Transcatheter Closure Of Perimembranous VSDs Using Amplatzer Ductal Occluder Type I

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Ventricular septal defects are the most common congenital cardiac malformation accounting for more than 20% of all defects.

Kirklin, et al classified these defects according to their location within the ventricular septum into:

- Perimembranous defect with extension to the outlet septum, kirklin type I.
- Perimembranous defect with extension to the trabecular septum, kirklin type II.
- Perimembranous defect with extension to the inlet septum, kirklin type III.
- Muscular defect.
Echocardiographic delineation of various VSDs

- Subpulmonary
- Perimembranous
- Subaortic
- Inlet
- Mid-muscular
- Marginal
- Apical

Ventricular Septal Defects
(Viewed from right ventricle)

1. Posterior A-V Canal Type
2. Perimembranous
3. Muscular
4. Apical Muscular
5. Multiple Anterior Muscular
6. Subaortic
7. Mural

- Panetal Band of Crista Supraventricularis
- Papillary Muscle of Conus
- Septal Leaflet of Tricuspid Valve
- Anterior Leaflet of Tricuspid Valve
Although transcatheter closure of perimembranous ventricular septal defect is an acceptable alternative for surgical closure but it is still associated with an unacceptable incidence of complete heart block.

We report our preliminary experience of transcatheter closure of perimembranous ventricular septal defects in different locations using Amplatzer Ductal Occluder Type I.

PATIENTS AND METHODS:

Between september 2013 and november 2014, 121 patients with perimembranous ventricular septal defect were enrolled for transcatheter closure using Amplatzer Ductal Occluder type I.

The inclusion criteria were

- ventricular septal defect diameter ranged from 4mm to 12 mm
- ventricular septal defect distance (rim) that at least 2 mm away from atrioventricular and semilunar valves.

Patients with malalignment type ventricular septal defects were excluded from this study.
### BASELINE AND CLINICAL DATA

<table>
<thead>
<tr>
<th>Total Number of patients</th>
<th>121</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>1 - 44 Yrs</td>
<td></td>
</tr>
<tr>
<td>8 - 95 kg</td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td></td>
</tr>
<tr>
<td>9.5 Yrs</td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td></td>
</tr>
<tr>
<td>Mean 19 Kg</td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Female 66 (54.5%)</td>
<td></td>
</tr>
<tr>
<td><strong>Indication of closure</strong></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td></td>
</tr>
<tr>
<td>changes on CXR or Echo.</td>
<td></td>
</tr>
<tr>
<td>Previous bacterial endocarditis</td>
<td>3 (2.5%)</td>
</tr>
<tr>
<td><strong>VSD type</strong></td>
<td></td>
</tr>
<tr>
<td>PM-Outlet</td>
<td></td>
</tr>
<tr>
<td>PM-Muscular</td>
<td></td>
</tr>
<tr>
<td>PM-Inlet</td>
<td></td>
</tr>
<tr>
<td><strong>VSD size by Echo.</strong></td>
<td></td>
</tr>
<tr>
<td>5 – 12 mm (7.5mm)</td>
<td></td>
</tr>
<tr>
<td>4 – 12 mm (7 mm)</td>
<td></td>
</tr>
<tr>
<td>28 – 64 mm (44 mm)</td>
<td></td>
</tr>
<tr>
<td><strong>LVEDD</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VSD TYPE</th>
<th>ANEURYSM</th>
<th>PROLAPSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RCC</td>
<td>NCC</td>
<td>Both</td>
</tr>
<tr>
<td>PM – Outlet</td>
<td>1</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>PM – Muscular</td>
<td>29</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>PM – Inlet</td>
<td>11</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>41 (45%)</td>
<td>13</td>
<td>11</td>
</tr>
</tbody>
</table>
## Associated Lesions

<table>
<thead>
<tr>
<th>Lesion</th>
<th>frequency</th>
<th>Fate</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFO</td>
<td>6</td>
<td>Follow up</td>
</tr>
<tr>
<td>PDA</td>
<td>1</td>
<td>Successful Transcatheter Closure</td>
</tr>
<tr>
<td>RVOTO</td>
<td>7</td>
<td>Beta Blocker, Regress on Follow up</td>
</tr>
<tr>
<td>Subaortic Ridge</td>
<td>3</td>
<td>Captured by device, No LVOT gradient or New Onset AR on Follow up</td>
</tr>
</tbody>
</table>

