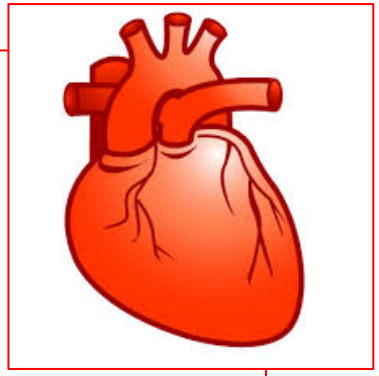


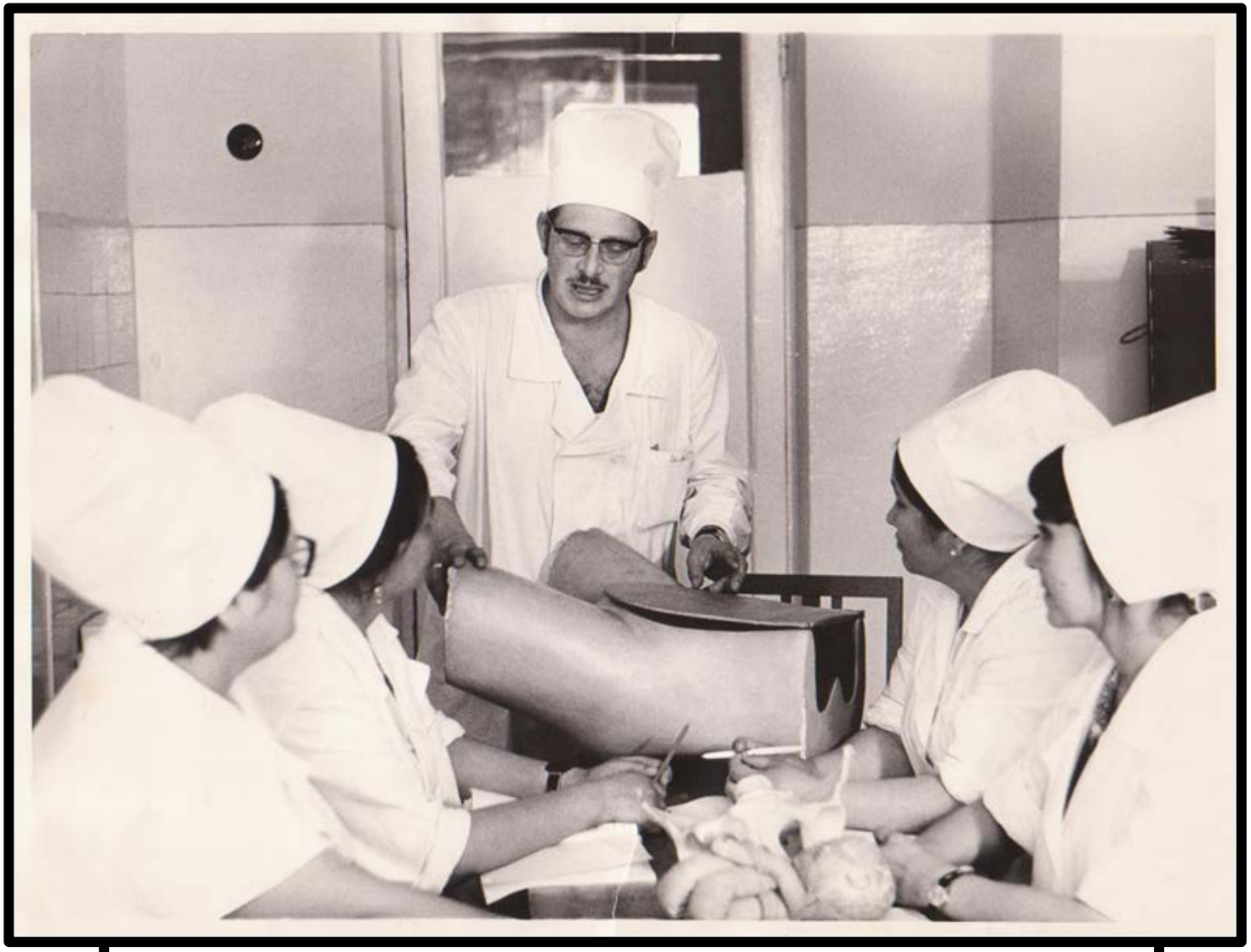
"Mama's weak heart"

Anesthetic approach to the pregnant patient with cardiac pathology

Alexander Ioscovich MD

Shaare Zedek Medical Center , Jerusalem

האוניברסיטה העברית בירושלים
The Hebrew University of Jerusalem



Michael Ioscovich

1939-2015

Shaare Zedek Medical Center, Jerusalem

16.000+6.000
labors annually

12% of caesarean sections

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:

A Clinical Lecture

ON

HEART DISEASE IN RELATION TO PREGNANCY AND LABOUR.

DELIVERED AT UNIVERSITY COLLEGE HOSPITAL.

