Original

Is Combined Abdominal Aortic Aneurysm Repair and Coronary Artery Bypass Grafting Feasible?

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Key Words
abdominal aortic aneurysm; coronary artery bypass

Background. Significant coronary artery disease requiring coronary artery bypass grafting (CABG) may co-exist with large abdominal aortic aneurysm (AAA) in some patients. We reviewed our experience in either staged or simultaneous operation.

Methods. The records of all patients receiving both CABG and AAA repairs in recent 7 years were retrospectively reviewed. The patient demographics, severity of coronary disease, AAA size, duration of staged procedures, perioperative morbidity and mortality rates as well as the hospital cost were analyzed.

Results. From June 1993 to Sept 2000, totally 14 patients received both CABG and AAA repair, including 6 patients for simultaneous operation (group A, 42.8%) and 8 for staged operation (group B, 57.2%) with CABG first. Patients in the group A were younger and with larger AAA. There was neither operative mortality in both group nor interprocedure AAA rupture in group B. Total postoperative hospital stay and hospital cost were significantly decreased in group A than in group B rehospitalized patients.

Conclusions. Simultaneous CABG and AAA repair is feasible in surgical technique. In those younger patients with larger AAA, combined surgery could be performed as safely as staged procedures.

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Although coexistence of significant coronary artery disease (CAD) and large abdominal aortic aneurysm (AAA) is not uncommon,[1] effective strategies for intervention remains much debated in patients requiring both. The significance of CAD is magnified with repair of AAA because aortic crossclamp during operation may heavily increase the cardiac afterload as well as oxygen demand. The fluid shifts after AAA repair may also induce cardiac ischemia.[2] In contrast, coronary artery revascularization in patients with coexist AAA may increase the risk of postoperative AAA rupture.[3] Thus, simultaneous operation of both coronary artery bypass grafting (CABG) and AAA repair is proposed to prevent such disastrous consequence of staged operation, although it makes higher operative mortality than any single procedure alone.[4]

Surgical strategies in patients with comorbid significant CAD and large AAA were up to surgeon preference in our service. In the group of staged operation, however, CABG was always followed by AAA repair in a few weeks. In patients with significant CAD coexistent with huge AAA or impending rupture, simultaneous CABG/AAA repair was recommended. In the present study, we reviewed the outcome of either staged or simultaneous operation in our experience while both CABG and AAA repair were

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mandatory. Hospital cost and postoperative hospital stay were also analyzed.

Methods

Data of all patients receiving both CABG and AAA repair in our service in recent 7 years were retrospectively reviewed. Six received simultaneous CABG/AAA repair (group A) and 8 received staged operation (group B). One patient in group B failed simultaneous CABG/AAA repair due to unstable hemodynamics after CABG and was subjected to staged AAA repair 3 weeks later. CAD was the reason of the first admission in 5 patients in group A (5/6, 83.3%) and in 3 patients in group B (3/8, 37.5%). Patients without both surgical indications during the initial hospitalization were excluded: 6 patients operated on for large AAA (5 elective, 1 ruptured AAA) during follow-up after CABG was excluded. Among them, the mean (± standard deviation, SD) interprocedure interval was 46.83 ± 14.37 months (range, 6-104 months). One patient with significant CAD diagnosed 4 years after AAA repair and 1 patient receiving transmyocardial laser revascularization (TMLR) after repair of impending ruptured AAA were also excluded.

CABG was performed with standard median sternotomy with cardiopulmonary bypass for all patients except one in group B who received minimally invasive direct coronary artery bypass (MIDCAB) with the left internal mammary artery (LIMA) anastomosed to the left anterior descending artery (LAD) only.

AAA repair was performed in standard fashion with either aortic approach up to surgeon preference. Transperitoneal approach was performed in 10 patients and retroperitoneal approach in 4 patients. In the group of simultaneous CABG/AAA repair, CABG was exclusively performed first. AAA was exposed during harvesting of the bypass conduits and repaired after completion of CABG with the cannulations left in situ, as previously described.[5]

All values are expressed as mean ± SD. The data were compared with Fisher exact test and Mann-Whitney U test between groups A and B. Differences were considered significant at p value of less than 0.05.

