Clinical Evaluation of Adjunct Procedures in Aneurysmectomy of the Descending Thoracic Aorta

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ABSTRACT

Eight patients with aneurysm of varying origins have had resection and graft replacement of the descending thoracic aorta with aid of vascular prosthesis bypass, partial left heart pump bypass, or femoral vein to femoral artery oxygenation bypass. All survived operation without post-operative renal malfunction and caudal neurologic deficiets.

Hemodynamic and enzymologic examinations reveal that the last adjunct procedure is most beneficial.

Key Words: *adjunct procedures*; *vascular prosthesis bypass*; *partial left heart bypass*; *femoral vein to femoral artery bypass*

In aneurysmectomy of the descending thoracic aorta, it is essential to use adjunct measures in order to prevent excessive hypertension in the upper half of the body and ischemia in the lower caused by cross-clamping of the aorta to facilitate the surgery. The hypertension imposes overload upon the heart, while the ischemia, if prolonged enough, damages irreversibly vital organs such as liver, kidneys and spinal cord.

Adjunct procedures available now include hypothermia[1], external temporary bypass with a vascular prosthesis[2], and pump bypass shunts including left atrium to femoral artery bypass without oxygenator[3] and femoral vein to femoral artery bypass with oxygenator[4].

The purpose of this report is to evaluate several support means clinically.

CLINICAL MATERIALS

During the period between January, 1973 and June, 1978, 8 patients with aneurysm of varying origins of the descending thoracic aorta were operated upon: atherosclerosis in 3, cystic medionecrosis in 1, giant cell aortitis in 1 and unknown in 3. In this series, 3 cases of dissecting aneurysm (type IIIa after DeBakey) were included.

TECHNIQUES OF ADJUNCT PROCEDURES

1. *Vascular prosthesis bypass.* The left subclavian and femoral arteries were exposed through a left posterolateral thoracotomy and a skin incision in the groin, respectively. Between both vessels a fabric graft, one and half times as wide as the subclavian artery in diameter, was placed in an end-to-side fashion (Fig. 1).

2. *Partial left heart bypass.* After heparinization, the blood was drained by gravity into a reservoir through a cannula inserted into the left

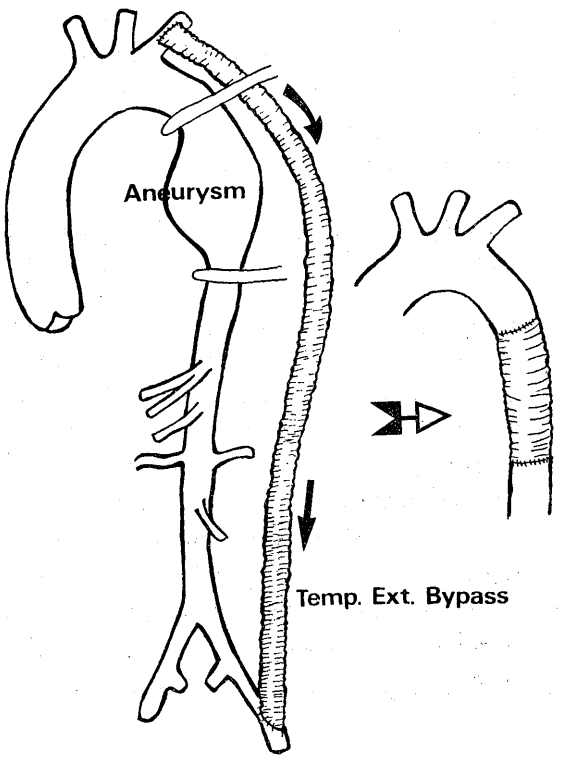

Fig. 1 Schematic illustration of vascular prosthesis bypass.

