

## ***“Mama’s weak heart”***

# **Anesthetic approach to the pregnant patient with cardiac pathology**

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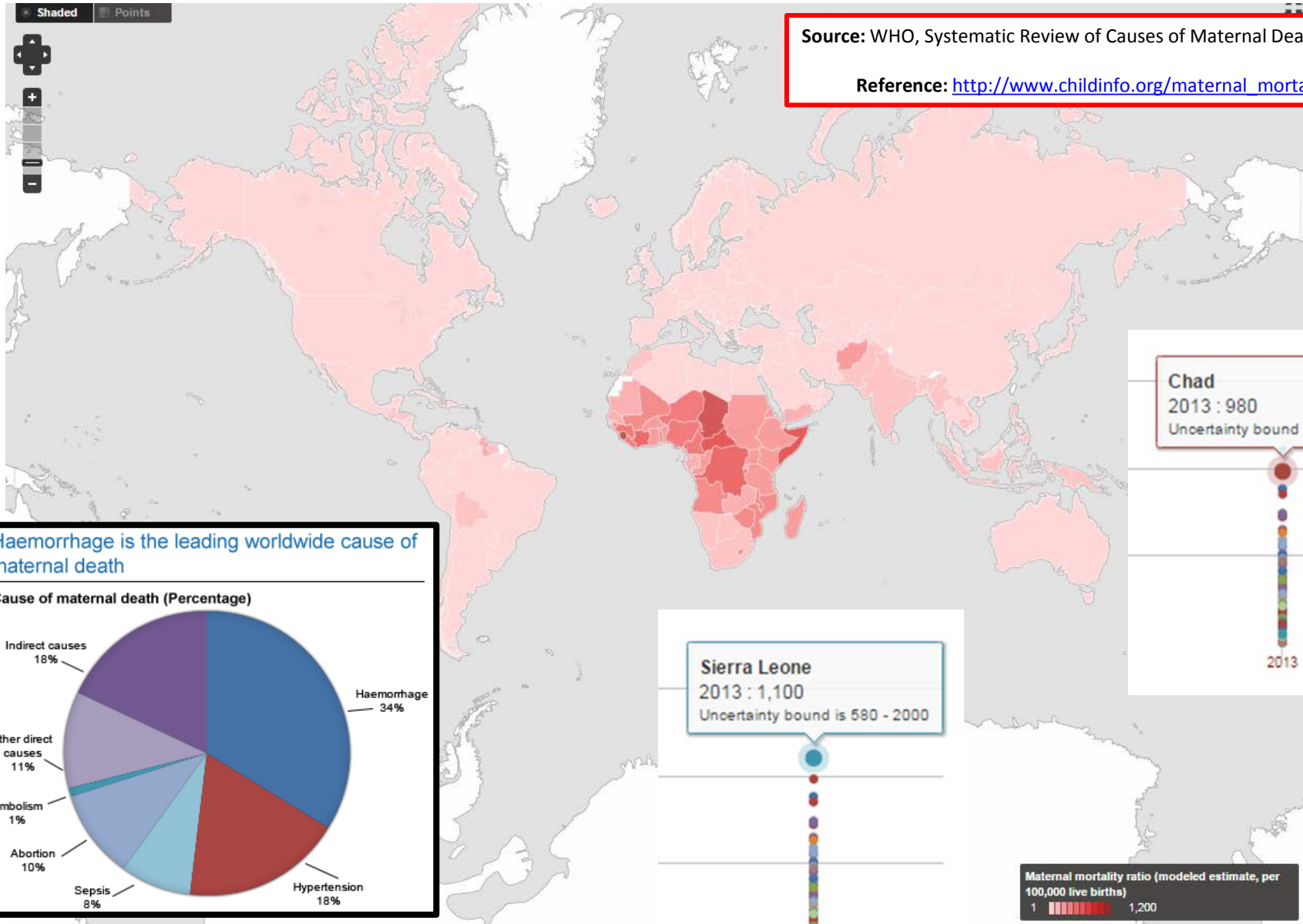


**16.000+6.000 labors annually**

**12% of caesarean sections  
53-56% epidural analgesia**

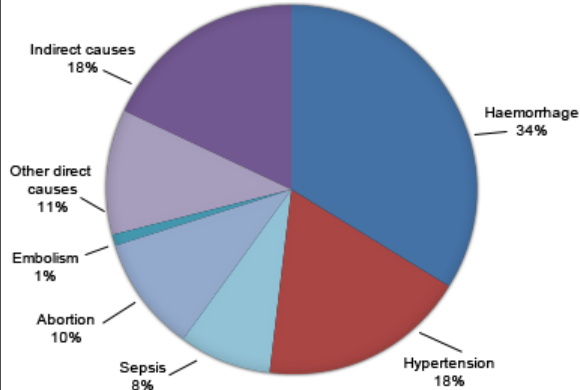
Source: WHO, Systematic Review of Causes of Maternal Death , 2010

Reference: [http://www.childinfo.org/maternal\\_mortality.html](http://www.childinfo.org/maternal_mortality.html)



### Haemorrhage is the leading worldwide cause of maternal death

Cause of maternal death (Percentage)



Maternal mortality ratio (modeled estimate, per 100,000 live births)

1 1,200

Knight M, Kenyon S, Brocklehurst P, et al. Saving Lives, Improving Mothers' Care: Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009–2012. 2014. MBRRACE.

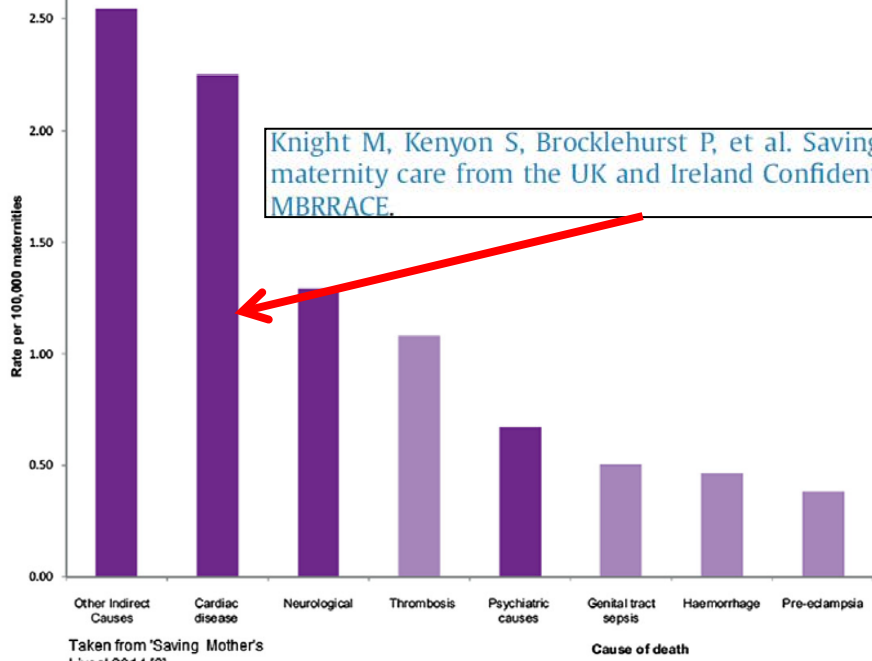
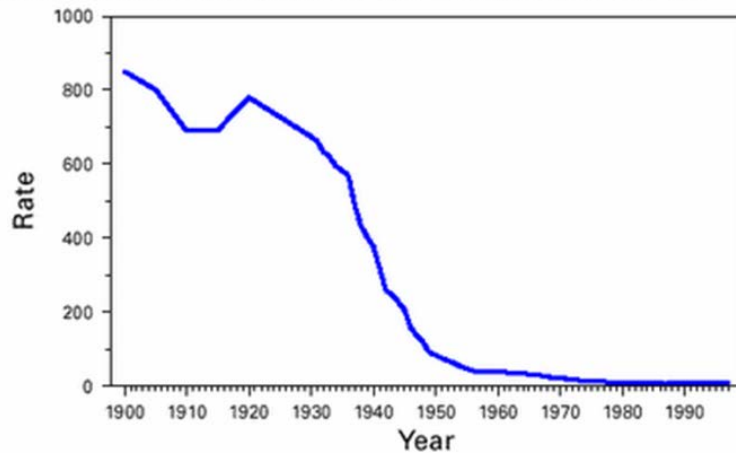


Fig. 1. Causes of maternal mortality.

TABLE 3 Indirect deaths reported to the Confidential Enquiry.

	1997–99	2000–02
Cardiac	35	44
Psychiatric	15	16
Malignancy	11	5
Other	75	90
<b>TOTAL</b>	<b>136</b>	<b>155</b>

FIGURE 2. Maternal mortality rate,\* by year — United States, 1900–1997



\*Per 100,000 live births.

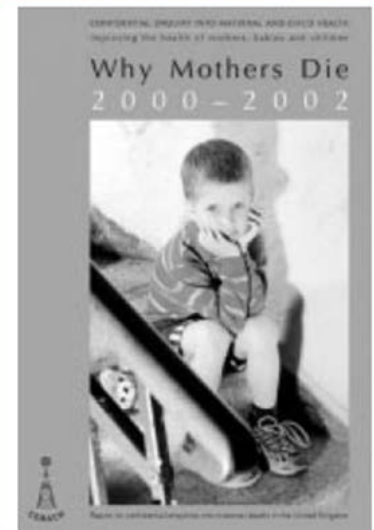
PAPER

J Obstet Gynaecol 2005; 32: 202–208  
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### Why mothers die

J Drake  
Department of Obstetrics and Gynaecology, University of Leeds, Leeds, England

ABSTRACT The UK maternal mortality rate is now 13.4 per 100,000 maternities. Published online May 2005



# Cardiac Disease in Pregnancy – 2015

Obstet Gynecol Clin N Am 42 (2015) 315–333

<http://dx.doi.org/10.1016/j.ogc.2015.01.012>

0889-8545/15/\$ – see front matter © 2015 Elsevier Inc. All rights reserved.

obgyn.theclinics.com

- Cardiac disease complicates approximately 4% of all pregnancies in the United States
- Maternal cardiac disease comprise up to 15% of obstetric ICU admissions
- These patients account for up to 50% of all maternal deaths in the ICU
- Risk for maternal deaths (<1% -10%–25%)

# What heart pathology we'll see more often?

## Congenital

- VSD and ASD
- Valvular disease
- Aortic coarctation
- Aortic dilatation: Marfan ,  
Loeys- Diets, Ehlers-Danlos and  
Turner's syndromes

## Acquired

- Rheumatic Valve Diseases
- Pulmonary Hypertension
- Coronary artery diseases
  - IHD or Vasculitis
- *s/p Repair of congenital abnormalities  
(Fontan procedure and others)*
- Peripartum Cardiomyopathy

**Congenital cardiac lesions are 3 times more common than acquired**



## Heart disease in pregnancy

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## Adult congenital heart disease and pregnancy

Shaline Rao, MD, and Jonathan N. Ginns, MD\*

Division of Cardiology, Columbia University Medical Center, New York, NY



# What should be our first “anesthetic” step?

Anaesthetists play a key role in the management of parturients with cardiac disease. Pregnant women with cardiac disease should be seen antenatally in a high-risk obstetric anaesthesia clinic, and a comprehensive management plan formulated.

## 153. An overview of a high risk obstetric anaesthetic clinic

**K.M.P. Salaunkey, D. Radhakrishnan, C. Mannakkara**  
Whipps Cross University Hospitals, London, UK

**Background:** Whipps Cross Hospitals is a large district general hospital in London, has a busy Obstetric unit catering to a cosmopolitan population with an increased incidence of high risk pregnancies. There are over 4500 deliveries conducted here per annum. The Department of Anaesthesia runs a high risk pregnancy clinic since 2002 in accordance with CEMAC regulations which came in later. We looked at the last hundred patients who attended the clinic approx 7 to 9 per week regarding their reason for referral, its

Cardiovascular symptoms/signs – 18%  
from all patients.

Second reason after Morbid obesity.