Results

All 14 patients in both groups were male with mean (± SD) age 71.00 ± 0.88 years in group A and 76.12 ± 1.44 years in group B ($p = 0.03$). The other preoperative data were similar in both groups except that group A patients had a past history of hypertension ($p = 0.03$) and the larger AAA diameter (6.92 ± 0.18 cm versus 5.63 ± 0.19 cm in group B) ($p = 0.01$, Table 1). All patients in the present study had AAA over infrarenal area. One patient in group A and 5 patients in group B had their initial hospitalization for

Table 1. Patient demographics and preoperative data

Demographic	Simultaneous OP ($n = 6$)	Staged OP ($n = 8$)	p value
Age (yr)	71.00 ± 0.88	76.12 ± 1.44	0.03[a]
Male	6/6 (100%)	8/8 (100%)	--
Smoking	2/6 (33.3%)	6/8 (75%)	0.16[b]
Diabetes	1/6 (16.7%)	0/8 (0 %)	0.43[b]
Hypertension	6/6 (100%)	3/8 (37.5%)	0.03[b]
COPD	0/6 (0 %)	2/8 (25%)	0.31[b]
EF	47.83 ± 2.98	46.75 ± 3.04	0.95[a]
No. of CAD	2.50 ± 0.31	2.75 ± 0.23	0.42[a]
AAA diameter	6.92 ± 0.18	5.63 ± 0.19	0.01[a]

All values are expressed as mean ± SD. OP = operation; COPD = chronic obstructive pulmonary disease; EF = ejection fraction; CAD = coronary artery disease; AAA=abdominal aortic aneurysm.
[a]Mann-Whitney U test; [b]Fisher exact test.

Table 2. Operative procedures and postoperative course

	Simultaneous OP (n=6)	Staged OP (n=8)	p value
Bypass No. of CABG	2.50 ± 0.48	3.13 ± 0.38	0.29[a]
Use of LIMA	2/6 (33.3%)	3/8 (37.5%)	1.00[b]
ETT day of CABG	2.50 ± 0.37	1.71 ± 0.21	0.15[a]
Bypass time (min)	155.17 ± 25.87	149.67 ± 10.98	0.36[a]
Transperitoneal approach	5/6 (83.3%)	5/8 (62.5%)	0.41[b]
Use of Y graft (for AAA)	3/6 (50%)	6/8 (75%)	0.34[b]
Total blood loss (ml)	1849.00 ± 269.28	2320.71±530.46	0.69[a]
Operative mortality (<30 day)	0/6 (0%)	0/8 (0%)	--
Total postoperative stay (day)	13.33 ± 0.71	30.00 ± 2.97	<0.01[a]
Total hospital cost (NTD)	464,323.17 ± 21,938.37	697,555.25 ± 59,860.28	0.01[a]

All values are expressed as mean ± SD; OP = operation; CABG = coronary artery bypass grafting; LIMA = left internal mammary artery; ETT = endotracheal tube; AAA = abdominal aortic aneurysm; NTD = new Taiwan dollar.
[a]Mann-Whitney U test; [b]Fisher exact test.

AAA, either pulsating mass or vague abdominal pain. The operative procedures and postoperative courses were similar in both groups (Table 2). Five patients in each group received AAA repair via transperitoneal approach. Group B patients had more total blood loss (2320.71 ± 530.46 ml) than group A patients (1849.00 ± 269.28 ml), but the difference did not attain statistical significance ($p > 0.05$). There was neither surgical mortality in both groups nor AAA rupture in the interprocedure period in group B. Three patients died in the study period: one patient in group A expired 3 months postoperatively and two in group B expired 6 months and 5 years after operation. The 1-year survival rate was similar in both groups (66.67% versus 85.71%; $p = 0.13$). None died at hospital and all were caused by cardiac events. All patients in group B except one with impending ruptured AAA received CABG/AAA repair in separate hospitalization. The mean (± SD) interprocedure interval was 56.25 ± 14.64 days (range, 12-150 days). The postoperative length of stay decreased significantly in the group A compared with that in group B (13.33 ± 0.69 days versus 30.00 ± 2.94, $p < 0.01$). Total hospital cost (indicated by the charge from hospital) was also significantly lower in the group A than in group B (NTD$464,323.17 ± 21,938.37 versus NTD $697,555.25 ± 59,860.28, $p = 0.01$).

Nonfatal complications occurred in 3 patients (3/6, 50%) in group A and 5 patients (5/8, 62%) in group B ($p = 1.00$) (Table 3). One patient with baseline creatinine level of 2.2 in group B suffered from postoperative renal insufficiency, who had the creatinine level increasing to 3.3 after CABG and subsequently decreasing to preoperative values. He also had abdominal wound disruption after AAA repair. One patient in each group suffered from drop foot in the saphenous vein harvest limb and got improved in two weeks. Peroneal nerve injury was impressed and was excused to the over-tight compression bandage.

Table 3. Postoperative complications

	Simultaneous OP (n = 6)	Staged OP (n = 8)	
		CABG	AAA Repair
Renal failure	1	1	0
Drop foot	1	1	0
Hemothorax	0	1	0
Wound infection/abdomen	1	0	2
Wound infection/leg	0	1	0
Total	3	4	2

OP = operation; CABG = coronary artery bypass grafting; AAA = abdominal aortic aneurysm.

Discussion

The combination of severe coronary artery disease and a large abdominal aortic aneurysm is certainly a surgical challenge. Surgical risk increases due to the natural course of each disorder. There is no universal agreement of surgical strategy to date, however, simultaneous or staged CABG/AAA repair at short interval was mostly suggested.

