Supplemental Table S1: Surgical History and Anatomy for N=41 Patients.

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| **Level of Corrected Aortic Pathology** | **Diagnoses** | **Type of Prior Surgeries** | **# Sternotomies** | **Age at Index (y)** | **Type of Index Surgery\*** |
| Post- Subvalvular | Shone syndrome (CoA, subAS) | 1. SubAS resection x2  2. Modified Konno procedure | 2 | 8 | SubAS and AS resection; AVr |
| Transitional AV canal  VSD  AI and MR s/p modified Konno | 1. AVSD repair 2. LVOT membrane resection 3. Modified Konno procedure | 3 | 13 | Konno-Rastan procedure; TVr; and MVr. |
| SubAS  VSD | 1. Modified Konno procedure  2. SubAS resection | 2 | 16 | SubAS resection |
| Shone’s syndrome (MS, SubAS, AS) | 1. LVOT resection | 1 | 21 | MVR; LVOT resection; AVr |
| Congenital coronary artery anomaly SubAS  AI | 1. SubAS resection, unroofing of RCA from L aortic sinus | 1 | 22 | Konno-Rastan procedure; RVOT patch |
| SubAS VSD  AI | 1. VSD closure and SubAS resection  2. Permanent pacemaker insertion | 2 | 24 | Konno-Rastan procedure; explant of unused pacemaker |
| AV canal defect  SubAS  Mitral dysfunction | 1. Repair of AV canal  2. MVr, SubAS resection | 2 | 30 | SubAS resection; TVr; and MVr. |
| SubAS  AS  AI | 1. SubAS resection x3 | 3 | 34 | Konno-Rastan procedure |
| Dilated AA  AS (BAV)  SubAS  Myocardial bridge w/ apical ischemia  Accessory MV papillary muscle | 1. SubAS resection | 1 | 36 | Aortoplasty; SubAS resection; detachment of secondary chordae to MV; unroofing of LAD. |
| Post- Valvular | Shone's syndrome (AS, parachute mitral valve, MR, hypoplastic aortic arch) | 1. AVr, PDA ligation, ASD closure | 1 | 0.25 | Ross-Konno procedure; MVr; endocardial fibroelastosis resection |
| AS (BAV)  Severe AI | 1. Ross procedure  2. Replacement of pulmonary homograft | 2 | 22 | Bentall procedure |
| Shone's syndrome (hypoplastic aortic annulus, LVOTO, MS, MR) | 1. Balloon aortic valvuloplasty x2 2. AVr | 1 | 31 | Konno-Rastan procedure, MVr; LVOT resection, subAS resection and CryoMaze. |
| Shone’s syndrome (BAV, Cleft MV, LVOTO due to septal hypertrophy) | 1. AVr 2. ASD repair 3. MVR  4. MVr | 4 | 34 | SubAS resection, resection of anterior MV leaflet, AVR |
| AS (BAV) Dilated AA  AI | 1. AVR  2. Ross procedure | 2 | 45 | Bentall procedure |
| ToF | 1. AVR  2. ToF repair | 2 | 48 | Redo AVR; Plication of non-coronary sinus; subAS resection |
| Post- Supravalvular | TGA  Supravalvar AS  ASD VSD | 1. ASO, ASD closure, VSD closure | 3 | 0.4 | Supravalvar AS repair; AA and transverse aortic arch patch augmentation |
| TA  AI | 1. TA repair, RV-PA conduit, VSD closure | 1 | 0.75 | Ozaki procedure; truncal valve repair; RV-PA conduit replacement |
| Shone's syndrome (supramitral ring, parachute MV, MS, LVOTO, BAV, supravalvar AS, hypoplastic aortic annulus, CoA) | 1. CoA repair with patch augmentation of the hypoplastic arch 2. Balloon angioplasty of supravalvar AS  3. Patch augmentation of supravalvar AS | 2 | 1 | Supramitral membrane resection; MVr; AVr; subAS resection |
| DORV (Taussig Bing type)  SubAS  RPA stenosis | 1. ASO and VSD closure  2. RPA balloon dilation  3. Diaphragm plication | 2 | 3 | SubAS resection; RPA augmentation |
| TA with interrupted aortic arch  RPA stenosis Dilated AA | 1. TA with interrupted aortic arch repair 2. RPA stenting | 2 | 12 | PA plasty; RV-PA conduit; Replacement of AA and noncoronary sinus. |
| TGA  PV stenosis Dilated AA Severe AI | 1. ASO and ASD closure; 2. PA plasty and closure of PFO | 4 | 16 | Bentall procedure |
