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Combined cardiac surgery and extra-anatomic ascendant aorto-bifemoral bypass: Short-term results

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ABSTRACT

Background: Valvular or coronary artery disease associated with aortoiliac vascular disease is uncommon but very severe. We report the short-term results of 4 cases of single-stage surgery performed cardiac surgery and extra-anatomic ascendant aorta-bifemoral shunt. *Methods:* Retrospectively describe 4 cases of cardiac surgery combined with single-stage ascendant aorta-bifemoral artery bypass. *Results:* 1 case of valve replacement and 3 cases of coronary artery bypass without extracorporeal circulation accompanied by ascending aorta-bifemoral artery bypasses through the anterior peritoneal tunnel. Dacron Y-grafts with size 14/7 mm are used. Before surgery, all 4 were in Leriche's classification stage 4 and TASC II grades D. Contrast angiography showed complete occlusion of the aorta-pelvis (just below the renal artery). There were no deaths or complications in the postoperative period. Follow-up up to 6 months and CT scan showed good patency of bypass, all the patient had no longer of pain in lower extremities and walking normally. *Conclusion:* Extra-anatomic ascendant aorta-bifemoral artery bypass is an effective, easy-to-implement, and safe solution in cases requiring cardiac surgery at the same time as an acute iliac aortic disease.

Keywords: Extra-anatomic ascendant aorto-bifemoral bypass (AABF), aortoiliac occlusive disease (AIOD), off-pump coronary artery bypass grafting (OPCAB)

1. INTRODUCTION

Peripheral vascular disease in the elderly with coronary artery disease may occur in 21-72% of cases (Duran et al., 2010; Hertzer et al., 1984). The most severe condition is coronary stenosis or valvular disease accompanied by stenosis or occlusion of the abdominal-pelvic aorta which is requires urgent

intervention. Aorto-Femoral Bypass (AFB) has been used clinically since the 1950s for the treatment of aortoiliac occlusive disease (AIOD) (Chiu et al., 2010; Sharma et al., 2018). However, if the heart surgery is performed at the same time as laparotomy to make the aorta-femoral artery bypass, it is very serious and has a high mortality rate (Sharma et al., 2018; Clair and Beach, 2015).

An alternative solution is to take advantage of midline sternotomy to perform the ascendant aorta-bifemoral artery (AABF). We report the short-term results of 4 cases of AABF associated with valvular surgery or coronary artery bypass graft without extracorporeal circulation (OPCAB) and review the literature to share experiences on indications and implementation techniques.

2. IMPLEMENTATION TECHNIQUE

All 4 patients were supine under general anesthesia exposing bilateral groin areas. Step 1, open midline sternotomy, establish extracorporeal circulation if mitral valve intervention is needed (patient 1), or perform OPCAB (patients 2, 3, and 4). Heparin doses are used at 3 mg/kg if extracorporeal circulation is present and 1.5 mg/kg if no extracorporeal circulation is available. Step two, expose two femoral arteries (common femoral artery, superficial femoral artery, and deep femoral artery all need dissection and control) and create a tunnel that goes anterior to the peritoneum from the lower end of the thoracic incision to the two femoral openings. We make an incision below the navel to easily create a tunnel behind the rectus muscle.

Step three; anastomose the proximal end of the 14/7mm Y-shaped Dacron graft to the lateral wall of the ascending aorta, then insert the graft into the pre-made tunnel (Figure 3). Check that the graft is not twisted all the way, then end-to-side anastomosis to the two common femoral arteries (endarterectomy prior to anastomosis if necessary) (Figure 4). Open the clamp and examine the new artery bridge with Doppler ultrasound.

