Transthoracic Echocardiography in Obstetric Anesthesia

Is it time we knew our patient's hearts?

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A pregnant patient suddenly collapses…

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Bleeding

Embolism

Anesthetic

Uterine atony

Cardiac disease

Hypertensive/preeclampsia/eclampsia

Other

Placental abruption/previa

Sepsis

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ECHO TO THE RESCUE

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ECHO TO THE RESCUE

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ECHO TO THE RESCUE

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What if you saw this?

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OBJECTIVES

- Review the use of bedside TTE in obstetric anesthetic care
- Present case examples of clinical benefits
- Explore options for training and implementation of TTE in clinical practice

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The not-so-hidden curriculum …

*…acquiring even basic echocardiographic skills can be **genuinely valuable** to **any** obstetric anesthesiologist on a **regular basis**…*

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Disclosure

- I have not received any financial or in-kind compensation for this presentation
- I have no financial relationship with any of the entities in any way related to obstetric anesthesia or perioperative echocardiography

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Dr. Richard B. Goldbloom
RESEARCH AND CLINICAL CARE PAVILION

Echocardiography in Acute Care Specialties

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- Performed by non-cardiologists
- Point-of-care
- Driven by clinical question/context
- Focused
- Often qualitative
- Dynamic
- Conclusions inform care in real time

Transthoracic Echocardiography in Acute Care Specialties

- Emergency Medicine embraced point of care ultrasound in the late 90s
- Critical Care Medicine caught up in the last 5-8 years
- Anesthesiology (other than cardiac) is in the early stages
  - **75% of anesthesia residents** in Canada and 36% of anesthesia residents in US get some form of teaching/training
  - **12% of anesthesiologists** who teach residents have POC Echo skills

J Cardiothorac Vasc Anesth. 2016 Jan;30(1):102

J Can Anesth 2017; 64:441

Adoption of Echocardiography in Anesthesia
• BARRIERS and CATALYSTS

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- We're really good at hemodynamics
- OR is the last hold-out of the pulmonary artery catheter
- Technology and training
- POC ECHO may not be billable

- We like the immediate gratification
- Toys are cool
- Improved understanding of the hemodynamics
- *"That resident can no longer upstage me"*

OB anesthesia and transthoracic echo are a good fit

- OB anesthesiologist is a peripartum physician and **birth unit intensivist**
- Pregnant women are comfortable with US technology
- Left lateral tilt moves the heart closer to the chest wall
- Anatomic changes in pregnancy facilitate insonation of the heart
- Obtain information in real time – important in rapidly evolving situations

Cardiopulmonary reserve in pregnancy

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Healthy non-pregnant patient

