Predictors of Reintervention After Repair of Interrupted Aortic Arch With Ventricular Septal Defect

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Background. Left ventricular outflow tract obstruction after neonatal repair of interrupted aortic arch with ventricular septal defect may warrant reintervention. We sought to identify clinical and preoperative echocardiographic predictors of reintervention for postoperative left ventricular outflow tract obstruction.

Methods. Retrospective data were collected on neonates with interrupted aortic arch with ventricular septal defect who underwent single-stage repair from 1995 to 2009. Univariate and multivariate analyses were performed to identify predictors of reintervention.

Results. Seventy patients underwent repair, with 16 patients requiring reintervention: 8 underwent surgical reintervention, 5 underwent percutaneous reintervention, and 3 underwent both. The median time to reintervention was 1.2 years (range, 0.2 to 7.7). All surgical reoperations involved subaortic resection, and all percutaneous reinterventions included balloon aortic valve dilation. Several preoperative echocardiographic measurements were significant by univariate analysis; however, smaller preoperative aortic root size was an independent predictor (p = 0.02) by multivariate analysis. Patients with an aortic root size less than 6.5 mm were at greater risk for reintervention compared with patients with a root size greater than 6.5 mm (reintervention rate 44% and 12%, respectively; p < 0.001). Postoperative left ventricular outflow tract gradient by echocardiogram before discharge was significantly higher in the reintervention group.

Conclusions. Preoperative aortic root size predicts reintervention for postoperative left ventricular outflow tract obstruction after single-stage repair of interrupted aortic arch with ventricular septal defect. Patients with elevated left ventricular outflow tract gradients at discharge are at higher risk of having progressive obstruction and require closer follow-up to ensure early identification and management.

The VSD repair is performed with either a pericardial or a Dacron (C.R. Bard, Haverhill, PA) patch. Postoperative follow-up was obtained by review of patient medical records and direct telephone contact.

**Data Collection**

Demographic, clinical, operative, and imaging data were obtained from patient medical records. Type of arch reconstruction and other specifics of the surgical procedures performed were obtained from operative reports. Review of preoperative and postoperative echocardiography was performed and relevant measurements were recorded. The majority of preoperative imaging data was collected from studies performed within 5 days of the date of surgery, with one study performed 7 days and one performed 11 days before surgery. All postoperative imaging data was collected from most recent studies.

**Echocardiographic Measurements**

Echocardiograms were reviewed by an independent cardiologist with measurements taken in accordance with previously described methods [7]. The following dimensions were measured: cross-sectional area (CSA) of the LVOT from the parasternal or subxiphoid short-axis views in early systole; LVOT anteroposterior diameter in early systole from the parasternal long-axis view; LVOT lateral diameter in early systole from the parasternal short-axis view; aortic valve annular diameter from the parasternal long-axis view in early systole; ascending aorta diameter from the parasternal long-axis or suprasternal notch views in early systole just above the sinuses of Valsalva; pulmonary valve annulus diameter from the parasternal or subxiphoid short-axis views in early systole; calculated aortic and pulmonary cross-sectional areas; mitral valve diameter from the apical four-chamber view in mid diastole; and short-axis and long-axis dimensions of the VSD from the corresponding parasternal views and calculated VSD area.

Additionally, the following morphologic features were reported: type of arch interruption; presence or absence of an aberrant origin of the right subclavian artery from the descending thoracic aorta; anatomy of the conal (infundibular) septum and presence of conal septal malalignment; and morphology of the aortic valve leaflets and number of commissures.

**Statistical Analysis**

Data are described as number with frequency and percentage, median with interquartile range, and mean with standard deviation. Actuarial freedom from reintervention secondary to postoperative LVOTO was determined using the Kaplan-Meier method. Paired t tests were used to identify univariate predictors of reintervention, with two-tailed values of \( p < 0.05 \) considered statistically significant. To control for possible confounding variables, a multivariable logistic regression model was applied to identify significant risk factors for reintervention, and included all variables with statistical significance on univariate analysis. Logistic regression modeling was then used to estimate the probability of reintervention with a 95% confidence interval based on preoperative aortic root size. Statistical analysis was performed using the SPSS version 19.0 software package (SPSS/IBM, Chicago, IL).

