Brief communication - Congenital

Treatment of complex coarctation of aorta with hypoplastic transverse aortic arch using left carotid artery flap

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Abstract

Coarctation of aorta associated with severe hypoplastic aortic arch and ductus arteriosus dependent, often combined with complex cardiac malformations, should be looked upon as bordering of hypoplastic left heart syndrome. The crucial and first objective is the adequate reconstruction of aortic arch, continuing with the repair of cardiac malformations. The surgical treatment making resection of the coarctation segment combined with left carotid flap plasty is a surgical alternative, useful in patients with this complex anatomic variant.

Keywords: Complex aortic coarctation; Carotid flap plasty

1. Introduction

Coarctation of aorta associated with hypoplastic aortic arch, continues to be a challenge for congenital cardiac surgeons, despite advances in surgical and interventional therapies, because there are many different and complex surgical approaches trying to resolve this pathology, but being the optimal treatment is still controversial.

2. Methods

From November 2007 to June 2008, four neonates with a complex hypoplastic aortic arch and severe coarctation were operated on in our hospitals. Average age at surgery: 6.5 ± 7.8 days; average weight: 2.75 ± 0.25 kg. All patients exhibited similar and unusual anatomic characteristics (Fig. 1a).

The clinical diagnosis was confirmed by complete trans-thoracic 2-D echo-Doppler evaluation, also cardiac catheterization was performed to better define the arch anatomy (Fig. 2). There was an excellent correlation between pre-operative exams and surgical findings. The Z-value was calculated −2 or more in the segment of the transverse arch as criterion for the diagnosis of arch hypoplasia (we considered normal Z-value: 5.5 mm).

All patients underwent surgical repair making coarctation resection and reconstruction of hypoplastic transverse arch by plasty using a flap of left carotid artery. Three patients had associated VSD; in all these cases we made a pulmonary artery banding.

Postoperative evolution was uneventful for all cases, no neurological complication was observed and they have undergone clinical supervision and 2-D echo-Doppler evaluation, with excellent results in early follow-up (we detected an harmonic growth of the new aortic arch without significant residual gradient).

3. Surgical technique

Approach was made by left posterolateral thoracotomy, with the patient in lateral decubitus. A standard incision was performed through the fourth intercostal space. Transverse aortic arch and its branches, ductus arteriosus and descending aorta were aggressively dissected, the intercostal arteries are mobilized and the first two or three were ligated.

A Castañeda occluding clamp was positioned after innominate artery, to allow appropriate blood flow to the brain, the left subclavian artery was ligated, and the distal aortic arch was temporarily occluded previous to the ductus arteriosus, allowing blood flow to the thoracic aorta while performing carotid flap plasty of the distal aortic arch (Fig. 1b).

The left carotid artery is ligated as distally as possible and transected. The distal portion of the distal aortic arch, previous to the occluder clamp, is also ligated and transected. A longitudinal incision is made in the medial circumference of the left carotid artery, going down towards the distal hypoplastic aortic arch (Fig. 1c).
Plasty of distal aortic arch is fashioned suturing both vessels with a 7-0 running monofilament polypropylene suture, increasing the vessel diameter (Fig. 1d).

An aortic cross-clamp is positioned in the thoracic descending aorta, the ductus arteriosus is ligated and all ductal tissue is resected with the coarctation area.

The undersurface of the reconstructed distal aortic arch is incised as proximally as possible towards the ascending aorta. Finally, the anastomosis between the distal thoracic aorta and enlarged transverse aortic arch is performed using an extended end-to-end anastomosis, using a 7-0 continuous monofilament polypropylene suture (Fig. 1e).

The distal clamp was removed first, followed by the proximal clamp and hemostasis was ensured. Pulse in the distal aorta and gradient throughout the anastomosis was checked.

4. Discussion

Since 1953 when Mustard performed the first successful repair of neonatal coarctation, a new age for aortic arch surgery started [1].

The incidence of coarctation associated with hypoplastic aortic arch in neonates varies from 65 to 81%. Coarctation of aorta with critical hypoplastic aortic arch must be seen as a malformation bordering on hypoplastic left heart syndrome and many times according to associated cardiac anomalies, treated in the same way [2].

The management of neonates with aortic coarctation and hypoplastic aortic arch associated with congenital cardiac defects remains controversial. Otherwise, the ideal surgical technique for reconstruction of the aortic arch is still debatable.

We consider our strategy as a useful alternative to complex one-stage procedures, lessening the risk of surgery and the number of patients going onto univentricular procedures. Starting with a procedure that avoids cardiopulmonary bypass and finally gets a reconstructed aortic arch without obstruction, improves the number of patients that will go to a future biventricular intracardiac repair.

In this study we focused on reconstruction of the aortic arch using carotid flap plasty. Our short- and medium-term results are very encouraging, without residual or recurrent obstruction and an harmonic growth of the new aortic arch in all patients. We consider that carotid artery flap plasty is an important surgical technique to reconstruct a severe hypoplastic aortic arch, with singular anatomical features, otherwise, only amenable to be repaired with complex extracorporeal patch procedures, Norwood type.

The carotid artery was used for the first time by Blalock in 1945, however, carotid flap plasty for neonatal coarctation...
tion of the aorta was introduced by Campbell et al. in 1982, without a lot of spreading. In 1994, Mellgren published his technique of carotid flap plasty and resection to repair aortic arch hypoplasia.

Left carotid artery ligation is the only drawback of our technique, however, it has been tolerated very well by our patients, without any neurological complication. Moreover, newborns and young children undergoing support with extracorporeal membrane oxygenation (ECMO), have one carotid ligation. Up to now, follow-up series after ECMO support do not report neurologic damage associated with carotid artery ligation. This experience has been extrapolated by us and other authors [3, 4].

The carotid artery plasty provides an adequate relief of aortic arch obstruction with very low risk of recoarctation. This technique supposes the only valid alternative to premature newborns and other patients with cardiopulmonary bypass contraindications [5].

References