Healthy pregnancy

Preexisting cardiovascular disease

Preeclampsia

Hemorrage

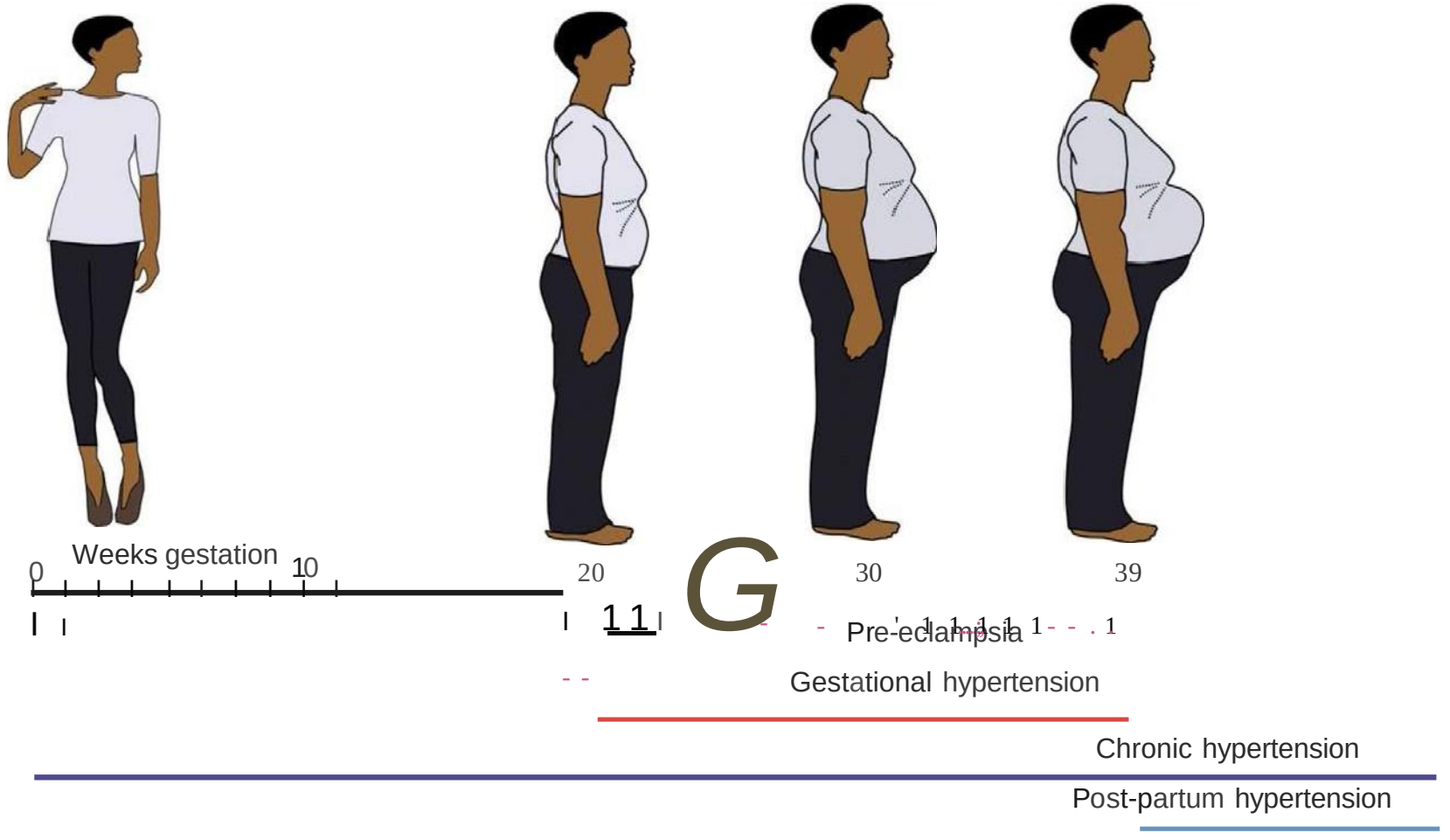
EDITOR'S CHOICE

Incidence and prevalence of pregnancy-related heart disease e

Karen Sliwa ' Michael Bohm

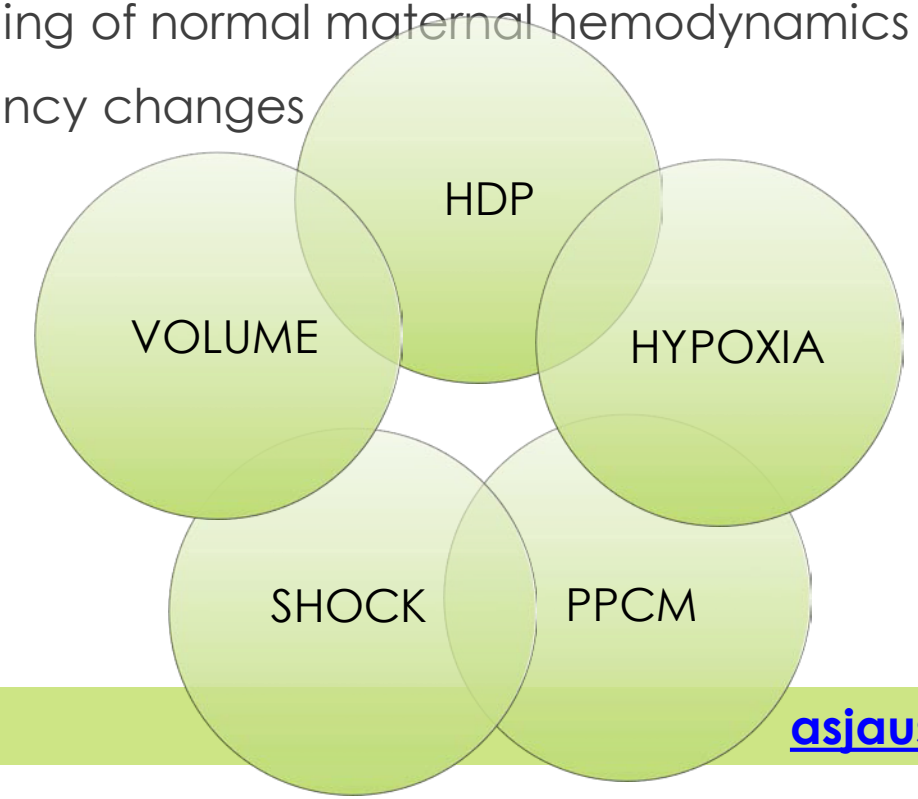
Cardiovascular Research, Volume 101, Issue 4, 15 March 2014, Pages 554-560, https://doi.org/10.1093/cvr/cvu012

Published: 23 January 2014 **Article history..-**



TTE in OB anesthesia is a growing field

- Contributing **new knowledge** to understanding of normal maternal hemodynamics
- **Preeclampsia** – early changes, post-pregnancy changes
- **Peripartum cardiomyopathy**
- **Volume responsiveness**
- New ways of using echo to:
  - DIAGNOSE
  - MONITOR
  - GUIDE



