Predicted Outcome after Repair of Tetralogy of Fallot by Postoperative Pressure Ratio between Right and Left Ventricle

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Background: *The surgical management of tetralogy of Fallot (TOF) has continued to evolve and there are now generally excellent early and long-term results following complete repair.*
Objective: *To investigate the early results of the authors' current surgical management of TOF by assessing the perioperative and early to intermediate follow-up period. The authors paid particular attention to the post-operative ratio of right ventricular to left ventricular systolic pressure (RVSP/LVSP), focusing on the presence of low cardiac output, intensive care unit (ICU) stay, prolonged of inotropic support and ventilation support time.*
Study design: *Retrospective study.*
Material and Method: *Between June 2002 and August 2004, 31 consecutive patients underwent complete repair of TOF. Their mean age was 7.7 $\pm$ 5.1 years (range, 2.9 to 25.3). A previous palliative shunt had been performed in 14 (45.2%) patients. Twenty-three patients (74.2%) were in NYHA FC II. Mean hematocrit and oxygen saturation were 50.9 $\pm$ 10.25% and 80.5 $\pm$ 8.6%, respectively. Mean preoperative ratio of RVSP/LVSP was 1.1 $\pm$ 0.15. The operative approach was transatrial/transpulmonary, and 17 (54.8%) patients required a transannular patch. An extracardiac valve conduit was necessary in 3 (9.7%) patients with pulmonary atresia.*
Results: *There were no operative or late deaths. Two cases were reoperated from cardiac tamponade. Mean postoperative ratio of RVSP/LVSP was 0.53 $\pm$ 0.16. Median ICU and hospital stays were 2.2 and 11 days, respectively. Presence of low cardiac output and prolonged inotropic support were significantly ($P < 0.05$) related to a RVSP/LVSP ratio of more than 0.5. At median follow-up of 6 months, 29 (93.5%) patients were asymptomatic and all patients were free of significant residual lesion.*
Conclusion: *The authors' early results in complete repair of TOF patients are acceptable with a low incidence of morbidity. A postoperative RVSP/LVSP ratio of more than 0.5 was significantly associated to adverse outcome. Late complications may, however, develop, and long term follow-up for early detection of any such complications is essential.*

Keywords: *Tetralogy of fallot (TOF), Right ventricular systolic pressure (RVSP), Left ventricular systolic pressure (LVSP), Early results*

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Tetralogy of Fallot (TOF) is the most common cause of cyanotic congenital heart disease[1]. TOF is identified by large ventricular septal defect (VSD), right ventricular hypertrophy (RVH), right ventricular outflow tract obstruction (RVOTO) and an overriding aorta[1]. Since the first successful repair by Lillehei et al in 1954[2], several studies[3-6] of early and late results have documented a favorable outcome in most patients[7]. In general, the surgical approach to TOF involves either initial palliation by means of construction of a systemic to pulmonary artery shunt followed by definite repair at a later date or by primary complete repair or total correction surgery[8]. This present report describes the early results after complete repair of TOF. The authors paid particular attention to the postoperative ratio of systolic blood pressure in the right ventricle to that in the left ventricle (RVSP/LVSP) on the presence of low cardiac output, prolonged inotropic drugs support, intensive care unit (ICU) stay and ventilation support time.

Material and Method

Patients

Between June 2002 and August 2004, 31 consecutive patients with a diagnosis of TOF who underwent surgical repair at Songklanagarind Hospital, Prince of Songkla University were identified from the cardiac surgery database and the medical records of all these patients were reviewed. The authors included patients with or without a prior systemic to pulmonary artery shunt and patients with classic TOF with associated pulmonary atresia (TOF-PA).

There were 16 (51.6%) male and 15 (48.4%) female patients. The mean age at the time of complete repair was 7.7 $\pm$ 5.1 years (range, 2.9 to 25.3 years). The mean body weight was 19 $\pm$ 8.2 kg (range, 11.5 to 47 kg). No patient was less than 1 year of age at the time of complete repair.