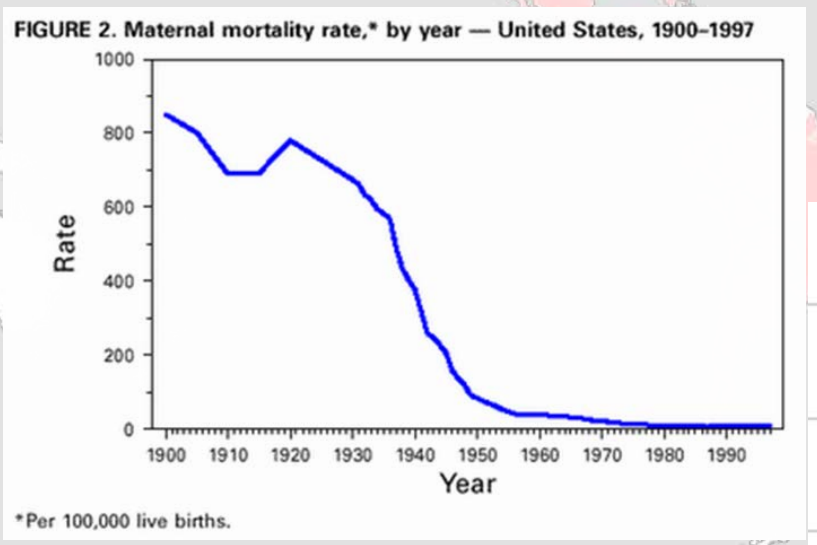
BY G. F. BLACKER, M.D., F.R.C.P., F.R.C.S.,
OBSTETRIC PHYSICIAN TO THE HOSPITAL.

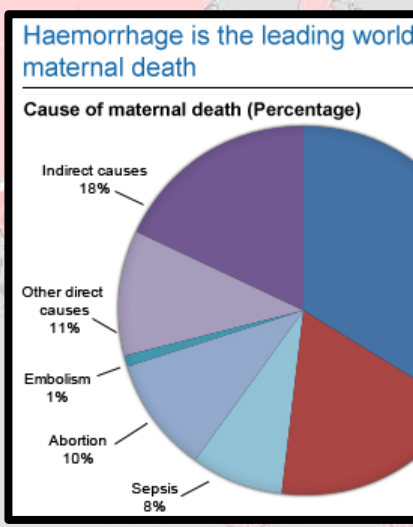
I HAVE chosen as the subject of this lecture heart disease complicating pregnancy and labour: first, because it is an important matter, and of not infrequent occurrence; and, secondly, because the teaching in some of the current textbooks is, I venture to think, erroneous, in that it exaggerates the danger and the mortality arising from this complication of labour.

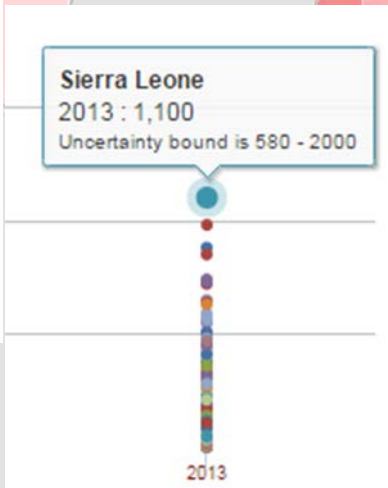
[MAY 25, 1907]

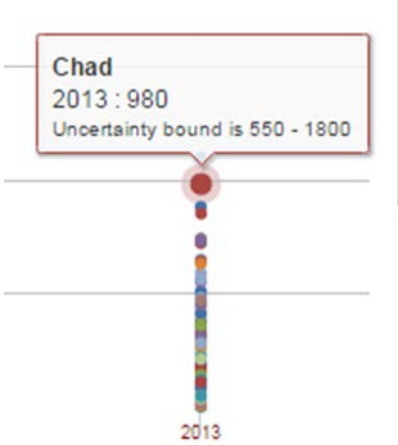
[THE BRITISH MEDICAL JOURNAL

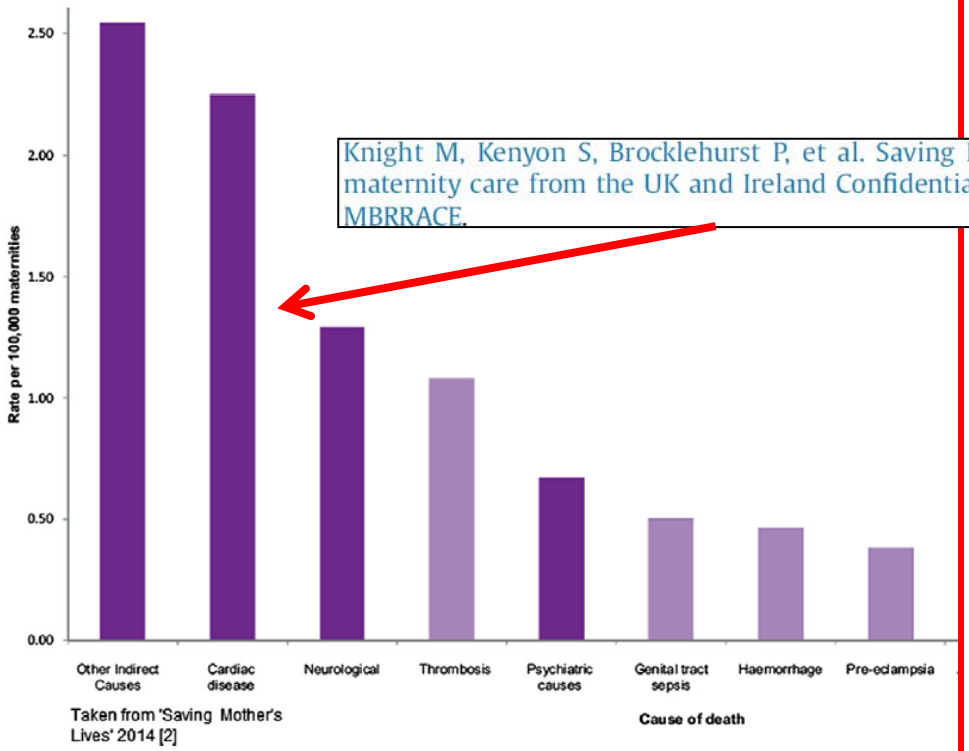
Reference: http://www.childinfo.org/maternal











