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Pregnancy and Heart Disease: The Role of Echocardiography

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No disclosures

October 10, 2017

Orlando ASE

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Overview:

- Normal hemodynamics in pregnancy
- Normal echocardiographic changes in pregnancy
- Case presentation

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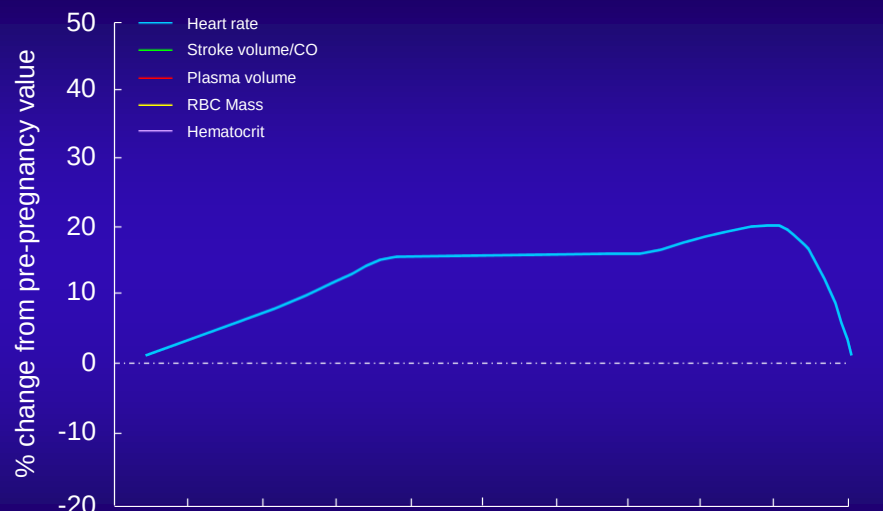
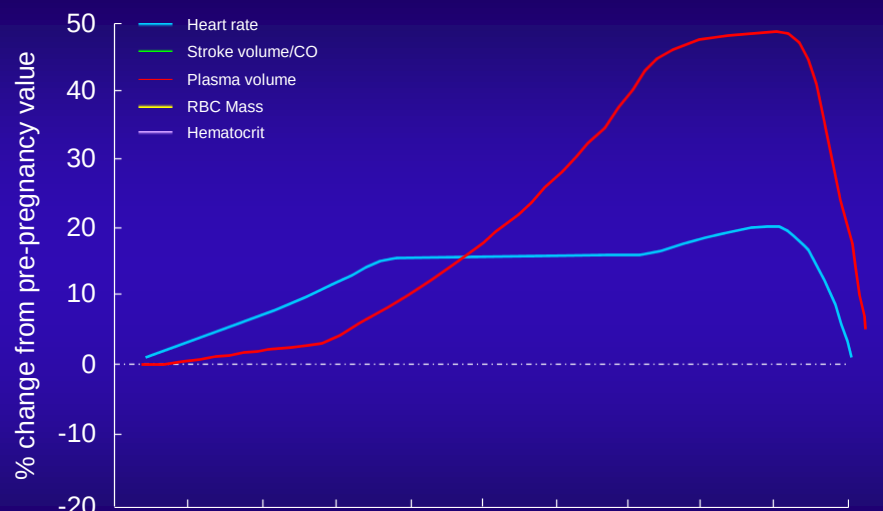
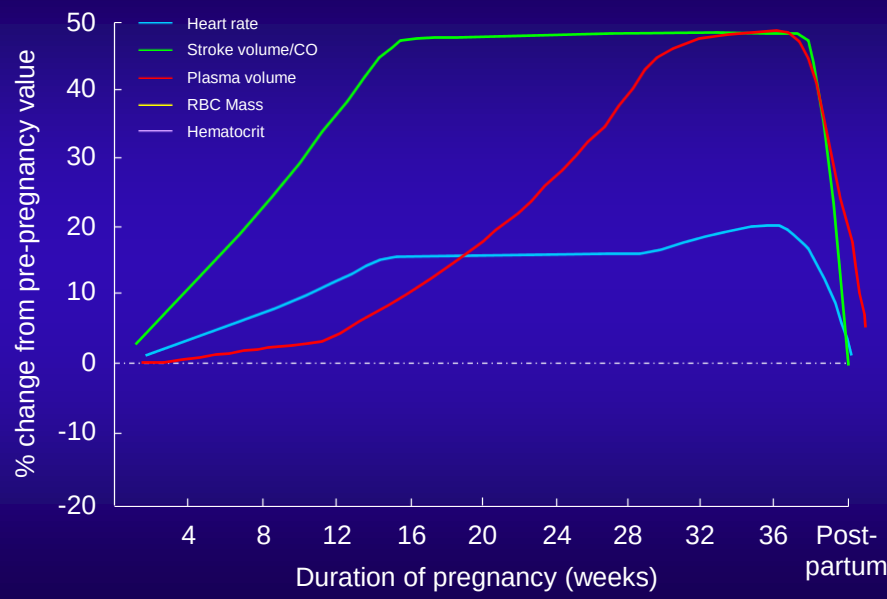
Hemodynamics During Pregnancy: Heart Rate