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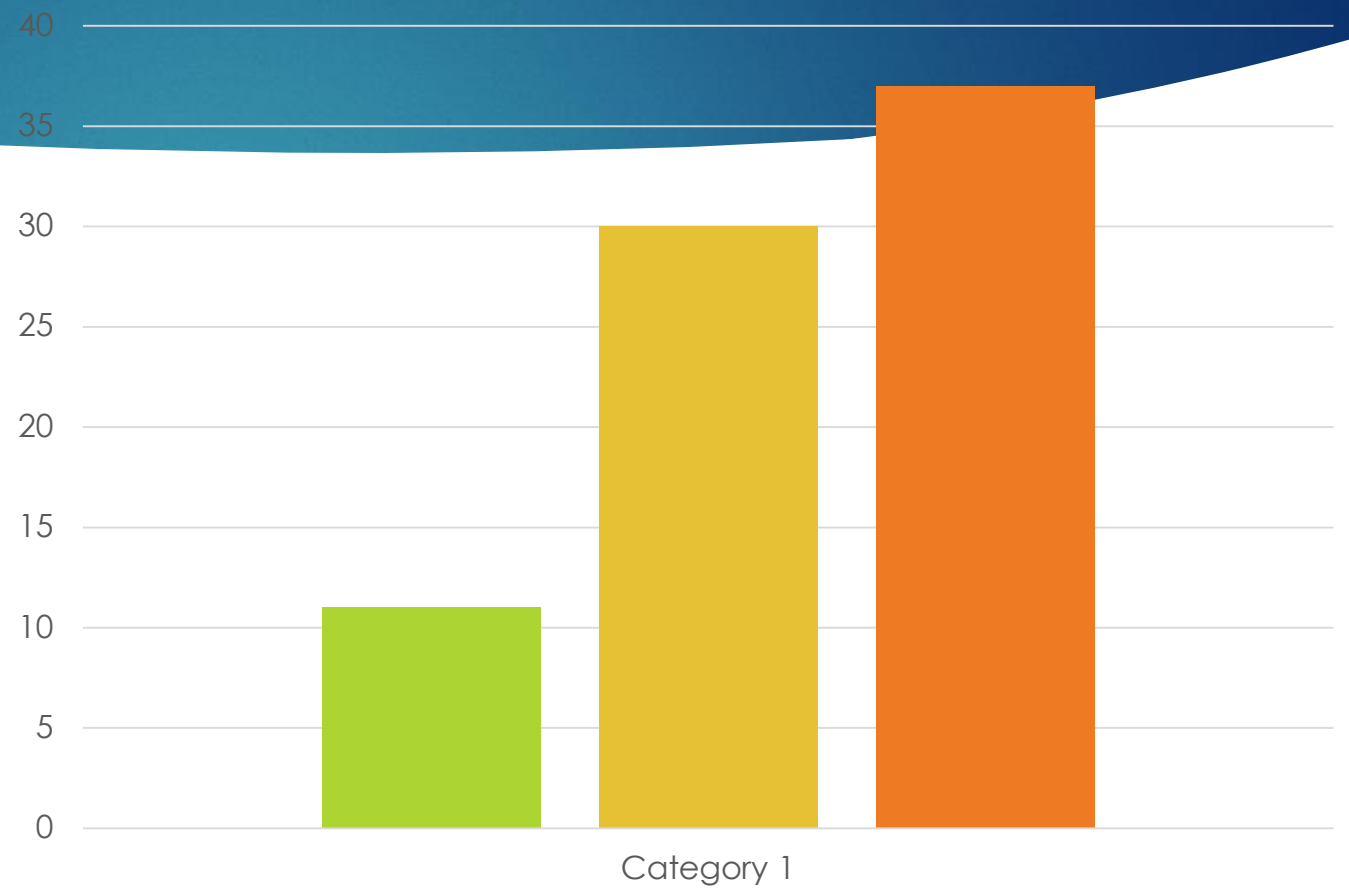
TTE in OB anesthesia is a growing field

- The literature examining TTE use in obstetrics has exploded in recent years
- Increasingly published in non-cardiology literature



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Focused POC ECHO – current evidence

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- Patient outcome studies in acute care are virtually non-existent

  Blyth L **Bedside focused echocardiography as predictor of survival in cardiac arrest patients: a systematic review.** Acad Emerg Med 2012 Oct;19(10):1119

- Improved decision making

  Jones AE, Tayal VS, Sullivan DM, Kline JA. **Randomized, controlled trial of immediate versus delayed goal-directed ultra- sound to identify the cause of nontraumatic hypotension in emergency department patients**. Crit Care Med 2004;32:1703–8

- Pregnant women have traditionally been excluded from major research in echocardiography
- Studies in obstetric anesthesia suffer from small sample sizes
- POC studies necessary to capture the dynamic nature of peri-partum maternal hemodynamics

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TTE in obstetrics – case for bedside research

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"The use of transthoracic echocardiography as a research tool compliments its clinical application in pregnant women and may there-fore be able to ***bridge the divide between experimental research work and clinical practice****."*

Alicia T. Dennis

TTE IN OB ANESTHESIA - INDICATIONS

- OB specific
  - Guidelines: SOGC, ACOG, SOAP – cardiac disease, no recommendation for routine use in severe preeclampsia
  - **Saving Mother's lives** recommends echo for any OB patient with unexplained hypotension, dyspnea or orthopnea and edema.

- CURRENT GUIDELINES DO NOT ADDRESS THE EVOLVING CLINICAL PRACTICE

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Recent reviews affirm the role of echocardiography in preeclampsia

Best Practice & Research Clinical Anaesthesiology 31 (2017) 125–138

Contents lists available at ScienceDirect

Best Practice & Research Clinical Anaesthesiology

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

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Preeclampsia in 2017: Obstetric and Anaesthesia Management

Ross Hofmeyr, MMed(Anaes), FCA(SA), Consultant Anaesthesiologist [a, *],
Mushi Matjila, PhD, FCOG(SA), Consultant Obstetrician [b],
Robert Dyer, PhD, FCA(SA), Professor & Second Chair [a]

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[b] Department of Obstetrics & Gynaecology, University of Cape Town, South Africa

Preeclamps

"Anaesthesiologists shoulc with point-of-care ultrasor subsequently refer the pat when indicated"

