic root and topical slush applied to the heart. Coronary revascularization was performed using reversed saphenous vein to the posterior descending, the left internal mammary artery to the circumflex and the right internal mammary artery to the left anterior descending coronary artery. Following the release of the aortic cross-clamp (33 min) and during rewarming the proximal vein graft anastomosis to the
ascending aorta was completed. During this time the heart spontaneously returned to sinus rhythm.

Attention was then turned to the abdominal aortic aneurysm. With the patient still on cardiopulmonary bypass the peritoneum was incised to the left of the small bowel mesentery, the incision being extended to divide the ligament of Treitz, thus enabling the mobilization of the duodenjejunal flexure to the midline. After mobilization of the neck of the aneurysm, the aorta was cross-clamped below the renal arteries, the sac was opened, thrombus curetted and back bleeding lumbar vessels oversewn within the aneurysm. An albumin impregnated Debakey Vasculour II bifurcated vascular prosthesis was inserted within the aneurysm sac proximally and anastomosed distally end-to-side to the left common iliac and right common femoral arteries. The patient was readily weaned from cardiopulmonary bypass after 199 min. He made an uncomplicated recovery: he was transferred back to his District General Hospital on the ninth post operative day for further convalescence and was discharged home 4 days later. He has returned to an active lifestyle and remains well 14 months later.

CASE 2

A 70-year-old man with chronic stable angina (New York Heart Association grade 2) had a 6 cm abdominal aortic aneurysm detected on clinical examination following the development of a right inguinal hernia. There was no history of intermittent claudication. An abdominal ultrasound and CT scan examination confirmed that the aneurysm was confined to the infra-renal aorta. In view of his cardiac history he underwent an exercise test which was stopped after 6 min of the modified Bruce protocol because of inferolateral cardiac ischaemia. Cardiac catheterization demonstrated good preservation of left ventricular function and severe triple vessel disease with a left main stem component. He underwent, at one operation, coronary bypass surgery and repair of his abdominal aortic aneurysm. Through a similar incision the abdominal aneurysm was exposed while the internal mammary arteries were being harvested. The coronary surgery was performed in identical fashion (ischaemic time 38 min). A similar albumin impregnated aortic bifurcation in lay graft was then inserted whilst still on cardiopulmonary bypass with distal anastomoses end-to-side to both common iliac arteries, the aneurysm sac being wrapped around the prostheses as a jacket. The patient was readily weaned from cardiopulmonary bypass after 128 min without inotropic support. The patient made a rapid and smooth postoperative recovery. He was transferred back to his District General Hospital on the sixth postoperative day and was discharged home after 7 days. He remains well and asymptomatic 12 months later.

CASE 3

A 61-year-old man was found to have an asymptomatic 8 cm abdominal aortic aneurysm. He had a very strong positive family history of coronary artery disease, was hypercholesterolaemic and although he had no angina his 12 lead ECG showed signs of a previous inferior myocardial infarction. Cardiac catheterization demonstrated impaired left ventricular function, a left main stenosis, blocked right and circumflex coronary vessels and a further critical stenosis in the left anterior descending involving a large first diagonal. In addition he had 50% stenoses in both internal carotid arteries but without neurological symptoms.

He underwent a simultaneous repair of his abdominal aortic aneurysm using a straight 18 mm albumin impregnated Debakey Vasculour II prosthesis while on cardiopulmonary bypass following coronary artery bypass surgery (reversed saphenous vein to the posterior descending, left internal thoracic artery to first diagonal and the right internal thoracic artery to the left anterior descending coronary arteries). The operation was performed in identical fashion with a cardiac ischaemic time of 28 min, an abdominal aortic cross clamp time of 32 min and a total bypass time of 120 min. The patient was readily weaned from cardiopulmonary bypass without inotropic support. His postoperative progress was smooth other than for a transient ischaemic attack from which he made a complete recovery and he was discharged home on the seventh postoperative day. He remains well 3 months later.

DISCUSSION

The conventional approach to the elective management of critical coexistent coronary artery disease and abdominal aortic aneurysm has been to undertake coronary revascularization several months prior to abdominal aneurysm repair in the hope of reducing in-hospital cardiac ischaemic mortality and morbidity. This staged procedure, however, involves two major surgical operations within a short space of time and a prolonged period of convalescence for the patient. It is also expensive in terms of the total number of days spent as an in-patient in an acute surgical bed. All of these patients spent less than 2 weeks in hospital and were delighted that the need for a second major operation had been avoided. Repair of the abdominal aneurysm on bypass is potentially attractive for several reasons. First, the abdominal aorta can be readily cross-clamped at low pressure thus reducing aortic wall tension and hence reducing the risk of aortic damage caused by the cross-clamp. Secondly, should the infra-renal segment of the aorta proximal to the aneurysm have been short (thus
making the placement of the cross-clamp hazardous because of the proximity of the renal artery origins, then it would have been a simple matter to rapidly systemically cool the patient and then to either briefly arrest the circulation, making the completion of the proximal aortic anastomosis simple because of a bloodless field and enhanced access, or to briefly clamp the supra-renal aorta, the systemic cooling thus affording a degree of renal, gastrointestinal and spinal protection. The third such attraction of this technique is that cardiopulmonary bypass permits the autotransfusion of any intra-abdominal blood loss. These three patients each required up to three units of donor blood for the combined procedures. Finally, the increase in afterload on the left ventricle is reduced when the aorta is cross-clamped on full cardiopulmonary bypass and this may be beneficial as the heart recovers from an episode of cold cardioplegic ischaemic arrest.

The one potentially major disadvantage with repairing the abdominal aneurysm sequentially on cardiopulmonary bypass following coronary artery bypass surgery is the prolonged total cardiopulmonary bypass time (range 120–199 min) versus 60 min for similar coronary surgery alone. The degree of activation of the various components of the acute inflammatory response, the extent of platelet activation and aggregation and dysfunction, and the consumption of elements of the clotting cascade, is related to the length of cardiopulmonary bypass. This in turn correlates directly with not only the risk of post-operative bleeding, but also the risk of acute lung injury and subsequent acute adult respiratory distress syndrome. In these three cases both the cardiac surgery and abdominal aneurysm repairs were performed by the same operating surgeon. However, with careful patient selection and increasing experience it should be possible to reduce the bypass time further even if there is only one operating surgeon. With meticulous attention to haemostasis (without the need for either fresh frozen plasma or platelets) the postoperative blood loss for these patients was less than 850 ml despite an average total cardiopulmonary bypass time of 150 min.

A potential cause for concern was the morbidity related to the extended incision. Should analgesia have been inadequate the patients ability to cough would have been seriously compromised and the patient would have been at great risk of sputum retention and hypostatic pneumonia. The insertion of a lumbar epidural (using a combination infusion of diamorphine and marcaine) in the anaesthetic room provided extremely effective analgesia and indeed all of these patients were able to cooperate well with physiotherapy. These patients were regularly reviewed by the pain control team and the epidural catheters were removed uneventfully by the fifth postoperative day.

Despite using both internal mammary arteries, with minimal use of electrocautery and the avoidance of bone wax, all the wounds healed rapidly without complication.

We believe that an elective stage operation for combined coronary artery bypass surgery and abdominal aortic aneurysm repair on cardiopulmonary bypass is an attractive option in carefully selected patients and may significantly reduce the in-patient stay and convalescent period in uncomplicated cases.

REFERENCES


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