**Close communication with  
obstetricians !!!**

**Table** Summary of consultations seen by primary indication

Primary Condition	2001 (n = 419)	2006 (n = 428)	2011 (n = 522)	Total (n = 1,369)
Cardiac	75	91	102	268
Musculoskeletal	80	52	78	210
Hematologic	58	56	69	183
Brain/Spinal Cord	37	40	49	126

F. Bharwani, MD (✉) · A. Macarthur, MD  
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The three most common diagnoses for maternal referral across the three years were cardiac (19.7%; 95% CI: 17.6 to 21.9), musculoskeletal (15.5%; 95% CI: 13.6 to 17.5), and hematologic (13.5%; 95% CI: 11.6 to 15.3) (Table). Congenital cardiac disease (corrected or uncorrected cyanotic congenital heart disease, septal defects, coarctation of the aorta, other complex congenital cardiac disease with or without repair) represented 25-27% of cardiac patients and 5-7% of all consults seen at the clinic.

Can J Anesth/J Can Anesth (2014) 61:282–283  
DOI 10.1007/s12630-013-0094-5



CORRESPONDENCE

## Review of a high-risk obstetric anesthesia antepartum consult clinic

Fayaz Bharwani, MD · Alison Macarthur, MD





## Maternal mortality associated with pregnancy

### Group 1: Mortality less than 1%

- Atrial septal defect
- Ventricular septal defect
- Patent ductus arteriosus
- Mitral stenosis: NYHA classes I and II
- Pulmonic/tricuspid valve disease
- Corrected tetralogy of Fallot
- Bioprosthetic valve

### Group 2: Mortality 5% to 15%

#### 2A

- Mitral stenosis: NYHA class III and IV
- Aortic stenosis
- Coarctation of aorta without valvular involvement
- Uncorrected tetralogy of Fallot
- Previous myocardial infarction
- Marfan syndrome with normal aorta

#### 2B

- Mitral stenosis with atrial fibrillation
- Artificial valve

### Group 3: mortality 25% to 50%

- Pulmonary hypertension
  - Primary
  - Eisenmenger syndrome
- Coarctation of aorta with valvular involvement
- Marfan syndrome with aortic involvement
- Peripartum cardiomyopathy with persistent left ventricular dysfunction

**Clark 1987**

## NYHA functional classification system

Class I	No limitations of physical activity. Ordinary physical activity does not precipitate cardiovascular symptoms such as dyspnea, angina, fatigue, or palpitations
Class II	Slight limitation of physical activity. Ordinary physical activity precipitates cardiovascular symptoms. Patients are comfortable at rest
Class III	Less than ordinary physical activity precipitates symptoms that markedly limit activity. Patients are comfortable at rest
Class IV	Patients have discomfort with any physical activity. Symptoms are present at rest

*Adapted from* Clark SL, Phelan JP, Cotton DB, editors. Critical care obstetrics: structural cardiac disease in pregnancy. Oradell (NJ): Medical Economics Company; 1987.

**Conditions in which pregnancy risk is WHO class I: risk not significantly higher than the general population**

Uncomplicated small VSD, mild pulmonary stenosis, small PDA or mitral valve prolapse with <mild MR  
Successfully repaired simple lesions (secundum ASD, VSD, PDA, anomalous pulmonary venous connection)

**Conditions in which pregnancy risk is WHO class II–III (depending on the individual)**

Unoperated ASD

Repaired tetralogy of Fallot

Mild systemic ventricular impairment (ejection fraction <55%)

Native or tissue valvular heart disease not considered WHO I or IV

Marfan syndrome without aortic dilatation (aortic size <40 mm)

Aorta <45 mm in association with bicuspid aortic valve disease

Repaired coarctation of the aorta

**Conditions in which pregnancy risk is WHO class III: significantly increased risk of maternal morbidity and mortality compared with the general population**

Mechanical valve replacement

Systemic right ventricle (ie CCTGA, DTGA post Mustard or Senning)

Fontan circulation

Unrepaired cyanotic heart disease

Other complex congenital heart disease

Aortic dilatation 40–45 mm in Marfan syndrome

Aortic dilatation 45–50 mm in bicuspid aortic valve disease

**Conditions in which pregnancy risk is WHO class IV: extremely high risk of maternal morbidity and mortality; patients should be counseled against pregnancy**

Pulmonary arterial hypertension from any cause

Severe systemic ventricular dysfunction from any cause (ejection fraction <30%, NYHA class III–IV symptoms)

Severe mitral stenosis

Severe symptomatic aortic stenosis

Marfan syndrome with dilated aorta >45 mm

Bicuspid aortic valve disease with dilated aorta >50 mm

Native severe coarctation of the aorta

**Table 4** Predictors of maternal cardiovascular events and risk score from the CARPREG study<sup>12</sup>

Prior cardiac event (heart failure, transient ischaemic attack, stroke before pregnancy or arrhythmia).

Baseline NYHA functional class >II or cyanosis.

Left heart obstruction (mitral valve area <2 cm<sup>2</sup>, aortic valve area <1.5 cm<sup>2</sup>, peak LV outflow tract gradient >30 mmHg by echocardiography).

Reduced systemic ventricular systolic function (ejection fraction <40%).

CARPREG risk score: for each CARPREG predictor that is present a point is assigned. Risk estimation of cardiovascular maternal complications

0 point 5%  
1 point 27%  
>1 point 75%

LV = left ventricular; NYHA = New York Heart Association.



European Heart Journal (2011) 32, 3147–3197  
doi:10.1093/eurheartj/ehr218

**Table 5** Predictors of maternal cardiovascular events identified in congenital heart diseases in the ZAHARA and Khairy study

**ZAHARA predictors<sup>57</sup>**

History of arrhythmia event.

Baseline NYHA functional class >II.

Left heart obstruction (aortic valve peak gradient >50 mm Hg).

Mechanical valve prosthesis.

Moderate/severe systemic atrioventricular valve regurgitation (possibly related to ventricular dysfunction).

Moderate/severe sub-pulmonary atrioventricular valve regurgitation (possibly related to ventricular dysfunction).

Use of cardiac medication pre-pregnancy.

Repaired or unrepaired cyanotic heart disease.

**Predictors from Khairy<sup>76</sup>**

Smoking history.

Reduced subpulmonary ventricular function and/or severe pulmonary regurgitation.

NYHA = New York Heart Association.

**Conclusions:** The clinic helped anaesthetists to anticipate problems, develop a multidisciplinary approach towards solving them, plan their management in terms of personnel and equipment. The incidence of supermorbid obese women is increasing greatly in our community.

Drenthen W, Boersma E, Balci A, et al. Predictors of pregnancy complications in women with congenital heart disease. *Eur Heart J.* 2010;31(17):2124–2132 [PubMed PMID: 20584777].

**Mitral stenosis of rheumatic etiology is the commonest  
valvular heart disease in women of reproductive age**

especially in developing countries.

**USA, Brazil, Turkey, Senegal - 0.25-0.8% women population**

[Circulation](#). 2001 Jul 31;104(5):515-21.

**Table 3. Quantification of Mitral Stenosis**

	Mild	Moderate	Severe
Valve area (cm <sup>2</sup> )	>1.5	1.0–1.5	<1.0
Mean gradient (mmHg)	<5	5–10	>10

Reproduced from Baumgartner H, Hung J, Bermejo J, Chambers JB, Evangelista A, Griffin BP, Jung B, Otto CM, Pellikka PA, Quiñones M, American Society of Echocardiography, European Association of Echocardiography: Echocardiographic assessment of valve stenosis: EAE/ASE recommendations for clinical practice. *J Am Soc Echocardiogr* 2009; 22:1–23 with permission from Elsevier Inc.

**EDUCATION**

*Bruno Riou, M.D., Ph.D., Editor*

**Case Scenario: Cesarean Section Complicated by Rheumatic Mitral Stenosis**

Menachem M. Weiner, M.D.,\* Torsten P. Vahl, M.D.,† Ronald A. Kahn, M.D.‡

*Copyright © 2011, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins. Anesthesiology 2011; 114: 949–57*

**Severe Mitral Stenosis with NYHA III and IV  
Relate to Class 2A with  
Peripartum mortality rate 5-15%**

# TWO CASES OF MITRAL STENOSIS COMPLICATED BY PREGNANCY.

BY G. A. WILKES, M.D. BIRM., D.P.H. CONJ.  
Birmingham.

THE following cases of mitral stenosis, ending fatally after the first parturition, illustrate the danger which attends this form of heart disease during gestation and labour:

JAN. 17, 1903.]

MEMORANDA.

### Case 1.

Mrs. W., aged 23 years, first seen on April 6th, 1899, gave a history of rheumatism at 10 years of age. She had no knowledge of any subsequent heart disease, and enjoyed good health till a few days before I saw her. She was then in the seventh month of her first pregnancy, and was deeply cyanosed, suffering great dyspnoea, and expectorating blood-stained sputum. Moist râles were heard all over the chest, back and front. The cardiac impulse was in the fifth space, displaced a little horizontally, and accompanied by a presystolic thrill. There was epigastric pulsation. The superficial cardiac dullness began at the third rib. A presystolic murmur and snapping first sound were heard at the

### Case 2.

Mrs. B., aged 29 years, first seen on April 10th, 1899, had had rheumatic fever at 15 years of age. Her subsequent history was good till she became pregnant. She was ignorant of her heart disease. During her pregnancy she suffered from cough and shortness of breath on exertion, symptoms which became more marked as she approached full term.

Labour commenced on April 9th, 1899. She was attended by a midwife. On April 10th she gave birth to a full time child after a long and exhausting labour, which greatly increased her dyspnoea. When I saw her some hours after parturition, she was in much the same condition as Case 1—cyanosed, breathless, and expectorating bloodstained sputum. There

23-y old asymptomatic before pregnancy

Severe Mitral Stenosis 13 y after RF

Cyanosis, Tachycardia

Venesection was suggested but refused by the patient

Died 2h after the birth

29-y old asymptomatic before pregnancy

H/O RF at here 15 years

Cough, cyanosed, Pulse 120/min

Venesection was recommended, but rejected... Digitalis ...

Died 13 h after delivery

# *What was the goal of treatment for patients with Mitral Stenosis 110 years ago ?*

- Venesection - **Decrease in preload**
- Digitalis - **Relative bradycardia**



- **Beta blockers and Diuretics**
- **Restricted fluids management**
- **Prevention of Arrhythmias !!!**



# The goals for peripartum/perioperative anesthetic management of patient with MS

- Blood pressure monitoring (Invasive BP monitoring for severe MS)
- ECG ( lead II)
- Maintenance of an acceptable slow heart rate
- Immediate treatment of acute atrial fibrillation
- Avoidance of aortocaval compression
- Maintenance of adequate SVR
- Prevention of pain, hypoxia, hypercarbia and acidosis
- ***Early slow titrated epidural for VD***
- ***CSE or slow titrated epidural anesthesia for CS***
- ***Continuous spinal anesthesia***

## Review Article



### Mitral stenosis and pregnancy: Current concepts in anaesthetic practice

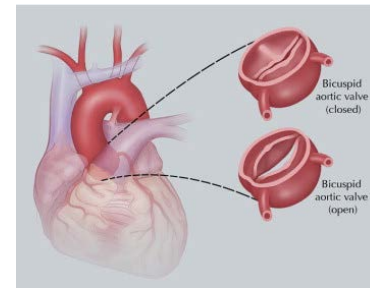
M Kannan, G Vijayanand

Department of Anaesthesia and Critical Care, Tirunelveli Medical College, Under Government of Tamilnadu, Tamil Nadu - 627 011, India

“Combined spinal-epidural analgesia is a useful technique for providing analgesia and maintaining haemodynamic stability in parturients with mitral stenosis”.

[Anaesth Intensive Care](#). 1999 Oct;27(5):

# Aortic stenosis – *was, is and will be.*



Bicuspid aortic valve (BAV) disease is the most common congenital heart defect, with a prevalence estimated between 0.5% and 2% . (1:3 female-male)

- **Fixed Stroke Volume**
- **Prevention decrease in Diastolic Pressure**
  - **Coronary Perfusion Pressure**
- **Keep HR !!!**
  - **Bradycardia – Low Cardiac Output (CO)**
  - **Tachycardia – Ischemic event**
  - **Atrial Fibrillation – No atrial kick and Low CO**
- 18y old
- 140kg
- Severe (Critical) AS - AVA ~0.5cm<sup>2</sup>
- Standard monitoring + IBP
- Continuous Slow Titrated Spinal for CS
- ICU
- Happy End!