Fourteen patients (45.2%) required a palliative procedure before complete repair and all of them had a right or left modified Blalock-Taussig shunt (MBT shunt). Unfavourable anatomy, which consisted of either diminutive pulmonary arteries, major coronary arteries crossing the right ventricular outflow tract (RVOT) or prematurity with worsening cyanosis, were our indications for palliative shunt before complete repair. The mean age at construction of MBT shunt was 3.2 $\pm$ 2.5 years (range, 10 months to 10 years). The mean time interval between palliative shunt and complete repair was 2.5 $\pm$ 1.5 years (range, 0.8 to 5 years).

At initial presentation, the mean oxygen saturation at room air was 80.5 $\pm$ 8.6% (range, 59 to 95%), and the mean hematocrit was 50.9 $\pm$ 10.25% (range, 31 to 73%).

Clinical and Pathologic Features

Twenty-four patients (77.4%) had been treated for two or more incidents of respiratory tract infection. No patients had clinical of congestive heart failure. Other preoperative findings and symptoms are summarized in Table 1. No patient had noncardiac congenital abnormalities. Associated congenital cardiac abnormalities are summarized in Table 2.

Preoperative Echocardiography and Cardiac Catheterization

Echocardiography and cardiac catheterization were performed in all 31 consecutive patients. Classic TOF was diagnosed in 28 (90.3%) patients and 3 (9.7%) patients had TOF-PA. From measurement of the diameters of the pulmonary artery branch and the descending aorta, the McGoon indices were calculated. The

Table 1. Preoperative findings and symptoms

Variable	Number	Percent
NYHA FC I	8	25.8
NYHA FC II	23	74.2
Frequent respiratory tract infection	24	77.4
Failure to thrive	16	51.6
More than one episode of hypoxic spell	5	16.1

NYHA FC = New York Heart Association Functional Classification

Table 2. Associated congenital cardiac abnormalities

Variable	Number	Percent
Patent foramen ovale	9	29.0
Patent ductus arteriosus at time of complete repair	5	16.1
Atrial septal defect	3	9.7
Right aortic arch	3	9.7
MAPCAs	12	38.7
Left superior vena cava	4	12.9
LAD from RCA	3	9.7

MAPCAs = Major Aorto-Pulmonary Collateral Arteries; LAD = Left anterior descending artery; RCA = Right main coronary artery

mean of the McGoon indices was 2.2 ± 0.4 (range, 1.7 to 4.1). The mean right ventricular systolic pressure (RVSP) and left ventricular systolic pressure (LVSP) were 91.7 ± 13.7 mmHg (range, 73 to 128 mmHg) and 83.9 ± 9.9 mmHg (range, 70 to 108 mmHg), respectively. The preoperative ratios of RVSP/LVSP were calculated. The mean ratio of RVSP/LVSP preoperatively was 1.1 ± 0.15 (range, 0.86 to 1.62). Location of RVOTO in all patients is summarized in Table 3. No patient had moderate or severe pulmonary insufficiency (PI). Three patients (9.7%) had moderate to severe tricuspid insufficiency (TI).

Surgical Repair

All complete repairs were performed after standard median sternotomy using a cardiopulmonary bypass (CPB) with moderate systemic hypothermia (25°C to 28°C). All the MBT shunts were dissected out and devided just after CPB was commenced. Intermittent, antegrade cold crystalloid and cold blood cardioplegia were used for myocardial protection. The preferred surgical approach was Transatrial/Transpulmonary in all patients. Obstructing muscle bands along the septal aspect of the RVOT were resected and other RVOTO locations were managed with variable strategies (Table 4). Extracardiac valve conduits were used in 3 (9.7%) patients with TOF-PA. The VSD was closed transatrially with double velour Dacron patch using simple, interrupted, 4-0 or 5-0 polypropylene pladgets sutures in all patients. To assess the adequacy of the RVOT, Hegar's dilators were introduced through RVOT to achieve adequacy based on normalized sizes for body surface.