**Results**

**Patient Characteristics**

A total of 70 patients with IAA-VSD who underwent aortic arch reconstruction and VSD repair at a single-stage operation were included in the study. Sixteen patients (23%) required surgical or percutaneous reintervention for clinically significant postoperative LVOTO. Demographic and baseline clinical data of the study population are summarized in Table 1. Median duration of postoperative follow-up was 5.0 years (range, 0.1 to 15.3), and mean duration was 5.8 ± 5.1 years.

**Operative Technical Considerations**

To perform a tension-free aortic anastomosis, 30 patients (43%) underwent patch augmentation with either pulmonary homograft or autologous pericardium. Five patients (7%) underwent resection of subaortic obstruction for LVOTO at the time of the initial operation. Of these patients, 1 had postoperative LVOTO requiring repeat intervention. There was no statistically significant difference in reintervention rates between patients who underwent subaortic resection at the initial operation and those who did not (Table 2).

**Event-Free Survival**

One patient death occurred secondary to sepsis in the perioperative period (15 days postoperatively). This

**Table 1. Patient Characteristics at Interrupted Aortic Arch With Ventricular Septal Defect Repair**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All Patients (n = 70)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>37 (62)</td>
</tr>
<tr>
<td>Female</td>
<td>33 (38)</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>2.9 ± 0.9</td>
</tr>
<tr>
<td>Body surface area, ( \text{m}^2 )</td>
<td>0.22 ± 0.09</td>
</tr>
<tr>
<td>Median age at IAA-VSD repair, years</td>
<td>0.02 ± 0.02</td>
</tr>
<tr>
<td>IAA type</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>16 (23)</td>
</tr>
<tr>
<td>B</td>
<td>54 (77)</td>
</tr>
<tr>
<td>C</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Aberrant right subclavian artery</td>
<td>25 (36)</td>
</tr>
<tr>
<td>Bicuspid aortic valve</td>
<td>37 (62)</td>
</tr>
<tr>
<td>22q11 chromosomal abnormality</td>
<td>22 (31)</td>
</tr>
<tr>
<td>Aortic arch patch augmentation</td>
<td>30 (43)</td>
</tr>
<tr>
<td>Subaortic stenosis intervention at IAA-VSD repair</td>
<td>5 (7)</td>
</tr>
</tbody>
</table>

Continuous data are expressed as mean ± SD; categorical data as n (%).

IAA = interrupted aortic arch; VSD = ventricular septal defect.
Table 2. Clinical and Preoperative Echocardiographic Measurements