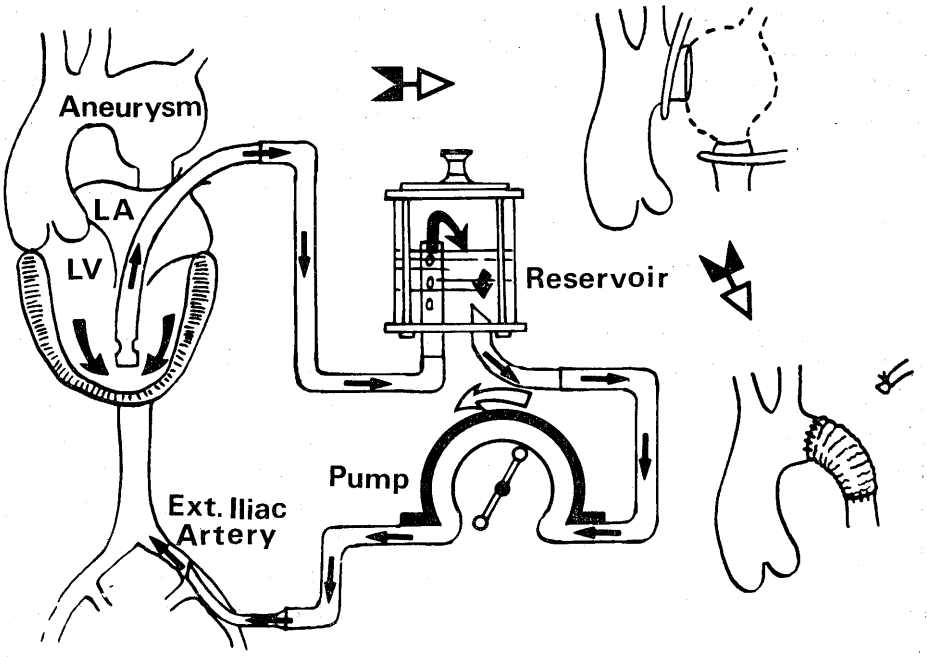

Fig. 2 Schematic illustration of partial left heart bypass.

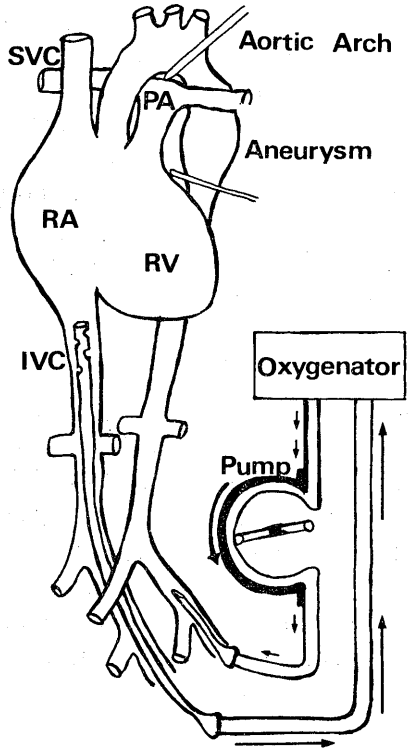

Fig. 3 Schematic illustration of femoral vein to femoral artery bypass.

atrium (or ventricle) and then pumped back into the left femoral (or external iliac) artery through a catheter (Fig. 2).

3. *Femoral vein to femoral artery bypass.* The inferior vena cava was cannulated through the left femoral (or external iliac) vein for drainning the venous blood into a reservoir, which was pumped into the left femoral (or external iliac) artery after oxygenation. (We preferred the external iliac vessels because of their larger caliber.) (Fig. 3).

TECHNIQUES OF SURGERY

Prior to operation the body temperature was reduced to 32°C in all but one. The descending aorta was isolated proximal and distal to aneurysm to be snared by tapes. Heparin, 1.0 mg per kilogram of body weight, was given intravenously if cannulation required. Immediately after the establishment of bypass, the aneurysm was excluded from the circulation by cross-clamping of the snared aortic portions. The aneurysmal wall was incised longitudinally. Openings of the intercostal arteries were closed from the inside using 4-0 Tevdek buttressed with pieces of Teflon felt after clots and/or atheromatous masses, if present, were evacuated.