The mean CPB and aortic cross clamp times were 119.2 ± 29.8 min (range, 77 to 216 min) and 72.6 ± 19.2 min (range, 44 to 127 min), respectively.

The RVSP and LVSP were routinely measured before chest closure. All patients underwent intraoperative post-repair direct measurement of RVSP. However, due to all patients having no left ventricular outflow tract obstruction, The authors accepted peak systolic pressure in ascending aorta can be represented for LVSP.

Table 3. Location of RVOT obstruction

Variable	Number	Percent
Infundibulum alone	6	19.4
Infundibulum and PVA	15	48.4
Infundibulum and PV	5	16.1
Infundibulum, PV and PVA	2	6.5
Pulmonary Atresia	3	9.7

PVA = Pulmonary valve annulus; PV = Pulmonary valve

Table 4. Management strategies of RVOT obstruction

Surgical procedure	Number	Percent
Infundibulum resection alone	6	19.4
Infundibulum resection + TAP	15	48.4
Infundibulum resection + PVC	5	16.1
Infundibulum resection + PVC + TAP	2	6.5
Extracardiac valve conduit	3	9.7

TAP = Transannular pericardial patch; PVC = Pulmonary valve commissurotomy

Postoperative Course

All patients were admitted to the ICU until ventilatory support was withdrawn. Postoperative parameters recorded and analyzed for all patients were: mechanical ventilation time; duration and dosage of inotropic drug infusion; ICU and hospital stays; presence of low cardiac output; and any other complication including re-explorations. Transthoracic echocardiographys were routinely performed within first 12 to 24 hours postoperatively.

Pre-hospital discharge and follow up echocardiography

All patients underwent pre-hospital discharge and subsequent follow up echocardiography evaluation. The present study investigated the residual RVOTO, residual VSD, PI and/or TI, RVSP and right ventricular (RV) function. Follow-up data were collected from outpatient medical records by case note review.

Statistical Methods

The Statistical Package for the Social Sciences program (SPSS Inc, Chicago, IL) was used to evaluate all data, which was expressed as mean ± standard deviation and range or median and range. Simple proportions including number of patients that presence of low cardiac output and prolonged inotropic support between patients with postoperative ratio of RVSP/LVSP equal 0.5 or less and more than 0.5 were compared by Fisher exact and Student's t test, however, unusual distribution variables such as median ICU stay and median ventilation time were compared by Wilcoxon rank-sum method and/or Mann-Whitney U test. A p value of less than 0.05 was set as the level of signifi-

cance. Paired t test was used for comparing the paired observations if it is normal distribution.

Results

There were no operative (includes any death occurring within 30 days after the operation or during the same hospital admission) or late deaths in the present series of patients. The median ventilation time was 14 hours (range, 2 to 242 hours), median ICU stay was 52 hours (range, 18 to 409 hours) and median hospital stay was 11 days (range, 6 to 45 days). After complete repair, the mean oxygen saturation at room air (96.9 $\pm$ 1.09%) was significantly ($p < 0.05$) increased compared to preoperatively.

The mean ratio of RVSP/LVSP after repair was 0.53 $\pm$ 0.16 (range, 0.25 to 0.89). This was 0.5 or less in 18 (58.1%) patients and more than 0.5 in 13 (41.9%) patients. There was a significantly lower RVSP/LVSP ratio in the postoperative group ($p < 0.05$). In no instance was immediate further enlargement of the RVOT required.

