Outcome of aortic arch reconstruction in infants with coarctation: Importance of operative approach

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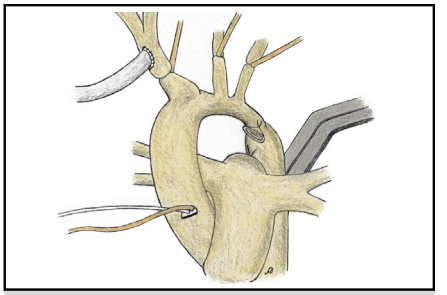
ABSTRACT

Objectives: Coarctation with hypoplastic aortic arch can be treated with resection and extended end-to-end anastomosis (REEEA) as well as end-to-side anastomosis (ESA). The aim of the study was to review our experience with these techniques in newborns and infants and to assess mid-term outcome with regards to morbidity, mortality, and reintervention rate in relation to operative access and technique.

Patients and Methods: Retrospective review of hospital charts and surgical reports from 183 consecutive newborns and infants with coarctation and hypoplastic aortic arch with or without ventricular septal defect between 1996 and 2013. Median age at surgery was 15 days (0-345). Lateral thoracotomy was used as operative access in 111 patients; 72 patients had a median sternotomy, 71 of them with cardiopulmonary bypass (ESA n = 30, REEEA n = 41). Fifty-two patients (28.4%) had an additional ventricular septal defect closure. Follow-up data were available for 75.96% with a median follow-up of 6.3 years (0.2-18.16 years).

Results: Thirty-day mortality was 0.54% with no late mortality occurring during follow-up. There was 1 severe complication: paraplegia and cerebral hypoxemia after REEEA. Freedom from mortality and reintervention at 10 years was 99.27% and 90.12%, respectively. Lateral thoracotomy as operative access was a risk factor for recurrent obstruction ($P = .03$).

Conclusions: REEEA and ESA were safe and effective treatments in newborns and infants. In borderline cases, aortic arch reconstruction should be performed through a median sternotomy on bypass. (J Thorac Cardiovasc Surg 2016;152:1506-13)



Aortic coarctation with hypoplastic transverse arch; surgery through a median sternotomy.

Central Message

Aortic arch reconstruction through a median sternotomy on bypass was associated with lower rates for recurrent obstruction.

Perspective

In neonates and infants with borderline hypoplastic aortic arch, the surgical approach and the operative technique are crucial factors considering recurrent obstruction. The surgical approach through a median sternotomy via bypass was as safe as a lateral thoracotomy but superior regarding recurrent obstruction, especially in patients with a proximal transverse aortic arch z score of less than −4.59.

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Coarctation of the aorta associated in the newborn and infant period can be treated by different surgical techniques such as simple end-to-end anastomosis, subclavian flap aortoplasty, or patch aortoplasty.[1,2] Here, the surgical repair focuses mainly on the excision of the coarctation site[3]; however, associated hypoplasia of the aortic arch frequently is present and if not sufficiently addressed may lead to relatively high rates of restenosis. Techniques such as resection and extended end-to-end anastomosis (REEEA) or the end-to-side anastomosis (ESA) of descending aorta and proximal aortic arch effectively address associated transverse aortic arch hypoplasia.[4] Although ESA always requires cardiopulmonary bypass (CPB), REEEA can be performed either through a lateral thoracotomy avoiding CPB but with limited access to the proximal part of the arch or also through a median sternotomy via CPB. In the newborn and infant period, however, arch repair on CPB has potential risks, especially regarding neurologic

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Abbreviations and Acronyms

CPB = cardiopulmonary bypass
ESA = end-to-side anastomosis
Q = quartile
REEEA = resection and extended end-to-end anastomosis
VSD = ventricular septal defect

complications. These procedures either require periods of deep hypothermic circulatory arrest in the patient, selective antegrade cerebral perfusion, or, as recently described, a double arterial perfusion technique.[5] Data regarding outcome especially after procedures in the newborn or infant period are still sparse.

The aim of this study was to review our experience with ESA and REEEA in newborns and infants with coarctation and associated hypoplasia of the aortic arch and to evaluate the midterm-outcome with focus on mortality, morbidity, and rate of reintervention in relation to operative access and technique.

PATIENTS AND METHODS

Between 1996 and 2013, 183 consecutive newborns and infants with coarctation of the aorta +/− outlet ventricular septal defect (VSD) underwent either REEEA or ESA +/− VSD closure in our center (Figure 1). Preoperatively, the proximal transverse aortic arch was measured between the innominate artery and the left common carotid artery by echocardiography. Almost all patients had at least some degree of associated proximal transverse aortic arch hypoplasia as defined with a z score of less than −2. Patients with interrupted aortic arch, Williams-Beuren syndrome, or Shone complex with a hypoplastic left ventricle were excluded.