For the restoration of aortic continuity a fabric graft was interposed between the two ends of the transsected aorta in an end-to-end fashion; a proximal anastomosis was made first and then followed by distal one. Interrupted mattress sutures were placed using 2-0 Tevdek buttressed with pieces of Teflon felt; the suture lines were further reinforced with continuous over-and-over sutures. Where the dissection had developed, Teflon backed sutures were used to reapproximate the layers of the aorta prior to anastomosis.

Upon the completion of grafting the distal and proximal cross-clamps were released in order. Protamin sulfate was given intravenously to neutralize the heparin effect. The graft was wrapped with the remaining aneurysmal wall.

RESULTS

Eight patients undergoing aneurysmectomy were classified according to the adjunct procedure as shown in Table I. All survived operation without post-operative renal malfunction and caudal neurologic deficients. In a case of vascular prosthesis bypass, ventricular fibrillation occurred during operation with successful conversionby countershock and in a case of partial left heart bypass, massive hemorrhage from the left atrial wall torn with sutures after decannulation was controlled with difficulty.

The mean operative time was longer in the femoral vein to femoral

Table I Synopsis of Patients

Adjunct procedures	Case No.	Age (yrs)	Sex	Operation Time (min)		Cross-clamping (min)		Bleeding Volume (ml)	
Vascular Prosthesis Bypass	1	40	M	540	457 ±60.5	75	90 ±23	4490	4739 ±2531
	2	59	M	435		130		8800	
	3	48	F	395		75		3788	
	4	21	M	355		80		1880	
Partial Left Heart Bypass	5*	41	M	565		85		7860	
Femoral Vein to Femoral Artery Bypass	6*	58	M	565	490 ±63	139	114.7 ±25	6860	5770 ±1677
	7	42	M	410		80		3400	
	8*	53	M	495		125		7050	

