Review Article

Surgery of Aorto-Pulmonary Window- A 10 years study- Review

Soumik Pal*, Mohan Dattatraya Gan†, Aruneshwari Dayal*, Mahadev Damodar Dixit*

Aims: A retrospective study of Aorto Pulmonary window, being diagnosed with increasing frequency, was done to find the incidence, the clinical findings, risk factors and operative techniques. Methods: Thirty cases of Aorto Pulmonary window were retrospectively studied at our Institution from January-2000 to October-2011. Four of them turned out to be inoperable because of development of Pulmonary Vascular Disease. Out of the 9 cases operated 6 were Males; age ranged from 3 months to 50 yrs (mean 21 months). Type 2 defects were found in two of them, while the rest had type I. One of them presented in adulthood and had associated Aneurysm of Ascending aorta requiring additional root replacement. Associated defects were found in one, 3 months infant case which included Atrial Septal Defect, Ventricular Septal Defect, Patent Ductus Arteriosus, Pulmonary Atresia. Patient with Pulmonary Atresia underwent associated pulmonary valve conduit. Cardiac cath was done in all the cases except 3 months old infant with associated defects. Mean Pulmonary Vascular Resistance Index was of 3.3 woods unit/cm². Seven patients underwent surgery on pump and had Dacron patch closure of the defect along with repair of associated defects. Two off pump case had closure of defect between clamps. Results: Out of 9 cases, one died of Pulmonary Hypertensive crisis, multiorgan failure. The mean follow up period of 3½ years showed no residual shunt with regression of Pulmonary Artery pressure. Conclusion: Aorto Pulmonary Window correction can be performed with low mortality before development of irreversible pulmonary hypertension.

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RESULTS and all were in New York Heart Association Class I.

Cardiac cath was done in all the above cases except 3 months old infant. She was operated on 2 Dimensional echocardiography findings.

Quotient Pulmonary/Quotient Systemic ranged from 1.5 to more than 3.0 (Mean of 2.6) Pulmonary Vascular Resistance was 4.8 under woods unit/m2 in all the cases (Mean 3.4 woods unit/m2). All showed increase in Quotient Pulmonary/Quotient Systemic with 100% oxygen. The angiography of the adult patient showed Ascending aorta aneurysm(Diameter by 5.5 cm) and a Quotient Pulmonary / Quotient Systemic of 3.18 & Pulmonary Vascular Resistance of 4.66 woods unit/m2 with good response to 100% oxygen[16].

3.RESULTS

Patients were operated under Cardio Pulmonary Bypass. Measures were taken to avoid flooding of the lungs by snugging Right and Left Pulmonary Artery during starting of Cardio Pulmonary Bypass and ligation of Patent Ductus Arteriosus.

Only two infants who had a small communication of <0.5 mm with good margins was operated without Cardio Pulmonary Bypass with direct closure (Fig. 1). In a 3 years old female child with type I defect seen on cardiac catheterization (Fig. 2). At operations Right Coronary Artery was seen arising from the common wall more on Pulmonary Artery side. During the repair, the Haemashield patch on aorta was stitched in such a way, so as to divert Right Coronary Artery opening in aortic area. Pulmonary Artery was then augmented with autologous pericardial patch.

The adult 50 years old male who had additional aneurysm of ascending aorta was operated under Cardio Pulmonary Bypass with replacement of ascending aorta by Haemashield graft(26mm). The window opening in pulmonary artery was repaired with a Dacron patch using 5-0 continuous prolene sutures[16].

All survived except one, 3 months old female had additional Ostium Secundum Atrial Septal Defect, Subaortic Ventricular Septal Defect, pulmonary atresia & type II Aorto Pulmonary Window opening in Right Pulmonary Artery with Patent Ductus Arteriosus. The child underwent surgery under deep hypothermic circulatory arrest for closure of Ventricular Septal Defect & Atrial Septal Defect with 14 mm Contegra Pulmonary valved conduit between Right Ventricle & Confluent of Right Pulmonary Artery. The child died of Pulmonary Artery crisis, multi organ failure in intensive care unit on 8th postoperative day.

Rest were discharged & follow up studies showed no residual shunt, regression of Pulmonary Artery pressure to near normal and all were in New York Heart Association Class I.