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
TOTAL	136	155

PAPER

J R Coll Physicians Edinb 2005; **35**:332–336

Why mothers die

J Drife
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

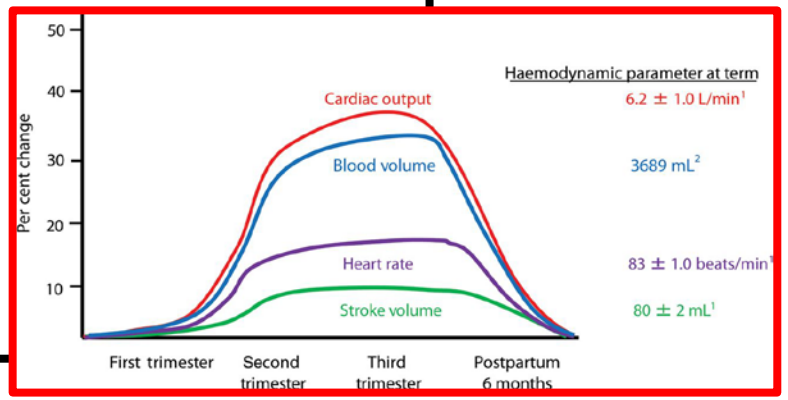
- Cardiac disease complicates approximately 4% of all pregnancies in the United States
- Risk for maternal deaths (<1% -10%–25%)
- Maternal cardiac disease comprise up to 15% of obstetric ICU admissions
- These patients account for up to 50% of all maternal deaths in the ICU
- Congenital cardiac lesions are 3 times more common than acquired

Obstet Gynecol Clin N Am 42 (2015) 315–333
http://dx.doi.org/10.1016/j.ogc.2015.01.012 obgyn.theclinics.com
0889-8545/15/$ – see front matter

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%



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

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

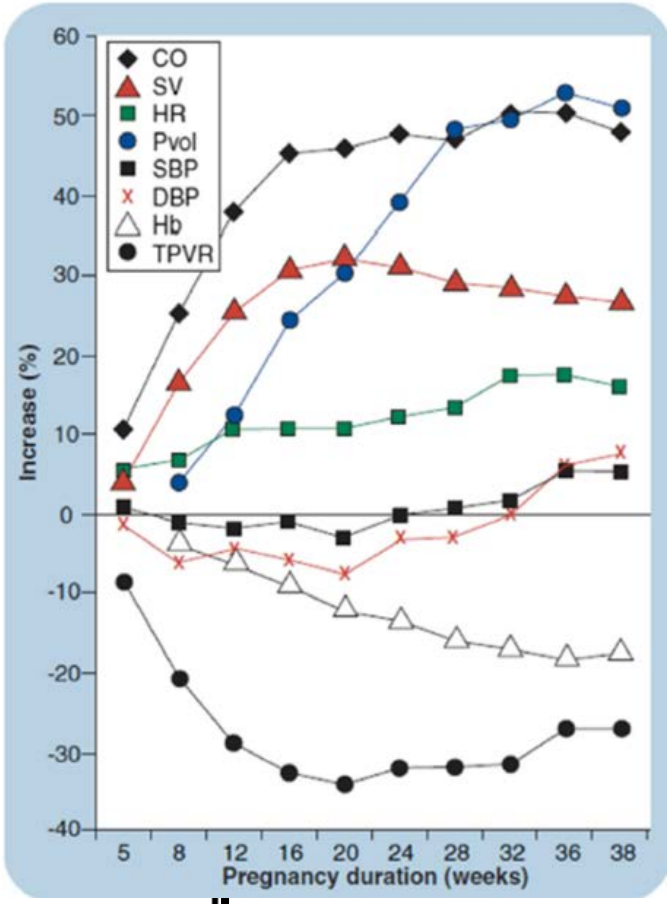
2B

- 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

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

SEMINARS IN PERINATOLOGY 38 (2014) 260–272

World Health Organization (WHO) Risk Classes for pregnancy by Medical Condition

What heart pathology we'll see more often?

Congenital

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

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

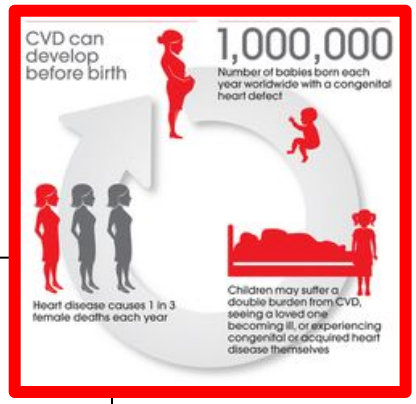


Table III. Specific diagnoses of the women in the category of congenital heart disease.

n	Diagnosis
15	Ventricular septal defects (VSD)
11	Atrial septal defects (ASD) not corrected, no pulmonary hypertension
2	Secundum atrial septal defects with moderate pulmonary hypertension
1	Secundum atrial septal defect surgically corrected, no pulmonary hypertension
4	Severe bicuspid aortic stenosis
2	Severe tricuspid regurgitation and moderate to severe pulmonary hypertension
1	Congenital mitral and tricuspid regurgitation, mild pulmonary hypertension
3	Surgically corrected Tetralogy of Fallot
2	Transposition of great vessels corrected by Fontan procedure
1	Leopard syndrome
1	Epstein anomaly
1	*situs inversus*

Heart disease in pregnancy

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

Adult Congenital Heart Disease Unit, Department of Cardiology, Queen Elizabeth Hospital, Edgbaston, Birmingham B15 2TH, UK

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.