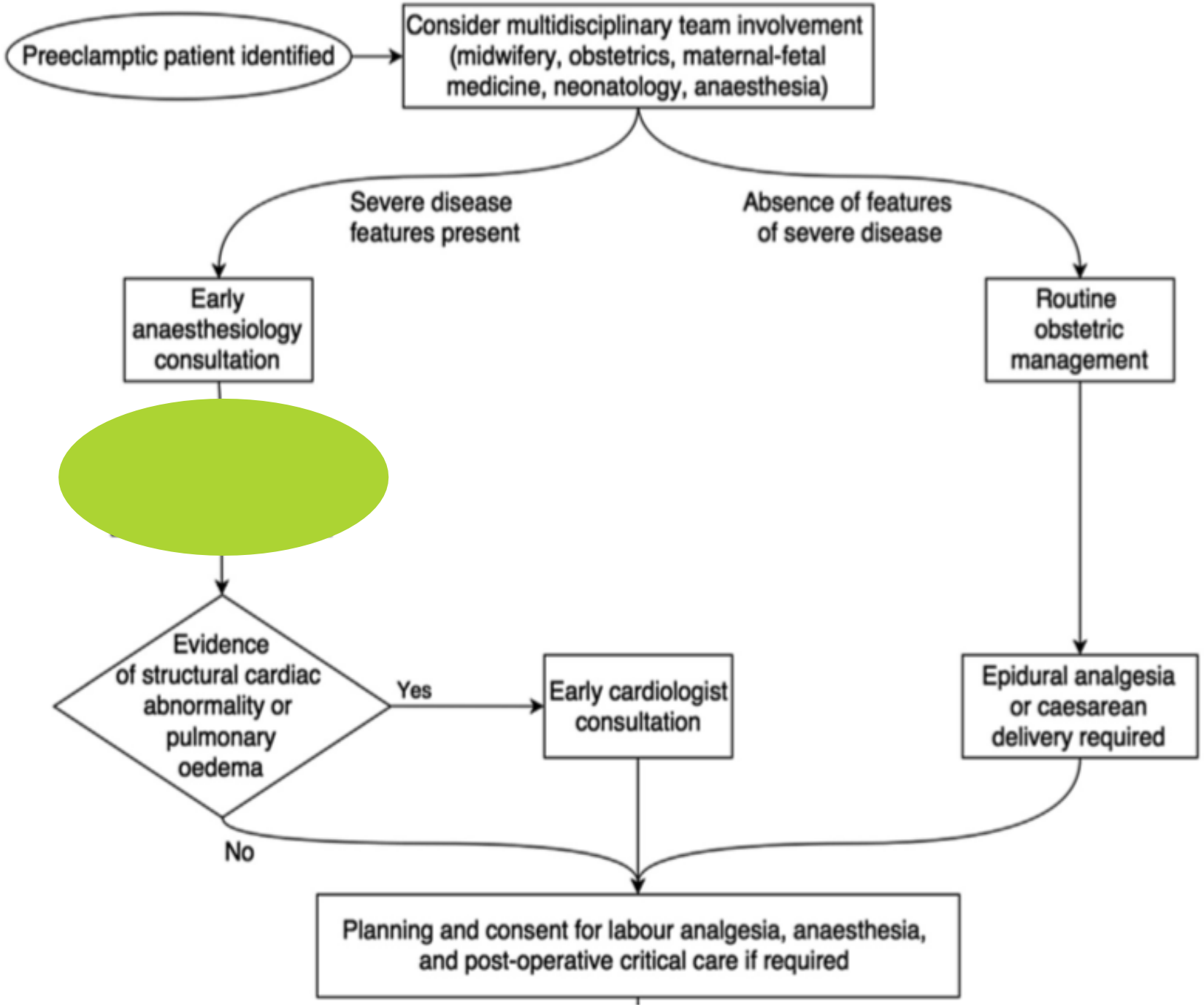

Fig. 1. Cognitive aid for the perioperative obstetric and anaesthesia management of patients with preeclampsia.

How do we do all this with TTE? MODALITIES USED

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- **2D**
  - Outlines structures
  - Shows movement
  - Qualitative assessment (“eyeballing”)
  - Quantitative assessment (measuring)
- **DOPPLER**
  - Shows movement of blood – color Doppler
  - Velocity of flow (color – qualitative, wave Doppler – velocity/pressure gradients)

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2D LV size and function, the pericardium

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2D IVC size and collapsibility

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Color Doppler – bicuspid aortic valve

2D **quantitative** analysis LVEF

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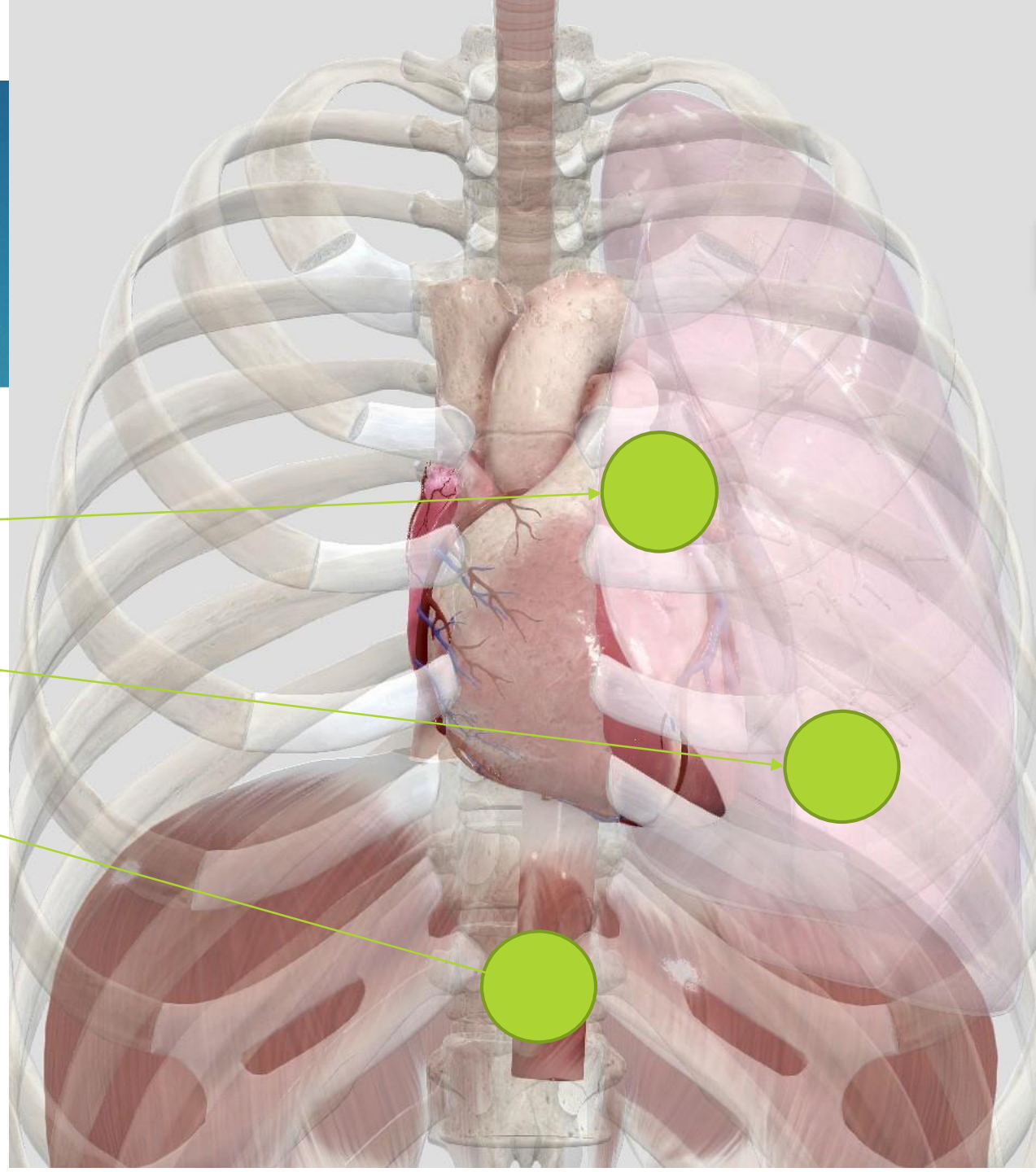
LUNG US

