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1 **Apico-aortic conduit: a readily available technical modification.**

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18 **Word count: 982**

19 **Abstract**

20 When neither surgical valve replacement nor transcatheter aortic valve implantation is possible,
21 performing an apico-aortic conduit remains a therapeutic option. This procedure has become rare and
22 the rigid angled apical connectors usually used to facilitate ventricular anastomosis are no longer
23 commercially available. We described the technique that we performed on a 60-year-old patient with
24 readily available material.

25 **Introduction**

26 In cases of calcific aortic stenosis, apico-aortic conduit (AAC), otherwise called aortic valve bypass, may
27 be indicated when no other option is possible. As this surgery has become infrequent, the specific
28 apical connectors formerly used are no longer available. Herein we describe an adaptation of the
29 technique that can be performed with readily available materials.

30 **Clinical case and surgical technique**

31 We report the case of a 60-year-old patient who presented with hemorrhagic shock complicated by an
32 acute coronary syndrome following right upper lobectomy surgery for pulmonary adenocarcinoma.
33 Cardiac examination then revealed an ischemic and valvular cardiac disease with significant stenosis
34 of the left anterior descending artery (LAD), chronic occlusion of the right coronary, and calcific aortic
35 stenosis with an average gradient of 53mmHg. The left ventricle was hypertrophied with an ejection
36 fraction of 60%. A surgical treatment with aortic valve replacement and coronary artery bypass was
37 then decided.

38 During the surgery, significant aortic root calcifications were found and contraindicated the aortotomy
39 and valvular replacement. Only coronary bypass grafting on LAD artery could be performed and a
40 transcatheter aortic valve implantation (TAVI) was considered in a second step. Unfortunately, cardiac
41 CT scan performed before the procedure did not allow TAVI due to major and protruding aortic root
42 calcifications and a too narrow left ventricular outflow tract.

43 Transthoracic echocardiography (TTE) at 6 months found significantly increased stenosis in the average
44 gradient of 116mmHg, a valvular surface of 0.54cm² and a maximal velocity of 6.6m/s. Left ventricular
45 ejection fraction was still preserved at 55%. At the same time, a primary hyperparathyroidism related
46 to an adenoma was diagnosed, but due to the aortic stenosis, surgical excision under general
47 anesthesia could not be performed. Moreover, the patient has become highly symptomatic and heart
48 transplantation was not considered possible taking account the recent lung neoplasia.

49 AAC was then decided.

50 A large left thoracotomy in the sixth intercostal space was carried out, the pericardium was opened
51 and the left ventricle apex was exposed. Cardiopulmonary bypass was established through left femoral
52 vessels. Normothermia was maintained. In Trendelenburg position with beating heart, a circular 2-
53 centimeter ventriculotomy was performed with a sharp knife. A series of U-shaped points of 2-0
54 polypropylene with large Teflon pledgets was placed through the full thickness of the surrounding
55 myocardium and secured to the biological valved tube as follows (Figure 1): 2 Mosaic 23mm
56 bioprostheses (Medtronic Inc., Minneapolis, MN, USA) were sewn to each other in an inverted position
57 using a 4-0 Prolene running suture. The first prosthesis was used as a rigid stent through the apical
58 ventriculotomy and the cups were removed. The second prosthesis was inserted into a 28mm Dacron
59 tube with a Prolene 4-0 running suture. A 20mm Dacron tube was anastomosed laterally on the
60 descending thoracic aorta using a 4-0 Prolene running suture. Finally, the 28mm tube was
61 anastomosed to the 20mm beveled tube with a Prolene 4-0 running suture. After carefully de-airing,
62 cardiopulmonary bypass was weaned without any difficulty.

63 A redo thoracotomy was necessary on post-operative day (POD) 9 for hemothorax without active
64 bleeding. No coronary events were observed postoperatively. The patient was discharged for a
65 rehabilitation center on POD 28. CT scan performed before leaving the hospital found an adequate
66 positioning and a permeability of the AAC (Figure 2). TTE found no valvular insufficiency, an average
67 gradient of 12mmHg and good biventricular function.

68 At 6 months, clinical improvement was obvious with an asymptomatic and active patient.

69 **Comment**

70 Initially developed in the late 1950s, the aortic bypass technique was supplanted in the 1960s by
71 conventional surgical valve replacement for aortic stenosis and in the 1970s by the development of
72 congenital surgical techniques for complex obstructions of the left ventricular outflow tract (1). This

73 technique was used again in the early 2000s, for the management of aortic stenosis in older patients
74 with more comorbidities and in cases of complex sternal re-entry in particular (2).

75 In the late 2000s, TAVI gradually supplanted this technique and the rigid angled apical connectors
76 usually used for this surgery are no longer commercially available. This device is described as one of
77 the three essential components of the AAC (3), as it reduces the risks of left ventricular false aneurysm
78 and extrinsic compression of the tube by ventricular wall (4).

79 Direct insertions of the conduit into the left ventricle, with reinforcement the apical vascular
80 anastomosis by using inner and outer Teflon felt strips or sewing cuff have already been described by
81 teams from China and Japan, where apical connectors are likewise unavailable. While their results
82 seem satisfactory, only a few isolated cases have been reported (5-8).

83 The technique we describe is simple and reproducible. It does not require specific equipment. The use
84 of a rigid device seems to us to be more effective to avoid conduit ventricular obstruction than simple
85 Teflon reinforcements. Nevertheless, the need to use of a second bioprosthesis as a stent through the
86 ventricular wall remains debatable.

87 **Conclusion**

88 In the rare cases where neither surgical valvular replacement nor TAVI is possible, and although the
89 specific apical connectors are no longer commercially available, AAC remains a possible and feasible
90 therapeutic option with readily available material.

91

92 **Data Availability Statement**

93 The data underlying this article will be shared on reasonable request to the corresponding author.

94 **Competing interest**

95 The authors have declared that non competing interests exist.

96 **Figure legends**

97 Figure 1: Intra-operative views of the biological valved tube (A and B) and its insertion at the ventricular
98 apex (C). Note the use of a reverse bioprosthesis without leaflets as apical connector.

99 Figure 2: Post-operative CT scan showing proximal (A) and distal (B) anastomoses of apico-aortic
100 conduit (white arrow) and 3-dimensional reconstruction (C). Note the valvular stent through the
101 ventricular wall (A) and the major calcifications of the aortic root (B).

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Figure 1