Best Practice & Research Clinical Obstetrics and Gynaecology 28 (2014) 593–605

Contents lists available at ScienceDirect

Best Practice & Research Clinical Obstetrics and Gynaecology

journal homepage: www.elsevier.com/locate/bpobgyn

10

Obstetric anaesthesia and peripartum management

James Turnbull, MBChB, FRCA, Specialty Registrar in Anaesthesia, Rory Bell, MBBS, FRCA, Consultant Anaesthetist *

Department of Anaesthesia, University College London Hospitals NHS Foundation Trust, 235 Euston Road, London NW1 2BU, UK

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
Department of Anesthesia, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada

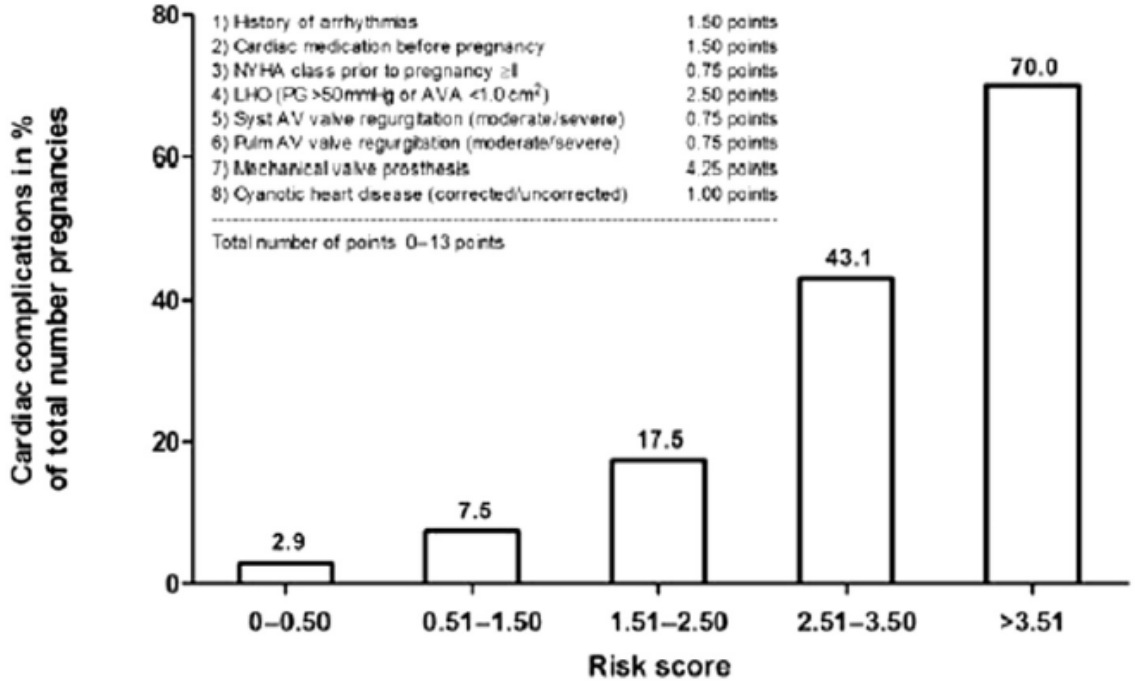
The three most common diagnoses for maternal referral across the three years were cardiac (19.7%; 95% CI: 17.6 to 21.9), musculoskeletal (15.5%; 95% CI: 13.6 to 17.5), and hematologic (13.5%; 95% CI: 11.6 to 15.3) (Table). Congenital cardiac disease (corrected or uncorrected cyanotic congenital heart 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



Number of pregnancies at risk	828	280	126	58	10
Percentage of total population	63.6	28.1	6.1	1.4	0.8

Fig. 3 – ZAHARA risk score: The modified risk score for cardiac complications during completed (>20 weeks of gestation) pregnancies in women with congenital heart disease (expressed as percent of the total number of completed pregnancies). AV = atrioventricular, AVA = aortic valve area, LHO = left heart obstruction, NYHA = New York Heart Association, PG = peak gradient, Pulm = pulmonary, Syst = systemic. (Adapted with permission from Drenthen et al.[14])

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^2)	>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, Iung 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.‡

 Anesthesiology 2011; 114: 949–57

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:

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 slapping first sound were heard at the

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

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 blood-stained sputum. There

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

- Invasive blood pressure monitoring and 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 *In Pre-, Intra- and Post-partum period (24h)*

- ***Early slow titrated epidural for VD***
- ***CSE or slow titrated epidural anesthesia for CS***
- ***Continuous spinal anesthesia***


Review Article

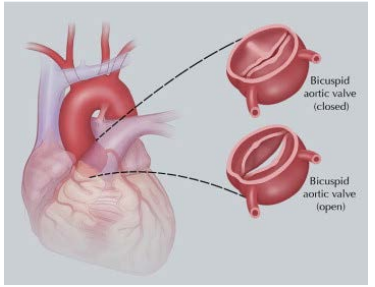
Mitral stenosis and pregnancy: Current concepts in anaesthetic practice