Hemodynamics During Pregnancy: Plasma Volume



Hemodynamics During Pregnancy: Stroke Volume



Increased cardiac output (CO = HR X SV)

- Increased metabolic requirements of mom and baby
- Preload↑, afterload↓, HR↑
- Normally CO rises 30-50% (1.8-2.0L)
  - Twins: increased by additional 20%, peaks 30 weeks
- Acutely influenced by posture
  - Highest left lateral decubitus position
  - Lowest supine (compression of IVC by gravid uterus)
- EJECTION FRACTION IS UNCHANGED!

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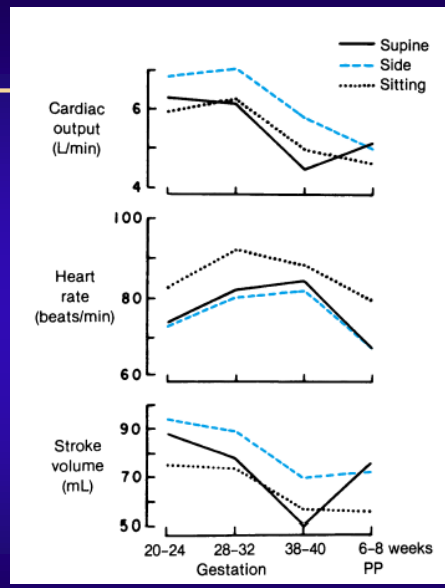
Positional Changes in Cardiac Output



Ueland K, Metcalf J. Clin Obstet Gynecol 1975;18:41

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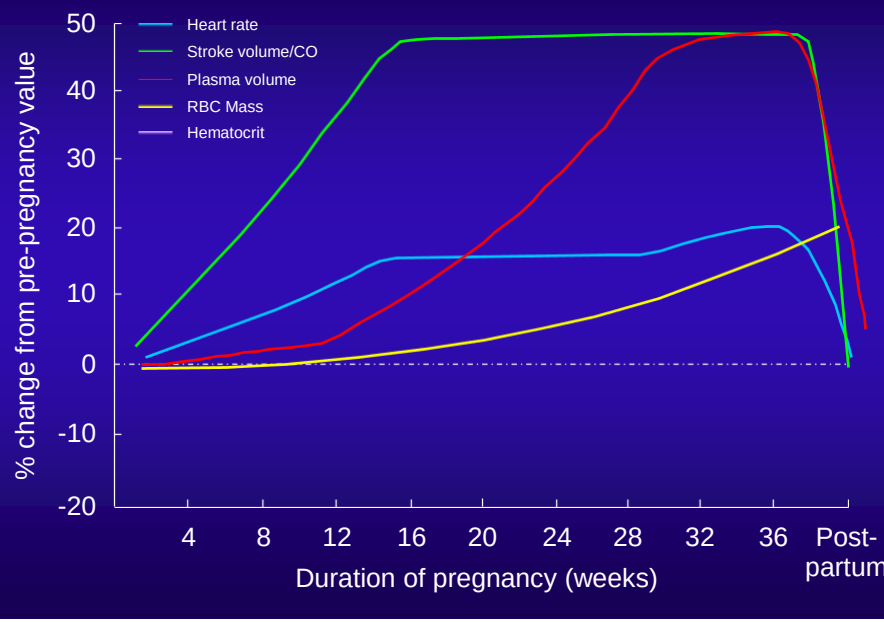
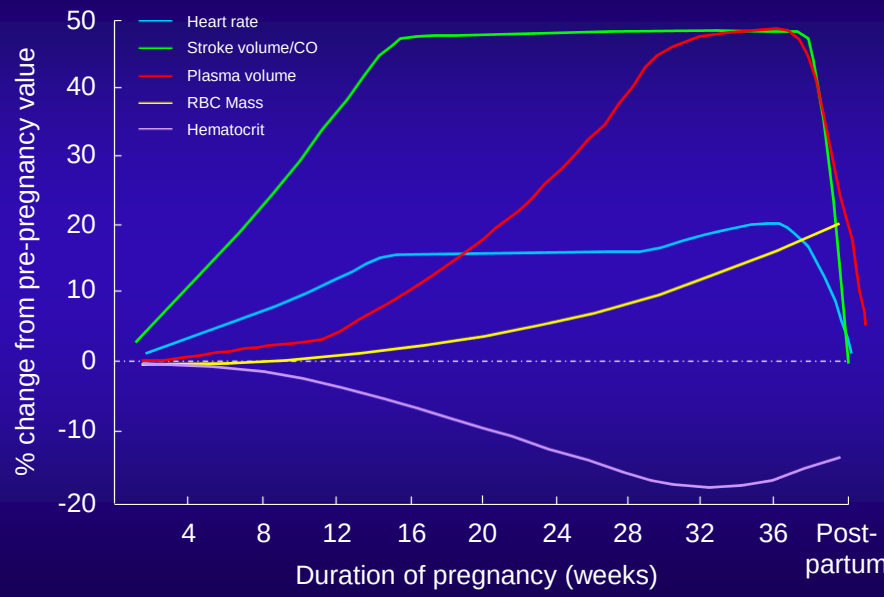
Hemodynamics During Pregnancy: RBC Mass