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (n = 54)</th>
<th>Group 2 (n = 16)</th>
<th>p Value</th>
<th>Multivariable Logistic Regression p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVOT CSA, cm²</td>
<td>0.30 ± 0.10</td>
<td>0.23 ± 0.11</td>
<td>0.039</td>
<td>0.32</td>
</tr>
<tr>
<td>Indexed LVOT CSA, cm²/m²</td>
<td>1.43 ± 0.48</td>
<td>1.17 ± 0.55</td>
<td>0.147</td>
<td></td>
</tr>
<tr>
<td>LVOT diameter, cm</td>
<td>0.46 ± 0.08</td>
<td>0.40 ± 0.10</td>
<td>0.032</td>
<td>0.12</td>
</tr>
<tr>
<td>Aortic root, cm</td>
<td>0.80 ± 0.12</td>
<td>0.69 ± 0.10</td>
<td>0.003</td>
<td>0.002</td>
</tr>
<tr>
<td>Aortic valve annulus, cm</td>
<td>0.50 ± 0.08</td>
<td>0.46 ± 0.09</td>
<td>0.079</td>
<td></td>
</tr>
<tr>
<td>Indexed aortic valve CSA, cm²/m²</td>
<td>0.96 ± 0.30</td>
<td>0.87 ± 0.33</td>
<td>0.346</td>
<td></td>
</tr>
<tr>
<td>STJ size, cm</td>
<td>0.60 ± 0.10</td>
<td>0.55 ± 0.10</td>
<td>0.130</td>
<td></td>
</tr>
<tr>
<td>Ascending aorta, cm</td>
<td>0.63 ± 0.12</td>
<td>0.64 ± 0.14</td>
<td>0.939</td>
<td></td>
</tr>
<tr>
<td>Pulmonary valve annulus, cm</td>
<td>1.05 ± 0.15</td>
<td>1.03 ± 0.25</td>
<td>0.703</td>
<td></td>
</tr>
<tr>
<td>VSD CSA, cm²</td>
<td>0.66 ± 0.16</td>
<td>0.63 ± 0.18</td>
<td>0.646</td>
<td></td>
</tr>
<tr>
<td>LVOT CSA/AV CSA</td>
<td>1.67 ± 0.67</td>
<td>1.60 ± 0.60</td>
<td>0.770</td>
<td></td>
</tr>
<tr>
<td>LVOT CSA/VSD CSA</td>
<td>0.49 ± 0.22</td>
<td>0.37 ± 0.16</td>
<td>0.108</td>
<td></td>
</tr>
<tr>
<td>AV CSA/PV CSA</td>
<td>0.25 ± 0.10</td>
<td>0.23 ± 0.14</td>
<td>0.714</td>
<td></td>
</tr>
<tr>
<td>SubAS intervention at repair</td>
<td>4 (7)</td>
<td>1 (6)</td>
<td>0.999</td>
<td></td>
</tr>
<tr>
<td>Conal septal malalignment/hypoplasia</td>
<td>36 (67)</td>
<td>11 (69)</td>
<td>0.999</td>
<td></td>
</tr>
<tr>
<td>Aberrant RSCA</td>
<td>19 (35)</td>
<td>6 (38)</td>
<td>0.999</td>
<td></td>
</tr>
<tr>
<td>DiGeorge syndrome (22q11.2 deletion)</td>
<td>18 (33)</td>
<td>4 (25)</td>
<td>0.760</td>
<td></td>
</tr>
<tr>
<td>IAA type</td>
<td></td>
<td></td>
<td>0.014</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>17 (31)</td>
<td>0 (0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>37 (69)</td>
<td>16 (100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicuspid AV</td>
<td>28 (52)</td>
<td>9 (56)</td>
<td>0.784</td>
<td></td>
</tr>
</tbody>
</table>

Paired t tests were used to assess differences in preoperative echocardiographic variables between group 1 (no reintervention) and group 2 (reintervention). Multivariate logistic regression modeling was used to control for confounding factors. Continuous data are expressed as mean ± SD, categorical data as n (%).

AV = aortic valve; CSA = cross-sectional area; IAA = interrupted aortic arch; LVOT = left ventricular outflow tract; PV = pulmonary valve; RSCA = right subclavian artery; STJ = sinotubular junction; SubAS = subaortic stenosis; VSD = ventricular septal defect.

There were 51 patients who had both percutaneous and surgical reinterventions included balloon dilation of the aortic valve. Patients who had both percutaneous and surgical reinterventions initially underwent unsuccessful balloon dilation of their aortic valve followed by subaortic resection secondary to residual LVOTO. Freedom from reintervention at 1, 5, and 8 years was 90%, 76%, and 60%, respectively (Fig 1).