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.*

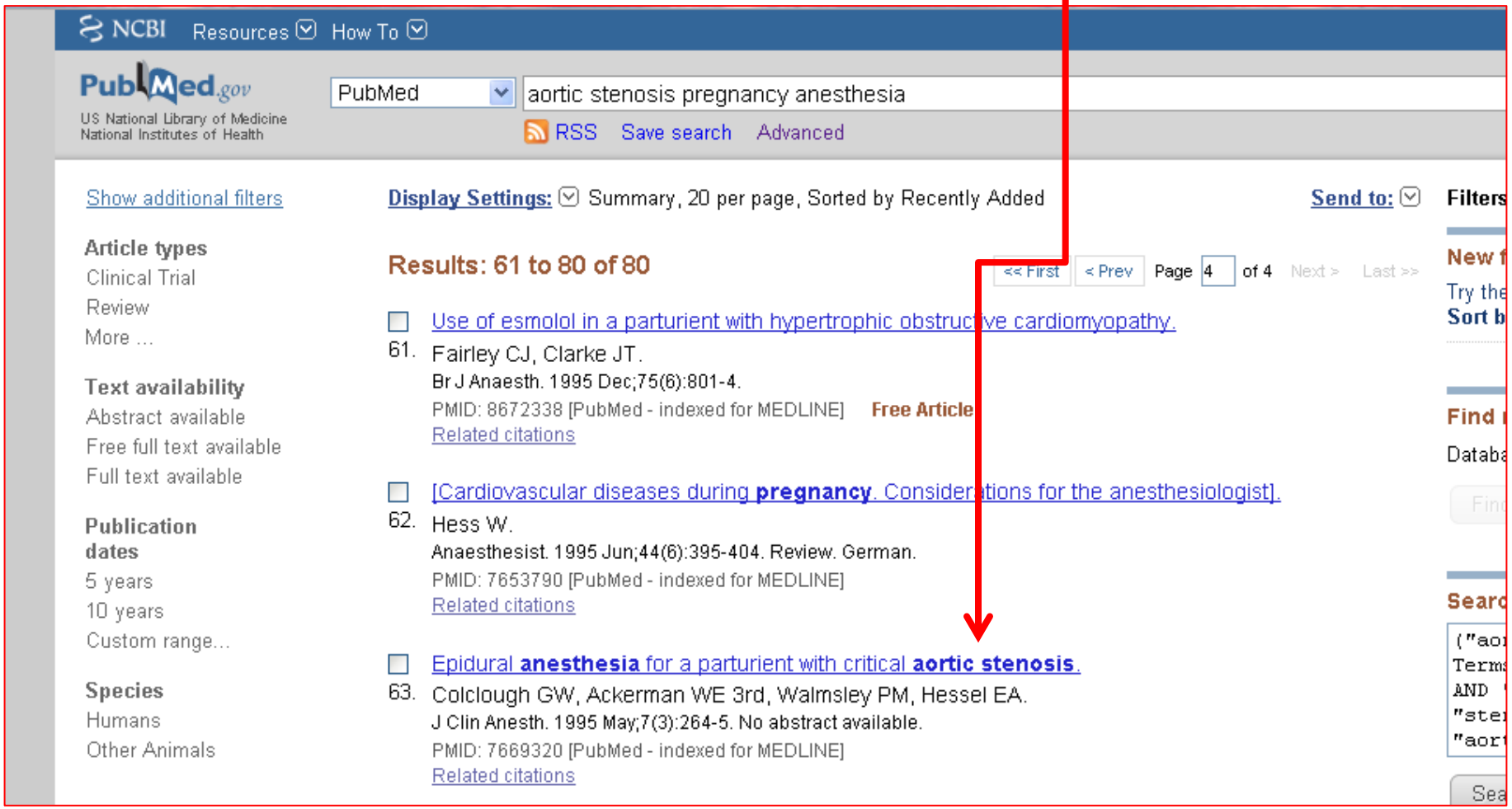


Bicuspid aortic valve (BAV) disease is the most common congenital heart defect, with a prevalence estimated between 0.5% and 2% . (1:3 female-male)

- Fixed Stroke Volume
- Prevention decrease in Diastolic Pressure
  - Coronary Perfusion Pressure
- Keep HR !!!
  - Bradycardia – Low Cardiac Output
  - Tachycardia – Ischemic event
  - Atrial Fibrillation – no atrial kick, low CO

- 18y old
- 140kg
- Severe AS; AVA ~0.5cm2
- Continuous Slow Titrated Spinal for CS
- AL
- ICU
- Happy End!

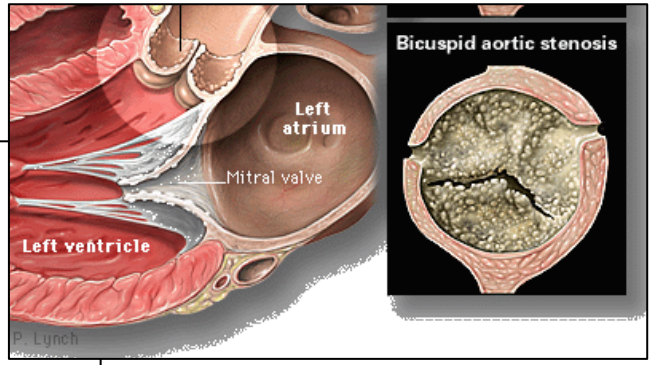
Aortic Stenosis and Pregnancy



Anesthetic approach to patient with AS

Brighouse 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.



- Mode of delivery
- Peripartum monitoring
- Mode of analgesia/anesthesia
- Postpartum/Postoperative care
- Postoperative Pain treatment

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 dep

International Journal of Obstetric Anesthesia (2009) 18, 379–386
0959-289X/$ - see front matter
doi:10.1016/j.ijoa.2009.02.019