# Aortic Stenosis and Pregnancy

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- [Use of esmolol in a parturient with hypertrophic obstructive cardiomyopathy.](#)  
61. Fairley CJ, Clarke JT.  
Br J Anaesth. 1995 Dec;75(6):801-4.  
PMID: 8672338 [PubMed - indexed for MEDLINE] **Free Article**  
[Related citations](#)
- [\[Cardiovascular diseases during pregnancy. Considerations for the anesthesiologist\].](#)  
62. Hess W.  
Anaesthesist. 1995 Jun;44(6):395-404. Review. German.  
PMID: 7653790 [PubMed - indexed for MEDLINE]  
[Related citations](#)
- [Epidural anesthesia for a parturient with critical aortic stenosis.](#)  
63. Colclough GW, Ackerman WE 3rd, Walmsley PM, Hessel EA.  
J Clin Anesth. 1995 May;7(3):264-5. No abstract available.  
PMID: 7669320 [PubMed - indexed for MEDLINE]  
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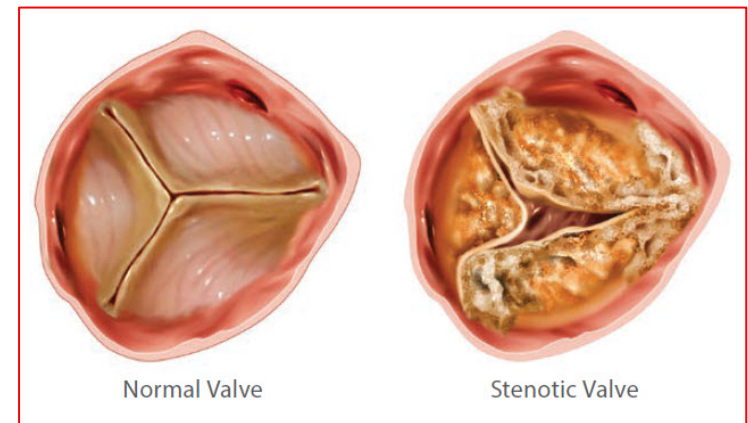
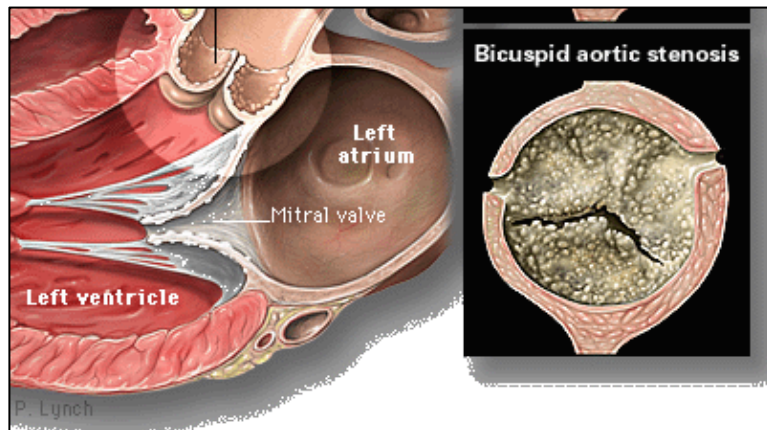
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# Anesthetic approach to patient with AS

Brighthouse D. Anaesthesia for Caesarean section in patients with aortic stenosis: the case for regional anaesthesia. *Anaesthesia* 1998;**53**:107–9.



Whitfield A, Holdcroft A. Anaesthesia for Caesarean section in patients with aortic stenosis: The case for general anaesthesia. *Anaesthesia* 1998;**53**:109–12.

**Table 2** Demographic data and peripartum management of our patients

Case #	Anesthesia		Hemodynamic Before and after anesthesia		Intrapartum fluids (mL)	Apgar scores (1/5 min)	Postoperative care and analgesia	Vasopressors and complications
	Type	Medications	Pre HR (bpm) BP (mmHg)	Post HR (bpm) BP (mmHg)				
1	Epidural	Bup 0.0625%+fent 2 µg/mL, 10mL/h +PCEA For vacuum: 2% lido 6mL	100 110/60	96 95/65	500	8/9	24 h HDU	
2	Epidural	Bup 0.0625%+fent 2 µg /mL, 10mL/h +PCEA	90 101/66	76 106/65	800	9/9	Delivery suite 4 h	
3	General	Thiopental 250 mg, fent 50 µg SCH 100mg, Isoflurane 0.8%	80 120/70	70 100/50	500	7/9	24 h HDU i.v. morphine	Failed epidural (no block)
4	Epidural	Bup 0.25%-5 mL; bup 0.08%+ sufentanil 1µg /mL – 9 mL/h	90 115/65	105 110/60	500	8/9	Delivery suite 6 h	
5	CSE	Spinal: bup 3 mg+ sufentanil 5µg  Forceps: 1.5% lido 13 mL	94 180/74	78 110/63	200	7/8	Delivery suite 6 h	
6	Epidural	Bup 0,5% 20 mL+ fent 100 µg for 20 min	115 145/98	105 140/90	300	8/9	24 h HDU Epidural morphine 4 mg	
7	i.v.	morphine 2 mg x 3	110 150/80	110 150/80	500	8/9	24 h HDU	
8	Epidural	1.5% lido 12 mL	110 140/70	100 120/60	150	8/9	24 h HDU	
9	Epidural	2% lido 20 mL+ fent 100 µg for 25 min	90 110/65	80 100/45	800	9/9	24 h HDU Epidural: morphine 4 mg	Ephedrine 25mg
10	Epidural	Ropivacaine 0.1%+ fent 2 µg/mL, 10 mL/h +PCEA; for vacuum, 2% lido 5 mL	128 97/51	115 82/48	500+ 3 uPC	6/8	24 h HDU Epidural: morphine 4 mg	PPH+ laceration Ephedrine 20 mg phenylephrine 200 µg
11	General	Etomidate 10 mg; succinylcholine 120 mg; remifentanil 300 µg	70 98/66	85 125/70	1000	8/9	48 h HDU i.v. morphine	
12	General+ spinal	Etomidate 10 mg; succinylcholine 100 mg; fent 100 µg			1000	9/9	24 h HDU	

bpm: beats/min; CSE: combined spinal-epidural; Bup: bupivacaine; lido: lidocaine; fent: fentanyl; HDU: high dependency unit

International Journal of Obstetric Anesthesia (2009) 18, 379–386  
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doi:10.1016/j.ijoa.2009.02.019ELSEVIER  
www.elsevier.com

CASE SERIES AND REVIEW

### Peripartum anesthetic management of patients with aortic valve stenosis: a retrospective study and literature review

A.M. Ioscovich, E. Goldszmidt, A.V. Fadeev, S. Grisaru-Granovsky, S.H. Halpern  
Departments of Anesthesia, Sunnybrook Health Sciences Centre, Mount Sinai Hospital, Toronto, Canada, and Shaare  
Zedek Medical Center, Jerusalem, Israel

Table 3 Review of peripartum anesthetic management of patients with aortic stenosis

Author year (reference)	Etiology and severity of AS	Mode of delivery	Anesthesia	Monitoring	Postpartum care	Complication and notes
Redfern 1987 <sup>4</sup>	MG 70 mmHg unknown etiology	Elective CS	General: etomidate +sch allentaniol +N <sub>2</sub> O/O <sub>2</sub> ; pancuronium, halothane			Apneic baby needed naloxone
Marron-Pena 1992 <sup>3</sup>	Rheumatic NYHA II cardiomegaly	NVD	Epidural: bup+fent for labor lid for forceps delivery			Discharged home after 24 h
Choi 1992 <sup>6</sup>	Congenital MG 100 mmHg	Elective CS	Epidural: lid + bup + fent	Standard + IBP + PAC	HDU postpartum	Discharged home after 4 days.
Brian 1993 <sup>7</sup>	Congenital, MG 90 mmHg	Elective CS	Slow titrated epidural (~30 min)	Standard + IBP + PAC	HDU 48 h, continuous epidural bup 0.125%	Hemodynamic changes secondary to oxytocin infusion
Cokclough 1995 <sup>8</sup>	Congenital, AVA 0.7cm <sup>2</sup> , MG 104 mmHg	CS and TL for breech presentation	Slow titrated epidural bup +sufent (~80 min)	Standard + IBP + PAC		Short period of intraoperative unstable angina
Pittard 1998 <sup>9</sup>	MG 57 mmHg asymptomatic	Elective CS @ 36 weeks	Continuous spinal bupivacaine 0.5% 2mL (1+1) over 10 min	Standard + IBP + CVP	Delivery suite 6 h	Mild headache
Tamura 1998 <sup>10</sup>	VSD repair, AVA 0.7cm <sup>2</sup> , MG 80 mmHg	Elective CS twins @ 29 weeks	2 epidural L1-2 and L4-5	Standard + IBP + PAC	HDU 24 h	
Suntharalingam 2001 <sup>14</sup>	#1 bicuspid MG 87 mmHg	Induction VD @ 38 weeks	Epidural: bup + fent	Standard + IBP		Two transient episodes of hypotension
	#2 bicuspid, VSD, PDA, PFO repair MG 85 mmHg NYHA I	Operative VD @ 40 weeks	Epidural: bup + fent			
	#3 bicuspid MG 44 mmHg	Induction VD @ 39 weeks	Epidural: bup + fent			
Van de Velde 2003 <sup>15</sup>	Bicuspid MG 101 mmHg NYHA 2	Induction VD @ 39 weeks	Continuous spinal L3-4	Standard + IBP	HDU 24 h	
Orme 2004 <sup>16</sup>	#1 bicuspid MG 64 mmHg AVA 0.7cm <sup>2</sup>	Elective CS @ 38 weeks for fetal anomalies	All four patients: general anesthesia: etomidate + sch + remifent + N <sub>2</sub> O+O <sub>2</sub> and isoflurane	Standard + IBP + CVP		Significant postpartum hemorrhage (once)
	#2 AVA 0.6 cm <sup>2</sup> MG 86 mmHg	Elective CS @ 38 weeks for breech		Standard + IBP + CVP		
	#3 AVA 0.8cm <sup>2</sup> MG 120 mmHg	Elective CS @ 38 weeks		Standard + IBP + CVP		
	#4 bicuspid MG 90 mmHg	CS @ 35 weeks		Standard + IBP + CVP		
Molins Espinosa 2004 <sup>11</sup>	Bicuspid MG 130 mmHg NYHA III	CS @ 32 weeks	General remifent + etomidate +fent rocuronium sevoflurane + O <sub>2</sub>	Standard + IBP + CVP	HDU 24 h	Digoxin and diuretics for 25 days
Kuzkowski 2004 <sup>12</sup>	AVA 0.7cm <sup>2</sup> MG169 mmHg asymptomatic	Induction @ 40.5 weeks Emergency CS for fetal distress	CSE for labor general for CS: etomidate +sch fent+ isoflurane	Standard + IBP+PAC	HDU 48 h	
Tihonen 2005 <sup>13,*</sup>	MG 101 mmHg	Elective CS @ 40 weeks	Spinal anesthesia 12.5 mg hyperbaric bup	Standard + whole-body impedance cardiography	HDU 48 h	Postoperative pulmonary edema
Hamlyn 2005 <sup>17</sup>	AVA 0.7 cm <sup>2</sup> MG 70 mmHg NYHA III, LAD stenosis 60%	Elective CS @ 38 weeks	CSE: Spinal: bup + fent; epidural bup	Standard + IBP + CVP	In HDU epidural diamorphine + i.v. oxytocin	ST depression when mean BP <70 mmHg.