The postoperative course was uneventful in 20 (64.5%) patients. Minor complications in forms of pleural effusion, fever and mild form of dysrhythmias were found in 3 (9.7%) patients. Eight patients (25.8%) had early major postoperative complications as shown in Table 5. All of these 8 patients had low cardiac output, one had acute renal failure (dialysis was not required) and one other had pneumonia that improved from intravenous antibiotic and chest physical therapy. Two patients (6.5%) had an early reoperation (within 12 hours postoperatively) due to bleeding from the suture line of the transannular patch (TAP) in one and from the pericardium of the other (both had cardiac tamponade). Table 6 shows postoperative data in both groups of patients, with RVSP/LVSP ratios 0.5 or less and more than 0.5.

Pre-hospital discharge echocardiography results showed that no patients had significant residual VSD, but 5 (16.1%) patients had small residual VSD. Most patients (61.3%) had mild PI and 19.4% had severe PI. Tricuspid valve function was well preserved and most patients (80.6%) had no or mild TI. Overall, right and left ventricular functions were well preserved. Pre-hospital discharge echocardiography data are summarized in Table 7.

The median follow-up was 6 months (range, 1 to 22 months). At the last follow-up, 29 (93.5%) patients were in NYHA FC I and 2 (6.5%) patients were in NYHA FC II. No patient required reoperation for PI, residual RVOTO or residual VSD. All patients had normal sinus rhythm and QRS duration. Detailed clinical and echocardiography follow-up data are summarized in Table 8. When all patients who had pre-hospital discharge echocardiography evaluation were compared with the follow up period, their RVSP and RVSP/LVSP ratio in patients with postoperative RVSP/LVSP more than 0.5 and patients with presence of low cardiac output were significantly ($p<0.005$) decreased, but only in their RVSP in patients with postoperative RVSP/LVSP 0.5 or less were similar ($p>0.05$). The RVSP and RVSP/LVSP ratio in the period of pre-hospital discharge were compared with their periods of follow-up (Table 9).

Discussion

Tetralogy of Fallot (TOF) is progressive with an unfavourable outcome. Progressive untreated

Table 5. Early major postoperative complications in 8 patients

Type of complication	Number of patients
Low cardiac output	8
Renal failure	1
Reoperation from bleeding	2
Pneumonia	1

Low cardiac output in this study was refered to cardiovascular failure that had prolonged inotropic support (> 5 mcg/kg/min) which presented in clinical of hypotension (systolic blood pressure < 90 mmHg), low urinary output (< 1 cc/kg/hr) and signs of inadequate tissue perfusion

Table 6. Postoperative data

Variable	RVSP/LVSP 0.5 or less (n = 18)	RVSP/LVSP more than 0.5 (n = 13)	p value
Presence of low cardiac output (No. of patients)	2	6	0.043
Median ICU stay (hours)	57.5 (range, 21 to 92)	46 (range 18 to 409)	0.548
Inotropic support $\geq$ 5 mcg/kg/min (> 48 hours) (No. of patients)	4	11	<0.01
Median ventilation support time (hours)	9 (range, 2 to 44)	21 (range, 4 to 242)	0.052

Table 7. Summary of pre-hospital discharge echocardiography data

RVSP	Mean: 44.2 ± 12.6 mmHg	Median: 45 mmHg	
Pulmonary insufficiency			
Degree	Mild	Moderate	Severe
No. of patients (%)	19 (61.3%)	6 (19.4%)	6 (19.4%)
Tricuspid insufficiency			
Degree	None-Mild	Moderate	Severe
No. of patients (%)	25 (80.6%)	6 (19.4%)	0 (0%)
RV function	Normal	Mild impairment	Moderate impairment
No. of patients (%)	21 (67.7%)	8 (25.8%)	2 (6.5%)

Table 8. Follow-up clinical and echocardiography data

NYHA class	I	II	III
No. of patients (%)	29 (93.5%)	2 (6.5%)	0 (0%)
Arrhythmias	None		
RVSP	Mean: 34.9 ± 11.2 mmHg	Median: 30 mmHg	
Pulmonary insufficiency			
Degree	Mild	Moderate	Severe
No. of patients (%)	24 (77.4%)	4 (12.9%)	3 (9.7%)
Tricuspid insufficiency			
Degree	None-Mild	Moderate	Severe
No. of patients (%)	23 (74.2%)	7 (22.6%)	1 (3.2%)
RV function	Normal	Mild impairment	Moderate impairment
No. of patients (%)	25 (80.6%)	6 (19.4%)	0 (0%)