Hemodynamics During Pregnancy: Hematocrit



Benefits of physiologic anemia?

- Reduces blood viscosity
  - Reduces resistance to flow and facilitates placental perfusion, lower cardiac work
- Absence of physiologic anemia likely harmful
  - Increased risk of stillbirth, preterm, small

Stephansson et al JAMA 2000

Post delivery as much as 500mL of blood sequestered in the uteroplacental unit is autotransfused to the mom

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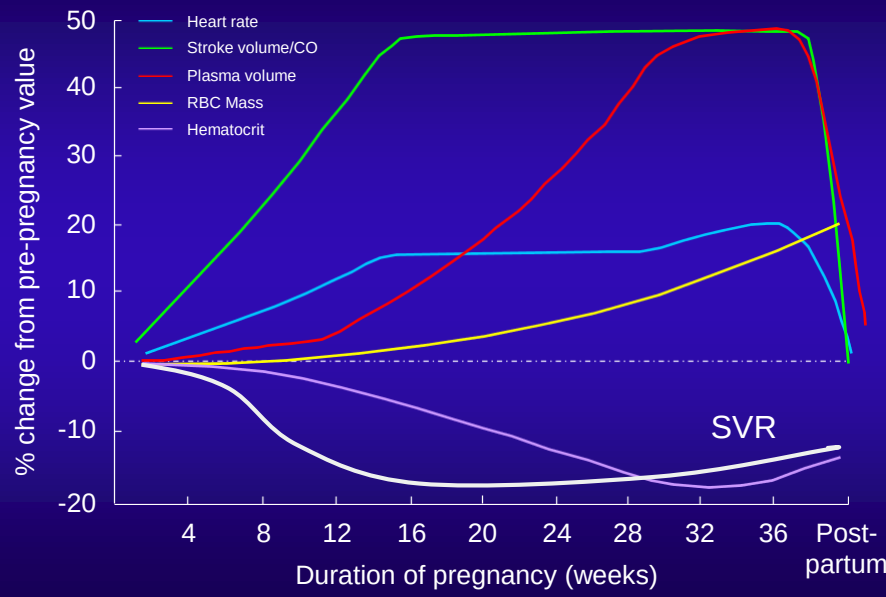
Hemodynamics During Pregnancy: SVR