SLIDING SIGN

B-lines

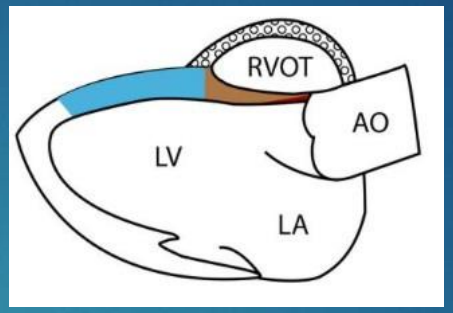
BASIC TTE WINDOWS

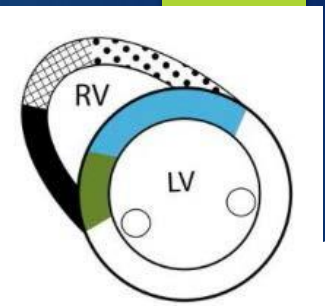
- 3 echocardiographic windows
  - Parasternal
  - Apical
  - Subcostal

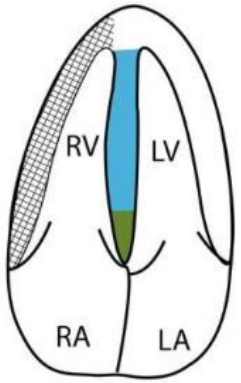


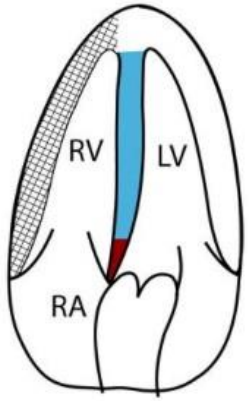
BASIC TTE Views

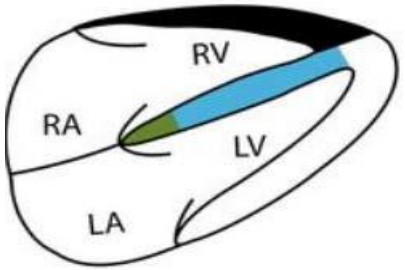
- 3-6 views
  - PLAX
  - PSAX
  - Apical 4CH
  - Apical 5CH
  - Subcostal 4CH
  - Subcostal IVC

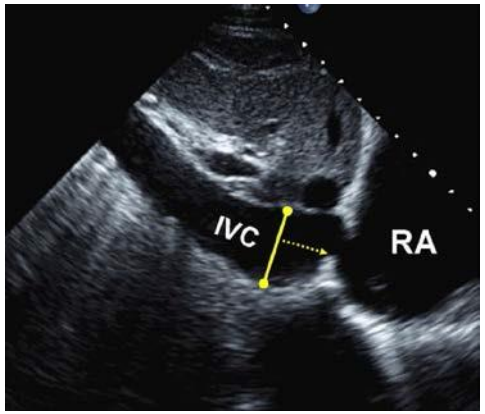












Echoanatomy www.lifeharmony.me

FoCUS - POCUS

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- eloped for non-cardiologists

FATE, FEEL, FAST, RUSH, BLEEP, HART, BLUE

None are OB specific

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What about OB anesthesia?