Standard monitoring = electrocardiogram + non-invasive blood pressure + continuous oxygen saturation. AV: aortic valve; AVA: aortic valve area; NVD: normal vaginal delivery; VD: vaginal delivery; CS: cesarean section; TL: tubal ligation; IBP: invasive blood pressure; CVP: central venous pressure; PAC: pulmonary artery catheter; MG: maximal peak gradient; VSD: ventricular septal defect; PDA: patent ductus arteriosus; PFO: patent foramen ovale; PCA: patient control analgesia; HDU: high dependence unit; PPH: postpartum hemorrhage; LAD: left anterior descending coronary artery; CSE: combined spinal-epidural; sch: succinylcholine; bup: bupivacaine; lid: lidocaine; fent: fentanyl; remifent: remifentaniol; \* personal communication.

Complication

# Clinical recommendation

- Carefully titrated regional analgesia for vaginal delivery
- Slow titrated regional anesthesia for moderate and even severe AS
  - CSE
  - Epidural
  - Continuous Spinal anesthesia
- In patients with critical AS and uncompensated cardiac failure GA may be necessary

Continuous spinal analgesia for labor pain in a parturient with aortic stenosis

M. Van de Velde,<sup>a</sup> W. Budts,<sup>b</sup> E. Vandermeersch,<sup>a</sup> B. Spitz<sup>c</sup>

## Anesthesia for pregnant women with valvular heart disease: the state-of-the-art

KRZYSZTOF M. KUCZKOWSKI<sup>1</sup> and ANDRÉ VAN ZUNDERT<sup>2</sup>

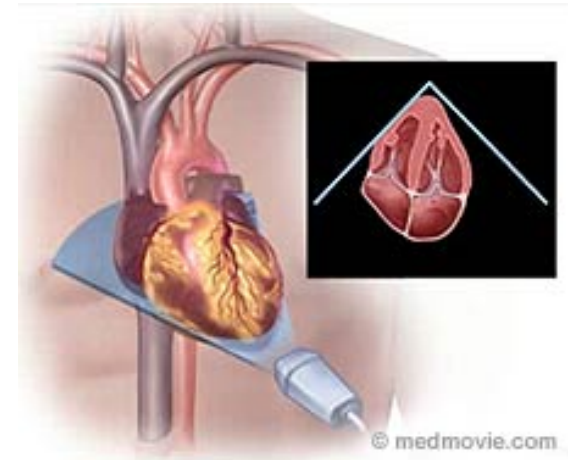
<sup>1</sup>Departments of Anesthesiology and Reproductive Medicine, University of California, San Diego, San Diego, California, USA  
<sup>2</sup>Catharina Hospital, Brabant Medical School, Eindhoven, The Netherlands

## General anaesthesia using remifentanyl for caesarean section in parturients with critical aortic stenosis: a series of four cases

R. M. L. 'E. Orme, C. S. Grange, Q. P. Ainsworth, C. R. Grebenik  
Nuffield Department of Anaesthetics, John Radcliffe Hospital, Oxford, UK

# Clinical recommendation -continued

- Invasive monitoring – **AL** ( CVP or SG –'passe' )
- **Perioperative Echocardiography**
  - Focused transthoracic echocardiography
  - TransEsophageal echocardiography
- Volemic status
- Ventricle motion
- Gradient on
  - Aortic valve
  - Mitral valves
- Grate of Pulmonary HTN



International Journal of Obstetric Anesthesia (2009) 18, 379–386  
0959-2688/\$ - see front matter © 2009 Elsevier Ltd. All rights reserved.  
doi:10.1016/j.ijoa.2009.02.019

CASE SERIES AND REVIEW

**Peripartum anesthetic management of patients with aortic valve stenosis: a retrospective study and literature review**

A.M. Ioscovich, E. Goldszmidt, A.V. Fadeev, S. Grisaru-Granovsky, S.H. Halpern  
Departments of Anesthesia, Sunnybrook Health Sciences Centre, Mount Sinai Hospital, Toronto, Canada, and Shaare  
Zedek Medical Center, Jerusalem, Israel



www.obstetranesthesia.com

# Clinical recommendation -continued

- Prevention of postoperative **tachycardia and arrhythmia**
  - Long acting neuraxial opioids for **postoperative pain management**
- **Observation in a high-dependency unit for 24-48h** for early detection and treatment of postoperative hemodynamic instability.
- Good communication – **“Team Approach”**

Combined general anesthesia and postoperative spinal analgesia for cesarean section in a patient with critical aortic stenosis A. Ioscovich, D. J. Nyman

***The rate of peripartum cardiac complications is almost 10% and includes ischemia, pulmonary edema and arrhythmias.***

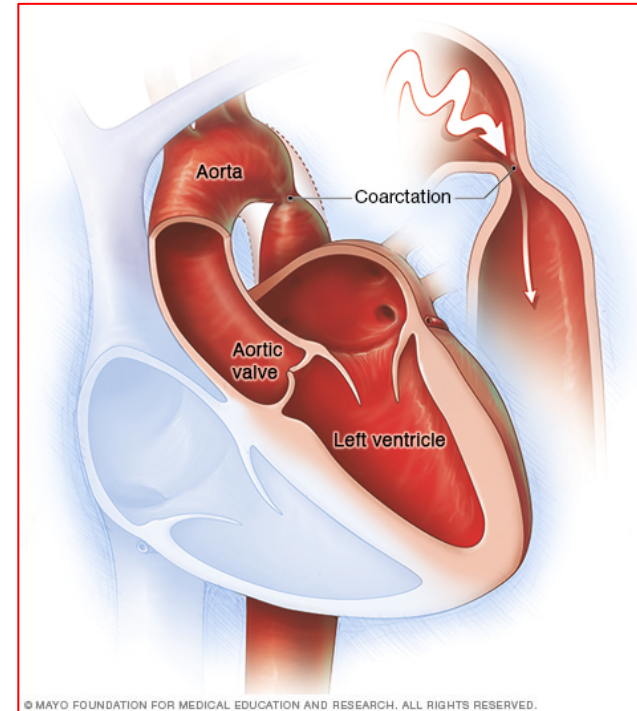
Heart disease in pregnancy

Dr Y. Emmanuel, MBChB, MRCP, DPhil,  
Dr S.A. Thorne, MD, MRCP\*

# Peripartum anesthetic management of a patient with Aortic Coarctation



**Aortic coarctation ~3.7 mm,**  
**gradient ~ 80mmHg**



## Coarctation of the Aorta: Outcome of Pregnancy

Luc M. Beauchesne, MD, FRCPC, Heidi M. Connolly, MD, FACC, Naser M. Ammash, MD, FACC,  
Carole A. Warnes, MD, FACC  
Rochester, Minnesota

- 50 women 118 pregnancies :
- 74 (63%) after repair
- 44(37%) no repair



CASE REPORT

Anaesthetic management of aortic coarctation in pregnancy

E. Walker, A. F. Malins

Department of Anaesthesia, Birmingham Women's Hospital, Edgbaston, Birmingham, UK

1-st case

s/p coarctation repaired at age 23m  
**Epidural for CS (breach presentation)**  
**AL as a additional monitoring**

2-nd case

BP 175/100 and 126/80 gradient 49mmHg Bicuspid AV  
35w progressive dyspnea and chest pain **Rt. Radial AL**  
**Spinal : 2.5mg Bupivacaine + Fentanyl 25mcgm**  
**Epidural : 10mL Lidocaine 2% + 10mL Bupivacaine 0.5%**

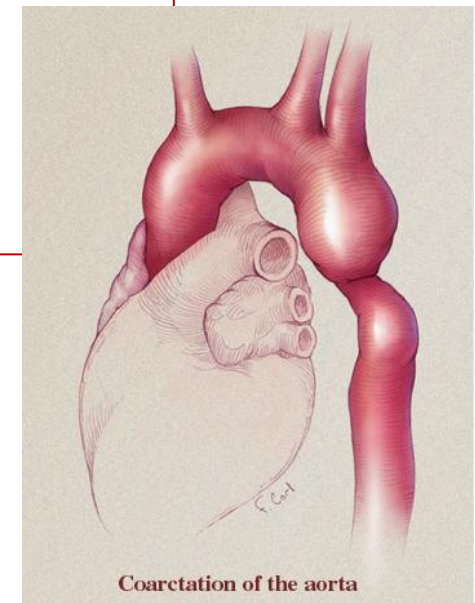
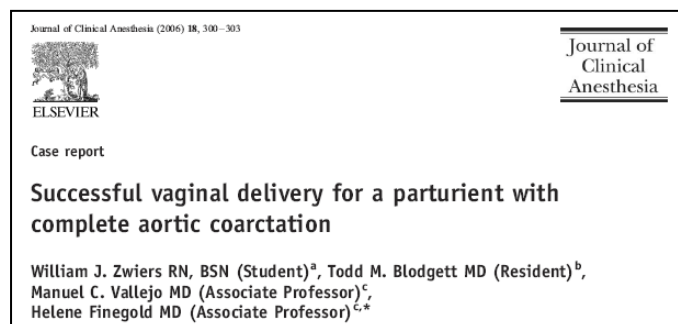


**Rt. Radial and Lt. Femoral arterial catheters**

Arm- Leg gradient ~ 50mmHg Vaginal delivery

**Epidural anesthesia**

0.125% Bupivacaine +Fentanyl2mcgm/mL 5-12mL/h





Premedication: Midazolam 2mg Metoclopramide 10mg

Spinal Anesthesia: Bupivacaine (heavy) 2.5 mg  
Fentanyl 15mcg Morphine 150mcg

Epidural Anesthesia: Lidocaine 2% 3mL+3mL +3mL

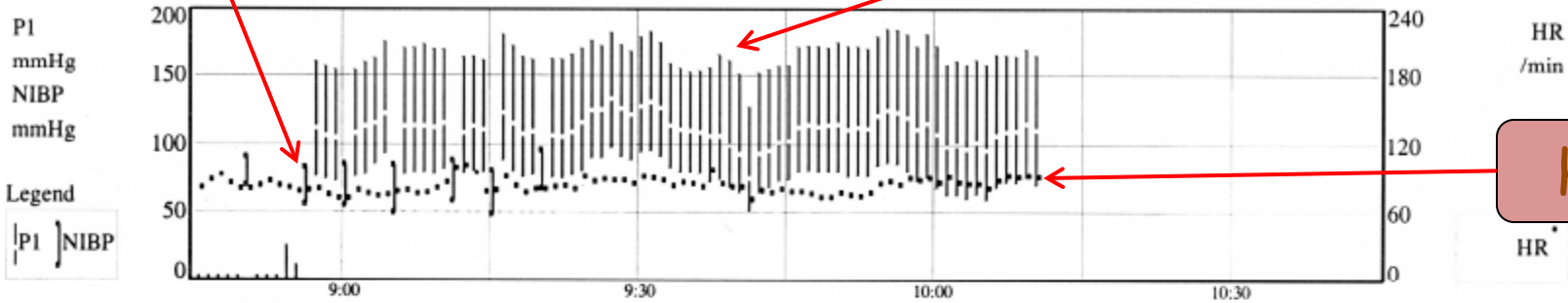
Independent invasive BP monitoring of upper and low parts of the body