*Dissecting Aneurysm, III-type after DeBakey

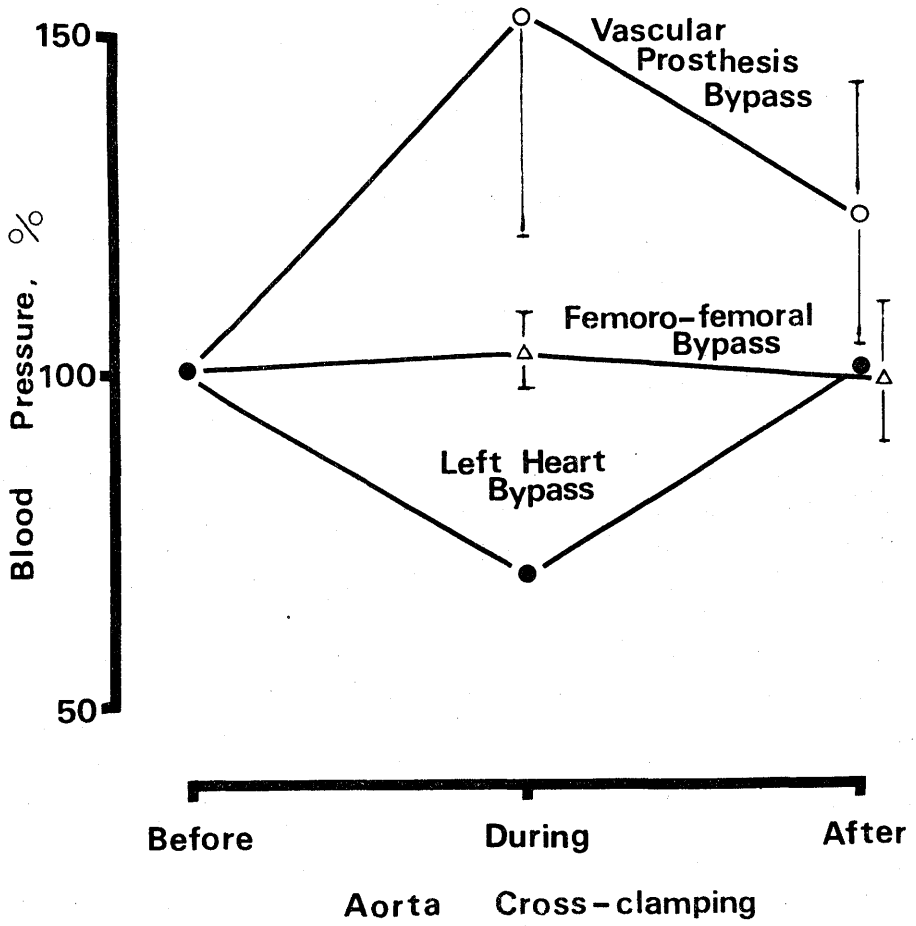

Fig. 4 Changes in systolic blood pressure of right brachial artery before, during and after cross-clamping of descending aorta.

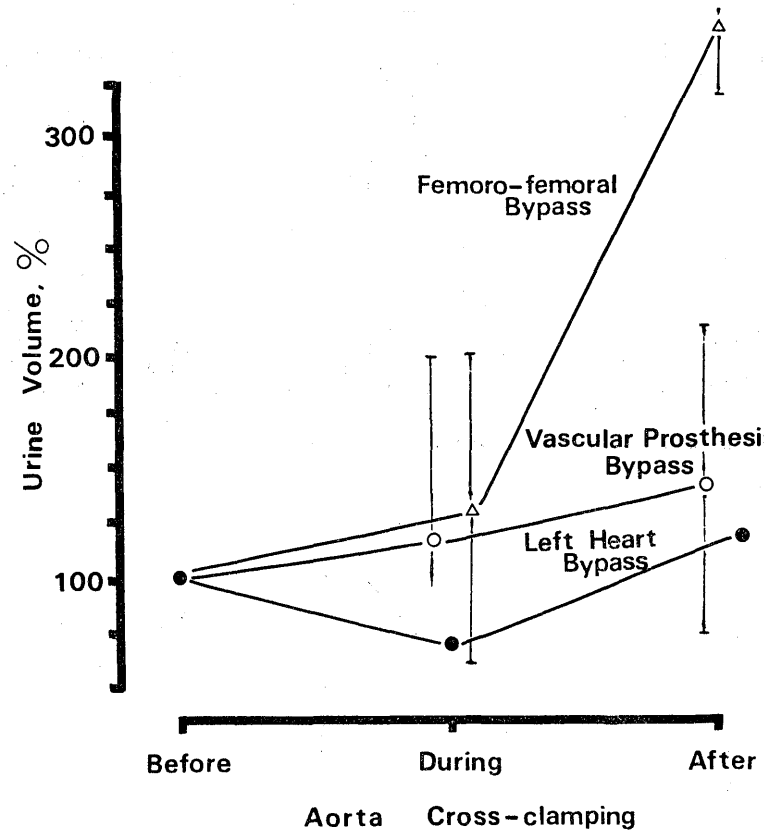

Fig. 5 Changes in urine output before, during and after cross-clamping of descending aorta.

artery bypass group than in the vascular prosthesis bypass group. This is probably because in the former group, 2 out of 3 patients had dissecting aneurysm, which is fragile in structure and usually more time-consuming for operation than conventional aneurysms as encountered all in 4 patients of the latter group.