The ROSE scan

Rapid

Obstetric

Screening

Echocardography

- Developed by Dr. Alicia Dennis of ANZCA

Dennis AT **Transthoracic echocardiography in women with treated severe pre-eclampsia** Anaesthesia 2014, 69, 436

Dennis **AT Transthoracic echocardiography in obstetric anaesthesia and obstetric critical illness** International Journal of Obstetric Anesthesia (2011) 20, 160

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Assessing heart function of critically ill pregnant women

News Categories

Cancer >

Contraception and abortion

Family violence

Fundraising

Gynaecology

Mental health

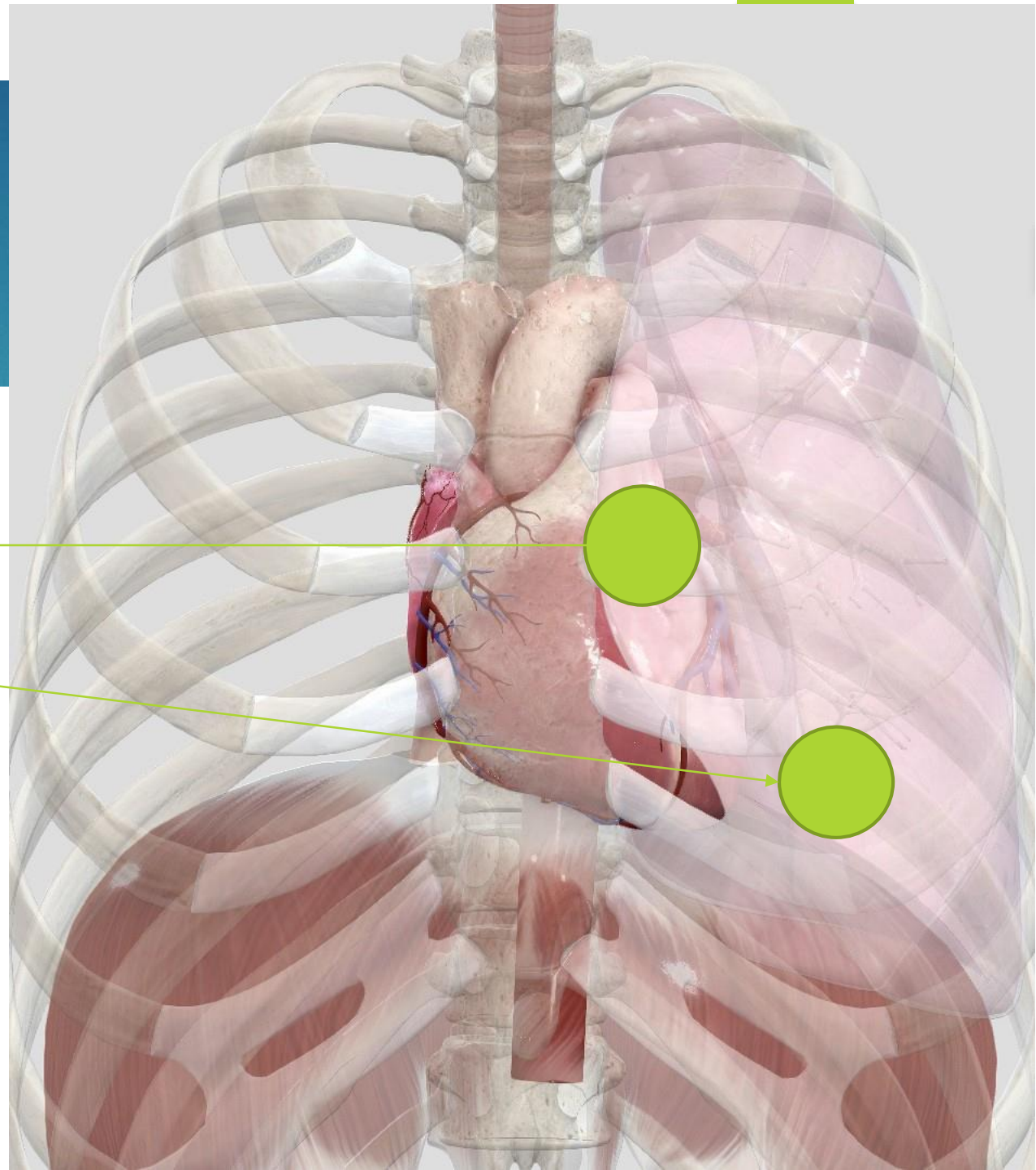
Events

Pregnancy and newborns >

Developed by a Women's anaesthetist, Clinical Associate Professor, Dr Alicia Dennis, the ROSE Scan lets doctors, for the first time, instantly see the inner workings of heart function in pregnant women without invasive high-risk monitoring.

