

# **Pregnancy outcomes in women after an arterial switch operation for transposition of the great arteries**

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# Introduction

- The arterial switch operation (ASO) has replaced the atrial switch operation and has become the standard operation for improving the survival and quality of life of patients with TGA.
- Many women with TGA, wishing to have children, are now expected to reach childbearing age.
- The purpose of this study was to determine the risk of a pregnancy with TGA repaired by ASO.



# Methods

Study design : retrospective cohort study

Population : 11 pregnancies in 8 women after ASO  
between 2006-2015 at our hospital

Reviews of records

Clinical status, echocardiography, and plasma BNP level

Main outcomes

## Adverse maternal cardiovascular events

- arrhythmia : need medical therapy
- heart failure : lower oxygen saturation with pulmonary edema
- deteriorated NYHA function class
- coronary event: chest pain and/or ST change in electrocardiography

Obstetrical events

Neonatal events

# Results

## Baseline clinical characteristics

Type	Prior palliation	Age at ASO	Re-intervention Since ASO	NYHA	Cardiac finding	Arrhythmia	Coronary artery disease	Medication	
A	2	—	11M	Right -sided	I	PR mod	-	-	-
B	1	BAS	3M	—	I	PS mod	-	-	-
C	1	BAS, PAB, ltBTS PDA ligation	6M	—	I	-	-	-	-
D	2	BAS PAB, lt BTS	11M	—	I	Aortic root dilation (54mm) AR mod, PR mod	-	-	Carvedilol
E	2	BAS	12M	Left -sided	I	MR mod, AR mod residual VSD	-	-	Diuretics
F	2	BAS	5M	Right -sided	I	-	-	-	-
G	1	BAS	6D	Right -sided	I	-	-	-	-
H	1	BAS	15D	Right -sided	I	-	-	-	-

A, B, C, E complicated with cardiovascular events in pregnancy and/or postpartum

# Obstetric outcomes / events

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Mean maternal age (years)	25.3 ± 5.3
Miscarriage	0
Parity status 1 / 2 / 3	5 / 2 / 1
Twin pregnancy	1
Obstetric events	
Pregnancy-induced hypertension	1 (9%)
Threatened premature delivery	1 (9%)
Fetal growth restriction	2 (18%)
Postpartum hemorrhage	1 (9%)
Mean gestational week of delivery (weeks)	37.6 ± 1.8
Mode of delivery	
Vaginal	6 (55%)
Cesarean section	5 (46%)
Indication: Cardiac / Obstetric	2 (40%) / 3 (60%)