Predictors of LVOTO
Both patient characteristics and echocardiographic measurements were assessed to determine predictors of reintervention secondary to LVOTO and are summarized in Table 2. By univariate analysis, LVOT cross-sectional area (p = 0.039), LVOT diameter (p = 0.032), and aortic root size (p = 0.003) were predictors of reintervention. These variables were then included as candidates within the multivariable linear regression model, where aortic root size was identified as an independent predictor (p = 0.002) of reintervention. Using logistic regression modeling, the relationship between preoperative aortic root size and the probability of reintervention was assessed (Fig 2). In identifying an aortic root size inflection point, patients with an aortic root size less than 6.5 mm were at greater risk for reintervention compared with patients with a root size greater than 6.5 mm (reintervention rate 44% and 12%, respectively; odds ratio 9.9, 95% confidence interval: 2.7 to 36.3, p < 0.001; Fig 3). Additionally, reintervention patients had a significantly higher LVOT gradient than non-reintervention patients (17 ± 19 mm Hg versus 7 ± 10 mm Hg, p = 0.002) at the time of discharge from their initial surgical repair.

Comment
Despite improved overall outcomes with primary repair of IAA-VSD, the incidence of reintervention for postoperative LVOTO still remains between 20% and 40% [1]. This study demonstrates that a small aortic annulus, LVOT CSA, and aortic root size on preoperative imaging are associated with the development of postoperative reintervention for LVOTO, but that aortic root size is the only independent predictor of reintervention for LVOTO. The LVOT gradients by echocardiography...
before discharge were elevated in patients who eventually underwent reintervention compared with those in patients who did not require reintervention.

The largest multiinstitutional study to examine the outcomes after IAA-VSD is the Congenital Heart Surgeons Society report, in which subaortic narrowing was found to be a risk factor for time-related death. In patients with an optimal risk factor profile, approximately 16% still underwent a reintervention on the LVOT at 16 years postoperatively. These findings have underscored the importance of developing preoperative clinical criteria that may help identify patients at a greater likelihood of having postoperative LVOTO, particularly those who require surgical or percutaneous reintervention.

Numerous studies identifying risk factors for postoperative LVOTO have highlighted various clinical and echocardiographic variables. Most studies report that an aberrant right subclavian artery is a risk factor for reintervention [1, 7]. Geva and colleagues [7] identified that smaller preoperative LVOT cross-sectional area is an independent risk factor for development of postoperative subaortic stenosis. Apfel and colleagues [8] similarly found an indexed LVOT CSA to be significantly smaller in patients requiring reintervention; however, a smaller
subaortic diameter index was the most reproducible measurement associated with reintervention. A smaller aortic valve diameter, specifically less than 4.5 mm (Z score less than −5), was identified by Salem and associates [9] to be an independent predictor of subsequent LVOT obstruction postoperatively. Hirata and coworkers [11] also focused on the relationship between aortic annulus diameter and rates of reoperation for LVOTO, and found that among patients whose aortic annulus is less than the patient’s weight plus 1.5 mm, nearly half required reoperation. In contrast to previous published studies, we did not find the aortic annulus size to be predictive of reintervention. Although there was a trend toward smaller aortic annulus size in the reintervention group, this was not a statistically significant finding. There were several patients with an aortic annulus diameter between 3.5 mm and 4.0 mm who did not require a reintervention and had acceptable postoperative LVOT gradients. These data suggest that the tendency of the clinician to focus upon the aortic annular diameter for prognostication is incomplete, and preoperative evaluation should additionally focus upon the aortic root size.

Resection of the subaortic muscle has been advocated by several investigators to prevent the eventual development of subaortic obstruction. Bove and associates [10] reported in their series that resection or incision of the infundibular septum at the time of primary repair was effective in preventing or prolonging the interval to recurrent LVOTO, and can be performed with low mortality. Others have advocated placement of the VSD patch on the left ventricular surface of the crest to distract it away from the LVOT [14]. Prophylactic surgical management of the subaortic conus was not associated with a lower risk of LVOT reintervention in our study. Future investigation may focus upon modification of existing surgical techniques to reduce the development of subaortic and aortic obstruction, particularly in patients with a small aortic root size.