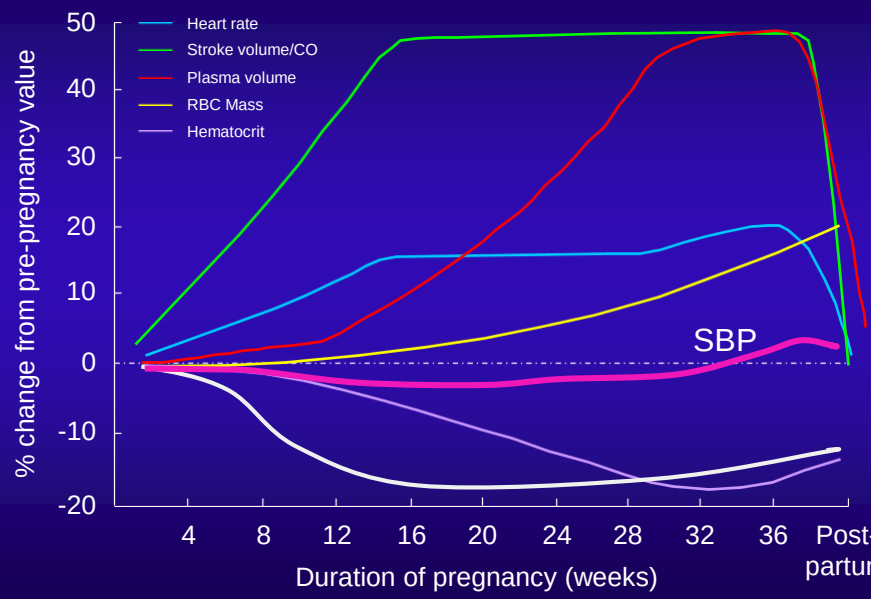


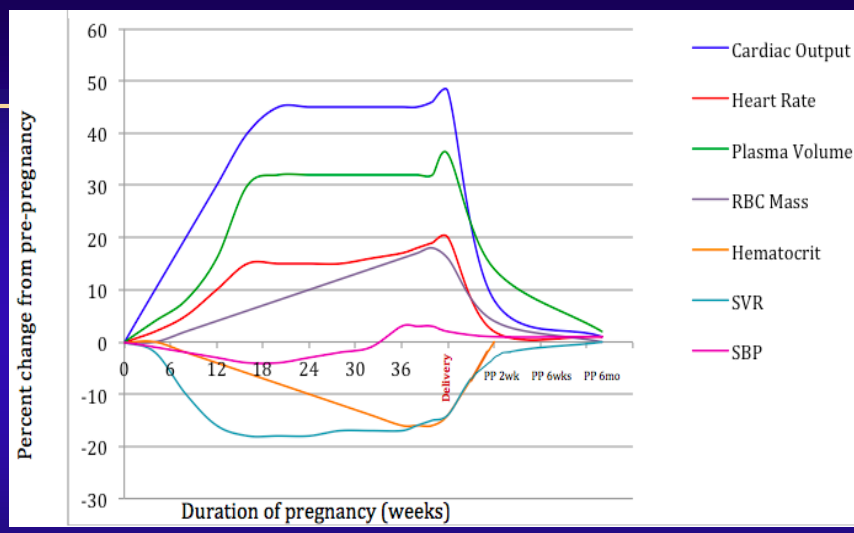
Drop in SVR

- Why? Low flow low resistance circuit in the uterus/placenta
- How?
  - Increased endothelial prostacyclin
  - Enhanced NO production
  - Reduced arterial stiffness: Relaxin

In animal models estrogen and prolactin can lower vascular resistance and increase cardiac output

Hemodynamics During Pregnancy: Blood Pressure





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Yucel, DeFaria Yeh. *Curr Tr Opt CV Med* 2017

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Physiologic Changes of Twin Pregnancy

	Term	Non-preg	Increase	%
Single (n=50)				
Blood vol	4820	3250	1570	48
RBC vol	1790	1355	430	32
Hct	37	41.7		
Twins (n=30)				
Blood vol	5820	3865	1960	51
RBC vol	2065	1580	485	31
Hct	35.5	41		

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Pritchard JA. Anesthesiology 1965;26:393.