4.DISCUSSION

A big changes have occurred in diagnosis and surgical approaches in management of Aorto Pulmonary Window in field of paediatric cardiac surgery. The initial approach of cardiac catheterization has been overtaken by 2 Dimensional echocardiography in infants but in older children the cardiac cath assessment is still the gold standard. The outcome of the patients from different surgical series shown in (Table 1) with present series of 12 cases showing only one death in 3 months old infant due to Pulmonary Hypertensive crisis secondary infection and multiorgan failure.

The surgical approach began with ligation without use of Cardio Pulmonary Bypass[10] progressed to division between clamps[11] with Cardio Pulmonary Bypass [12]. Then progressed to division and primary closure with Cardio Pulmonary Bypass, Aortic cross clamp [13,14] and now trans aortic patch closure[15].

The age and time of repair has dropped to the neonates. This has improved the results without development of pulmonary vascular disease. Now transcatheter closure has also been replaced particularly for small and intermediate type[18].

Mori et. al[6] classified Aorto Pulmonary Window into three types, proximal, distal and total. In the Richardson classification [7], type I is proximal, type II is distal with extension of the communication into the origin of the right Pulmonary Artery and type III is anomalous origin of the right Pulmonary Artery from the ascending aorta. Ho et al.[8] modified the Mori classification based on the recent utilization of transcatheter devices to close Aorto Pulmonary Window. Jacobs et. al in the Congenital Heart Surgery nomenclature and Database project[9] noted use of Hierarchy level 1 i.e., An Aorto Pulmonary Window is a communication between the main pulmonary artery and the ascending aorta in the presence of two separate semilunar valves. (The presence of two separate semilunar valves distinguished Aorto Pulmonary window from truncus arteriosus.) and Hierarchy level 2, Jacobs et. al[9] further simplified classification in to Aorto pulmonary window, type I proximal defect: An Aorto Pulmonary Window located just above the sinus of vaskalva, a few millimeters above the semilunar valves. Aorto Pulmonary window, Type 2 distal defect: An Aorto pulmonary window located in the uppermost portion of the ascending aorta, with a well-formed inferior rim but little superior rim. Aorto Pulmonary Window, Type 3 total defect: An Aorto pulmonary window involving the majority of the ascending aorta, with little superior and inferior rims. Aorto pulmonary window, intermediate type: An Aorto pulmonary window similar to the total defect but with a adequate superior and inferior rims.

Wright et. al.[14] who performed first transaortic closure noted that most of Aorto Pulmonary Window have virtually no length, and usually large thin walled and under high pressure. Transaortic closure allow good visualization and preservation of coronary orifice, aortic valve leaflet. In one of the cases where Right Coronary Artery was arising from Pulmonary Artery & was diverted in Aorto with Dacron patch.

Deverall et. al[15] who first reported patch closure of Aorto Pulmonary Window through pulmonary anatomy caused narrowing at Aortic end. He subsequently performed all cases with
vertical Aortomy, which give good visualization of defect, anatomical structures and does not distort either the aorta or pulmonary artery & is naturally self healing without any stenosis or bleeding.

**TABLE 1 - Surgical results of Aorto pulmonary window in different series by different surgical groups (A historical note, Ref. No. 17)**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Year(s)</th>
<th>Number of patients</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Ormond Street[RefNo 15]</td>
<td>1958-1968</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>University of Minnesota[Ref No. 19]</td>
<td>1959-1974</td>
<td>12</td>
<td>4</td>
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<tr>
<td>Melbourne[Ref No. 20]</td>
<td>1970-1975</td>
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<tr>
<td>Bergamo[Ref No. 17]</td>
<td>1975-1986</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Mayo Clinic[Ref No. 21]</td>
<td>1953-1990</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Zurich[Ref No. 17]</td>
<td>1971-1993</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>University of California San Francisco[Ref No. 17]</td>
<td>1972-1995</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>Children’s Memorial Hospital[Ref No. 17]</td>
<td>1961-2001</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>KLES Heart Foundation</td>
<td>2000-2011</td>
<td>13</td>
<td>1</td>
</tr>
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</table>

5.Conclusion

Early surgery and avoiding developing pulmonary hypertension gives best result. Complete correction of Aorto Pulmonary Window can be performed with low mortality in early childhood before developing irreversible pulmonary hypertensive changes. In adult age group Aorto Pulmonary communication is usually associated with other cardiac defects requiring repair of all defects at the same sitting. In all cases prompt diagnosis & surgical treatment lead to successful outcome.

6. References