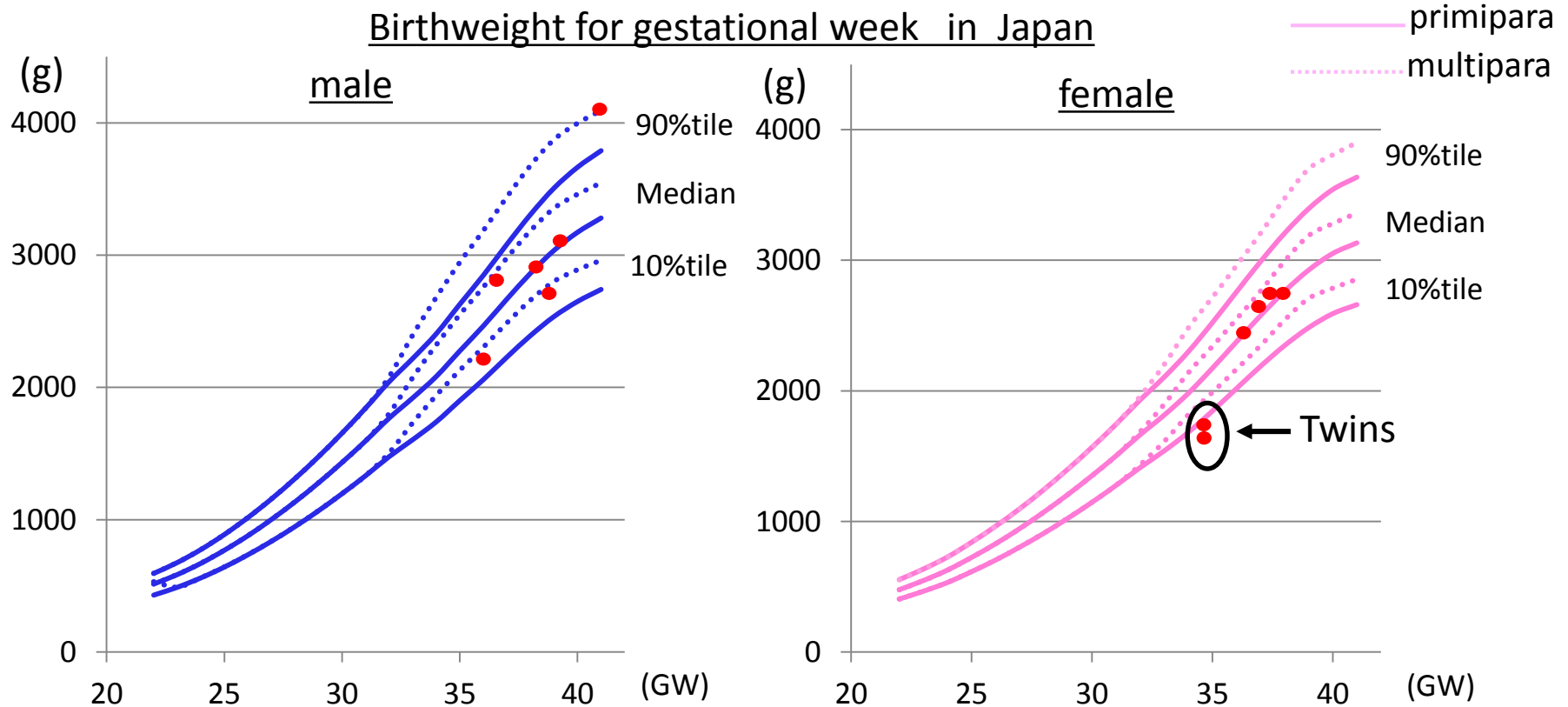
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# Neonatal Outcomes in 12 babies

Neonatal birth weight (g) 2598 ± 616

## Neonatal events

Preterm birth ( <37weeks )	3 (25%)
Very preterm birth ( <34weeks)	0
Small - for-gestational age	4 (36.4%)
Heavy -for-gestational age	1 (8.3%)
Transient tachypnea of neonate	2 (16.7%)
Congenital heart disease	0