**NIBP**

Rt. Leg

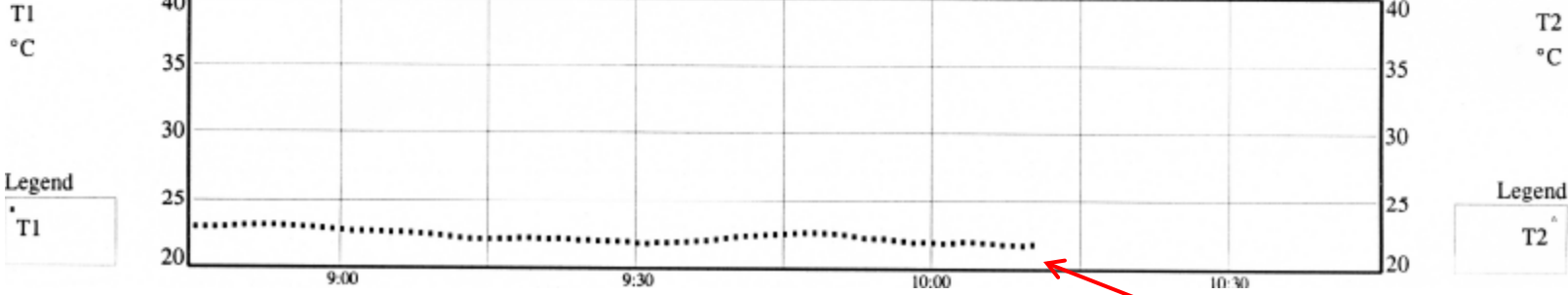
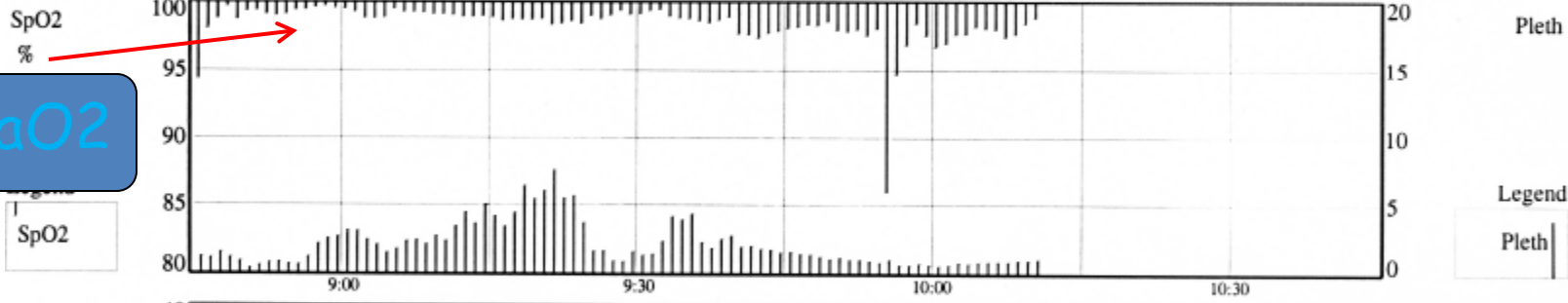
**IBP**

Rt. Rad. Art

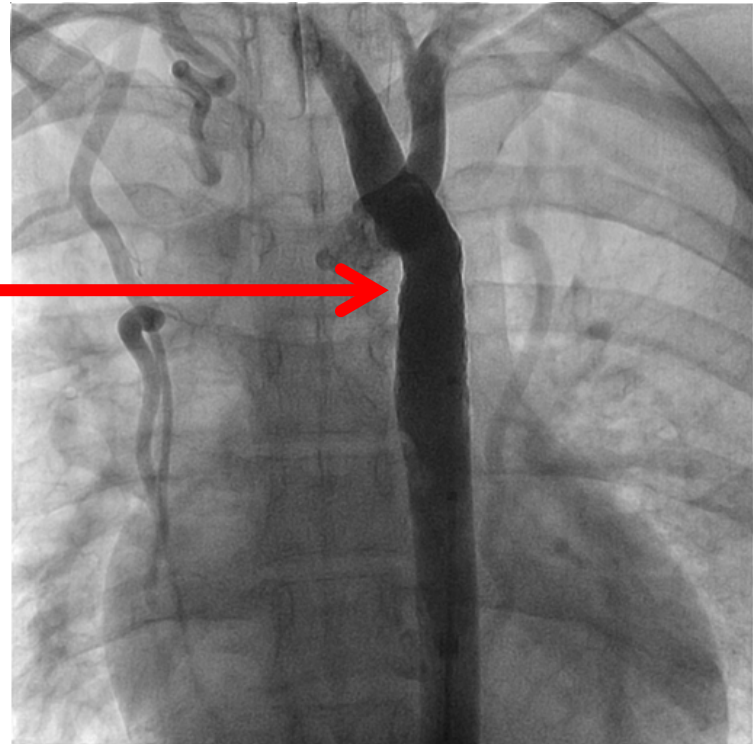
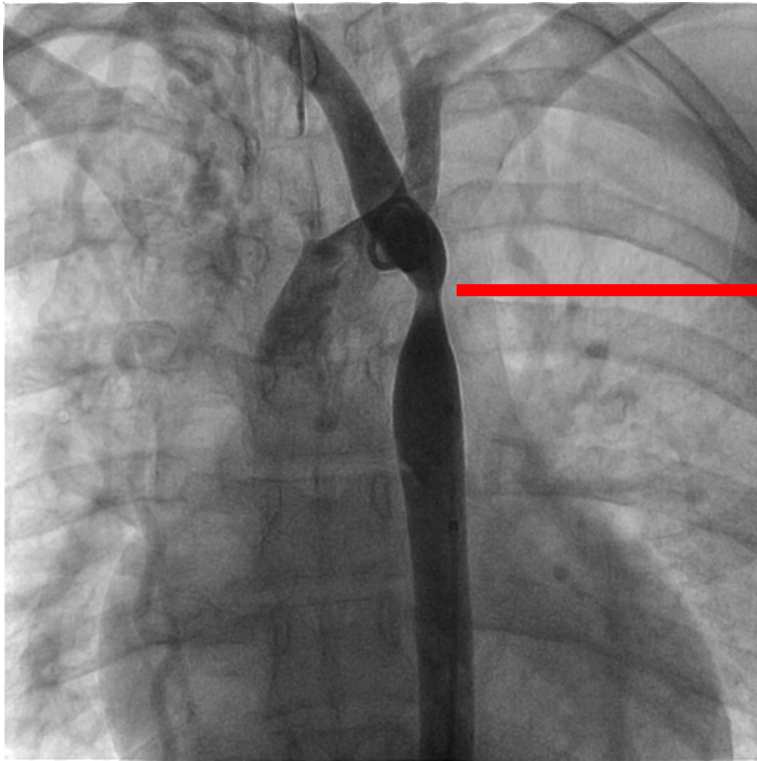


**HR**

**SaO2**



**CVP**



2 addition CS with CSE anesthesia

# Pulmonary Hypertension

Table 1 Classification of pulmonary hypertension\*

1. Pulmonary arterial hypertension

- Idiopathic
- Familial
- Related to:
  - ❖ Connective tissue diseases
  - ❖ Human immunodeficiency virus
  - ❖ Portal hypertension
  - ❖ Anorexigens
  - ❖ Congenital heart diseases
- Pulmonary capillary haemangiosis
- Pulmonary veno occlusive disease
- Others (e.g. glycogen storage disease, splenectomy)

2. Associated with left heart disease

- Atrial or ventricular dysfunction
- Valvular disease

3. Associated with lung disease/hypoxemia

- Clinical obstructive pulmonary disease
- Interstitial lung diseases
- Sleep-disordered breathing
- Developmental abnormalities
- Chronic exposure to high altitude

4. Associated with chronic thrombotic and/or embolic disease

- Obstruction of proximal pulmonary artery
- Obstruction of distal pulmonary artery
- Non-thrombotic pulmonary emboli (e.g. tumour)

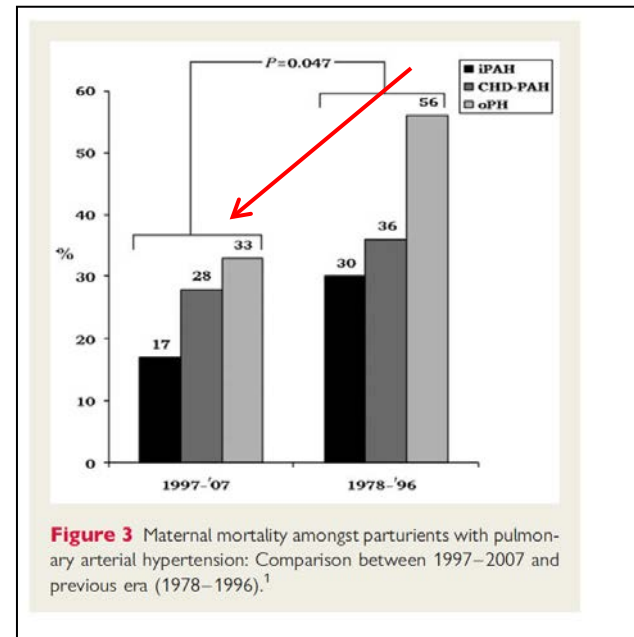
5. Miscellaneous

- Histiocytosis
- Lymphangioliomyomatosis
- Sarcoidosis
- Compression of pulmonary vessels (adenopathy, tumour, mediastinal fibrosis)

\* Proceedings of the Third World Symposium on Pulmonary Arterial Hypertension. Venice, Italy, June 23–25, 2003. J Am Coll Cardio. 2004; 43(12 Suppl): 1S–90S.

Pulmonary hypertension is defined by a mean pulmonary artery pressure  $>25$  mmHg at rest or  $>30$  mmHg





- **Patient with significant Pulmonary HTN**
  - >25mmHg mean pulmonary artery pressure**
    - Mortality still remains up to 50%
    - Even with targeted pulmonary vasodilator therapies mortality still remains up to 33%
    - **Should be offered termination of pregnancy**

# General Anesthesia

- Increased Pulmonary Artery Pressure during laryngoscopy and tracheal intubation
- Adverse effects of Positive-Pressure ventilation on Venous return

**May ultimately lead to cardiac failure**

Macchia A, Marchioli R, Marfisi R, Scarano M, Levantesi G, Tavazzi L, Tognoni G. A meta-analysis of trials of pulmonary hypertension: a clinical condition looking for drugs and research methodology. *Am Heart J* 2007;**153**:1037–1047.

**Table 3.** Management during pregnancy and current functional status

	Patient									
	1	2	3	4	5	6	7	8	8*	9
Baseline targeted Rx	Nil	B*****	Nil	Nil	Nil	Nil	Nil	Nil	B*****/S	Nil
Treatment commenced Nebulised iloprost (weeks' gestation)	19	8	18	31	34	28	26	30	14	34
Intravenous iloprost (weeks' gestation)/dose (µg/hour)		25/8					34/2**	32/4***	34/2****	
Sildenafil (weeks' gestation)							33	31	0	
LMWH	F	F	N	F	F	F	P/MC	P	P	P
Delivery (weeks)	36	26	35	34	35	34	34	32	34	37
Mode	CS	CS	CS	CS	CS	CS	SVD	CS	CS	CS
Anaesthesia	E	S/E	E	E	S/E	E	E	S/E	S/E	S/E
Monitoring	SG	SG	C/L	u/k	C/L	C/L	Ref	C/L	C/L	C/L
Current Rx	S	B	neb I	neb I	S	Nil	S	B/S	RIP	neb I
NHYA class	II	II	III	II	III	II	II	II		II
ISWT (m)	450	440	130	420	90	*****	470	350		340
Follow-up (years to 1 May 2009)	6.5	5.9	4.8	3.2	3.3	3.1				

**Improved survival in pregnancy and pulmonary hypertension using a multiprofessional approach**

DG Kiely,<sup>Ab</sup> R Condliffe,<sup>Abb</sup> V Webster,<sup>c</sup> GH Mills,<sup>c</sup> I Wrench,<sup>c</sup> SV Gandhi,<sup>d</sup> K Selby,<sup>d</sup> JJ Armstrong,<sup>e</sup> L Martin,<sup>e</sup> ES Howarth,<sup>f</sup> FA Bu'Lock,<sup>f</sup> P Stewart,<sup>g</sup> CA Elliot<sup>h</sup>

# Does the anesthetic approach determine the maternal outcome of patients with Pulmonary Hypertension?

## GA for CS

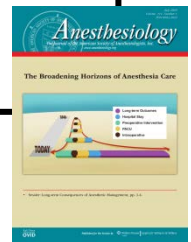
7 days she was judged to be ready for discharge when she experienced chest pain, severe hypotension, and sudden cardiovascular collapse. All attempts at resuscitation were unsuccessful. The patient died 4 h later. Autopsy showed right heart hypertrophy and extensive atheromatosis in the pulmonary arteries.



## Epidural For VD

“No hypotensive episodes were observed in connection with the epidural block, .....

The patient died 9 days after the delivery because of intractable cardiac failure.”



Pulmonary Hypertensive patients receiving general anesthesia for Cesarean Section were 4 (!!!) times more likely to die compared to patients receiving regional anesthesia.

