Aortic Arch Advancement for Aortic Coarctation and Hypoplastic Aortic Arch in Neonates and Infants

Carlos M. Mery, MD, MPH, Francisco A. Guzmán-Pruneda, MD, Kathleen E. Carberry, RN, MPH, Carmen H. Watrin, RN, MSN, Grant R. McChesney, BS, Joyce G. Chan, RN, Iki Adachi, MD, Jeffrey S. Heinle, MD, E. Dean McKenzie, MD, and Charles D. Fraser, Jr, MD

Division of Congenital Heart Surgery, Texas Children's Hospital, and Michael E. DeBakey Department of Surgery, Baylor College of Medicine; and Outcomes and Impact Service, Texas Children's Hospital, Houston, Texas

Background. **The optimal treatment for infants with aortic coarctation and hypoplastic aortic arch is controversial. The goal of this study was to report the short-term and mid-term outcomes of aortic arch advancement (AAA) in infants with hypoplastic aortic arch.**

Methods. **All infants who underwent AAA at our institution from 1995 to 2012 were included. AAA consisted of coarctectomy and end-to-side anastomosis of the descending aorta to the distal ascending aorta/proximal arch through a median sternotomy. The cohort was divided into four groups: (1) isolated AAA (n = 29, 11%), (2) AAA with closure of ventricular septal defect (n = 56, 20%), (3) AAA with other biventricular repairs (n = 115, 42%), and (4) AAA as part of single-ventricle palliation (n = 75, 27%).**

Results. **The cohort included 275 patients: 125 (45%) were female, and the median age was 14 days (interquartile range, 7–34 days). Genetic abnormalities were present in 48 patients (17%). Neurologic adverse events occurred in 3 patients (1%), all in group 4. Left bronchial compression was seen in 2 patients (0.7%); only one required intervention. Vocal cord dysfunction was noted in 36 of 95 patients (38%) on routine laryngoscopy. Only 1 patient had clinical residual dysfunction at the last follow-up visit. Perioperative mortality was 3% (n = 8). At a median follow-up time of 6 years, 8 patients (3%) had reinterventions at a median time of 5 months (3–17 months) after repair.**

Conclusions. **AAA is a safe, effective, and durable operation with low rates of adverse events and mid-term reintervention. The advantages include native tissue-to-tissue reconstruction and preserved potential for growth. As such, it is the ideal technique for the management of hypoplastic aortic arch in neonates and infants.**

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Multiple surgical techniques have been used to treat aortic coarctation (CoA) [1]. Recurrent aortic arch obstruction and long-term hypertension remain significant problems [2–4].

The optimal treatment of neonates and infants with CoA and hypoplastic aortic arch (HAA) is controversial. Some studies have shown variable degrees of growth of the proximal HAA after CoA repair through a left thoracotomy [5, 6]. However, it has been postulated that the long-term development of hypertension and recurrent aortic arch obstruction may be partly related to incomplete relief of the obstruction at the time of initial operation in patients with HAA [7, 8]. In addition, the optimal management of CoA in the setting of concomitant cardiac anomalies is unclear, with some authors suggesting a single-stage approach that addresses the arch and all other anomalies, and others advocating a staged approach [9, 10].

Since 1995, our group has used a completely autologous end-to-side anastomosis repair, aortic arch advancement, (AAA) through a median sternotomy for patients with HAA or as part of a single-stage repair for patients with CoA in the setting of concomitant intracardiac anomalies. This technique, described by Karl and colleagues [11], allows for complete relief of proximal arch obstruction and may translate into better long-term outcomes.

The goal of this retrospective study was to report the short-term and mid-term outcomes of AAA for the treatment of CoA and HAA in neonates and infants.

Patients and Methods

Study Population

The study cohort included all patients younger than 1 year who underwent an AAA for the initial treatment of CoA with HAA or concomitant treatment of CoA and associated intracardiac anomalies at Texas Children's Hospital from 1995 to 2012.

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Address correspondence to Dr Mery, Congenital Heart Surgery, Texas Children's Hospital, 6621 Fannin St MC19345H, Houston, TX 77030; e-mail: cmmery@texaschildrens.org.