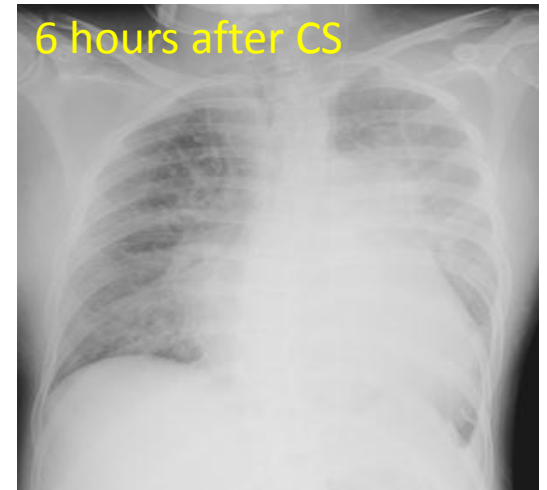
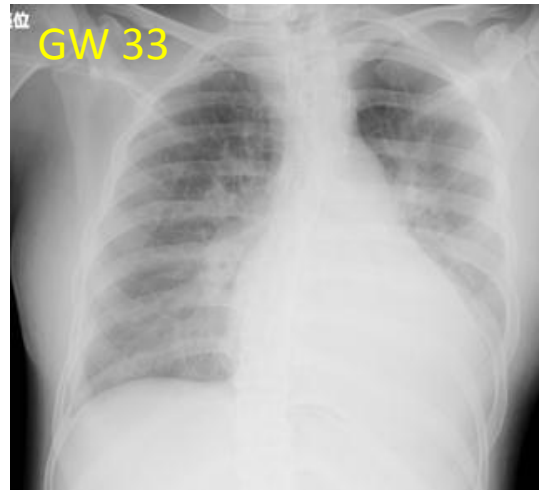
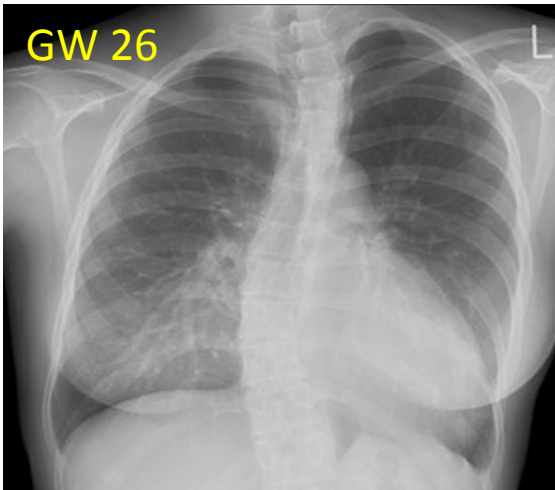
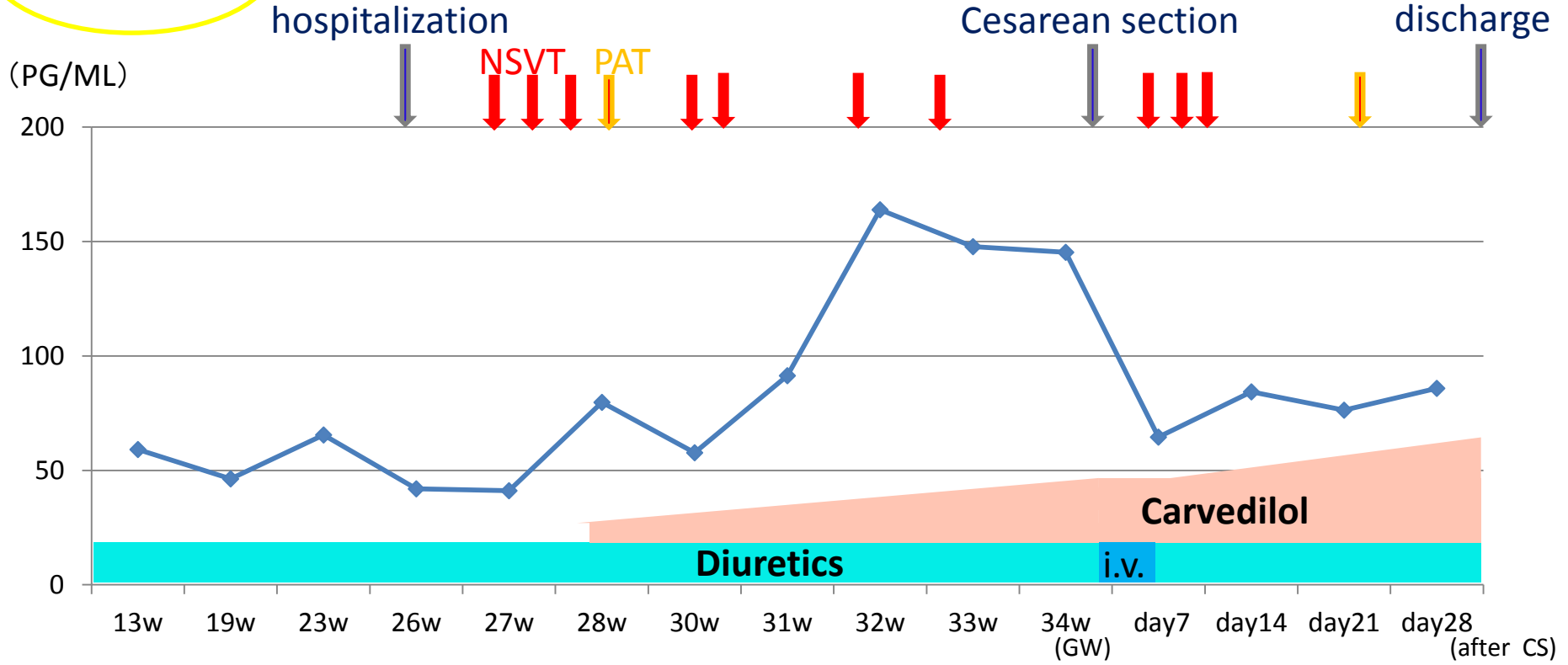
# Overview of pregnancies with cardiovascular events