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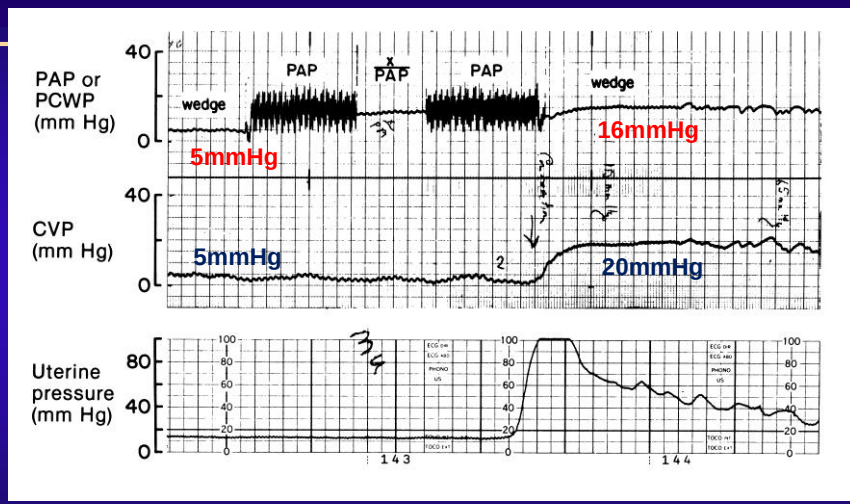
Labor and uterine contractions: normal heart



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Hankins GDV, et al. Obstet Gynecol 1985;65:139

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Normal Echocardiographic Changes in Pregnancy

Physiologic multivalvular regurgitation during pregnancy

- Campos et al. *Int J Cardiol* 1993 (18 pregnancies)
- Presence of physiologic valve regurgitation

	Early pregnancy	Full term	Early post partum
Mitral	0%	28%	0%
Aortic	0%	0%	0%
Tricuspid	39%	94%	83%
Pulmonic	22%	94%	67%

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Echo Assessment of Cardiovascular Hemodynamics in Normal Pregnancy

Desai DK, Moodley J, Naidoo DP. *Ob Gyn* 2004

Table 6. Longitudinal Echocardiographic Structural and Function Changes in Pregnancy

Gestation (wk)	Left atrium	Left atrium/aorta	Left ventricle filling*	L ventricle mass (g)	Left ventricle mass index (g/m^2)	Left ventricle systolic function (%)†
14–19	3.0 ± 0.2	1.18 ± 0.12	2.1 ± 0.6	102 ± 16 (−15)	63 ± 10 (−15)	32 ± 4
20–23	3.1 ± 0.6	1.34 ± 0.28	2.1 ± 0.4	127 ± 18 (6)	77 ± 11 (4)	34 ± 4
P	.391	.428	.495	.038‡	.099	.014‡
24–27	3.2 ± 0.5	1.38 ± 0.23	2.1 ± 0.5	124 ± 23 (3)	75 ± 12 (1)	34 ± 4
P	.088	.431	.303	.096	.089	.277
28–31	3.2 ± 0.5	1.35 ± 0.23	2.0 ± 0.6	131 ± 24 (9)	78 ± 11 (5)	34 ± 4
P	.171	.335	.067	.210	.376	.032‡
32–36	3.2 ± 0.5	1.37 ± 0.23	1.8 ± 0.3	139 ± 30(16)	81 ± 13 (9)	33 ± 4
P	.457	.244	.208	.052‡	.072	0.074
37–term	3.5 ± 0.4	1.46 ± 0.17	1.8 ± 0.3	151 ± 35(26)	87 ± 15 (18)	35 ± 4
P	.016‡	.006‡	.309	.027‡	.048‡	.369
Postpartum	3.0 ± 0.5	1.27 ± 0.21	2.0 ± 0.5	120 ± 31 (0)	74 ± 16 (0)	32 ± 4
P	.002‡	.005‡	.048‡	.001‡	.006‡	.130

Data are presented as absolute mean ± 1 standard deviation (percent change from baseline).
Percent change from baseline is calculated by comparing mean value for the measured parameter to the postpartum value.
P values indicate statistical change from preceding gestational period.
* Reflected by early diastolic to atrial filling ratio.
† Expressed as fractional shortening.
‡ Statistically significant.