| PV stenosis  Aortic arch anomaly DORV with subaortic VSD  AI | 1. BT shunt  2. Full repair with LV to aortic tunnel and RV-PA conduit 3. Melody insertion in RV-PA conduit | 2 | 19 | AVR, RV-PA conduit replacement; Modified Konno procedure |
| TGA with VSD AS (BAV)  AI  MR | 1. ASO | 1 | 23 | AVR, MVr, and LeCompte reconstruction |
| TGA PA stenosis  Supravalvar AS | 1. ASO 2. PA plasty 3. Diaphragm plication | 2 | 29 | Pulmonary valve replacement, PA plasty and aortoplasty |
| TGA  Dilated AA  AI | 1. ASO | 1 | 29 | AVR and aortoplasty |
| Supravalvar AS  SubAS | 1. ST junction augmentation, AA replacement | 1 | 30 | AA graft replacement; subAS resection |
| Aorto-left ventricular tunnel  Dilated AA  AI  Accessory mitral chordae | 1. Repair of LV to aortic tunnel x2 | 2 | 32 | AA replacement and hemi arch; MVr |
| TA Dilated AA and aortic root  Bicommissural truncal valve | 1. TA repair  2. Replacement of RV-PA conduit x2 | 4 | 33 | Plication of aortic root, replacement of truncal valve; RV-PA conduit replacement |
| Post- Multilevel | TGA  CoA  AS  Branch PA stenosis PV incompetence  VSD | 1. CoA repair  2. ASO and VSD closure 3. RVOT patch 4. Arch repair, AVr, and RV-PA conduit 5. Bentall procedure, RPA reconstruction, transventricular subpulmonic resection 6. Redo root replacement | 6 | 9 | Konno Rastan procedure; pulmonary valve replacement; RVOT augmentation |
| Shone's syndrome (MS, AS) | 1. MVR; Konno-Rastan procedure; Pacemaker placement | 1 | 16 | Konno-Rastan reconstruction repair; redo AVR; redo MVR; BiV pacemaker insertion |
| CoA  VSD  BiV failure with multi-valve dysfunction (AI, MR, TR) | 1. CoA repair and PA banding 2. VSD closure and PA plasty 3. Redo PA plasty and AVr | 3 | 19 | Konno-Rastan procedure; MVr; TVr; Cryomaze procedure |
| CoA AS (BAV)  Severe AI  PAPVR  Gerbode defect | 1. CoA repair and anomalous L pulmonary venous confluence repair  2. AVR | 2 | 21 | Konno-Rastan procedure; TVr; Gerbode defect repair |
| Interrupted aortic arch, type A  SubAS  AS  Severe AI  DiGeorge syndrome | 1. Interrupted aortic arch repair 2. SubAS resection x2 3. Modified Konno procedure 4. AVR | 5 | 21 | Hemi-arch replacement; Bentall procedure; Konno-Rastan procedure; RPA and MPA plasty |
| TA  Severe AI  RVOTO | 1. RV-PA conduit 2. Truncal valve replacement  3. Aortic homograft replacement  4. AVR, RV-PA conduit replacement | 5 | 22 | Bentall procedure, RV-PA conduit replacement |
| CoA  AS  AI  MR | 1. Balloon aortic valvuloplasty 2. Aortic arch repair 3. AVr 4. Ross procedure 5. Pulmonary autograft replacement | 4 | 24 | Konno-Rastan procedure; MVr |
| Shone’s syndrome (Cleft leaflet of MV, MS, SubAS, AS, CoA)  AI  MR | 1. Konno-Rastan procedure | 1 | 25 | Redo AVR, RVOTO resection, MVr, and subAS resection |
| TA  MS  MR | 1. Primary TA repair 2. Truncal valve replacement  3. RV-PA conduit replacement and AA repair 4. RV-PA conduit replacement and debridement of AV  5. AVR  6. TAVR | 5 | 25 | MVR; AVR and root replacement; RV-PA conduit replacement |
| CoA  AS (BAV)  Dilated AA and innominate artery  Severe AI | 1. AVR 2. CoA repair  3. Balloon aortic valvuloplasty | 1 | 26 | Bentall procedure |
| SubAS TR | 1. SubAS resection x2 2. SubAS resection, AVR, enlargement of aortic root, resection of septal hypertrophy | 3 | 32 | Konno-Rastan procedure; BiV pacemaker insertion; TVr |
| Shone’s syndrome (CoA, AS, mitral dysfunction)  TR | 1. CoA repair  2. AVR x2 | 3 | 34 | AVR and aortic root replacement; TVr |
| SubAS  Dilated AA  AS  AI | 1. SubAS resection, AVr | 1 | 35 | SubAS resection; MVr, AVr; AA replacement |