	Gestational Weeks	Event	Treatment
A	24 postpartum	NSVT increased PVC	Start Carvedilol Carvedilol ↑
B	37	NSVT	rest (asthma +)
C	post	Pulmonary edema	Diuretic
	28 31	NSVT Atrial tachycardia	Start Carvedilol Carvedilol ↑
E	post	Pulmonary edema NSVT	Diuretics ↑ Carvedilol ↑ ACE-I

# Case E

twin pregnancy

## Serial BNP levels and the cardiovascular events

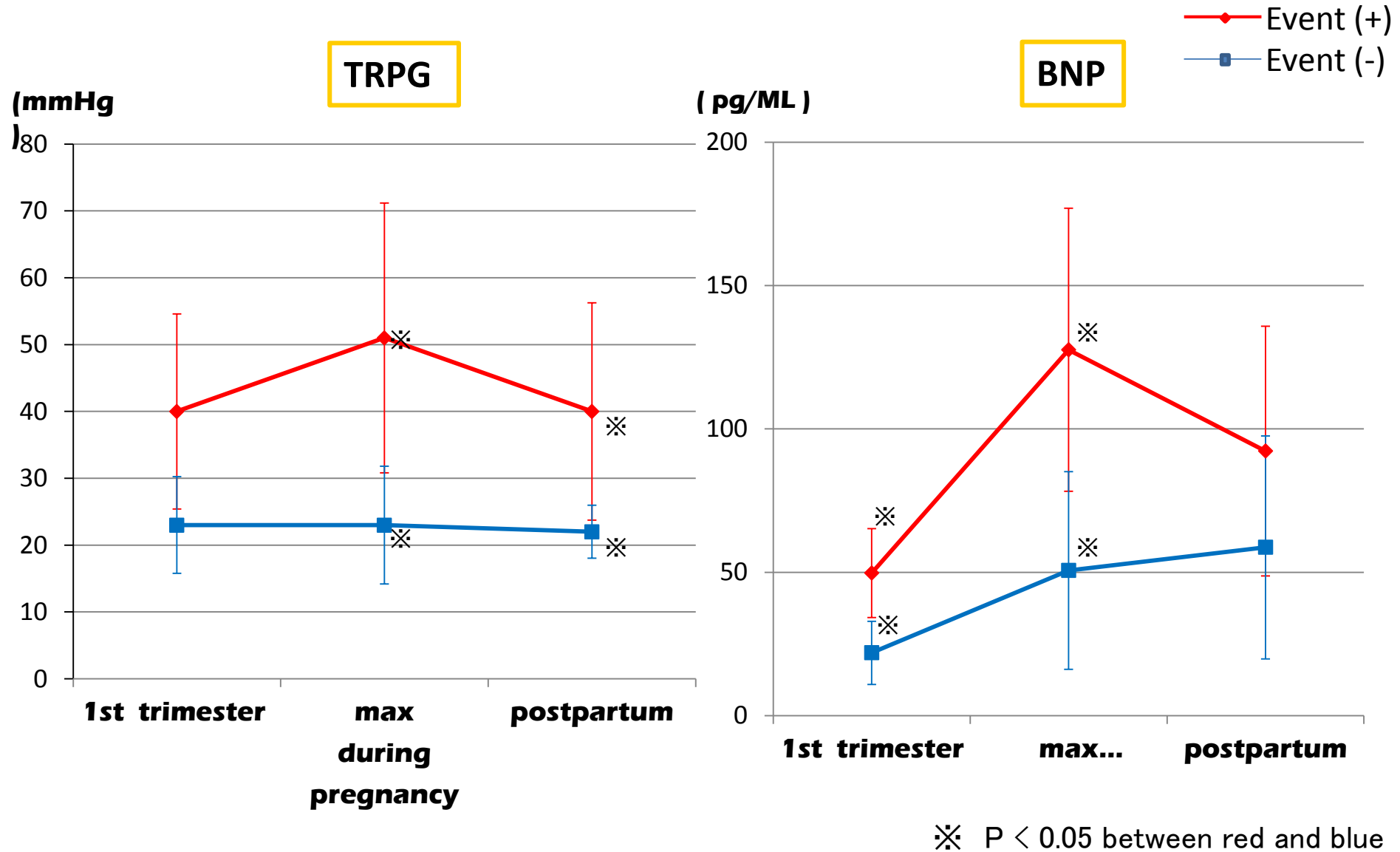




# Risk factors for cardiovascular events

	Event ( + ) (n=4)	Event ( - ) (n=7)	P-value
TGA type 1	2	6	
type 2	2	1	ns
Re-operation post ASO	2	5	ns
Cardiac medications before pregnancy	1	1	ns
Twin pregnancy	1	0	ns
Tricuspid valve regurgitation $PG \geq 30$ mmHg during pregnancy	4	1	0.015
Aortic valve regurgitation (moderate/severe)	1	1	ns
Neo-aortic root dilatation ( > 40mm)	2	1	ns
Pulmonary valve regurgitation(moderate/severe)	1	1	ns
Left ventricular end-diastolic diameter( $\geq 50$ mm) during pregnancy	4	2	ns
BNP $\geq 30$ pg/ML in 1 <sup>st</sup> trimester	4	1	0.015

# Serial TRPG and BNP levels in pregnancies with and without cardiovascular events



# Long-term follow-up after pregnancy (3– 120 months)

	No. Pregnancy	NY HA	Coronary artery disease	PS		PR		AR		Aortic root dilatation	
				before	after	before	after	before	after	before	after
A	1	I	-	-	-	Mod.	Severe	-	-	-	-
B	1	I	-	Mod.	Mod.	-	-	-	-	-	-
	2	I	-	Mod.	Mod.	-	-	-	-	-	-
C	1	I	-	-	-	-	-	-	-	-	-
D	1	I	-	-	-	Mod.	Mod.	-	-	+	+
										54mm	54mm
E	1	I	-	-	-	-	-	Mod.	Mod.	-	-
G	1	I	-	-	-	-	-	-	-	-	-
H	1	I	-	-	-	-	-	-	-	-	-
	2	I	-	-	-	-	-	-	-	-	-
	3	I	-	-	-	-	-	-	-	-	-

- ; abscent or mild