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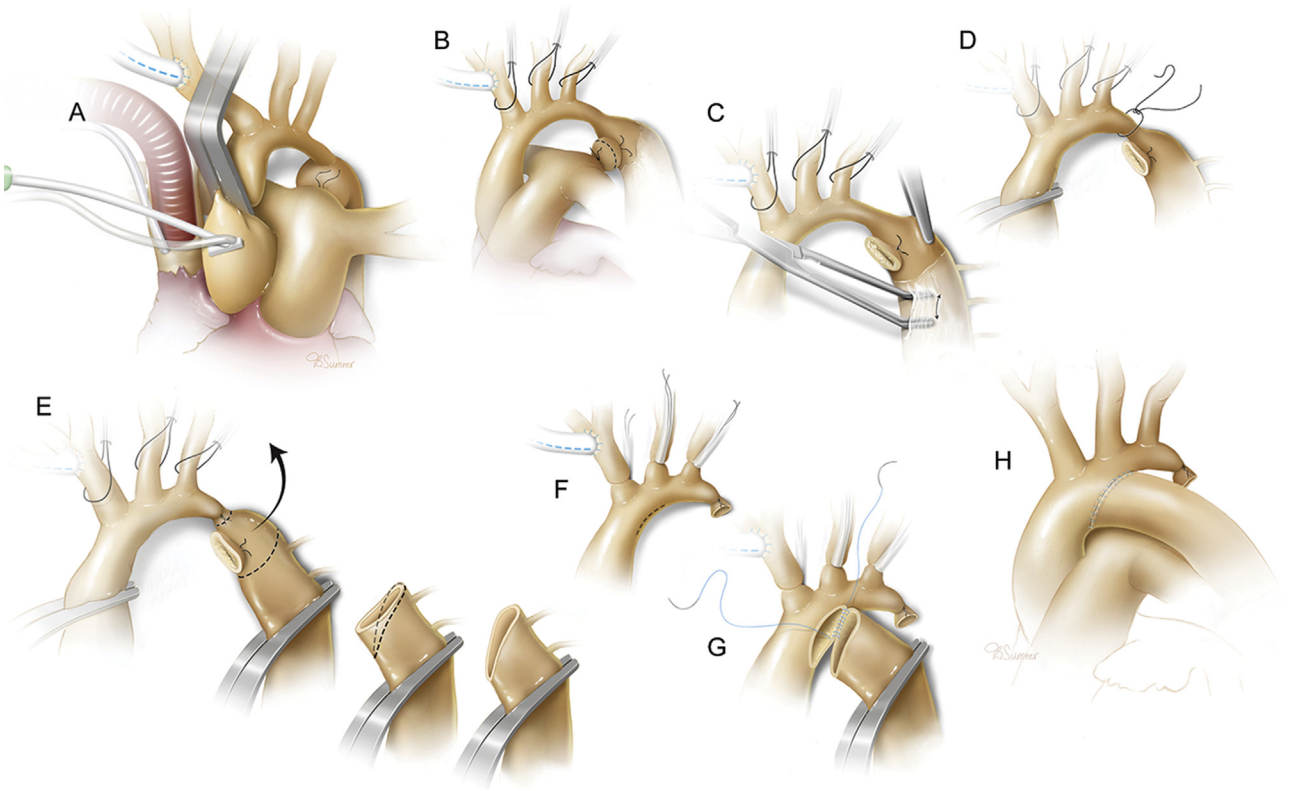

Fig 1. Surgical technique. (A) The procedure is performed with the use of bicaval cannulation and a graft sutured to the innominate artery to provide antegrade cerebral perfusion. (B) The ductus arteriosus is divided, and (C) the descending aorta is widely mobilized to allow for a tension-free anastomosis. (D) The isthmus is divided, (E) the ductal tissue is excised, and the descending aorta is prepared for anastomosis. (F) An incision is made on the undersurface of the distal ascending aorta and proximal aortic arch, and (G) the anastomosis is created. (H) completed repair. (Reprinted with permission from Texas Children's Hospital, copyright 2014).

The population was divided into four groups: (1) isolated AAA (with or without atrial septal defect repair), (2) AAA with closure of ventricular septal defect (VSD), (3) other biventricular procedures, and (4) non-Norwood single-ventricle palliation.

Surgical Technique

All procedures were performed through a median sternotomy with the patient under cardiopulmonary bypass (CPB) and deep hypothermia. Early in the series, the

Table 1. Preoperative Characteristics of the Cohort

Preoperative Characteristics	Overall Cohort (n = 275)	Isolated AAA (n = 29)	VSD Closure (n = 56)	Other Biventricular (n = 115)	Single Ventricle (n = 75)
Age, days, median (IQR)	14 (7-34)	10 (6-17)	21 (9-61)	15 (7-36)	12 (7-28)
Female gender, n (%)	125 (45)	10 (34)	26 (46)	56 (49)	33 (44)
Weight, kg, mean ± SD	3.3 ± 0.9	3.1 ± 0.7	3.4 ± 0.9	3.4 ± 1.1	3.2 ± 0.6
Genetic syndromes, n (%)	48 (17)	8 (28)	7 (13)	23 (20)	10 (13)
Prenatal diagnosis of CHD	87 (32)	10 (34)	7 (13)	36 (31)	34 (45)
Preoperative PGE1, n (%)	164 (60)	17 (59)	29 (52)	67 (58)	51 (70)
Cardiogenic shock, n (%)	43 (16)	6 (21)	10 (18)	15 (13)	12 (16)
Preoperative echocardiographic measurements of the transverse aortic arch					
Proximal transverse arch diameter, mm, median (range) (n = 233)	3.6 (1.3-7.6)	3.6 (1.5-5.5)	3.9 (1.7-6.4)	3.8 (2.0-7.6)	3.2 (1.3-6.8)
Proximal transverse arch *z* score, median (range) (n = 233)	−5.06 (−12 to −0.31)	−4.84 (−10.3 to −2.46)	−4.75 (−9.34 to −1.59)	−5.09 (−8.55 to −0.31)	−5.83 (−12 to −0.68)

AAA = aortic arch advancement; CHD = congenital heart disease; IQR = interquartile range; PGE1 = prostaglandin E1; SD = standard deviation; VSD = ventricular septal defect.

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