In our study population, 1 patient required a Ross procedure for postoperative LVOTO. Although we did find a significant difference in freedom from reintervention between patients with an aortic root size greater than 6.5 mm or less than 6.5 mm, the data do not advocate for neonatal Yasui, Ross, or stage 1 palliation procedures in all patients with an aortic root size less than 6.5 mm at the initial surgery. These alternatives are associated with mortality and reintervention rates that may not provide significant advantage over primary IAA-VSD repair. At our institution, an aortic valve diameter less than 3 mm in a patient with two adequate-sized ventricles has traditionally been an indication for Ross or Yasui procedures. A univentricular approach is reserved for patients with concomitant hypoplasia of the left ventricle. In patients undergoing primary repair, the risk of medical management with close observation of LVOTO before surgical intervention was low, and the operative morbidity and mortality related to reoperation was also favorable. Close follow-up after discharge in these patients is critical, and the frequency of echocardiographic interrogation of the LVOT should be adjusted accordingly. Patients unlikely to have reliable postoperative follow-up may be candidates for alternative techniques.

This study did not demonstrate any patient characteristics that were predictive of reintervention. Interestingly, the presence of an aberrant right subclavian artery did not correlate with an increased risk for reintervention as has been previously reported. It is very likely that the mechanism underlying recurrent LVOTO in patients with an aberrant right subclavian artery is associated hypoplasia of the LVOT, resulting in significant interaction upon statistical analysis. Not surprisingly, patients who
had a higher LVOT gradient just before discharge were more likely to require postoperative reintervention secondary to LVOTO. Therefore, those patients with elevated gradients postoperatively would benefit from closer monitoring and more frequent imaging to evaluate for the development of LVOTO.

The LVOT reintervention included percutaneous and surgical procedures. Three of 8 patients (38%) who initially underwent a percutaneous procedure subsequently required surgery on the LVOT. Additionally, several patients underwent multiple percutaneous procedures in the postoperative period and ultimately may require surgery in the future. The nature of LVOTO in many of these patients is a combination of aortic annular hypoplasia and circumferential subaortic membrane that extends onto the undersurface of the aortic valve leaflets, creating immobility of the aortic leaflets. Interestingly, this pathology develops beyond the immediate postoperative period, perhaps secondary to turbulent flow dynamics that accelerate the development of the subaortic membrane and aortic valvular thickening. In our experience, we have not observed that VSD patch or conal septal protrusion into the LVOT on immediate postoperative echocardiograms predicts subsequent development of LVOTO. The appearance of the aortic valve by echocardiography and catherization is similar to that of aortic stenosis, and explains why many of the patients underwent catheter-based balloon dilation as an initial approach. Dilation is seldom effective, and many of these patients eventually require surgical reintervention because the membrane is much more extensive than purely valvular.

The major limitation of this study is its retrospective study design. In addition, this study would benefit from improved patient follow-up and longer term follow-up times to develop a better understanding of late postoperative LVOTO, as the majority of patients who require reintervention do so within the first postoperative year.

In conclusion, postoperative LVOTO after single-staged primary IAA-VSD repair is a significant problem, with 25% of patients requiring reintervention within 5 years. Smaller aortic root size was an independent risk factor of reintervention for LVOTO, and the inflection point for reintervention was at an aortic root size of approximately 6.5 mm. Although LVOT intervention at the time of primary repair did not alter the risk of reintervention, surgical management should be considered at the time of primary repair for patients at highest risk. The development of novel methods addressing the LVOT at the time of a primary single-stage repair is warranted. For select patients, alternative options such as a Yasui procedure, Ross procedure, or staged reconstruction may be necessary. The LVOT gradients at the time of discharge correlate with risk of LVOT reintervention. Thus, close follow-up would be warranted in patients with a small aortic root size or elevated postoperative LVOT gradients at discharge.

References

DISCUSSION

DR MUNETAKA MASUDA (Yokohama, Japan): Thank you for your excellent presentation. I would like to ask one question about your strategy after this study. Your cutoff value is 6.5 mm. So when you see a patient with an aortic size of 6 mm, what is
your strategy for the initial treatment, go straight to the Yasui procedure or just wait until the development of left ventricular (LV) obstruction?