Figure 1 Occlusive aortoiliac artery

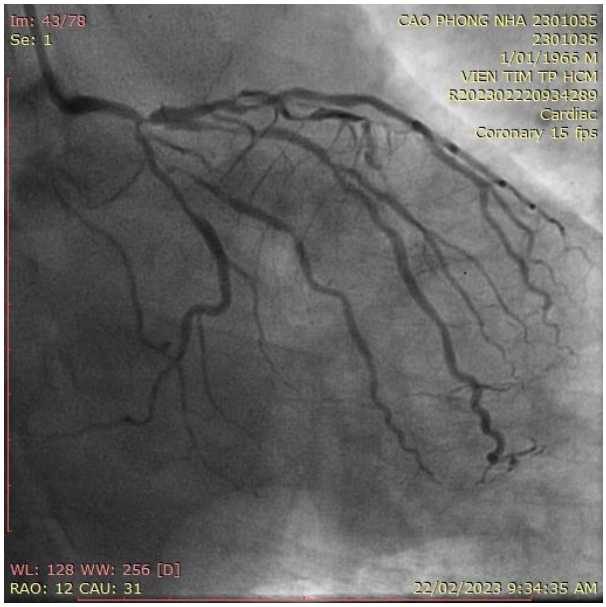

Figure 2 Two vessels of coronary artery disease

3. RESULT

During 6/2022- 3/2023, we operated on four cases of AABF with valve replacement surgery (1) or OPCAB (3). All 4 patients were male and in TASC II grade D. All of the patients were severe smokers and showed severe lower extremity ischemia with Leriche-Fontaine classification in grade 3B (3 patients) or 4 (1 patient). 1 patient had an erosive ulcer due to anemia. 1 patient has to have semi-urgent surgery and 3 patients can perform elective surgery. Some preoperative and surgical characteristics are presented in (Table 1).

Table 1 Pre-operative and surgical characteristics of patients

Patient	Underlying disease	Heart disease	AIOD	Surgery	Results
Patient N. 1, 68 y.o	Hypertensive, Lipid disorder	Severe mitral stenosis MVA#0.6cm2 SPAP: 60mmHg	TASC II D	MVR (tissue 27) + AABF	Alive, no complication
Patient N. 2, 63 y.o	Hypertensive, Lipid disorder	3-vessel disease	TASC II D	1 bypass (LAD)+ AABF	Alive, still have leg pain (minor)
Patient N. 3, 57 y.o	Hypertensive, Lipid disorder, diabetes	3-vessel disease	TASC II D	2 bypass (LAD-OM) + AABF	Alive, no complication
Patient N. 4, 68 y.o	Hypertensive, Lipid disorder	3-vessel disease	TASC II D	2 bypass (LAD -OM) + AABF	Alive, no complication

*MVR: Mitral valve replacement; LAD: Left anterior descending; OM: Obtuse marginal

All patients were alive and had no cardiovascular or local complications. 3 patients had no longer pain in the lower extremities after surgery, and 1 patient had complete pain relief after 2 weeks. The incision in both groins healed well; there was no infection, no lymphatic leakage. All 4 patients underwent contrast-enhanced CTA 1-3 months after surgery, showing that the AABF Bridge worked perfectly (Figure 5).

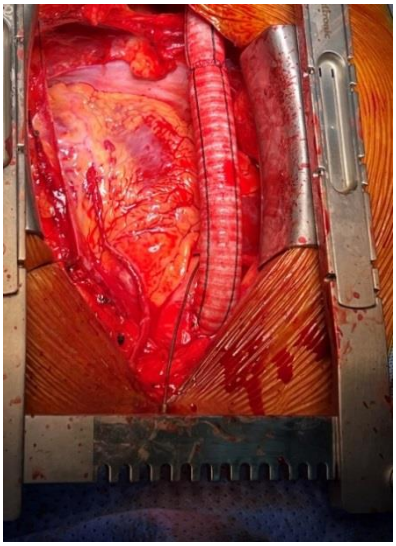

Figure 3 Proximal anastomosis

Figure 4 AABF completed

Figure 5 CTA at 3 months showed AABF working perfectly

4. DISCUSSION

Extra-anatomic aorta-bifemoral bypass is usually performed from the abdominal aorta to the femoral or iliac artery and goes retroperitoneal. However, the technique is quite complicated and needs at least one segment of the superior renal aorta which is long and good enough to perform proximal anastomosis. Another option is to perform an extra-anatomic bypass from the ascending or descending aorta to the two femoral arteries. The advantage is that the ascending aorta is rarely calcified and can be combined with valvular surgery or coronary artery bypass grafting when the patient has cardiovascular disease requiring intervention. The disadvantage is that it requires midline sternotomy and cardiopulmonary bypass.

