Non-conduit repair of truncus arteriosus

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Abstract

Background: Primary complete repair of truncus arteriosus (TA) is the goal in the current era of cardiac surgery. In the absence of valved conduits, non-conduit repair remains possible in spite of less optimal hemodynamics and could be a solution for this category of patients in the developing countries.

Patients and methods: This is a review of eight patients operated upon in the national heart institute from January 2013 to November 2015. They underwent non-conduit repair of truncus arteriosus by the modifications of the Barbero-Marcial technique through window like separation of the common trunk, approximating the pulmonary artery to right ventricular outflow tract and completed by autologous pericardial patch.

Results: The mean age was 43.75 days with range 20–80 days. The mean body weight was 3.5 kg with range 2.8–4.5 kg. There were two early mortality cases in the intensive care unit (ICU). The mean ventilation time was 38.6 h with range 18–66 h. The mean ICU stay was 6.3 days with range 3–11 days. Pre-discharge echocardiography revealed mean gradient across the right ventricular outflow tract (RVOT) 24 mmHg with range 14–34 mmHg and mean grade of pulmonary incompetence (PI) was 2.3 with range of 1–3.

Conclusion: The non-conduit repair is a good alternative for type I TA, especially when it is the only available solution.

Keywords: Truncus arteriosus; Conduits; Non-conduit repair

1. Background

Absence of continuity between RVOT and pulmonary artery (PA) calls for complicated interventions. In these cases, a conduit must be implanted, or the pulmonary arteries must be approximated to the pulmonary ventricle directly, using a variety of well-known techniques [1–3].

Valved conduits were first used by Ross [4] and soon after by Rastelli [5] and since then have remained the mainstay of the treatment of right ventricle to pulmonary artery (RV – PA) discontinuity. Irradiated cryopreserved homografts [6], Stented glutaraldehyde treated porcine aortic valve mounted in Dacron tubes (Hancock conduits) [7], Fresh antibiotic sterilized homografts [8,9] and cryopreserved homografts came into use successively till mid-1980s. But In 1999, Contegra came in use and it is now commercially available and more widely used internationally [10,11].
Given the problems with the use of conduits, surgeons have constantly tried to evolve surgical techniques that would obviate their use. The common surgical principle in all these so called non conduit options is the direct continuity of right ventricular muscle with native PA and this would allow age-related growth [1].

The first successful attempt at non-conduit repair for TA was reported by Reid in 1986 [12]. Subsequently a series of cases were reported by Barbero-Marcial who modified the technique by using the left atrial appendage in the posterior wall [13]. Subsequent modifications had been attempted to avoid the use of the left atrial appendage [3].

2. Patients and methods

Eight patients below 3 months of age underwent primary complete repair of TA type I without RV – PA conduits using the technique described by Barbero-Marcial. The data of these patients were collected as a retrospective randomized study. These patients were operated upon in the national heart institute from January 2013 to November 2015. The technique consisted of direct connection between the posterior wall of PA and RVOT, completed anteriorly with a trans-annular patch combined with window like repair through patch separation of the common trunk without division of PA from aorta (Fig. 1). [14] Any associated anomalies, coronary artery anomalies or truncal valve incompetence more than grade I or stenosis with gradient more than 30 mmHg were excluded. Echocardiography was the standard tool for diagnosis (also for postoperative evaluation and follow up) but CT angiography required in three cases to clarify coronary and pulmonary arterial anatomy.

2.1. Technique [14]

Standard techniques of anesthesia, cannulation and cardiopulmonary bypass for TA repair were carried out as usual. A longitudinal incision was made into the antero-superior aspect of the left pulmonary artery and extended inferiorly into the truncal root toward the left sinus of Valsalva. The interior of the truncal root was inspected through the incision, and orifices of left and right pulmonary arteries, coronary ostia (particularly that of the left coronary artery), and truncal valve cusps were identified. A polytetra-flouro-ethylene (PTFE) patch is then sewn into place to partition the truncal root into aortic and pulmonary trunks. A vertical incision was made into the right ventricle, extending it nearly to the truncal wall over the left-sided sinus of Valsalva. The VSD was closed. The posterior wall of the right ventricular—pulmonary trunk pathway was created by suturing the inferior flap of the initial left pulmonary artery/truncal root incision to the superior aspect of the right ventricular borders of the ventriculotomy. The anterior wall was created by suturing into place a patch of autologous pericardium. The remainder of operation was completed in the usual manner [14] Figs. 2 and 3.