DR CHEN: Looking at our logistic regression model, the aortic root size should be viewed more as a continuous variable. We arbitrarily chose that cutoff point because our most significant difference occurred in patients with an aortic root size above versus below 6.5 mm. We would not base our decision for a single stage versus staged Yasui procedure based solely on an aortic root size above or below 6.5 mm. We generally perform staged procedure typically in those with an annulus size less than 3 mm.

DR MASUDA: So you just wait. You prefer to do the two-stage repair for these patients?

DR CHEN: First of all, we have not significantly changed our practice regarding performing a single-stage repair versus a staged repair based upon these data. The data provide indication regarding which patients to follow more closely after surgery for concern of postoperative outflow tract obstruction—those with a smaller aortic root size. I do not think necessarily based on our results alone would we decide whether or not to perform a single-stage repair versus a Yasui procedure.

DR YVES D’UDEKEM (Victoria, Australia): First of all, 6.5 mm, where was that measured, because that seems quite large to me. I would be happy to have patients with a 6.5 mm root.

DR CHEN: The location we measured the aortic root diameter at is in the largest dimension just above the aortic valve. So the measurement is in close relation to the aortic annulus size.

DR D’UDEKEM: Because you have a composite outcome here with balloon dilation and surgical reintervention, and I believe that they may be related to two different phenomenon. If I have seen well, you had 11 patients who needed surgery and I think 10 who needed balloon dilation. The balloon dilation may be done for a stenotic bicuspid valve or a stenotic aortic valve, and that’s a different phenomenon that one that would create a LV outflow tract obstruction.

DR CHEN: That’s a great point. We had discussed separating the two groups. We believe that the group who undergoes a percutaneous reintervention is at a high risk for requiring a surgical reoperation in the future. There were, I believe, 3 of 8 patients who required a surgical intervention after a percutaneous reintervention. We were interested in looking at how soon after surgery patients needed their first reintervention on the LVOT, knowing that eventually they require surgery.

DR D’UDEKEM: And finally, I believe that LV outflow tract obstruction in patients with interrupted arch VSD is not so much morphologically related to intrinsically the patient but is very related to the type of operation you are doing at the time of the repair and the closure of the VSD. A lot of the obstructions are because the outlet septum is protruding below the aortic valve. So what appears to me would be the most important morphologic parameter to look at is the size of the LV outflow tract once the VSD has been closed, because obviously if you want to have good results on that, you want to pull this outlet septum as much as possible with a very small patch, and if you fail to do so, maybe you will have more LV outflow tract obstruction. So did you look at postoperative echo parameters as well?

DR CHEN: We looked at gradients postoperatively and determined that those with smaller preoperative aortic root sizes have larger gradients, as well as the reintervention group. There was a statistically significant difference in the postoperative LV outflow tract gradient in the reintervention group versus non reintervention, with it being higher in the reintervention group. Regarding aortic root size, while we did notice a trend toward a larger outflow tract gradient with smaller aortic root size, this finding was not statistically significant. We did not identify any anatomic variables on the postoperative echocardiography that could predict reintervention.

DR TARA KARAMLOU (San Francisco, CA): One question and a comment. You compared one of the risk factors to the Congenital Heart Surgeons Society study, and I think we have to be careful. That study looked at outcomes as a time-related phenomenon to reintervention and therefore I don’t think the two are comparable. So not finding an aberrant right subclavian artery as a risk factor, I am not sure what to make of that. You are comparing two different endpoints. The second question relates to that. You showed a Kaplan-Meier curve where clearly there was a change in the risk over time. Why did you select to use a logistic regression model, which is not time related, when clearly this is a time-related phenomenon?

DR CHEN: Thank you for the comment and the question. We thought it was appropriate to look strictly at a patient’s risk for reintervention during the follow-up period, and therefore used logistic regression modeling. However, your suggestion to use a time-related regression analysis which factors in time to reintervention is appreciated and we will consider adding this to our current work.

DR KARAMLOU: But I think a better analysis is to use what the data show you, which is that it changes over time. So I think you may want to go back to your statistician and ask him or her if you did it in a different way whether you would get the same risk factors or not. That’s my only comment.