*Bedard E. Systematic Review*

Has there been any progress made on pregnancy outcomes among women with pulmonary arterial hypertension?

Elisabeth Bédard<sup>1,2</sup>, Konstantinos Dimopoulos<sup>1,2</sup>, and Michael A. Gatzoulis<sup>1,2\*</sup>



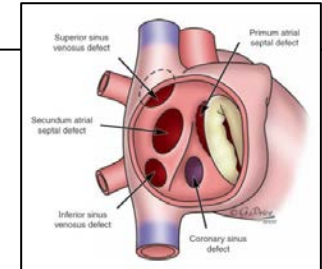
# ***Anesthetic approach to the pregnant patient with severe Pulmonary HTN (SZMC, Jerusalem)***

- Early (ideally - Prepartum) anesthetic consultation
- **Repeated multidisciplinary case discussion (mandatory in 28-32w)**
- Repeated echocardiography with dynamic cardiac treatment
- **NYHA 3-4 – hospitalization and active observation/treatment**
- **36w – elective CS**
  
- **Standard monitoring + IBP**
- **Minimal (150-200mL) crystalloid preloading + 1mg Midazolam**
- Lt lateral tilt and 2L O<sub>2</sub> (via nasal cannula)
- **CSE anesthesia**
  - Spinal - 2.5-3mg hyperbaric Bupivacaine +150mcg MO + 20mcg Fentanyl
  - Epidural- 3+3+3 mL Lidocaine 2% (over 25-30 min)
- **Nitric Oxide system** and Echocardiography Machine on standby
- **Pitocin 1u IV with cont. infusion 1u/h (50cc/h)**
- **24-48h CCU or PACU monitoring**

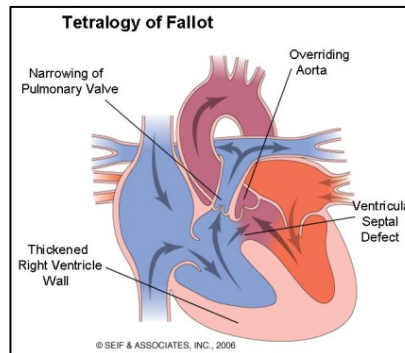


*There are increasing numbers of women with congenital heart disease who are considering pregnancy, as a result of joint expert specialist cardiac, cardiac surgeons, genetic and obstetric care.*

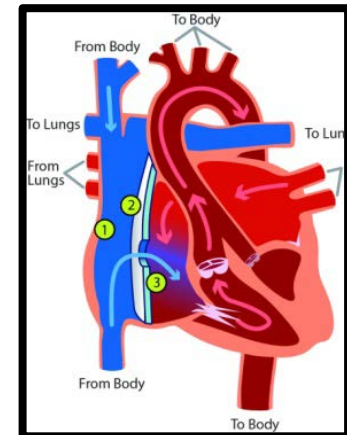
- **Atrio/Ventricular septal defect (ASD and VSD)**



- **Tetralogy of Fallot**



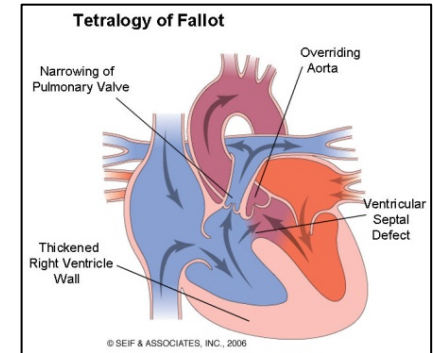
- **Patients with a single functional ventricle (atrioventricular septal defects and hypoplastic right or left heart syndrome) after Fontan repair**



# Tetralogy of Fallot

**Table 2. Cardiac, Surgical, and Medical History**

Patient	Initial cardiac diagnosis	Initial TOF repair	Age at repair (years)	Further cardiac surgeries	Further cardiac disease	Severe PR	RVSP (mm Hg)
1	TOF/PA	RV/PAC	5	Re-do RV/PAC at 13 years old	RV/PA conduit obstruction during pregnancy	No	84
2	TOF	TAP	<1	6 years before pregnancy: maze procedure, PV repair, RV to PA patch augmentation, ligation of L SVC, ASD closure	None	No	46
3	TOF	TAP	1.5	None	VSD and RV dysfunction	Yes	37
4	TOF	NTAP	1.5	1 year before first pregnancy: PA balloon dilation & stent placed	None	Yes	51
4	TOF	NTAP	1.5	As above	RV dysfunction	Yes	36
5	TOF	TAP	2	PV replacement 2 years before pregnancy	RV dysfunction	No	56
6	TOF	TAP	8	PV replacement 2 years before pregnancy	Right PA thrombosed, RV dysfunction	No	54
7	TOF	NTAP	9	None	RV dysfunction	Yes	28
8	TOF	TAP	5	None	None	Yes	30
9	TOF	NTAP	4	None	None	No	No TR
9	TOF	NTAP	4	None	None	No	No TR
9	TOF	NTAP	4	None	None	No	No TR
10	TOF	TAP	18	None	PFO, small VSD, RV dysfunction	Yes	65
11	TOF/PA	TAP	<1	None	None	Yes	62
12	TOF	TAP	7	None	Severe TR and PR, decreased RV function	Yes	44
13	TOF	NTAP	4	Balloon dilation and stenting of aortic coarctation at 21 years old	None	No	22
14	TOF	TAP	12	None	None	Yes	37
14	TOF	TAP	12	None	None	Yes	35
14	TOF	TAP	12	None	None	Yes	35
15	TOF	TAP	17	None	None	Yes	35
16	TOF	TAP	2	None	None	Yes	55
17	TOF	TAP	2	None	None	Yes	25
18	TOF	TAP	5	None	None	No	45
18	TOF	TAP	5	None	None	Yes	45
19	TOF	TAP	1	None	None	Yes	30
19	TOF	TAP	1	None	None	Yes	30
20	TOF	TAP	<1	None	None	No	45



## A Case Series of the Anesthetic Management of Parturients with Surgically Repaired Tetralogy of Fallot

2-3 (depending on residual defects such as pulmonary and tricuspid regurgitation and PA stenoses)

Frequently repaired in childhood primarily now, some patients may have undergone shunting procedure prior.

Residual pulmonary stenosis and regurgitation is common, occasionally PA stenosis and other valve lesions.

General: Pregnancy generally well tolerated, though some authors note an increased risk of RV failure with severe PI. Modest risk of arrhythmias. Variability in CHF probably reflects different definitions across studies.

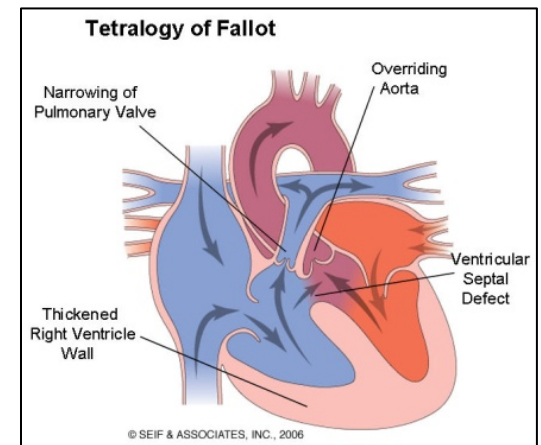
C: Arrhythmias 6.4%, CHF 2.4%, and MI/CVA/death 0%<sup>5</sup>; CHF 14% associated with mod-sev PR and PA stenosis<sup>23</sup>; CHF 23%<sup>24</sup>; arrhythmias 6.5% (1/2 were VT), CHF 1.6%.<sup>25</sup>

O: PIH 8.3%, preeclampsia 1.8%, PROM 0.8%, prematurity 6.3%, SGA 9%, and PPH 8.8%<sup>5</sup>; miscarriage 19%, PIH 4.8%, preeclampsia 3.2%, prematurity 17.7%, and SGA 18.5%.<sup>25</sup>

**CONCLUSIONS:** Pregnancy outcomes for patients with repaired tetralogy of Fallot were found to be generally favorable. All patients undergoing a trial of labor or cesarean delivery had neuraxial analgesia or anesthesia. Recognition and management of congestive heart failure was necessary in 19% of deliveries. (Anesth Analg 2011;113:307-17)

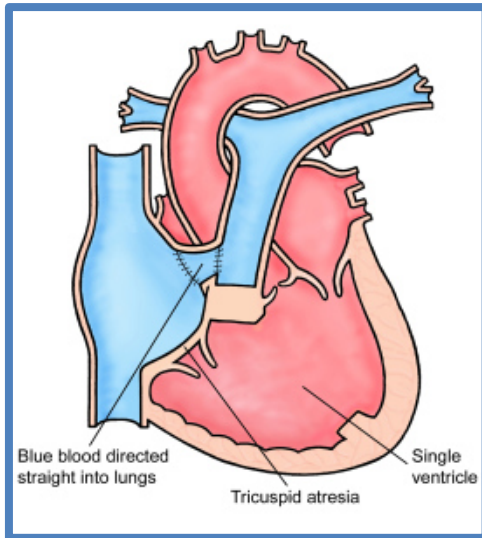
**Placenta percreta in a parturient with uncorrected Tetralogy of Fallot.**

[Bhatia N<sup>1</sup>](#), [Arora S](#), [Bhukal I](#), [Padmanaban A](#).  
[Int J Obstet Anesth](#). 2013 Nov;22(4):358-60



Patients with a **single functional ventricle**, including **complete atrioventricular septal defects** and **hypoplastic right or left heart** syndrome.

***Pregnant patients after Fontan procedure.***



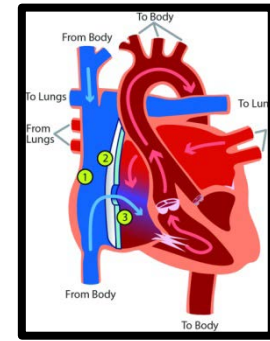
[Br Heart J. 1975.](#)  
**Correction of tricuspid atresia.**  
[Walker DR,](#)

### **Classic Fontan physiology**

Separates pulmonary and systemic circulations, allowing the **single functional ventricle to maintain systemic flow**, whereas pulmonary blood flow becomes entirely passive.

- The population of patients with congenital heart diseases (CHD) is steadily growing
- Many woman with CHD are becoming pregnant
- The anesthesiologist must have an understanding of the
  - physiology of the corrected heart
  - Impact of the physiologic changes of pregnancy
- Clear communication with the obstetrical and cardiology team

# Anesthesia/analgesia for pregnant patients after Fontan procedure



## Successful epidural anesthesia for cesarean delivery in a woman with Fontan repair<sup>☆</sup>

Edward Mathney MD (Assistant Professor of Anesthesiology),  
Yaakov Beilin MD (Professor of Anesthesiology and Obstetrics, Gynecology and Reproductive Sciences)\*

*Department of Anesthesiology, Icahn School of Medicine at Mount Sinai, New York, NY*

**Elective CS 36w**  
Milrinone infusion  
IBP + CVP monitoring  
Epidural Lidocaine 16mL (over 40 min)

## Emergency cesarean section in a patient with Fontan circulation using an indwelling epidural catheter

A. Ioscovich MD<sup>a,c,d,\*</sup>, A. Briskin MD<sup>a,c,d</sup>, A. Fadeev MD<sup>a</sup>,  
S. Grisaru-Granovsky MD<sup>b</sup>, S. Halpern MD<sup>c,d</sup>

<sup>a</sup>Department of Anesthesia, Shaare Zedek Medical Center, Jerusalem, Israel

<sup>b</sup>Department of Obstetrics and Gynecology, Shaare Zedek Medical Center, Jerusalem, Israel

<sup>c</sup>Department of Anaesthesia, Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada

<sup>d</sup>University of Toronto, Toronto, Ontario, Canada

## **Labor analgesia and Emergency CS secondary to fetal distress**

10ml/h 0.1% Bupivacaine with 2.5mg/mL Meperidine  
IBP monitoring (without CVP !)  
Epidural 20mL 2% Lidocaine for CS