Table 9. Comparison of RVSP and RVSP/LVSP ratio in among of pre-hospital discharge and follow-up period

Mean of RVSP and RVSP/LVSP ratio	Pre-hospital discharge	Follow-up	p-value
All patients (n = 31)			
RVSP (mmHg)	44.2 ± 12.6	34.9 ± 11.2	<0.005
RVSP/LVSP ratio	0.53 ± 0.16	0.36 ± 0.11	<0.005
Patients with RVSP/LVSP ratio ≤ 0.5 (n = 18)			
RVSP (mmHg)	36.1 ± 7.7	33.0 ± 11.9	>0.05
RVSP/LVSP ratio	0.42 ± 0.07	0.33 ± 0.1	<0.005
Patients with RVSP/LVSP ratio > 0.5 (n = 13)			
RVSP (mmHg)	55.4 ± 8.9	37.5 ± 10.1	<0.005
RVSP/LVSP ratio	0.69 ± 0.11	0.39 ± 0.12	<0.005
Patients with low cardiac output (n = 8)			
RVSP (mmHg)	53.8 ± 10.9	33.1 ± 9.6	<0.005
RVSP/LVSP ratio	0.66 ± 0.15	0.34 ± 0.11	<0.005

hypoxemia, hypoxic spells, RV dysfunction and endocarditis are major causes of morbidity and mortality[5]. However, early and late results of surgical repair have steadily improved[5,9,10] and recently many centers have reported a low operative mortality ranging from 0% to 7%[10], as confirmed in the present study.

There is no doubt that primary repair without palliative intervention is preferable if this can be achieved safely[11]. Now, the trend is for surgical repair of TOF at an early age. Many centers now report good early results with neonatal and early infant repair[9,12]. The classic approach of a two-stage repair with initial shunting, later followed by complete repair, has been associated with excellent results and long-term survival[13]. In the present study, the authors performed both primary and two-stage repair. No patient under 1 year of age received surgical repair by the authors' team, because the authors have less experience in surgical techniques and limitations of postoperative care in this age group.

The presented mortality rate of 0% for complete repair compares very favourably with the reported mortality for this congenital defect, however there was only a small number of patients in the present study. The median ventilation time, ICU stay and hospital stay in the present study were similar to many previous studies[12,14,15].

Despite excellent early results, late RV dysfunction, PI and ventricular dysrhythmias have been reported[16-19]. These adverse outcomes are usually related to the length of ventriculotomy required during TAP repair of TOF[18-20]. In the present study, the authors avoided right ventriculotomy and/or extended (> 1 cm from pulmonary valve annulus) transannular incision to obtain a sufficient RVOT diameter, and possibly due to this, there were no hazardous ventricular dysrhythmias in the present study.

The RVSP/LVSP ratio of 0.5 or more was predictive of higher morbidity and mortality after repair[1], with survival among patients with ratio less than 0.5 and 0.5 or more 94 and 88 percent respectively[1]. The authors found a significant difference ($p < 0.05$) in the number of presence of low cardiac output and prolonged inotropic support patients between groups of RVSP/LVSP ratio of 0.5 or less and more than 0.5. However, there seemed to be a rather significant difference ($p = 0.052$) in ventilation time between these groups, and more patients are needed for more accurate statistical results. The small number of patients and unusual distribution of patients' data may be a cause of non-significant difference in ICU stay of the two groups.