Indications for performing this type of bridge when endovascular intervention is not possible in the following cases: (1) Stenosis or occlusion of the iliac artery or severe stenosis abdominal aorta with acute symptoms; (2) claudication unresponsive to medical treatment or necrosis, non-healing lower extremity ulcer or severe lower extremity ischemia (pain at rest, severe intermittent claudication); (3) Impotence. Before surgery, it is necessary to stop smoking, needs to lose weight, treat the underlying disease, and use antiplatelet drugs. Open AABF bypass surgery also has contraindications such as patients unable to have general anesthesia, recent cerebrovascular accident, or myocardial infarction. Horseshoe kidney and retroperitoneal fibrosis are also relative contraindications.

According to Indes et al., (2010) the short-term mortality rate of endovascular and open surgery was not different (1.8% vs 2.5%). The AABF anatomical bypass can physiologically completely replace the abdominopelvic aorta due to its large size, and inflow revascularization, so it ensures sufficient flow for the lower body and can also be reperfusion retrograde to the major intra-abdominal arterial branches. Because there is no laparotomy, no retroperitoneal open, and the concomitant cardiac disease were performed at the same time, this type of bypass avoids serious complications that can be fatal such as myocardial infarction (accounting for 50% of deaths) renal failure (due to prolonged suprarenal aortic clamping, decreased perfusion, or intrinsic renal disease and embolism).

Furthermore, it can be performed in patients with multiple laparotomies or abdominopelvic aortic stenosis as well as excluding complications of aorto-enteric fistulas. Other related late complications such as graft infection; hernia is very uncommon. According to the literature, Baird et al., (1986) reported 5 cases of coronary artery bypass grafting (CABG) with AABF bypass, which the author called "ventral aorta" with very positive results: No mortality, the rate of patency bypass after 5 years is 70%. Similarly, Jebara et al., (1994) reported 10 cases, all men, with a mean age of 63, CABG associated with AABF bypass (only 1 patient died).

Recently, Al-Musawi et al., (2020) reported a case of CABG concurrently with AABF bypass with a very good postoperative outcome. Bosse et al., (2018) study on 8 cases of both CABG and AABF also showed no surgical mortality, the rate of bypass surgery and survival at 5 years is 86% and 100%, respectively. The technical difference is that these authors all used Gore-tex tube No. 10 with reinforced ring connecting the ascending aorta to the left femoral artery and then bridging the two femoral arteries. This kind of extra-anatomic shunt generally seems to be working well and lasting long. We use a large graft equivalent to a normal abdominal aorta to maintain adequate pressure and perfusion flow for the entire lower body.

Thus, with the use of anticoagulants or antiplatelet drugs, it is possible to maintain long-term bridging activity with this anatomical size. In our opinion, it is very easy to create an anterior peritoneal tunnel and the use of a Y-tube helps to balance the flow of both femoral arteries. Another technical change as a bridge by Suzer et al., (2009) is midline sternotomy, cardiac intervention, then performed bypass from the thoracic aorta to the femoral artery, which passes through the posterior diaphragm and goes retroperitoneal.

In our opinion, this technique is more complicated and can cause left diaphragmatic paralysis. We stopped performing axillo-femoral bypass to treat this particular group of diseases because the 5-year survival rate is quite low from 55-67.7% (Onohara et al., 2000; Stewart et al., 2021). Another reason is aesthetics and the patient cannot use a belt when wearing pants because it can cause collapse of the prosthetic bridge. Except for 1 case, we had to replace the mitral valve, in the remaining 3 cases; we carried out OPCAB, a great advantage for patients who have many underlying diseases.

As a result, it helps to limit the complications related to running extracorporeal circulation and the patient quickly recovers after surgery. Thus, it can be seen that the extra-anatomic AABF is an effective, easy-to-implement, and suitable solution for cases in which both cardiac surgery and AIOD needed revascularization are required.

5. CONCLUSION

The extra-anatomic AABF bypass is an effective, easy-to-implement, and safe solution in cases requiring cardiac surgery at the same time as acute AIOD. It also requires a longer follow-up time and a larger number of patients to accurately assess the effectiveness of this combination approach.

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Author Contributions

(I) Conception and design: Van Hung Dung
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(V) Study design, review and corrected the English version: MS Minh Chau Van Nguyen
(VI) Manuscript writing: All authors
(VII) Final approval of manuscript: All authors

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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