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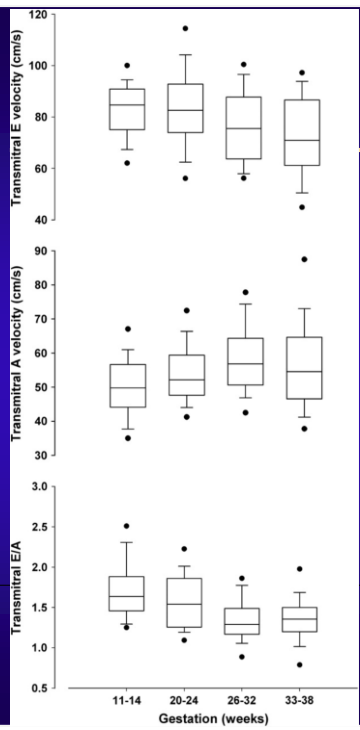

Maternal left ventricular diastolic and systolic long-axis function during normal pregnancy

Eur J Echocardiogr. 2007;8(5):360-368

- Transmitral A velocity increases
- E/A ratio decreases over the course of a pregnancy
- Post partum returns to prepregancy values

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Normal echocardiographic changes

- Increased stroke volume thus increased LVOT VTI
  - Increased gradients across stenotic lesions
- Increase in all chamber sizes
- Increased disdensibility of the aorta
- IVC plethoric
- Ejection fraction should remain constant
- Slight decreases in E/A ratio
- Increase in valvular regurgitation (exception of aortic)
- Small pericardial effusion

Case:

- 22F G1P0 at 34 gestation who presents with increased dyspnea, orthponea and palpitations

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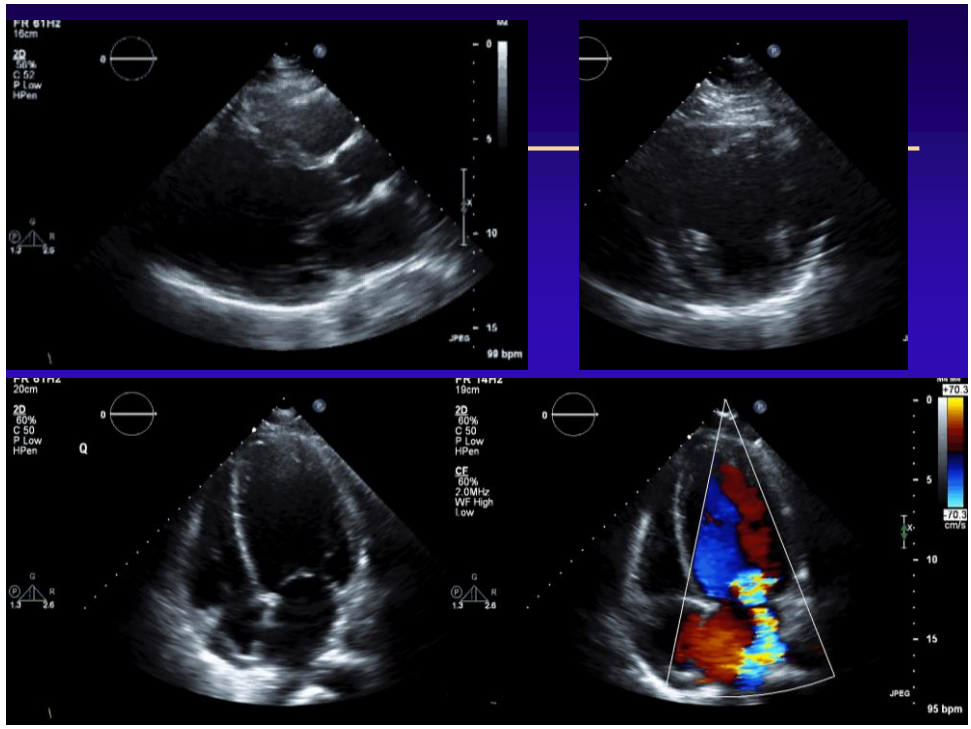
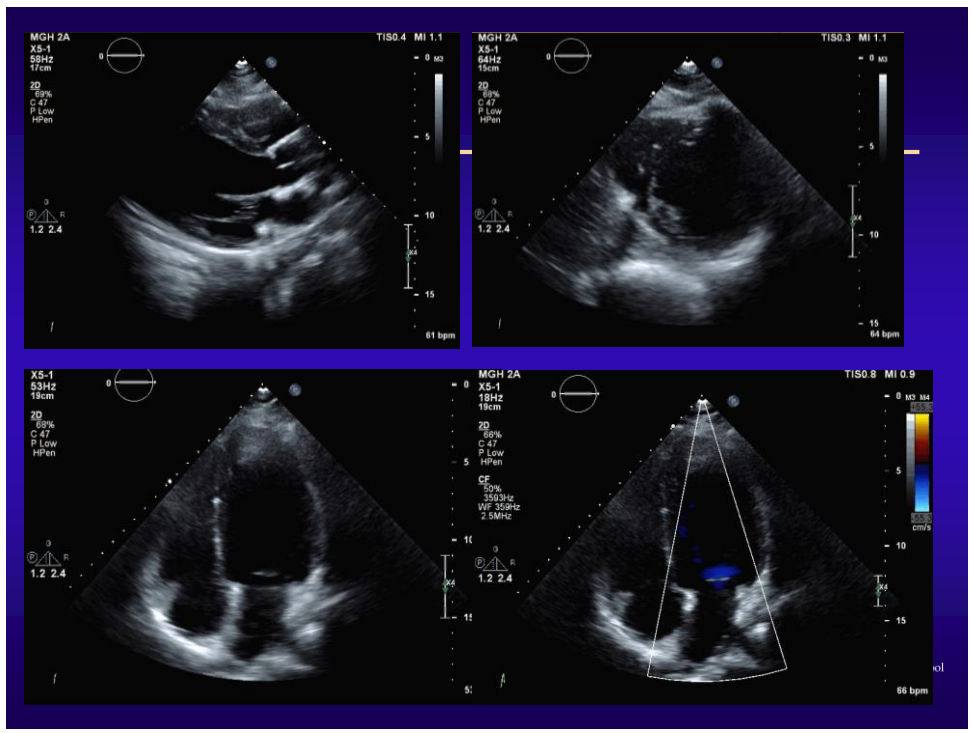