While staged CABG/AAA repair was planned, CABG was exclusively performed first for reduction of cardiac-specific morbidity and mortality after AAA repair. Simultaneous CABG/AAA repair was more popular, however, among those younger patients in relatively healthy general condition as well as with larger AAA. Patients with other risk factors that were prone to AAA rupture after CABG, such as hypertension or symptomatic AAA,[6] were also candidates for simultaneous CABG/AAA repair.

There is no doubt that simultaneous procedures have many advantages. One-stage approach can free the patients from not only repeated anesthesia but also worry about the AAA rupture after CABG. The only drawback may be systemic hypothermia from extensive exposure and pulmonary complication due to prolonged anesthesia. In the present study, simultaneous CABG/AAA repair seemed to carry no increased morbidity or mortality, but the postoperative hospital stay and total hospital cost were significantly reduced.

Despite the advocate of retroperitoneal aortic approach,[7,8] the transperitoneal aortic approach was used more frequently in our experience. Aside from easier approach and adequate exposure, transperitoneal aortic approach carried little risk factors in severe obesity (> 90 kg), multiple prior intra abdominal operations, suprarenal aneurysms, or aneurysms associated with extensive visceral occlusive disease. In patients receiving simultaneous operation, transperitoneal approach was more feasible to perform in a supine position after CABG.

Incidence of abdominal aortic aneurysm formation in patients scheduled for elective CABG was reported 5.2% to 13% by routine preoperative ultrasonography evaluation.[9] However, evaluation by ultrasonography for AAA before CABG was not performed routinely in our service except physical examination and history review. Six patients who received AAA repair 6 to 104 months after elective CABG were excluded in the present study. Their records for original admission revealed no diagnosis of AAA, nor abnormal finding during abdominal palpation. More careful evaluation of coincident peripheral vascular disease before CABG and frequent examinations during follow-up after CABG are recommended.

In light of cost-effectiveness, surgical strategies cannot be considered without taking costs into account. The reduction of perioperative morbidity cannot be over-emphasized to prevent legal-medical events such as AAA rupture after CABG or perianesthesia morbidities. In the present study, simultaneous CABG/AAA repair significantly decreased hospital stay and cost compared with staged procedures. We will not jump into conclusion because of the small sample size and age difference (71 versus almost 77). Age is, in fact, one of the most important risk factors of morbidity and length of stay.

In conclusion, simultaneous CABG and AAA repair is feasible in surgical technique. Simultaneous operation could be performed as safely as staged procedures, especially in younger patients with larger AAA and hypertension, taking mortality and morbidity into account.

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References

1. Blackbourne LH, Tribble CG, Langenburg SE, Mauney MC, Buchanan SA, Sinclair KN, Kron IL. Optimal timing of abdominal aortic aneurysm repair after coronary artery revascularization. *Ann Surg* 1994;219:693-8.
2. Gooding JM, Archie JP, McDowell H. Hemodynamic response to infrarenal aortic cross-clamping in patients with

and without coronary artery disease. *Crit Care Med* 1980;8:382-5.
3. Paty PS, Darling RC III, Chang BB, Lloyd WE, Kreienberg PB, Shah DM. Repair of large abdominal aortic aneurysm should be performed early after coronary artery bypass surgery. *J Vasc Surg* 2000;31:253-9.
4. Gade PV, Ascher E, Cunningham JN, Kallakuri S, Scheinman M, Scherer H, et al. Combined coronary artery bypass grafting and abdominal aortic aneurysm repair. *Am J Surg* 1998;176:144-6.
5. King RC, Parrino PE, Hurst JL, Shockey KS, Tribble CG, Kron IL. Simultaneous coronary artery bypass grafting and abdominal aneurysm repair decreases stay and costs. *Ann Thorac Surg* 1998;66:1273-6.
6. Dobrin PB. Pathophysiology and pathogenesis of aortic aneurysms. *Surg Clin North Am* 1989;69:687-703.
7. Sicard GA, Freeman MB, VanderWoude JC, Anderson CB. Comparison between the transabdominal and retroperitoneal approach for reconstruction of the infrarenal abdominal aorta. *J Vasc Surg* 1987;5:19-27.
8. Hudson JC, Wurm WH, O'onnell TF, Shoenfeld NA, Mackey WC, Callow AD, et al. Hemodynamics and prostacyclin release in the early phases of aortic surgery: comparison of transabdominal and retroperitoneal approaches. *J Vasc Surg* 1988;7:190-8.
9. Bergersen L, Kiernan MS, McFarlane G, Case TD, Ricci MA. Prevalence of abdominal aortic aneurysms in patients undergoing coronary artery bypass. *Ann Vasc Surg* 1998; 12:101-5.