## PROTOCOL

- An informed consent was obtained from all patients.
- Procedures were done under deep sedation and transthoracic echocardiographic guidance.
- Right and left heart catheterization with aortogram and LV angiography (LAO 70°, Cranial 20° for infracristal defects and LAO 80°, Cranial 40° for supracristal defects) were performed, and RV and LV defect sizes were measured.
PROTOCOL

- A modified cut-off 5F pigtail catheter and 0.35 inch Terumo guide wire were used to cross the defect from LV to RV and then into pulmonary artery or vena cavae.

- An Amplatz exchange wire replaced the Terumo wire and was snared and exteriorized through the femoral vein to create an arterio-venous loop.

PROTOCOL

- After the appropriate device was loaded and advanced to the tip of the long sheath, a 5F end hole catheter was introduced retrogradely into the aortic root and hand injection of contrast material was performed to guide proper deployment of the device disk just beneath aortic valve.
PROTOCOL

- Under fluroscopic control and transthoracic echocardiographic guidance the long sheath was pulled gently and the device was deployed completely.
- Angiograms of the LV and the aorta were performed to assess device position, efficacy of closure and device effect on the surrounding structures.
- Only after meticulous Angiographic and echocardiographic assessment the device was released.

PROTOCOL

- Clinical, electrocardiographic and echocardiographic assessment at 1 day, 1, 6 and 12 months post closure was followed for each patient.
- The mean period of follow up was 9 ms (4 – 18 ms)
- Successful closure was defined as successful implantation of device with no adverse effect on the surrounding structures and with or without small residual shunt.
- Complete closure was defined as successful closure without adverse effect on the surrounding structures and without residual shunt.
RESULTS

- Successful closure of VSD using ADO type I was achieved in 116/121 patients (95.9%).
- Complete closure was found to be (92.5%) at 24hrs post closure and (98.3%) and (100%) at 1 month and 6 months respectively.
- Failure cases (5): 2 PM-Outlet, 2 PM-Inlet and 1 PM-Muscular
  - large defect with insufficient rims (2 cases),
  - AO valve contact with new onset AR (3 cases).
- The procedure and fluoroscopic times were (23-120 mean 58) and (9 – 50 mean 22) minutes respectively.
- No major complications were observed during follow up period, No aortic or tricuspid valve insufficiency, No bundle branch block or complete heart block and No infective endocarditis.

CONCLUSION

- The Amplatzer Ductal Occluder type I is suitable and effective in occlusion of perimembranous VSD in different locations with or without aneurysm and has high rate of complete closure and with no significant adverse events.
- More than one device may be used to close defect in one patient.
Noor k. Hashim, 7 yrs,
PM-Outlet VSD (Intracristal), PH, 80° LAO and 40° Cranial view
PDA Occluder 8:6
Azhar H. Mahmood, 5 Yrs,
PM-Inlet VSD, Aneurysm, Multiple defects, Prolapse NCC
PDA Occluders 8:6 and 6:4
Tabark Osama, 4yrs,
PM-Inlet VSD, PH (PAP Mean 40 mmHg)
PDA Occluder 10:8
Doaa Hannon Ali, 24yrs, PM VSD, Prolapse Rcc and Ncc, PDA Occluder 8:6
Shubair Fadhel Mohammed, 3yrs, PM-Muscular VSD, PH (PAP Mean 35 mmHg), Prolapse Ncc PDA Occluder 10:8
Homam Mustafa, 1 Yr,
PM – Inlet VSD, small Aneurysm, PH (PAP peak 75 mean 55 mmHg),
PDA Occluder size 10:8
Abd Alqader Hussein, 18 Yrs,
PM – Inlet VSD, Prolapse NCC, PH (PAP Mean 45 mmHg),
PDA Occluder size 12:10
Vian Abdulabbas, 20 Yrs
PM-Outlet VSD (Subpulmonic), PH (PAP Mean 45 mmHg)
PDA Occluder size 12:10
Mustafa F. Salim, 8Yrs
Situs Inversus, Dextrocardia, Moderate-large PM VSD, PH (PAP peak 60, mean 45 mmHg)
PDA Occluder size 10:8
THANK YOU