During cross-clamping of the descending aorta, the systolic pressure in the right brachial artery rose markedly in the vascular prosthesis bypass group (151.6±30% of that before cross-clamping). Whereas, in the femoral vein to femoral artery bypass group it was well controlled by using the flow rate of about 40 ml/kg/min (Fig. 4). After declamping, the urinary output much more increased in the femoro-femoral technique gorup (375±28.6% of that before cross-clamping) than in the remaining group (Fig. 5). This is indicative of the more satisfactory

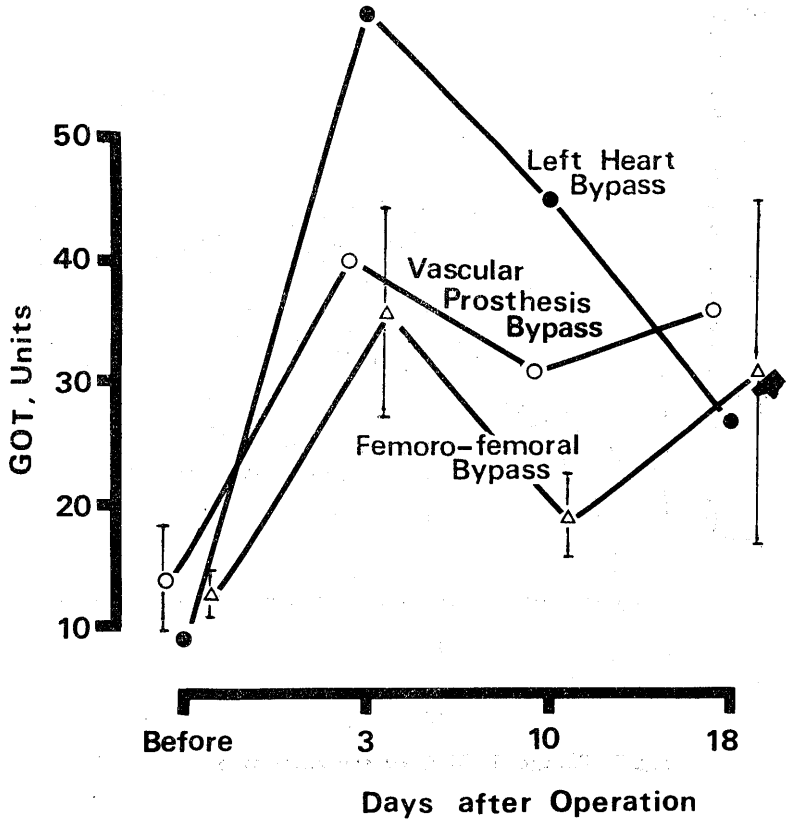

Fig. 6 Changes in GOT after aneurysmectomy.

renal perfusion during bypass. In all groups, the serum GOT level increased markedly 3 days after operation with a subsequent gradual decrease. Even on the 18th postoperative day, however, it was considerably higher than the pre-operative level (Fig. 6). The serum GPT level rose gradually, at least, until the 18th post-operative day (Fig. 7). It was noteworthy that these mesurements swung with the least narrow range in the femorofemoral group. The blood urea level changed within normal limits after operation in all groups (Fig. 8).

DISCUSSION

Interposition of a fabric graft for bypass is apparently simple. In our experiences, however, it was considerably difficult and time-consuming to anastomose the proximal end of the graft with the left subclvaian artery if it had been involved with pathological changes. Another defect