CASE SERIES AND REVIEW

ELSEVIER
www.obstetanesthesia.com

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 Zedekc 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[4]	MG 70 mmHg unknown etiology	Elective CS	General: etomidate +sch alfentanil +N_2O/O_2; pancuronium, halothane			Apneic baby needed naloxone
Marron-Pena 1992[5]	Rheumatic NYHA II cardiomegaly	NVD	Epidural: bup+fent for labor lid for forceps delivery			Discharged home after 24 h.
Choi 1992[6]	Congenital MG 100 mmHg	Elective CS	Epidural: lid + bup + fent	Standard + IBP + PAC	HDU postpartum	Discharged home after 4 days.
Brian 1993[7]	Congenital, MG 90 mmHg	Elective CS	Slow titrated epidural (~30 min)	Standard + IBP + PAC	HDU 48 h, continues epidural bup 0.125%	Hemodynamic changes secondary to oxytocin infusion
Colclough 1995[8]	Congenital, AVA 0.7cm^2, 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[9]	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[10]	VSD repair, AVA 0.7cm^2, MG 80 mmHg	Elective CS twins @ 29 weeks	2 epidural L1-2 and L4-5	Standard + IBP + PAC	HDU 24 h	
Suntharalingam 2001[14]	#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 1	Operative VD @ 40 weeks	Epidural: bup + fent			
	#3 bicuspid MG 44 mmHg	Induction VD @ 39 weeks	Epidural: bup + fent			
Van de Velde 2003[15]	bicuspid MG 101 mmHg NYHA 2	Induction VD @ 39 weeks	Continuous spinal L3-4	Standard + IBP	HDU 24 h	
Orme 2004[16]	#1 bicuspid MG 64 mmHg AVA 0.7cm^2	Elective CS @ 38 weeks for fetal anomalies	*All four patients*: general anesthesia: etomidate + sch + remifent + N_2O+O_2 and isoflurane	Standard + IBP + CVP		Significant postpartum hemorrhage (once)
	#2 AVA 0.6 cm^2 MG 86 mmHg	Elective CS @ 38 weeks for breech		Standard + IBP + CVP		
	#3 AVA 0.8cm^2 MG 120 mmHg	Elective CS @ 38 weeks		Standard + IBP + CVP		
	#4 bicuspid MG 90 mmHg	CS @ 35 weeks		Standard + IBP + CVP		
Molins Espinosa 2004[11]	Bicuspid MG 130 mmHg NYHA III	CS @ 32 weeks	General remfent + etomidate +fent rocuronium sevoflurane + O_2	Standard + IBP + CVP	HDU 24 h	Digoxin and diuretics for 25 days
Kuczkowski 2004[12]	AVA 0.7cm^2 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	
Tihtonen 2005[13,*]	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[17]	AVA 0.7 cm^2 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: remifentanil; * 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,[a] W. Budts,[b] E. Vandermeersch,[a] B. Spitz[c]

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

Krzysztof M. Kuczkowski[1] and André van Zundert[2]

[1]Departments of Anesthesiology and Reproductive Medicine, University of California, San Diego, San Diego, California, USA
[2]Catharina Hospital, Brabant Medical School, Eindhoven, The Netherlands

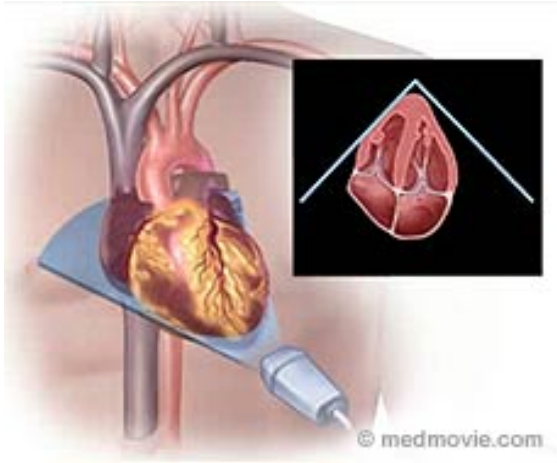
General anaesthesia using remifentanil for caesarean section in parturients with critical aortic stenosis: a series of four cases

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`)
- **Trans Thoracic/Esophageal Perioperative Echocardiography**
  - Focused transthoracic echocardiography
    - Volemic status
    - Ventricle motion
    - Gradient on
      - Aortic valve
      - Mitral valves
      - Grate of Pulmonary HTN



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doi:10.1016/j.ijoa.2009.02.019

CASE SERIES AND REVIEW

ELSEVIER
www.obstetanesthesia.com

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 Zedekc Medical Center, Jerusalem, Israel

Clinical recommendation -continued

- Long acting neuraxial opioids for **postoperative pain management**

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

- **Observation in a high-dependency unit for 24-48h** for early detection and treatment of postoperative hemodynamic instability.
- Good communication – **"Team Approach"**

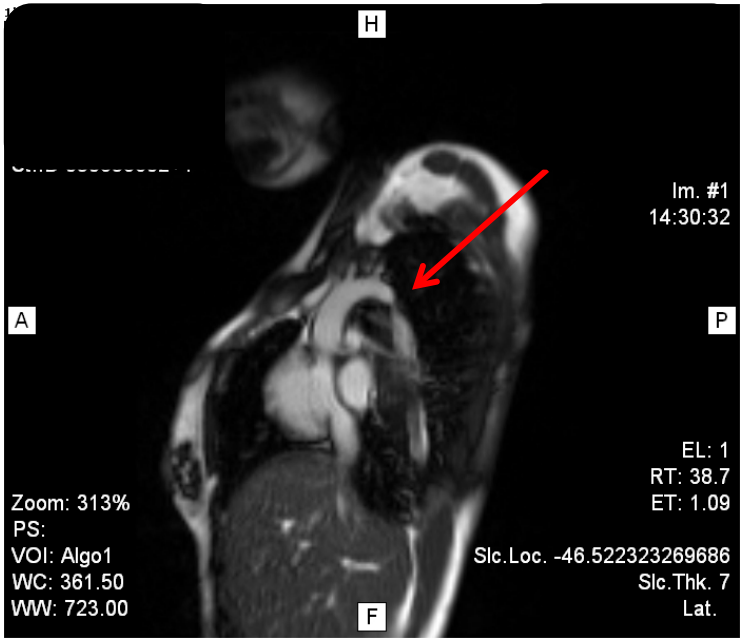
The rate of peripartum cardiac complications is almost 10% and includes ischemia, pulmonary edema and arrhythmias.