3. Results

The mean age of the eight patients was 43.75 days with range (20–80 days). The mean body weight was 3.5 kg with range (2.8–4.5 kg). There were two early mortality cases in ICU; first case was 75 days old, died from cardiac
failure and low cardiac output (COP) as a result of severe pulmonary hypertension (PH), severe pulmonary PI, moderate aortic incompetence (AI) and poor myocardial function. The second case was 25 days old baby with Di-George syndrome died from bronchopneumonia and septic shock complicating a prolonged course of mechanical ventilation as a result of repeated apnea shortly after extubation. The mean ventilation time of the remaining six cases was 38.6 h with range 18–66 h. The mean ICU stay was 6.3 days with range 3–11 days. Pre-discharge echocardiography revealed mean gradient across RVOT 24 mmHg with range (14–34 mmHg) and mean grade of PI was 2.3 with range (1–3). During follow up, one case presented after one year with progressive stenosis across RVOT (gradient 65 mmHg) with narrowing also at the ostia of right PA. Redo surgery was underwent using Contegra (size 16) connecting the RVOT with PA confluence after separation from aorta and augmentation of RPA. Post-operative course was uneventful and post-operative gradient across RVOT came down to 19 mmHg.

4. Discussion

Early attempts at conduit less RV-PA connection were confined to conditions with decreased pulmonary blood flow, because of fear that postoperative pulmonary incompetence in the face of pulmonary hypertension would not be well tolerated and lead to adverse outcomes. Reid in 1986 [12] made the first successful attempt at non-conduit repair for TA in which the pulmonary arterial confluence can be separated and drawn down directly to the right ventriculotomy. The rationale was that PR is well tolerated with low PVR and good size pulmonary tree, so, this type of repair should be done during the neonatal period or early infancy [1]. Subsequently a series of cases were reported by Barbero-Marziali who modified the technique by using the left atrial appendage in the posterior wall and subsequent modifications had been attempted to avoid the use of the left atrial appendage [3].

In our country, while dealing with this category of complex cases in the absence of valved conduits, this type of repair is considered as a very good option especially that it is technically easier and more feasible in small weight.
babies with very limited mediastinal space. We tried to select our cases as much as possible during initiation of this repair, so, all cases were below three months of age, type I TA (although it is applicable in type II also) and normal coronary artery anatomy. Special importance was given to evaluation of truncal valve anatomy and function (future aortic valve) so, we excluded cases with more than grade I incompetence or gradient more than 30 mmHg to protect against additional hemodynamic burden rather than the expected PR. We preferred the use of window like modification in dealing with the distal anastomosis because it is technically easier and more hemostatic.

Postoperatively, the plan was to keep the baby mechanically ventilated with good sedation at least overnight. The ICU and hospital stay was acceptable for us. The high mortality (25%) was accepted by us in this initial series because of the lack of valved conduits and low experience in our center in dealing with small weight babies with complex anomalies. During follow up, most of patients were not or mildly symptomatic, good myocardial function and of nearly same grade of PI. The case who underwent redo surgery passed the post-operative course smoothly and progressive RVOT obstruction is a less common consequence after non conduit repair and is more frequent after repair with Contegra especially at the site of distal anastomosis.

5. Conclusion

The non-conduit repair is a good alternative for type I TA, especially when it is the only available solution. Like other options, it has its specific value and limitations and surgical strategy should be tailored according to each patient. Preoperative selection and close postoperative follow up is mandatory to optimize the outcome of valve-less repair with expected but tolerable PI.

Conflict of interest

The author declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References