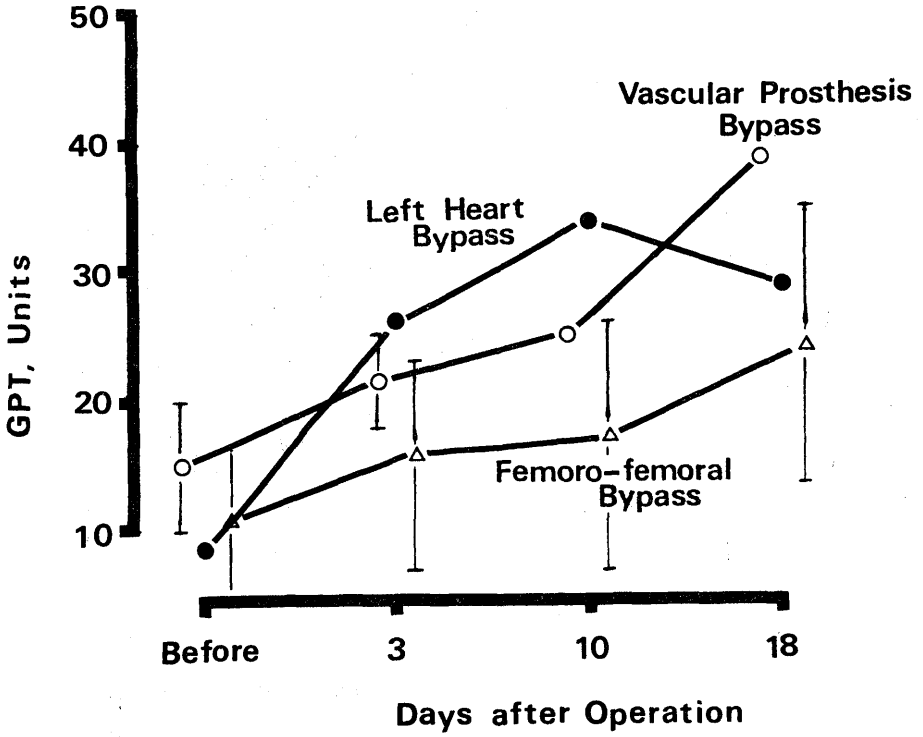

Fig. 7 Changes in GPT. after aneurysmectomy.

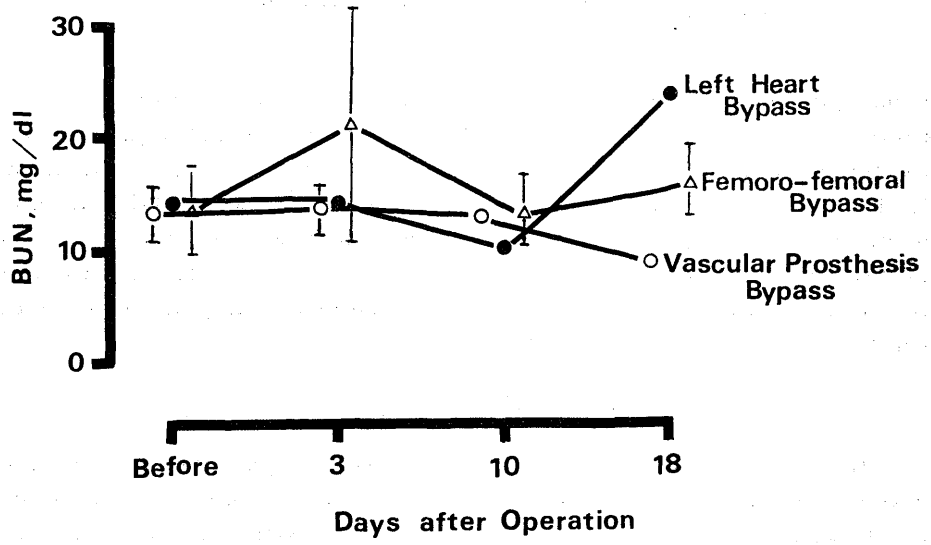

Fig. 8 Changes in BUN after aneurysmectomy.

of this technique was impossibility to controll the blood flow through the graft.

DeBakey and associates[5] used partial left heart bypass with caudal neurologic deficiets in the frequency of 5.5% (4/73). In performing this technique, intrapericardial manipulations are required and furtheremore the bypass tubing hat goes across the operative field is troublesome. Sometimes, constant drainage can not be attained because the position of intraatrial cannula change often.

Neville et al.[4] and Bloodwell et al.[6] have recommended femoral vein to femoral artery oxygenation bypass, giving several advantages; the most important thing is its easy control of the perfusion rate in response to hemodynamic changes. Kaya[7] demonstrated experimentally that cross-clamping of the descending aorta for one hour was performed without renal damage when using the flow rate of 20 to 30 ml/kg/min. This finding supports the adequacy of the flow rate of 40 ml/kg/min in our clinical trials. We prefer the external iliac vessels to the femoral for cannulation because of larger caliber. Also in our clinical evaluation, this support measures was most beneficial.

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