There appears to be consensus that postoperative RVSP/LVSP ratio in excess of 0.85 is not acceptable and revision of RVOT repair is advisable in such case[21-23]. There was one patient in the present study who had pre- and postoperative RVSP/LVSP ratios of 1.62 and 0.89, respectively. This patient had not received revision of RVOT repair, due to: **(a)** easy to wean off CPB; **(b)** good RV contractility; **(c)** no evidence of more than mild TI; and **(d)** end tidal capnography showed good pulmonary blood flow, the postoperative course was uneventful with a further significant fall in RVSP/LVSP ratio on predischarge echocardiography.

The present study reported a relatively high incidence of insertion of TAP, in 17 (54.8%) patients, which reflects the authors' effort to adequately relieve RVOTO. This resulted in obtaining a mean RVSP/LVSP ratio of 0.53, with the highest being 0.89, and this may have been the cause of severe postoperative PI (19.4%) in the present study. If the authors had accepted a higher RVSP/LVSP ratio (more than the mean value in this study), the frequency of TAP would have been lower, and this may have reduced the incidence of PI and the need for further pulmonary valve intervention in the future. The authors need a higher number of repairable patients to decide on an appropriate RVSP/LVSP ratio as our protocol, based on adequately relieving RVOTO, and minimizing postoperative PI and ventricular dysfunction.

Overall, specifically, during early follow-up, there was significantly lower RVSP and RVSP/LVSP ratio and pulmonary valve insufficiency did not progress. From this existence data, the authors can explain that all of the presented patients have some dynamic RVOTO. Because the hypercontractile state of RVOT, which exists in the postbypass period, usually as a result of inotropes and hypovolumia, tends to exaggerates systolic clamping of RVOT and RVSP. Thus, significant RVSP and RVSP/LVSP ratio may be generated in the postbypass period even in the presence of an adequate RVOT. In the course of time, remodelling of the RVOT occurs, the free wall of RV become stretched out and less hypercontractile, and hence the RVSP and RVSP/LVSP ratio fall. In the present study, the authors had 6 patients with the presence of low cardiac output in the group of patients with postoperative RVSP/LVSP more than 0.5 ($n = 13$). To circumvent this problem, the authors think a combination of parameters should be used, which includes: (1) Adequate degree of resection, including the ability to pass an adequate sized Hegar dilator across the RVOT; (2)

Intraoperative post-repair RVSP/LVSP ratio measurement, if this high (more than 0.5), the surgeon should be comfirmed this occurs from dynamic or fixed obstruction, which can be evaluated by intraoperative echocardiography; and (3) Hemodynamic stability. Thus, even in the patients who had postoperative RVSP/LVSP ratio more than 0.5 and surgeons impression of adequate RVOT correction, may be have dynamic obstruction, the authors recommend early diagnosis and management of the possible presence of low cardiac output, which usually improves by appropriate inotropic drugs supportation and a good postoperative care team.

Conclusion

The results of complete repair of TOF in the present study show acceptable morbidity, mortality and overall clinical outcome at early follow-up. The presence of low cardiac output and prolonged inotropic support are significantly associated with postoperative RVSP/LVSP ratio of more than 0.5. Further studies will be necessary to ascertain an appropriate postoperative RVSP/LVSP ratio for our operative strategies.

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ผลการผ่าตัดแก้ไขแบบสมบูรณ์ในผู้ป่วย Tetralogy of Fallot โดยใช้ค่าสัดส่วนระหว่างความดันในหัวใจเวนตริเคิลขวาและซ้ายหลังการผ่าตัดเป็นปัจจัยทำนาย

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ที่มา: *การผ่าตัดรักษาผู้ป่วย Tetralogy of Fallot (TOF) ได้มีวิวัฒนาการ และมีผลการผ่าตัดที่ดีทั้งในระยะแรกและระยะยาวภายหลังการผ่าตัดแก้ไขแบบสมบูรณ์*