Heart disease in pregnancy

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

Best Practice & Research Clinical Obstetrics and Gynaecology 29 (2015) 579–597

Peripartum anesthetic management of a patient with Critical Aortic Coarctation



Aortic coarctation ~3.7 mm, gradient ~ 80mmHg

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

Pulmonary Hypertension

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

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 •Lymphangioleiomyomatosis •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.

- **Patient with significant Pulm 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**

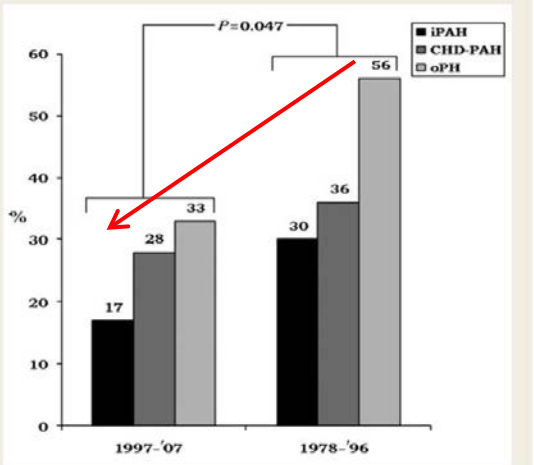


Figure 3 Maternal mortality amongst parturients with pulmonary arterial hypertension: Comparison between 1997–2007 and previous era (1978–1996).[1]

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/IVC	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,[a,b,*] R Condliffe,[a,b,*] V Webster,[c] GH Mills,[c] I Wrench,[c] SV Gandhi,[d] K Selby,[d] IJ Armstrong,[a] L Martin,[a] ES Howarth,[e] FA Bu'Lock,[f] P Stewart,[d] CA Elliot[a,b]

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

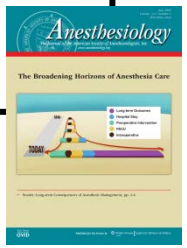
GA for CS

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

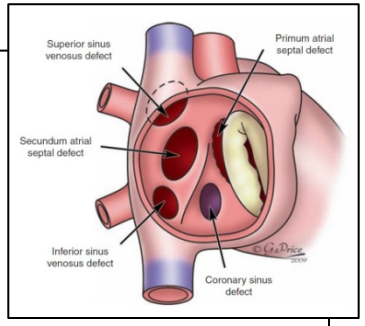
Has there been any progress made on pregnancy outcomes among women with pulmonary arterial hypertension?

Elisabeth Bédard[1,2], Konstantinos Dimopoulos[1,2], and Michael A. Gatzoulis[1,2]

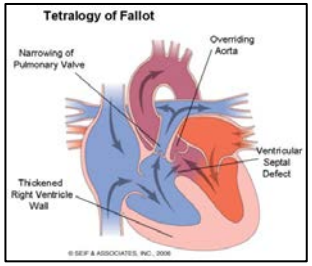
Our approach to the pregnant patient with severe Pulmonary HTN

- 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_2 (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)
- NO 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.



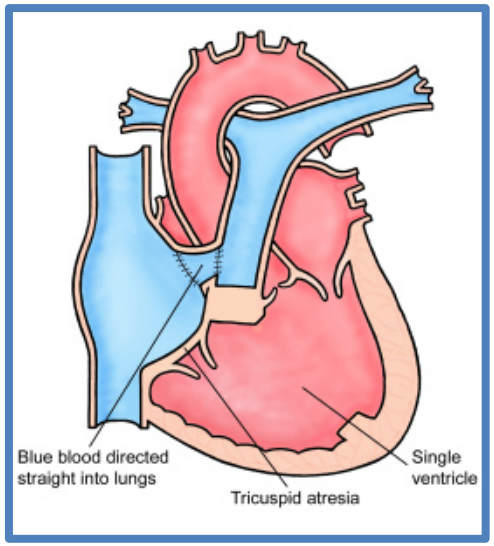
- Atrio/Ventricular septal defect (ASD and VSD)
- Congenital corrected transposition of the great arteries
- Aortic coarctation
- **Patients with a single functional ventricle** (complete atrioventricular septal defects and hypoplastic right or left heart syndrome) **patient after Fontan repair**
- **Tetralogy of Fallot**



- **S-ms with effects on tensile strength of connective tissues** ***Marfan , Loeys - Diets, Ehlers-Danlos and Turner syndromes***

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

Pregnant patients after Fontan procedure.



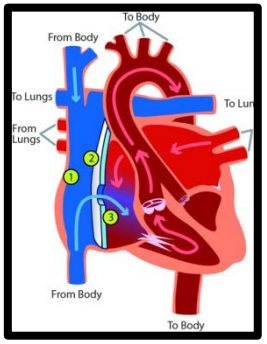
Br Heart J. 1975.
Correction of tricuspid atresia.
Walker DR,

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☆

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[a,c,d,*], A. Briskin MD[a,c,d], A. Fadeev MD[a],
S. Grisaru-Granovsky MD[b], S. Halpern MD[c,d]

[a]*Department of Anesthesia, Shaare Zedek Medical Center, Jerusalem, Israel*
[b]*Department of Obstetrics and Gynecology, Shaare Zedek Medical Center, Jerusalem, Israel*
[c]*Department of Anaesthesia, Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada*
[d]*University of Toronto, Toronto, Ontario, Canada*

Labor analgesia and Emergency CS secondary to fetal distress
10ml/h 0.1% Bupivacaine with 2.5mg/mL Meperedine
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 are can be best accomplished with neuraxial anesthesia.