- Maintaining **higher-than-normal CVPs**
- Minimizing intrathoracic pressure
- **Avoiding positive pressure ventilation**
- Preventing increased Pulmonary Vascular Resistance (PVR)
  - **Avoiding Hypercarbia, Hypoxia, and Acidosis**

***These goals can be best accomplished with neuraxial anesthesia.***

- **Marfan** , **Loeys - Diets**, **Ehlers-Danlos** and **Turner** syndromes - severe effects on tensile strength of connective tissues → **Dilated Aorta, Aortopathy** and risk of dissection during pregnancy and especially in 28-32 week of pregnancy and in peripartum period.
  - For Marfan s-m – aorta >40mm associated with up to 10% risk of dissection



Matura LA, Ho VB, Rosing DR, et al. Aortic dilatation and dissection in turner syndrome. Circulation 2007

Lipscomb KJ, Smith JC, Clarke B, et al. Outcome of pregnancy in women with Marfan's syndrome. BJOG

# Marfan Syndrome

Same name – different anesthetic approach

Aortic condition

History of previous cardiac or other operations

**Table 2. Characteristics of Delivery and Anesthetic Technique**

Patient	Delivery (weeks' gestation)	Type of delivery	Mode of delivery	Indication for cesarean delivery	Birth weight (g)	Type of anesthesia
1	35	Elective	Cesarean	History of aortic surgery	2360	General anesthesia
2	33	Emergency	Cesarean	Severe fetal heart rate abnormality	NA	General anesthesia
3	36	Elective	Vaginal (spontaneous labor)	—	2550	Epidural analgesia
4	34	Elective	Cesarean	Lumbar spine arthrodesis	3300	General anesthesia
5	36	Elective	Cesarean	Maternal preference	1950	General anesthesia
6	36	Elective	Cesarean	Severe scoliosis and ARD between 40–45 mm	2800	General anesthesia
7	35	Elective	Cesarean	Severe scoliosis and ARD between 40–45 mm	2930	General anesthesia
8	36	Elective	Cesarean	Lumbar spine arthrodesis	3040	General anesthesia
9	32	Emergency	Cesarean	Severe fetal heart rate abnormality	1480	General anesthesia
10	35	Elective	Cesarean	Severe scoliosis and ARD between 40–45 mm	2320	General anesthesia
11	35	Elective	Cesarean	Maternal preference	2520	General anesthesia
12	36	Elective	Cesarean	ARD 45 mm	2960	General anesthesia
13	31	Elective	Vaginal (induced labor)	—	1520	Epidural analgesia
14	35	Emergency	Cesarean	Acute type 1 aortic dissection	2810	General anesthesia
15	36	Emergency	Cesarean	Severe fetal heart rate abnormality	2410	Spinal anesthesia
16	37	Elective	Cesarean	History of aortic surgery	2970	General anesthesia

Fetal condition

## Marfan's Syndrome During Pregnancy: Anesthetic Management of Delivery in 16 Consecutive Patients

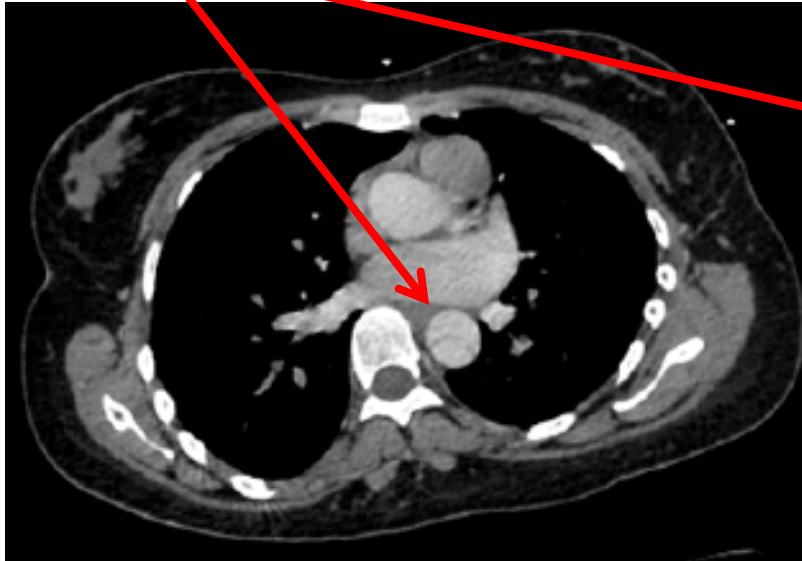
**CONCLUSIONS:** Pregnant women with Marfan's syndrome who received care in a multidisciplinary tertiary care setting that included active peripartum involvement of anesthesiologists had good clinical outcomes. (Anesth Analg 2013;116:392–8)



# Images in Anesthesia: Transesophageal echocardiography during Cesarean section in a Marfan's patient with aortic dissection

CAN J ANESTH 2005 / 52: 7 / pp 737-738

Alexander Ioscovich MD  
Deborah Elstein PhD  
Shaare Zedek Medical Center, Jerusalem, Israel  
E-mail: elstein@szmc.org.il



- Emergency CS for acute (Stanford) type B aortic dissection
- General "Cardiac" anesthesia
- Intraoperative TEE observation for real-time control of aortic condition
- Cardiac surgeons Standby for emergency aortic arch replacement

Patient with Marfan for 5-th CS  
Aorta 4.5 cm  
S/P Scoliosis repair



## 247. Peripartum regional anesthesia for the patient with Turner's syndrome (TS)

J. Shapiro, A. Ioscovich, A. Fadeev  
Shaare Zedek Medical Centre, Anaesthesia, Jerusalem, Israel

**Introduction:** TS is one of the most common chromosomal abnormalities in women (affecting the X chromosome and a 45XO karyotype; 1 in 2500 to 3000 live female births). Patients express different degrees of mental retardation, micrognathia, dental abnormalities, scoliosis, aortic arch and valve anomalies. These parturients clearly present a unique anesthesiological challenge.

**Case Presentation:** A 23-yr old, 150cm, 75kg parturient, with TS (45XO karyotype), presented in her 39<sup>th</sup> week of pregnancy, following successful ovum donation, to the labor ward in spontaneous labor. Her physical examination revealed crowded teeth in an overbite position, micrognathia, narrow palate, Mallampatti score 3-4, scoliosis and lordosis. She had normal blood tests and an echocardiogram revealing a bicuspid aortic valve.

Successful epidural placement was performed by a second anesthetist and only with the help of two midwives holding the patient (anatomic difficulties and poor patient cooperation).

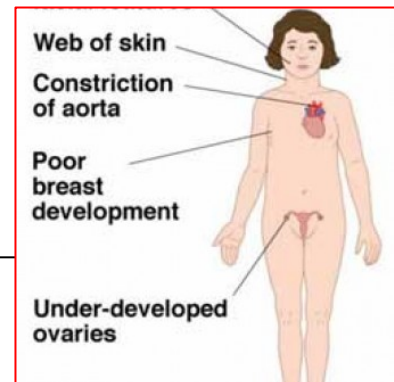
An hour and 40 min later, the parturient delivered a healthy 2600g newborn (Apgar 9/9). The post partum period was complicated by atonic bleeding. Uterine lysis was performed successfully with epidural anesthesia. Her hemoglobin had dropped to 7.6 g/dl. She received 2 units of blood and was discharged home after 72 hours.

**Discussion and Conclusion:** Changes of pregnancy exacerbate many of the physiological abnormalities relevant to the anesthetist: cardiac decompensation, risk of aortic dissection, HTN, diabetes, and an increased risk of a difficult airway. Scoliosis and lordosis with poor patient's communication (part of a borderline mental status) also make neuraxial analgesia difficult to perform.

Management of the patient with TS in the peripartum period requires a team approach, including the involvement of obstetric, anesthetic, cardiac and psychiatric consultations. Early epidural analgesia (possibly US-guided) is recommended to increase patient cooperation, is crucial for prevention of a hypertensive response and obviates the need for airway management in an emergency situation.

# Turner's syndrome

- The most common chromosomal abnormalities in women 45XO cariotipe (1:2500-3000 life female births)
- Mental retardation, micrognathia, scoliosis
- Aortic arch and aortic valve anomalies
- World oocyte (egg) donor program for patients with TS
- For Turner s-m – aorta >25mm associated with up to 33% risk of dissection



# Coronary Artery Disease and Myocardial Infarction

- Acute MI is estimated as 0.6-1 case per 10.000 pregnancies
- The risk of MI ↑ significantly with age
  - 30-34 years – 8.8/100.000 deliveries
  - > 40 years – 30.2/100.000 deliveries
- More commonly in the third trimester and most commonly in anterior wall
- Good maternal survival and fetal outcome

## Medical conditions and the risk of pregnancy-related acute myocardial infarction

Medical condition	OR (95% CI)	P
Hypertension	11.7 (6.9–21.2)	<0.01
Thrombophilia (including history of thrombosis and antiphospholipid syndrome)	22.3 (8.2–61.1)	<0.01
Anemia	2.0 (1.3–3.2)	<0.01
Diabetes mellitus	3.2 (1.5–6.9)	<0.01
Migraine headaches	4.2 (1.0–17.1)	0.05
Smoking	6.2 (4.1–9.5)	<0.01

AJ Kealey. Coronary artery disease and myocardial infarction in pregnancy: A review of epidemiology, diagnosis, and medical and surgical management. Can J Cardiol 2010;26(6):e185-e189.

- **In the case of acute MI** delivery should be **at least 2 weeks** from the MI (if possible!)

- **Outcome** after CS ≈ Outcome after VD

Roth A, Elkayam U. Acute myocardial infarction associated with pregnancy. *Ann Intern Med* 1996;125:751-62.

- In case of VD **assistance during the 2-nd stage** is recommended

Dufour P, Berard J, Vinatier D, et al. Pregnancy after myocardial infarction and a coronary artery bypass graft. *Arch Gynecol Obstet* 1997;259:209-13.

- **Antiplatelets Anticoagulation** therapy (?)
  - Case by case management

Anesthesia	Epidural fentanyl 50 µg, 2% lidocaine and 0.5% bupivacaine 22 mL
CSE Spinal: bupivacaine 6.6 mg and sufentanil 3.3 µg	General (maternal request) propofol 3 mg/kg, succinylcholine 1.5 mg/kg; 60% N <sub>2</sub> O in O <sub>2</sub> ; isoflurane 0.7%; alfentanil; midazolam; atracurium  Spinal lidocaine 50 mg
	Epidural 3% chlorprocaine 15 mL

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0959-289X/S - see front matter © 2008 Elsevier Ltd. All rights reserved.  
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CASE SERIES

## Peripartum anesthetic management of patients with Takayasu's arteritis: case series and review

A. Ioscovich,<sup>a,b</sup> R. Gislason,<sup>b</sup> A. Fadeev,<sup>a</sup> S. Grisar-Granovsky,<sup>c</sup> S. Halpern<sup>b</sup>



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# Summary

## Baseline (Prepartum) clinical assessment

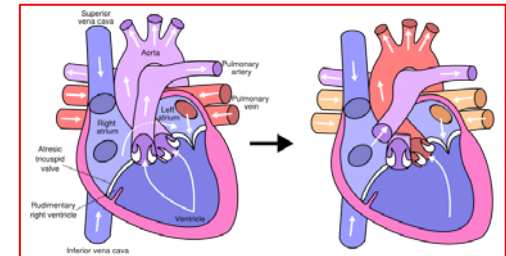
- Preconception (or as early as possible) anesthetic consultation
- Multidisciplinary consultation
- Review of patient's history
- Prior imaging finding and surgical records
- **Understanding of current cardiac physiology of this patient**

### – Complete cardiovascular examination

- Oxygen saturation (BL)
- **Signs of CHF**
- 12-lead ECG
- **Echocardiography** (preconception; 12w; 20w; 28-32w; 36w)

#### » Occasionally

- **Cardiac MRI**
- Cardiac catheterisation
- Stress test



# Peripartum anesthetic management



- **Slow titrated Epidural analgesia/anesthesia**
- **Low dose CSE analgesia/anesthesia**
- **Careful** Co-hydration with crystalloid
- Concurrent Phenylephrine infusion
- Standard monitoring + IBP
- Focused Transthoracic or Transesophageal Echography
- Oxytocin
  - Repeated dose of 0.1-0.5U
  - Slow titrated or continuous infusion of 1U/h
- Postpartum 24-48 monitoring in CCU/ICU/PACU

A planned caesarean section has, in our view, many advantages in high-risk parturients, especially if the patient has not given birth before. One

*Acta Anaesthesiol Scand* 2010; 54: 46-54

**Regional anaesthesia for a Caesarean section in women with cardiac disease: a prospective study**

E. LANGESÆTER, M. DRAGSUND and L. A. ROSELAND  
Division of Anaesthesia and Intensive Care Medicine, Oslo University Hospital, Rikshospitalet, Oslo, Norway

## In conclusion

Well managed, motivated mothers with HD who benefit from comprehensive antenatal care, and are managed primarily by their

**Obstetric, Cardiac and Anaesthesia teams**

can aspire to a good outcome for themselves and their babies.



