Interrupted aortic arch: Measure twice, cut once

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When the renowned congenital heart surgeon George Trusler was a visiting professor at our institution in 1991, he asked whether I knew what the Carpenter's Rule was. He explained the Carpenter's Rule very simply as "measure twice, cut once." I believe that this simple but profound bit of wisdom applies well to the management strategy for interrupted aortic arch proposed by the Emory group in this issue of the *Journal*.¹ Alsoufi and colleagues¹ have reviewed their 10-year experience with interrupted aortic arch in 77 neonates. Their overall operative mortality is a strikingly low 4%, and their reoperation rate is also low at 14%, revealing that their selective management strategy has been successful in stratifying patients to minimize reoperations. This series contrasts with the 2005 report from the Congenital Heart Surgeons' Society. In a series of 453 neonates with interrupted aortic arch, 34% underwent reoperation for left ventricular outflow tract (LVOT) obstruction.²

The Emory management strategy has essentially evolved into 2 different approaches: standard repair (ventricular septal defect closure, arch anastomosis) or initial LVOT bypass (Damus-Kaye-Stansel with Sano shunt) followed by the Rastelli procedure at a median age of 8 months. Retrospective analysis revealed clues that a given patient might require the staged LVOT bypass approach. These included type B interrupted aortic arch, aberrant distal aortic origin of the right subclavian artery, and bicuspid aortic valve. The most granular data predicting which of these 2 approaches to select, however, was provided by *measuring* multiple parameters, including the aortic valve annulus and the LVOT diameter, and then calculating the aortic valve *z* score and the LVOT-indexed cross-sectional area (cm^2/m^2). The mean aortic valve annulus size in the patients undergoing standard repair was 4.8 mm, whereas that in the LVOT bypass group was 4.0 mm. The aortic valve *z* score in the standard repair group was -2.9 , whereas that in the LVOT bypass group was -4.1 . Finally, aortic valve indexed cross-sectional area was $0.9 \text{ cm}^2/\text{m}^2$ in the standard repair group, versus $0.6 \text{ cm}^2/\text{m}^2$ in the LVOT bypass group. Measuring twice and then applying the

z score and indexed cross-sectional analysis appears to stratify these patients to receive the appropriate initial operation (cut once).

The other contribution of this article is that it appears that Alsoufi and colleagues¹ have essentially abandoned LVOT enlargement (conal resection); 4 of 7 patients undergoing initial LVOT resection at the time of repair required a reoperation. I would also add that in my experience resection of the conal septum in a neonate is not particularly easy and carries the possibility of injuring both the aortic and mitral valves. In addition, for many patients their immediate sub-aortic area is fibrous in nature, and there is no muscle to resect. In retrospect, Alsoufi and colleagues¹ believe that those patients (the conal resection group) would have been better served by a staged LVOT bypass. The other technical strategy that Alsoufi and colleagues¹ appear to favor is the use of a staged LVOT bypass approach for the small aortic annulus, rather than the primary Yasui type of repair.

The Emory group is to be congratulated for their outstanding results with a complex group of patients. Their strategy has been successful in reducing the number of patients requiring unplanned reoperation for LVOT obstruction. Their management suggestions for that complex group focusing on the aortic valve and LVOT measurements are quite useful. Their careful analysis of the preoperative measurements (measure twice) has led to a majority of patients having either a single successful operation or a successfully *planned* 2-stage operation (cut once!).

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Central Message

The group from Emory University have presented their 10-year experience with interrupted aortic arch in 77 neonates.

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