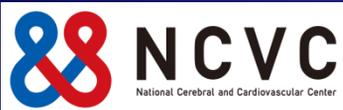# Preoperative dilatation of the right pulmonary artery is a risk factor for refractory respiratory complications late after the definitive repair of Tetralogy of Fallot with absent pulmonary valve

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Background

Refractory respiratory complication is not a rare condition late after definitive surgery of Tetralogy of Fallot with absent pulmonary valve (TOF/PVA).

Here we evaluated perioperative risk factors for the post-operative respiratory complications in TOF/PVA patients.

Enrolled patients

Twenty-one TOF/PVA cases who had underwent the definitive repair at our institute from 1/1/1987 to 31/12/2012.

Patient profiles

Sex (male : female)	8 :13
Age at definitive repair	26d to 10y (median 10.5months)
- neonate (～30days)	4 (14%)
- infant (～12 months)	11 (53%)
- child (1 year～)	7 (33%)
Pre-operative catheter exam.	18 (86%)
Operative details	
- with plication of PAs	19 (90%)
- type of RVOTR	valved conduit （VPR) 5 (24%) monocusped patch (TAP) 16 (76%)
Pre-operative respiratory failure	15 (71%) *all neonates or infants
- need for mechanical ventilation	9 (43%)
Post-operative catheter exam.	18 (86%)

Definition of 'clinically significant' respiratory complication in this study

1. repeated admission from respiratory infection
2. mechanical ventilation over one month

Method

· Retrospectively perioperative clinical indices were analyzed from the medical record.
·Included indices: sex, age, body weight, body surface area(BSA), cardio-thoracic ratio(CTR), days at definitive operation, type of operation (with/without plication of pulmonary arteries, type of RVOTR), hemodynamic values from cardiac echocardiography and catheter examination at preoperative and postoperative periods.
·Each pulmonary arterial index(PAI) is also evaluated.

RPAI (right PAI) is calculated as below:
$$RPAI = \pi(3.14) \times (RPA\ diameter(mm)\ /2)^2/BSA$$
*RPA diameter was measured by angiogram or echocardiography
LPAI(left PAI) was calculated same as RPAI.

Results
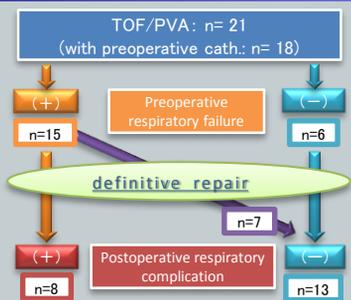
- Overall Persistent respiratory complication : 8/21 (38%)
- Postoperative respiratory complication in the cases of preoperative respiratory failure : 8/15 (53%)

Survival curve
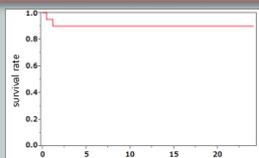
2 deaths: perioperative 1 (respiratory tract infection)
late 1 (sudden death at home)

Fig. 1: Preoperative factors for post-operative respiratory complication

Post-operative respiratory complication	+(n=8)	-(n=13)	P
Preoperative respiratory failure (+ : -)	8 : 0	7 : 6	0.04
Preoperative respiratory rate	32±11	30±8	n.s.
Preoperative CTR	62.1±5.6	60.3±1.1	n.s.
Sex (male:female)	2:4	3:9	n.s.
Body weight at definitive surgery	3.9±1.2	6.9±3.9	0.02
Preoperative echocardiographic indices			
LVDd % of normal	76.0±14.1	83.5±8.3	n.s.
LVEF (%)	73.4±5.8	64.5±32.4	n.s.
PA flow (m/s)	4.00±0.79	4.12±0.67	n.s.
PR flow (m/s)	2.20±0.34	2.43±0.49	n.s.
RPAI (from 2DE)	817±346	704±201	n.s.
LPAI (from 2DE)	668±450	651±388	n.s.
Preoperative cardiac catheterization indices	(n=6)	(n=12)	
LVEDV% of normal	107.0±41.9	123.5±27.8	n.s.
LVEF (%)	69.4±11.3	62.5±11.0	n.s.
RVEDV% of normal	174.8±97.2	163.8±62.6	n.s.
RVEF (%)	65.2±10.9	60.0±10.2	n.s.
CI (L/min/㎡)	3.04±0.76	3.87±0.30	n.s.
Rp (Wood U·㎡)	0.91±0.39	1.83±0.83	0.02
RPAI	1654±298	942±272	0.03
LPAI	1472±791	820±555	n.s.
mean RAP(mmHg)	4.0±3.4	2.9±2.1	n.s.
mean PAP(mmHg)	14.6±4.3	13.6±2.7	n.s.
systolic PAP(mmHg)	22.6±5.9	21.8±3.5	n.s.
RVEDP(mmHg)	5.4±3.5	6.5±2.3	n.s.
RVSP(mmHg)	86.1±15.3	74.8±10.8	n.s.
LVEDP(mmHg)	6.0±2.3	7.1±3.2	n.s.