Case F was excluded because the last examinaton was performed at 3 days postpartum

# Discussion – Reviews of previous reports –

	Arterial switch operation		Atrial switch operation ( Mustard/Senning)					
	Horiuchi 2016	Tobler 2010	Guédès 2004	Drenthen 2005	Metz 2011	Doninica 2012	Trigas 2014	Cataldo 2015
n (women/pregnacy )	<b>8/11</b> <b>(twin 1)</b>	9/13	16 / 28	-/49 (twin 2)	10/14	19/43 (twin 1)	34/44	34/21
Cardiac events								
deteriorated NYHA	<b>0</b>		7	17	2/14		7	
Arrhythmia	<b>3(27%)</b>	1	2	11	1	2	4	
Heart failure	<b>2 (18%)</b>	1	2	2	1	2 Death 1	5 Arrest 1	
Increased of TR	<b>0</b>	-	7/20	-	+	-	-	-
systemic ventricle dysfunction	<b>0</b>	2 (valve thrombus 1)	4/21	33%	89%			
Obstetric events								
PE /PIH /HELLP	<b>1</b>		1	10	1	1	1	1
FGR	<b>1</b>							5
PE / DVT				2				
Neonatal events								
premature labor	<b>3</b>	0	-	7	7	8	11	10
SGA ( < 10% )	<b>4</b>	1		11	-	-	5	10
IUFD	<b>0</b>	-		4	-	2	-	-
Long-term outcome								
valve lesions	<b>PR↑ 1</b> <b>(14%)</b>	PS ↑ 1	TR ↑ 2		-			TR↑ (33%)
systemic ventricular dysfunction		1	4			2 Death 1		(67%)
NHHA(↓)	<b>0</b>	-	2	(8.2%)	-		5	(14%)

# Conclusion

- ✓ Pregnancy after ASO was well-tolerated.
  - The most severe case was complicated with twin pregnancy; Such cases need special attentions.
- ✓ Neonatal outcomes were mostly good.
- ✓ Women with the RV hypertension or the higher plasma BNP levels in 1<sup>st</sup> trimester tended to have adverse cardiovascular events in the peripartum period.
- ✓ Pregnancy seems to have less adverse impact in women after ASO compared to women after atrial switch operation, who have the systemic right ventricle.