DR CHEN: Yes, we definitely will go back and look at that.

DR KARAMLOU: Nice study.

DR BAIRD: Just one thing to clarify, I think it’s really important to note that that’s the measurement in the largest dimension, and clearly these annuli are often oval. And so now we are even more critically trying to look and analyze the dimensions in two planes, and looking at it with three-dimensional echocardiography, we are taking that one step further. So I think that’s an important point, your comment about 6.5 being large. That’s the largest dimension, not the smallest.

DR EMILE BACHA (New York, NY): Why didn’t you use Z scores versus absolute values given that these scores were really practically invented in Boston?

DR CHEN: We have looked at Z scores, and reported the statistically significant findings. Therefore the values that were not statistically significant were not highlighted in this presentation, but they will be reported in the manuscript.

DR MICHAEL MITCHELL (Milwaukee, WI): What do you make of the fact that all of the reinterventions occurred in type B interruption?
DR CHEN: That’s a great observation. I think this is strictly an artifact of the relatively high percentage of patients who had a type B interrupted aortic arch. I am not certain there is a physiologic explanation as to why we saw this observation.

DR JAMES JAGGERS (Aurora, CO): How many of your patients had interrupted aortic arch type B2?

DR CHEN: We have not specifically looked at those numbers, but that is a great suggestion.

DR CHRISTOPHER CALDARONE (Toronto, Ontario, Canada): It’s clear that interrupted aortic arch is associated with a potential for a lifetime of reinterventions. Based on your cutoff point at 6.5 mm, where is the cutoff point where you think you ought to opt out for a single ventricle repair or accept the reinterventions, which you have shown you have been able to manage quite well?

DR CHEN: I think that’s a great question. At our institution, we would proceed with a Yasui procedure with an aortic annulus size less than 3 mm or 3.5 mm. As you stated, there is a risk of reintervention regardless of what operation is performed. Given our relative success with reinterventions, we would not advocate for proceeding down a single ventricle pathway based solely on an aortic root cutoff size of 6.5 mm. The question is if there is a population in whom intervention on the LV outflow tract at the initial operation with a subaortic muscle resection may lengthen the time to reintervention, or possibly improve the chances of not requiring a reintervention in the future.

DR EMANI: I don’t think we would be prepared to send any of these kids down a single ventricle pathway just based upon these data. I think a lot of this is going to make us think a little bit more about how we actually manage the LV outflow tract. There have been previous descriptions of techniques, placing the patch on the left side of the septum, trying to divide conus or perform conal resection, and I think that is going to be where a lot of our focus is. But at this point, in the absence of significant mortality with waiting, I think the focus is going to be on really following these kids closely and making sure they don’t have LV dysfunction or further complications related to LV outflow tract obstruction.

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Mark your calendar for the Fiftieth Annual Meeting of The Society of Thoracic Surgeons (STS) to be held at the Orlando World Center Marriott in Orlando, Florida, January 25–29, 2014. Attend the Annual Meeting to meet the experts, network with colleagues from around the world, participate in a dynamic learning experience, and share an historic moment in the Society’s history—its Fiftieth Anniversary.

This preeminent educational event is open to all physicians, residents, fellows, research scientists, perfusionists, physician assistants, nurses, and other interested individuals who work with cardiothoracic surgeons.

Meeting participants will have the opportunity to attend traditional abstract presentations, invited lectures, surgical forums, Early Riser Sessions, Surgical Motion Pictures, and procedural hands-on courses. Parallel sessions on Monday and Tuesday will focus on specific subspecialty interests. The STS Annual Meeting offers more translational science than any other cardiothoracic surgery conference!

An advance program with information about housing and registration will be mailed to STS members this Fall. Nonmembers may contact the Society to receive a copy of the advance program; however, detailed up-to-date meeting information will be available on the STS website at www.sts.org.

I hope to see you in Orlando.

Keith S. Naunheim, MD
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