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Combined transdiaphragmatic off-pump and minimally invasive coronary artery bypass with right gastroepiploic artery and abdominal aortic aneurysm repair

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Patient: Male, 74
Final Diagnosis: Abdominal aortic aneurysm (AAA)
Symptoms: Palpable abdominal mass
Medication: —
Clinical Procedure: Abdominal aortic aneurysm repair
Specialty: Surgery

Objective: Rare disease
Background: Coronary artery disease is common in elderly patients with abdominal aortic aneurysms. Here we report a case of the combination of surgical repair for abdominal aortic aneurysm and off-pump and minimally invasive coronary artery bypass surgery.
Case Report: A 74-year-old man who presented at our clinic with chest pain was diagnosed with an abdominal aortic aneurysm. His medical history included right coronary artery stenting. Physical examination revealed a pulsatile abdominal mass on the left side and palpable peripheral pulses. Computed tomography scans showed an infrarenal abdominal aneurysm with a 61-mm enlargement. Coronary angiography revealed 80% stenosis in the stent within the right coronary artery and 20% stenosis in the left main coronary artery. The patient underwent elective coronary artery bypass grafting and abdominal aortic aneurysm repair. Abdominal aortic aneurysm repair and transdiaphragmatic off-pump and minimal invasive coronary artery bypass grafting with right gastroepiploic artery were performed simultaneously in a single surgery.
Conclusions: We report this case to emphasize the safety and effectiveness of transdiaphragmatic off-pump and minimally invasive coronary artery bypass surgery with abdominal aortic aneurysm repair. This combined approach shortens hospital stay and decreases cost.

Key words: abdominal aortic aneurysm • coronary artery bypass • beating heart

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Background

Abdominal aortic aneurysm (AAA) is commonly associated with coronary artery disease (CAD) [1], which is the most common cause of death after AAA repair [2]. Coronary artery bypass grafting (CABG) before AAA repair decreases postoperative cardiac mortality rates [3] but increases the incidence of postoperative AAA rupture. The combination procedure involving CABG, cardiopulmonary bypass (CPB), and AAA repair can be very invasive. Limited reports are available in the literature on beating heart and AAA repair, including CABG. Here, we report our experience with combined surgical intervention, including AAA repair and transdiaphragmatic minimally invasive CABG of the right gastroepiploic artery (RGEA), in a single surgery.

Case Report

A 74-year-old man presented with AAA at our clinic. He did not show any symptoms of AAA but had unstable angina pectoris (Canadian Cardiovascular Society Class III). His medical history included ischemic heart disease (stent within the RCA), hypertension, hyperlipidemia, and chronic obstructive lung disease. There was no family history of AAA. On physical examination, a pulsatile abdominal mass was observed on the left side and the lower limb pulses were normal. Electrocardiography revealed inferolateral ischemia and a chest radiograph showed a normal-sized heart without enlargement of the ascending or descending aorta. Pulmonary function tests showed a slight obstructive pattern. Preoperative bronchodilatory treatment was administered. An exercise stress test showed inferior ischemic changes in the second stage of the test.

Creatinine and blood urea nitrogen (BUN) levels were at the upper limits (creatinine, 1.11 mg/dL; BUN, 37 mg/dL). Results of other laboratory tests indicated no relevant abnormalities. The infrarenal aneurysm measured 60×61×113 mm, with severe circumferential mural thrombosis and an effective diameter of 32×37 mm on computed tomography (CT). Three calculi, 9–10 mm in diameter, were observed in the intraluminal area of the gallbladder. Echocardiography showed posterobasal hypokinesia with an ejection fraction of 63%. Coronary angiography revealed 80% stenosis of the stent within the RCA and 20% stenosis in the distal portion of the left main coronary artery.

Anesthesia

A lumbar epidural catheter was inserted into the L2–3 intervertebral space. After administration of general anesthesia (fentanyl, 20 µg/kg; midazolam, 0.1 mg/kg; and pancuronium, 0.1 mg/kg), an epidural ropivacaine and fentanyl infusion was started with a patient-controlled analgesia device.

Figure 1. (A) Harvested right gastroepiploic artery (RGEA). (B) The transdiaphragmatic exploration of the right coronary artery (RCA) and the RGEA was anastomosed to the RCA on the beating heart. (C) Repair of the abdominal aortic aneurysm with the collagen-impregnated Dacron graft.

Surgery

The patient underwent an elective operation for CABG and AAA repair. After the left paramedian incision was made and the peritoneum was opened, we created a passage at the front part of the diaphragm with electrocautery to inspect the RCA and to determine if revascularization was appropriate. After the RGEA was harvested for the transdiaphragmatic exploration of the RCA, the front part of the diaphragm and both arcus costalis were retracted using a sternal retractor (Figure 1A). The RGEA was anastomosed to the RCA on the beating heart using an Octopus4 tissue stabilizer (Medtronic, Inc, Minneapolis, MN, USA) (Figure 1B). Coronary anastomosis was performed in 16 min. After CABG, the aneurysm was excised and circulation was re-established using a collagen-impregnated Dacron graft (20 mm) (Figure 1C).

The total operating time was 4 h. The patient was discharged from the intensive care unit on the second day and from the hospital on the eighth day. No complications were observed.

Figure 2. Computed tomography angiography showing that the coronary anastomosis was patent in the first month of follow-up period.

during the early or late postoperative period, and CT angiography revealed that the anastomosis was patent in the first month of follow-up (Figure 2).

Discussion

Cardiac complications constitute the principal cause of morbidity and mortality after AAA repair because AAA are frequently associated with clinically significant coexistent CAD. Sprung et al reported that >80% of patients with AAA had angiographically atherosclerotic CAD [4]. The 5-year mortality

rate from myocardial infarction in patients with preoperative evidence of heart disease is 4 times higher than that for patients without CAD [3]; therefore, if indicated, cardiac evaluation and coronary revascularization is recommended before AAA repair [5–8].

CAD is generally treated first, followed by AAA repair; however, this procedure may lead to postoperative AAA rupture. There is an increased incidence of AAA rupture after thoracic operations [9], with the primary operation and then postoperative factors playing a role in hastening the rupture. On the other hand, combined intervention for coronary bypass and AAA surgery is safe and certainly cost effective, without any early or late complications [10]. A single surgery avoids repeat anesthesia and avoids having 2 separate convalescence periods. The combined approach is also cost effective because it eliminates the need for a second hospitalization.

Combined CABG on a beating heart and AAA repair may reduce the invasiveness of simultaneous CABG with CPB under cardiac arrest and AAA repair.

The use of a combined operation for coronary revascularization on the transdiaphragmatic beating heart followed by AAA repair has many advantages, such as avoiding sternotomy or thoracotomy and the possible associated risks (patient discomfort, sternal dehiscence, and postoperative sternal bone pain), avoiding large thoracoabdominal exposure, a shortened hospital stay, and reduced hospital costs. In this case, we used RGEA for revascularization; this is an alternative arterial graft for RCA revascularization of patients with AAA and a single CAD.

Conclusions

We conclude that combined CABG on the beating heart and AAA repair using a one-step approach appears to be a safe and effective therapeutic strategy for patients with AAA and CAD. In patients with a single RCA revascularization, the transdiaphragmatic approach may be indicated to avoid a sternotomy. Further follow-up studies of the combined surgical approach are necessary to determine its long-term results.

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