AA = ascending aorta, AI = aortic incompetence, AS = aortic stenosis, ASD = atrial septal defect, ASO = arterial switch operation, AV = aortic valve, AVI = aortic valve intervention, AVr = aortic valve repair, AVR = aortic valve replacement, AVSD = atrioventricular septal defect, BiV = biventricular, BT = Blalock-Taussig, CoA = coarctation, DORV = double outlet right ventricle, L = left, LV = left ventricle, LVOT = left ventricular outflow tract, LVOTO = left ventricular outflow tract obstruction, MPA = main pulmonary artery, MS = mitral stenosis, MR = mitral regurgitation, MV = mitral valve, MVr = mitral valve repair, MVR = mitral valve replacement, PA = pulmonary artery, PAPVR = partial anomalous pulmonary venous return, PDA = patent ductus arteriosus, PFO = patent foramen ovale, PA = pulmonary artery, PV = pulmonary vein, R = right, RCA = right coronary artery, RPA = right pulmonary artery, RVOT = right ventricular outflow tract, RVOTO = right ventricular outflow tract, RV-PA = right ventricle to pulmonary artery, TA = truncus arteriosus, TAVR = transcatheter aortic valve replacement, TGA = transposition of great arteries, ToF = Tetralogy of Fallot, TR = tricuspid regurgitation, TVr = tricuspid valve repair, VSD = ventricular septal defect

Each patient in the cohort is described, including presenting anatomy/diagnoses, operations prior to index surgery, number of pre-index sternotomies, age at index surgery, and index surgery type. Each row describes an individual patient. Categorization was dependent on the anatomic level(s) of aortic pathology that was surgically corrected in interventions prior to index surgery.

Supplemental Table S2: AI Grades and LVOT Gradients

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| **Group** | **Pre-Index Grade of AI** | **Discharge Grade of AI** | **Pre-Index LVOT gradient (mean)** | **Discharge LVOT gradient (mean)** |
| Primarily AI  (N = 12) | Moderate/Severe (12) | None (2)  Trace/Trivial (10)  Mild (1) |  | |
| Without AI  (N = 29) |  | | 34.9±17.5 | 12.6±6.0 |
| P<0.001 | |

AI = aortic insufficiency, LVOT = left ventricular outflow tract

Grade of aortic insufficiency (AI) and mean left ventricular outflow tract (LVOT) gradients are noted for the ‘primarily AI’ and ‘without primarily AI’ groups, respectively. The number of patients with a particular AI grade is shown in parentheses pre-index and post-index surgery (discharge). LVOT gradients pre-index and post-index surgery (discharge) are recorded as mean ± standard deviation.