Demographic data of the study populations are listed in Tables 1-3 and Table E1. The decision among ESA on bypass, REEEA with access through a median sternotomy on CPB, and REEEA through a lateral thoracotomy without CPB was made by an experienced pediatric cardiologist together with a pediatric cardiac surgeon, based on the size and anatomy of the proximal transverse aortic arch. Cut-off values used were diameters of the proximal transverse arch of 4 mm or less in newborns and young infants in the earlier study period and z scores of −4.5 or less in recent years.

One hundred twenty patients (65.57%) were neonates; 153 of 183 patients (83.6%) had coarctation repair with REEEA, 42 of them through a median sternotomy on CPB, and 30 of 183 patients (16.4%) underwent ESA (Table 2) (time distribution of ESA between 1996 and 2013: 1996 and 2001, n = 0; 2002 and 2005, n = 5; 2006 and 2009, n = 15; 2010 and 2013, n = 10). A total of 71 of 183 patients (38.79%) underwent aortic arch repair on CPB with or without intracardiac VSD closure (Table 3). During CPB, 2 of 71 patients had deep hyopthermic circulatory arrest, 13 of 71 had selective cerebral antegrade perfusion, and 56 of 71 patients had antegrade cerebral perfusion together with lower body perfusion through cannulation of the descending aorta. A total of 44 of 183 patients (24.04%) were lost to follow-up, mostly because they were referred from other countries and we were not able to get sufficient follow-up information.

After approval from the institutional review board (TA-12-13), a retrospective analysis of patient's charts was performed. Charts were reviewed for type of surgery and operative access, demographics, operative details, perioperative events, need for prostaglandins, in-hospital mortality, postoperative complications, evidence of arch restenosis, and the need for reintervention. Echocardiographic measurements of the proximal transverse arch were performed from digitally stored data (Echopac; GE Healthcare, Wauwatosa, Wis) and the original videotapes. One single investigator (A.T.) did all the assessment of follow-up.

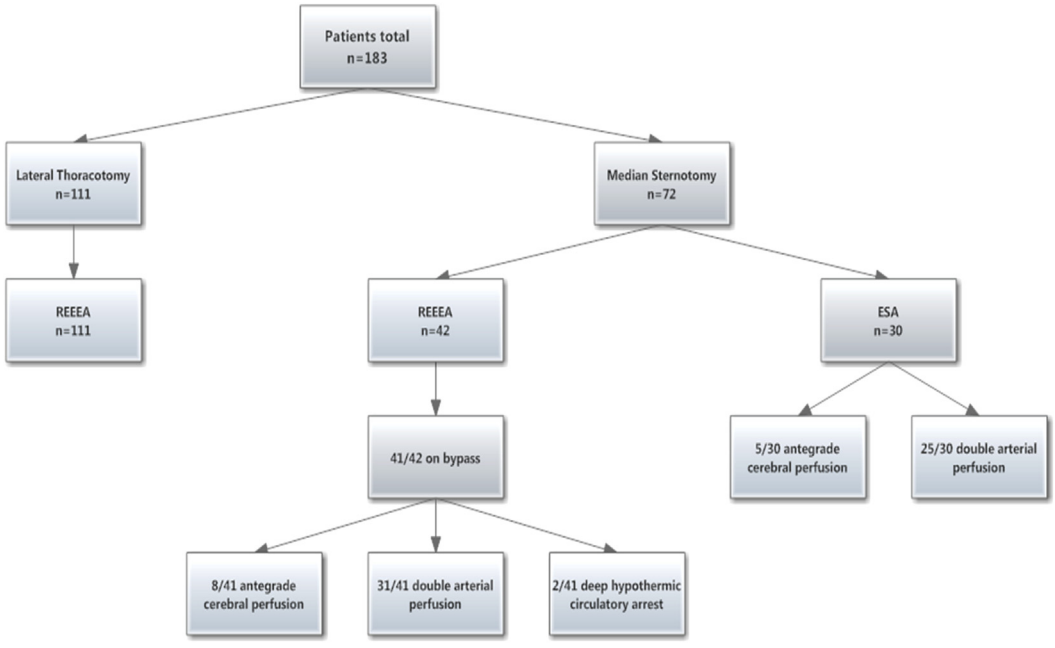

FIGURE 1. Overview of the study population. *REEEA*, Resection and extended end-to-end anastomosis; *ESA*, end-to-side anastomosis.