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

(Anesth Analg 2011;113:307–17)

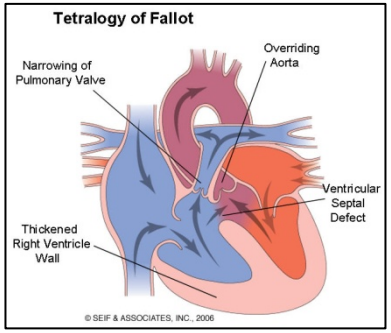
2–3 (depending on residual defects such as pulmonary and tricuspid regurgitation and PA stenoses)	Frequently repaired in childhood primarily now, some patients may have undergone shunting procedure prior.	General: Pregnancy generally well tolerated, though some authors note an increased risk of RV failure with severe PI. Modest risk of arrhythmias. Variability in CHF probably reflects different definitions across studies.
	Residual pulmonary stenosis and regurgitation is common, occasionally PA stenosis and other valve lesions.	C: Arrhythmias 6.4%, CHF 2.4%, and MI/CVA/death 0%[5]; CHF 14% associated with mod-sev PR and PA stenosis[23]; CHF 23%[24]; arrhythmias 6.5% (1/2 were VT), CHF 1.6%.[25] O: PIH 8.3%, preeclampsia 1.8%, PROM 0.8%, prematurity 6.3%, SGA 9%, and PPH 8.8%[5]; miscarriage 19%, PIH 4.8%, preeclampsia 3.2%, prematurity 17.7%, and SGA 18.5%.[25]

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[1], Arora S, Bhukal I, Padmanaban A.

Int J Obstet Anesth. 2013 Nov;22(4):358-60



- ***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
  - For Turner s-m – aorta >25mm associated with up to 33% 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

Fetal condition

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

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
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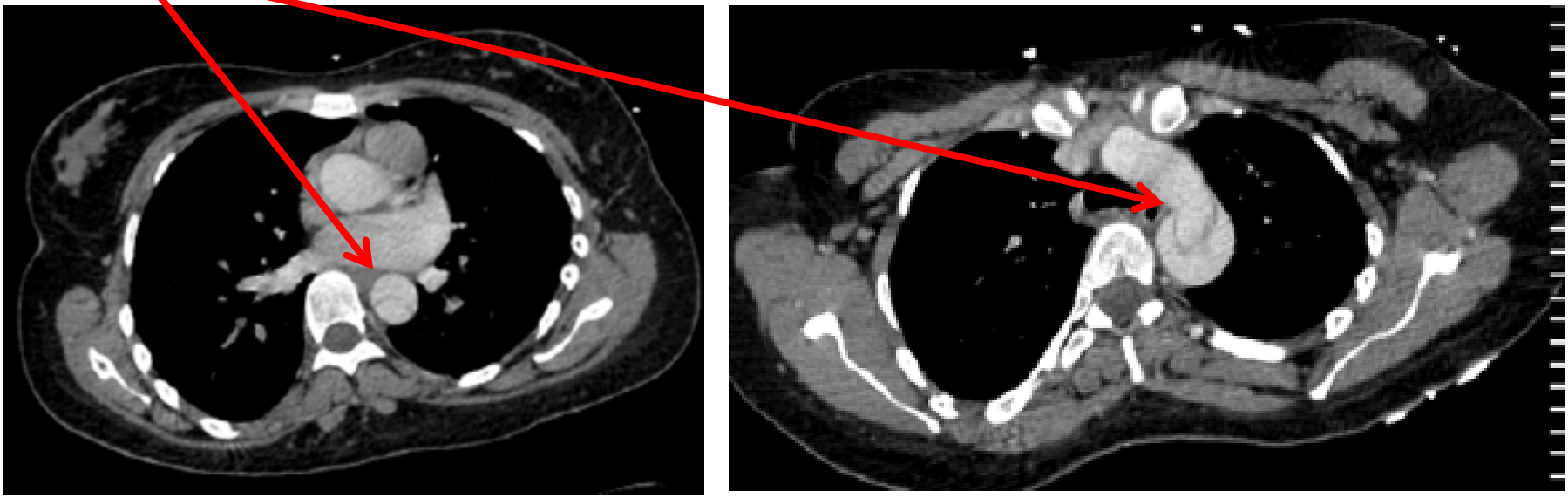
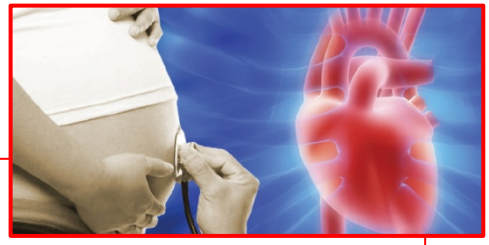
E-mail: elstein@szmc.org.il



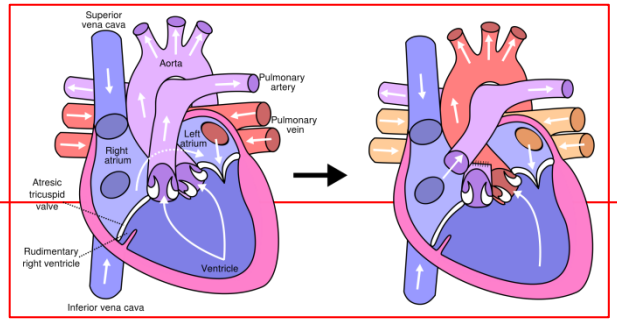
- Emergency CS for acute (Stanford) type B aortic dissection
- General "Cardiac" anesthesia
- Intraoperative TEE observation for real-time control of aortic condition
- Cardiac surgeons Standby for emergency aortic arch replacement

Summary



Baseline 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
    - stress test
    - cardiac MRI
    - Cardiac catheterisation



- **Slow titrated Epidural analgesia/anesthesia**
- **Low dose CSE analgesia/anesthesia**
- **Careful** Co-hydration with crystalloid
- Concurrent Phenylepherine 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. Rosseland
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 and anaesthesia teams

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

Journal of Obstetrics and Gynaecology, October 2011; 31: 597–602
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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

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Thank you!!!