2D
C 52
P Low
HPen
99 bpm
2D
60%
C 50
P Low
HPen
Q
2D
60%
C 50
P Low
HPen
CF
60%
2.0MHz
WF High
Low
JPEG
95 bpm


MGH 2A
X5-1
58Hz
17cm
TIS0.4 MI 1.1
61 bpm
MGH 2A
X5-1
64Hz
15cm
TIS0.3 MI 1.1
64 bpm
X5-1
53Hz
19cm
MGH 2A
X5-1
18Hz
19cm
TIS0.8 MI 0.9
66 bpm

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Heart Failure: Peripartum Cardiomyopathy

Idiopathic heart failure with reduced LVEF during late pregnancy or several months post partum

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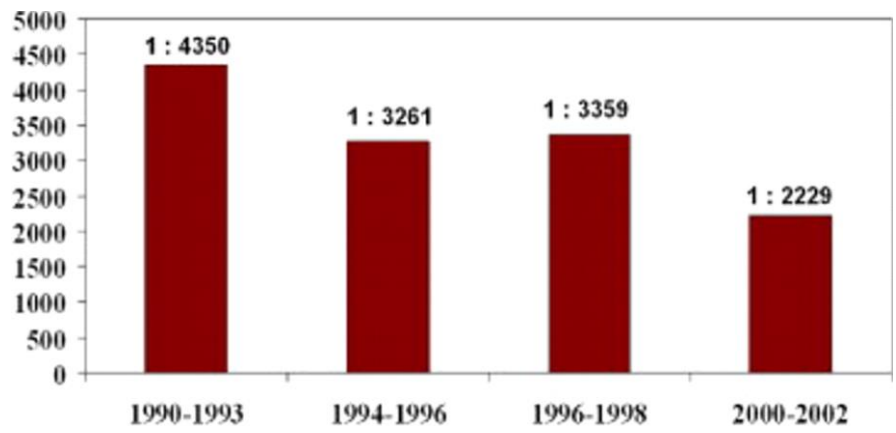
25

Peripartum Cardiomyopathy
Change in Incidence of Disease



Elkayam U, et al. *J Am Coll Cardiol* 2011;58:659-70

***Peripartum Cardiomyopathy Risk Factors

- Older maternal age, teenage pregnancy
- Mutiparity
- Mutifetus pregnancy
- African descent, Haiti
- Hypertension, diabetes
- Prior toxin exposure (cocaine)
- Preeclampsia
- smoking