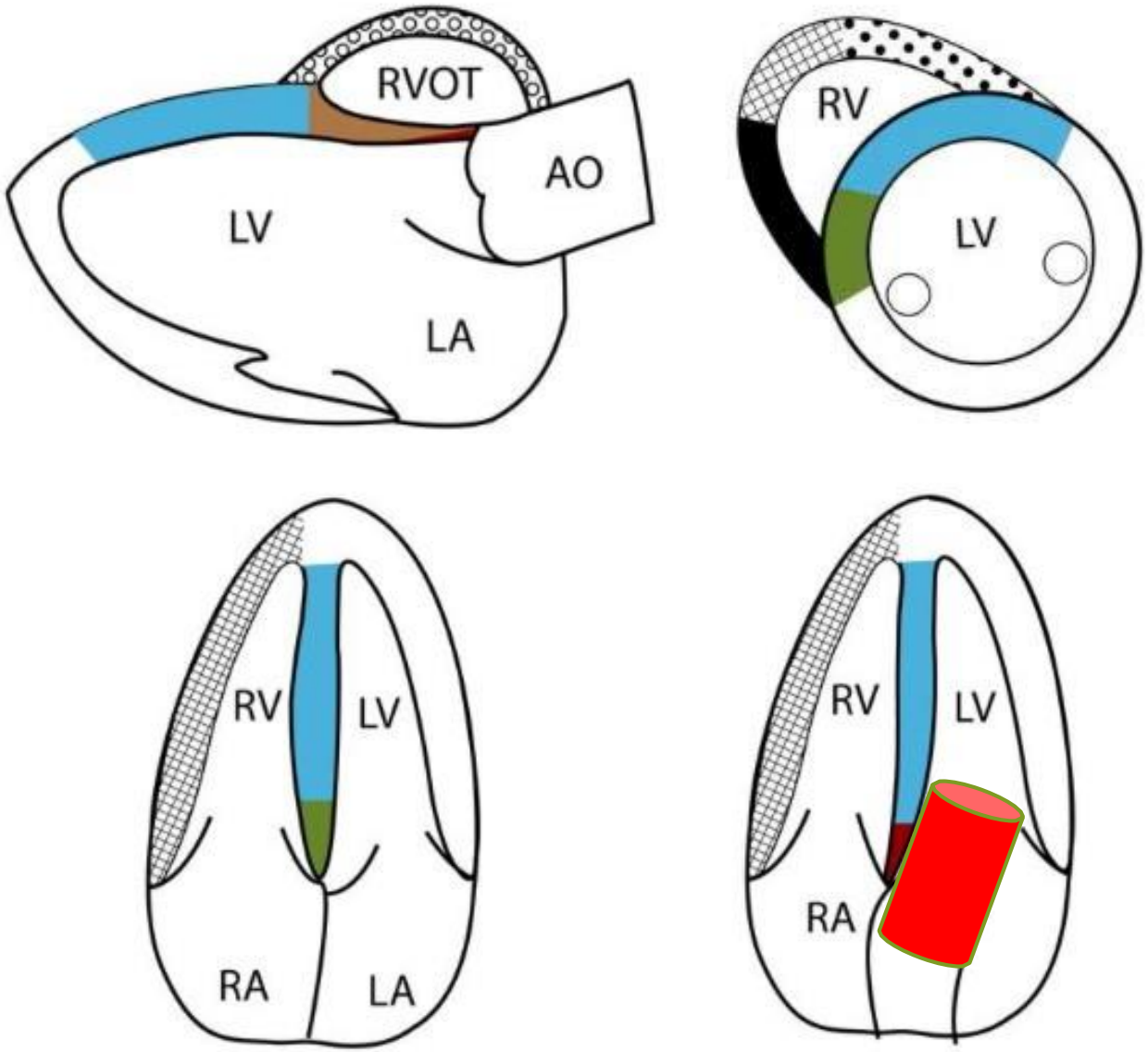
ROSE Scan

- 2 echocardiographic windows
  - Parasternal
  - Apical



ROSE Scan

- 4 views
  - PLAX
  - PSAX
  - Apical 4CH
  - Apical 5CH



Echoanatomy www.lifeharmony.me

ROSE Scan

- A systematic examination for causes of hemodynamic compromise that are **common** and **OB specific**
  - Differentiate between causes of shock/hypotension in OB population
  - Identify preeclamptic patients who are at risk of HFpEF

- The ROSE exam includes more advanced elements of echocardiography
  - ventricular regional wall motion function
  - valve function
  - diastolic function

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Table 2. The Rapid Obstetric Screening Echocardiography Scan

			Key findings sought	
Transthoracic images	**Modality**	**Measurements**	**Structure**	**Size and function**
Parasternal long axis	2D video, M-mode	Left ventricular outflow tract diameter, left atrial diameter, aortic root diameter, fractional shortening, left ventricular end-diastolic diameter, heart rate and rhythm	Presence of a pericardial effusion, presence of an intracardiac mass, aortic dissection	Left ventricular size and systolic function, right ventricular size and function
Parasternal short axis	2D video, M-mode	Fractional area change, movement of the interventricular septum, fractional shortening, left ventricular end-diastolic diameter, left ventricular	Presence of regional wall motion abnormalities, presence of a pericardial effusion, presence of an intracardiac mass, position of the interventricular septum	left ventricular size and systolic function
Apical 4-chamber	2D video, pulse wave Doppler, septal tissue Doppler	Left atrial volume, mitral valve E velocity, mitral valve A velocity, mitral valve deceleration time, mitral valve A wave duration, septal s' velocity, septal e' velocity, septal a velocity, isovolumetric relaxation time, mitral valve E/septal e' ratio	Presence of increased right ventricular size compared with left ventricular size, presence of regional wall motion abnormalities, presence of a pericardial effusion, presence of an intracardiac mass, position of interventricular septum, position of interatrial septum	left ventricular diastolic function, Left ventricular size and systolic function, right ventricular size and function
Apical 5-chamber	Pulse wave Doppler	Left ventricular outflow tract velocity time integral, cardiac output		

International Journal of Obstetric Anesthesia (2018) **34**, 3–4
0959-289X/$ - see front matter
https://doi.org/10.1016/j.ijoa.2018.02.001

ELSEVIER
www.obstetanesthesia.com

EDITORIAL

Adding diagnostic power to the physical exam: can employing focused cardiac ultrasound lead to improved obstetric outcomes?