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DOI: 10.3109/01443615.2011.603064

informa  
healthcare

### OBSTETRICS

**Severe heart disease complicating pregnancy does not preclude a favourable pregnancy outcome: 15 years' experience in a single centre**

R. Michaelson-Cohen<sup>1</sup>, D. Elstein<sup>1</sup>, A. Ioscovich<sup>2</sup>, S. Armon<sup>1</sup>, M. S. Schimmel<sup>3</sup>, A. Butnaru<sup>4</sup>,  
A. Samueloff<sup>1</sup> & S. Grisaru-Granovsky<sup>1</sup>

*Departments of <sup>1</sup>Obstetrics and Gynaecology, <sup>2</sup>Anaesthesia, <sup>3</sup>Neonatology and <sup>4</sup>Cardiology, Hebrew University of Jerusalem, Shaare Zedek Medical Centre, Jerusalem, Israel*

**Thank you!!!**



# Welcome to Israel!

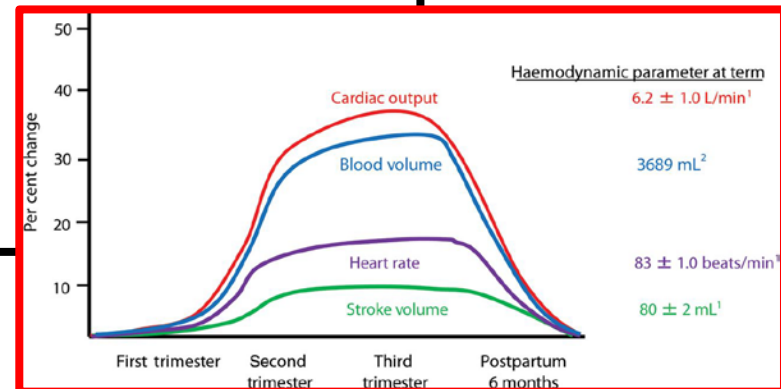




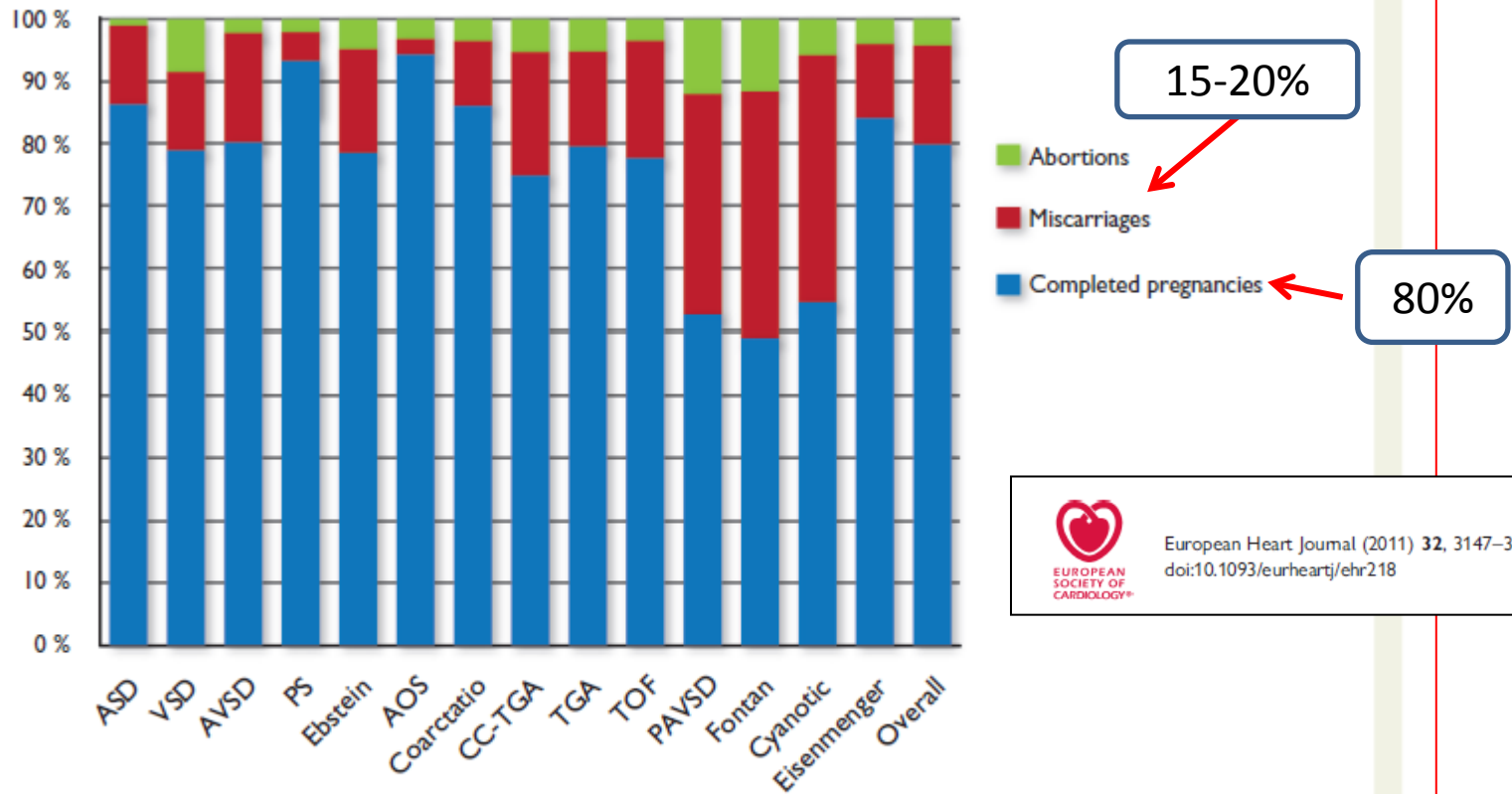
## Expected physiologic changes occurring the antepartum, intrapartum, and postpartum periods

### Antepartum

- Blood volume increases by 20% to 50%
- In nonpregnant women total blood volume is ~ 60 to 70 mL/kg
- Systemic vascular resistance decreases by 20%
  - Accounts for most of the reduction in blood pressure (BP).
  - Accommodates increase in circulating volume without increase in BP.
- BP (taken in sitting position)
  - BP greater than or equal to 140/90 mm Hg abnormal at any time in gestation.
  - BP decreases to lowest point at 28 wk.
  - After 28 wk, BP increases to nonpregnant level by term.
- Mean arterial pressure unchanged
- Heart rate increases by 10 to 15 beats per minute (bpm)
- Stroke volume increases by 30%
- Cardiac output (CO) increases by 30% to 50%



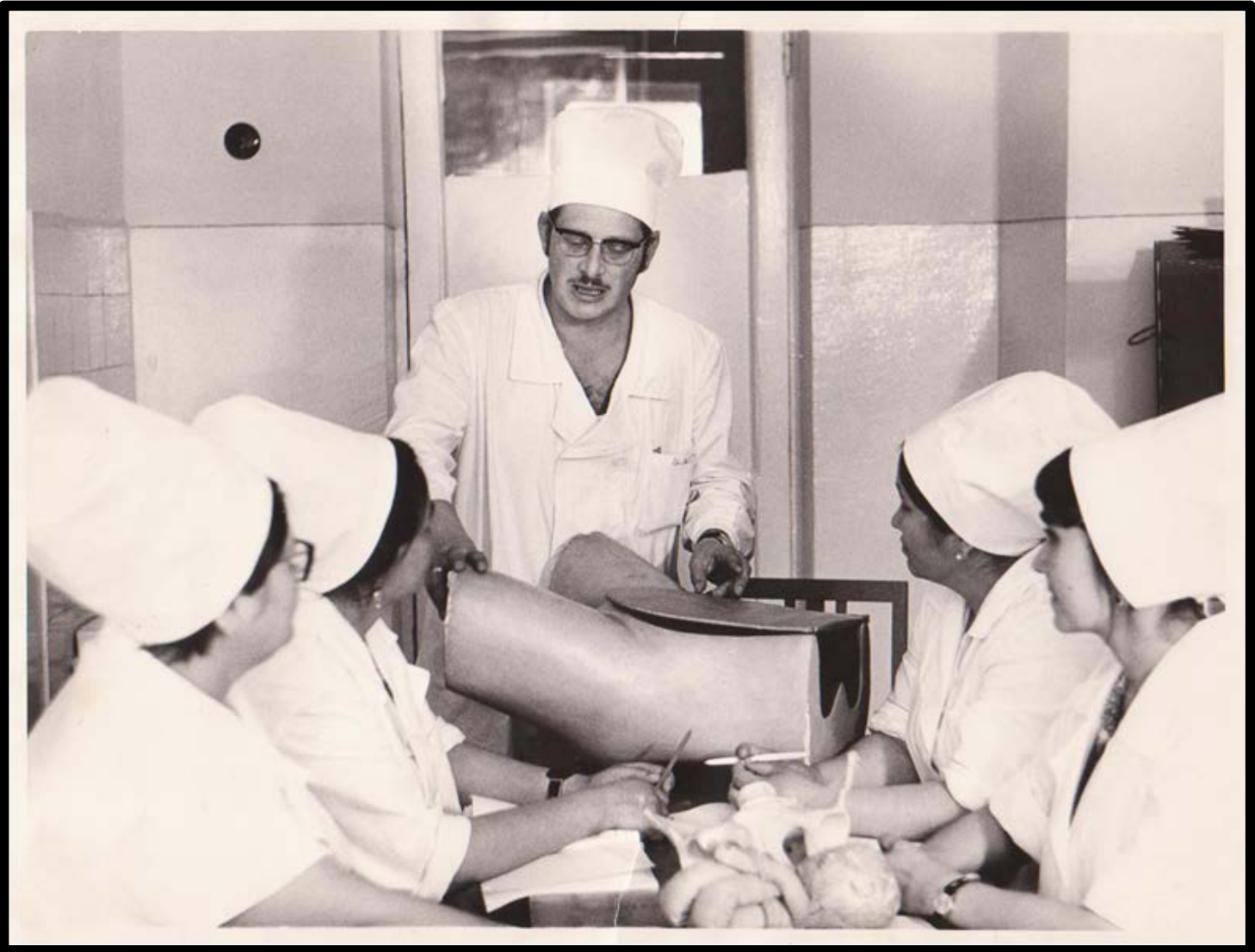
# Obstetric Outcome



**Figure 1** Distribution of miscarriages, completed pregnancies (>20 weeks pregnancy duration), and elective abortions for each congenital heart disease separately and the overall rates. ASD = atrial septal defect; AVSD = atrioventricular septal defect; AOS = aortic stenosis; CC-TGA = congenital corrected transposition of the great arteries; CHD = congenital heart disease; Coarctatio = aortic coarctation; Ebstein = Ebstein's anomaly; Eisenmenger = Eisenmenger syndrome; Fontan = patients after Fontan repair; PAVSD = pulmonary atresia with ventricular septal defects; PS = pulmonary valve stenosis; TGA = complete transposition of the great arteries; TOF = tetralogy of Fallot; VSD = ventricular septal defect.



European Heart Journal (2011) 32, 3147–3197  
doi:10.1093/eurheartj/ehr218



**Michael Loscovich**  
**1939-2015**