วัตถุประสงค์: *เพื่อศึกษาผลการผ่าตัดในระยะแรกโดยประเมินจากปัจจัยระหว่างการผ่าตัดและการติดตามผล โดยให้ความสนใจศึกษาถึงสัดส่วนระหว่างความดัน systolic ในหัวใจห้องล่างขวาและหัวใจห้องล่างซ้าย (RVSP/LVSP) ที่มีผลต่อการเกิดภาวะ ปริมาณเลือดฉีดออกในหัวใจน้อย ระยะเวลาในหออภิบาลผู้ป่วย (ICU) ระยะเวลาการใช้ยา inotrope และระยะเวลาการใช้เครื่องช่วยหายใจหลังการผ่าตัด*

รูปแบบการศึกษา: *การศึกษาเชิงวิเคราะห์เปรียบเทียบแบบย้อนหลัง*

วัสดุและวิธีการ: *ระหว่างเดือนมิถุนายน พ.ศ. 2545 ถึงเดือนสิงหาคม พ.ศ. 2547 มีผู้ป่วย TOF ที่เข้ารับการ ผ่าตัดรักษา 31 ราย อายุเฉลี่ย 7.7 $\pm$ 5.1 ปี เพศหญิง 15 ราย (ร้อยละ 48.4) ผู้ป่วย 14 ราย (ร้อยละ 45.2) ได้รับการผ่าตัดแบบประคับประคอง (palliative shunt) ก่อนการผ่าตัด ผู้ป่วย 23 ราย (ร้อยละ 74.2) มี NYHA FC II ความเข้มข้นของเลือดเฉลี่ย 50.9 $\pm$ 10.25 เปอร์เซ็นต์ ระดับความเข้มข้น oxygen เฉลี่ย 80.5 $\pm$ 8.6 เปอร์เซ็นต์ ค่าเฉลี่ยของ RVSP/LVSP ก่อนผ่าตัด 1.1 $\pm$ 0.15 วิธีการ ผ่าตัดที่ใช้ คือ transatrial / transpulmonary ผู้ป่วย 17 ราย (ร้อยละ 54.8) ได้รับการทำ transannular patch และผู้ป่วย 3 ราย(ร้อยละ 4.7) ที่มี pulmonary atresia ได้รับการทำทาง ต่อเชื่อมเทียมนอกหัวใจ (extracardiac valve conduit)*

ผลการศึกษา: *ไม่มีผู้ป่วยเสียชีวิตหลังผ่าตัด ผู้ป่วย 2 ราย (ร้อยละ 6.5) ได้รับการผ่าตัดซ้ำเนื่องจากภาวะ cardiac tamponade ค่าเฉลี่ยของ RVSP/LVSP หลังผ่าตัด 0.53 $\pm$ 0.16 ระยะเวลาเฉลี่ยการอยู่ในโรงพยาบาลและ ICU 11 และ 2.2 วัน ตามลำดับ การเกิด low cardiac output และระยะเวลาการใช้ยา inotrope มีความสัมพันธ์กับค่า RVSP/LVSP ที่มากกว่า 0.5 อย่างมีนัยสำคัญ ที่ระยะเวลาเฉลี่ย 6 เดือนในการติดตามผู้ป่วย พบว่าผู้ป่วย 29 ราย (ร้อยละ 93.5) ไม่มีอาการและผู้ป่วยทุกรายไม่มีพยาธิสภาพที่ต้องได้รับการผ่าตัดแก้ไขเพิ่มเติม*

สรุป: *ผลการผ่าตัดในระยะแรกมีการเกิดภาวะทุพพลภาพในอัตราที่ต่ำ ค่าของ RVSP/LVSP หลังการผ่าตัดที่มากกว่า 0.5 มีความสัมพันธ์อย่างมีนัยสำคัญกับผลการผ่าตัดในทางลบ การติดตามผลการผ่าตัดในระยะยาวอย่างต่อเนื่องทำให้ทราบถึงผลแทรกซ้อนที่อาจเกิดขึ้นต่อไปได้*