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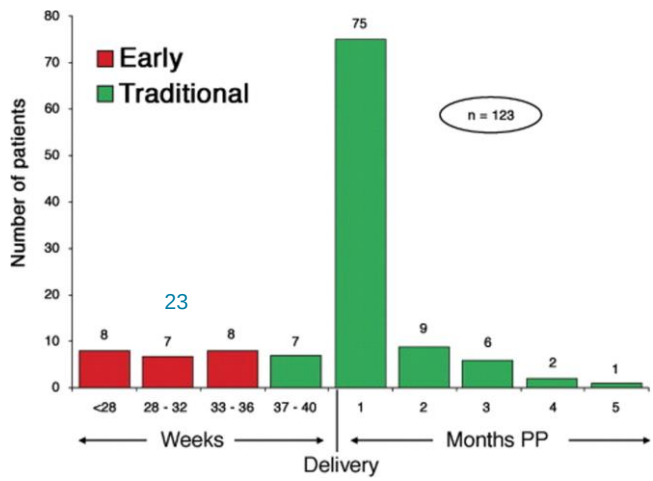
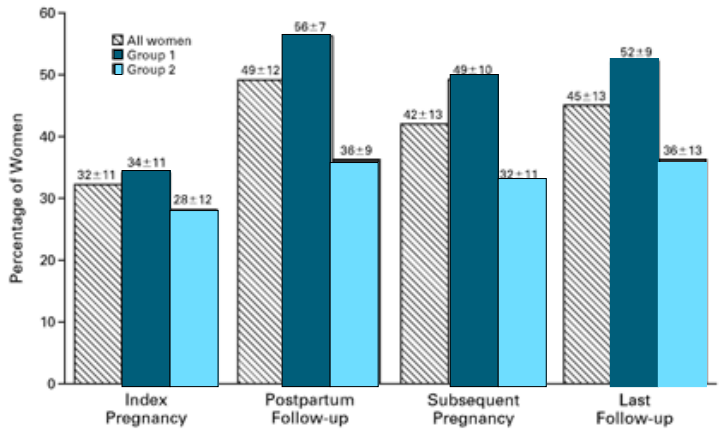
Peripartum Cardiomyopathy
Time of Diagnosis



Elkayam U, et al. *J Am Coll Cardiol* 2011;58:659-70

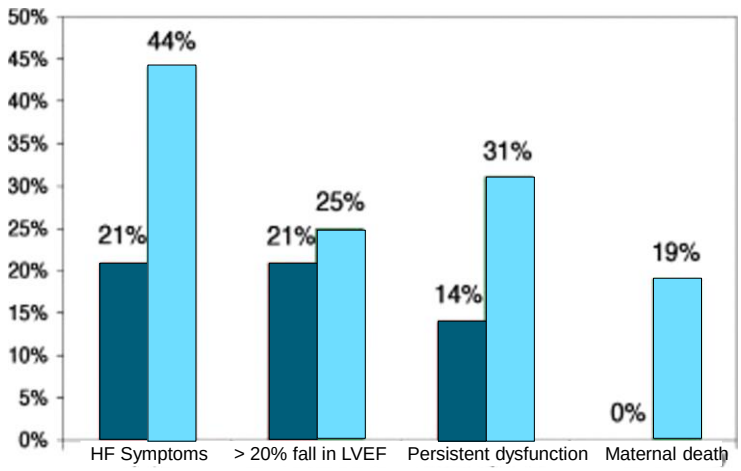
Effect of Subsequent Pregnancy on Left Ventricular Function in Peripartum Cardiomyopathy



N=44

Elkayam U, et al. *NEJM* 2001;344:1569

Maternal Complications During Subsequent Pregnancies



Elkayam U, et al. *J Am Coll Cardiol* 2011;58:659-70

Summary:

- Pregnancy is a stress test!
  - Increase HR, increased plasma volume, increased contractility
  - Underlying cardiac disease unmasked 28-32 weeks
- Chamber dimensions all increase in pregnancy as does valvular regurgitation, E/A may decrease a bit
  - All should return to normal post partum
- Hemodynamic shifts are not over when the baby is out!
  - Remember the post partum rise in SVR can uncover heart failure

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Thank You!

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