Fig. 2: Operative/post-operative factors for post-operative respiratory complication

Post-operative respiratory complication	+(n=7)	-(n=13)	P
Operative factor			
type of RVOTR	VPR2:TAP5	VPR2:TAP11	n.s.
plication of pulmonary arteries (with : without)	6:1	12:1	n.s.
Post operative cardiac catheterization indices	(n=6)	(n=12)	
RVEDV % of normal	140±41	148±68	n.s.
RVEF(%)	57.5±8.2	51.0±10.8	n.s.
LVEDV % of normal	121±25	111±29	n.s.
LVEF(%)	64.8±7.8	66.3±9.9	n.s.
RPAI	365±113	385±163	n.s.
LPAI	449±308	406±268	n.s.
PS△p (mmHg)	9±12	26±40	n.s.
mean RAP (mmHg)	5.6±3.2	4.3±2.5	n.s.
RVEDP (mmHg)	5.2±3.3	4.9±2.2	n.s.
CI (l/min/㎡)	3.41±0.75	3.66±1.39	n.s.
Rp (WoodU·㎡)	4.09±1.50	2.70±1.70	n.s.

Summary of Results

From Fig. 1
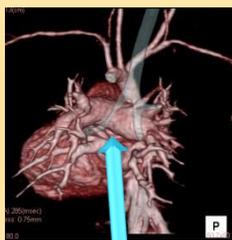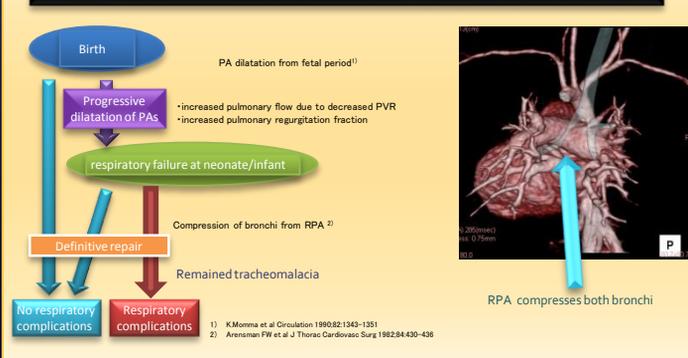Postoperative respiratory complication is correlated with
1) Pre-operative respiratory failure
2) Smaller body weight
3) Pre-operative RPAI from cardiac catheterization
4) Pre-operative Rp
※ No significant correlation with preoperative echo-cardiographic indices

From Fig. 2
·Postoperative respiratory complication had no significant correlation with postoperative cardiac catheterization data
·Type of operation was not correlated with postoperative respiratory complication.

Discussion

PA dilatation from fetal period[1]

·increased pulmonary flow due to decreased PVR
·increased pulmonary regurgitation fraction

Compression of bronchi from RPA [2]

Remained tracheomalacia

RPA compresses both bronchi

1) K.Momma et al Circulation 1990;82:1343~1351
2) Arensman FW et al J Thorac Cardiovasc Surg 1982;84:430~436

Conclusion

- The postoperative respiratory complications were correlated to body weight, the preoperative respiratory failure, the dilatation of the right pulmonary artery from angiogram and decreased pulmonary vascular resistance.

- The post-operative outcomes could be improved by earlier surgical interventions before pulmonary vascular resistance decrease and marked dilatation of the right pulmonary artery develops.