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Department of Anesthesiology, St. Clair Hospital
Pittsburgh, PA, USA

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TTE - Assesment of volume status

- PRELOAD
  - LV filling (LV end diastolic volume)
  - RA pressure (IVC diameter and collapsibility index)
- Response to volume augmentation
  - Change in stroke volume after fluid bolus or **leg raise**

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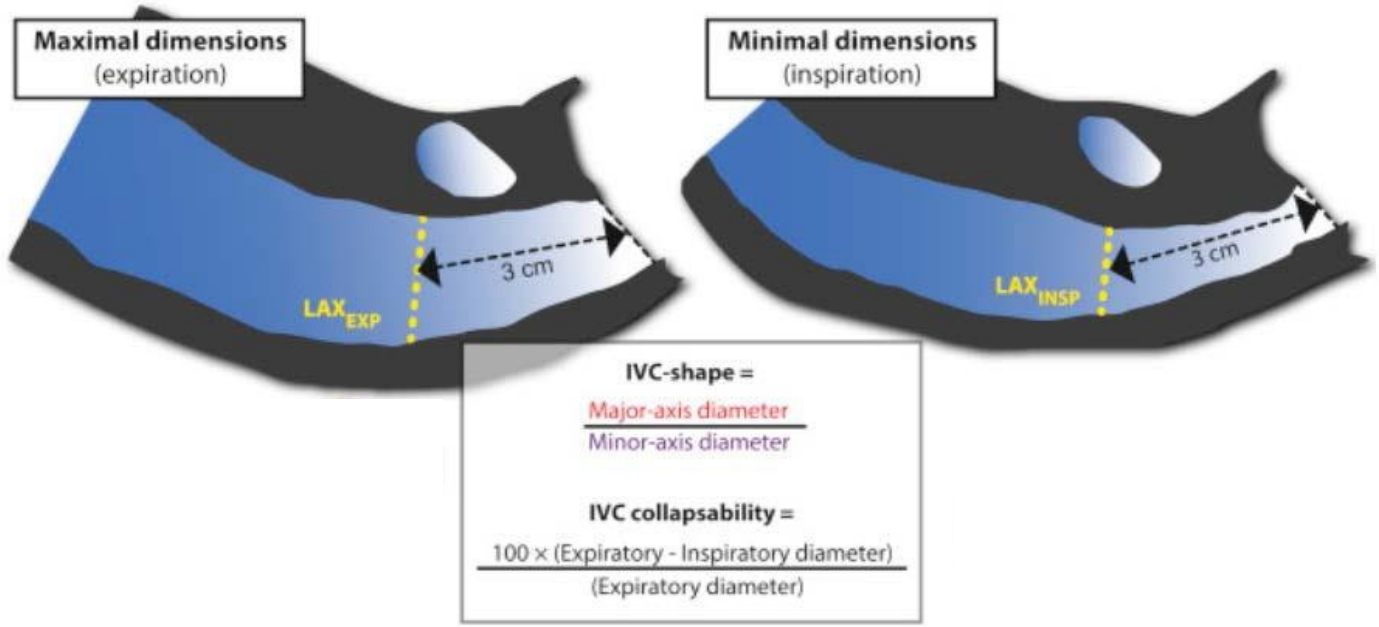
IVC diameter and collapsibility RA pressure = VENOUS RETURN

<2 cm, >50% collapse = RAP 3mmHg

>2cm, <50% collpapse = RAP 15 mmHg

In between = RAP 8mmHg



J Am Soc Echocardiogr 2010;23:685
ASE GUIDELINES for echocardiographic assessment of the right heart

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IVC in pregnancy

Changes in the size of maternal inferior vena cava during pregnancy:

enlarges early (4-7 W)

contracts until 16 W

after 16 W which it doesn't change in supine position

ongoing enlargement in left decubitus

J PerinatMed. 2004;32(4):327-31.

IVC supine vs. LUD

FREE

Perioperative Medicine | August 2017

Left Lateral Table Tilt for Elective Cesarean Delivery under Spinal Anesthesia Has No Effect on Neonatal Acid–Base Status: A Randomized Controlled Trial

CPC[1], Andre

anada, [3]University

Allison J. Lee, M.D.; Ruth Landau, M.D.; James L. Mattingly, C.R.N.A.; Margaret M. Meenan, C.R.N.A.; Beatriz Corradini, M.Sc.; et al

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Prediction of post-spinal hypotension

Anaesthesia. 2018 Jan;73(1):15-22. doi: 10.1111/anae.14063. Epub 2017 Oct 7.

Can point-of-care ultrasound predict spinal hypotension during caesarean section? A prospective observational study.

Zieleskiewicz L[1], Noel A[1], Duclos G[1], Haddam M[1], Delmas A[1], Bechis C[1], Loundou A[2], Blanc J[3], Mignon A[1], Bouvet L[4], Einav S[5], Bourgoin A[1], Leone M[1,6].

- Change in LVOT velocity time index (VTI) pre and post PLR
- ≤ 8% predicted hemodynamic stability
- ≥ 21%, predictive for hypotension

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Fluid responsiveness in OB anesthesia

Intensive Care Med (2013) 39:593–600
DOI 10.1007/s00134-012-2770-2

ORIGINAL

Clément Brun
Laurent Zieleskiewicz
Julien Textoris
Laurent Muller

Prediction of fluid responsiveness in severe preeclamptic patients with oliguria

- PLR dVTI >12 % accurately predicts fluid responsiveness
- IVC CI had no predictive value
- only 52 % of patients with severe preeclampsia who develop oliguria responded to fluid challenge

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Twins, treated preeclampsia, urgent C section

27 y, mono-di twins (A breech/IUGR) with preeclampsia diagnosed at 28 weeks. Now 32 weeks with diastolic flow reversal for semi urgent CS.

Rx: Adalat XL 60mg PO QD

Labetalol 300 mg PO TID

NPO for >8h

BP 150/96, HR 82 NSR, diffuse peripheral edema

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Twins, treated preeclampsia, urgent C section

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CONCERNS:

IS SHE AT RISK OF SIGNFIICANT POST SPINAL HYPOTENSION?

What is her intravascular volume status?

Systemic adrenergic and calcium channel blockade

Twins – exaggerated aorto–caval compression

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No change at the site of collapsibility but a significantly smaller IVC when supine

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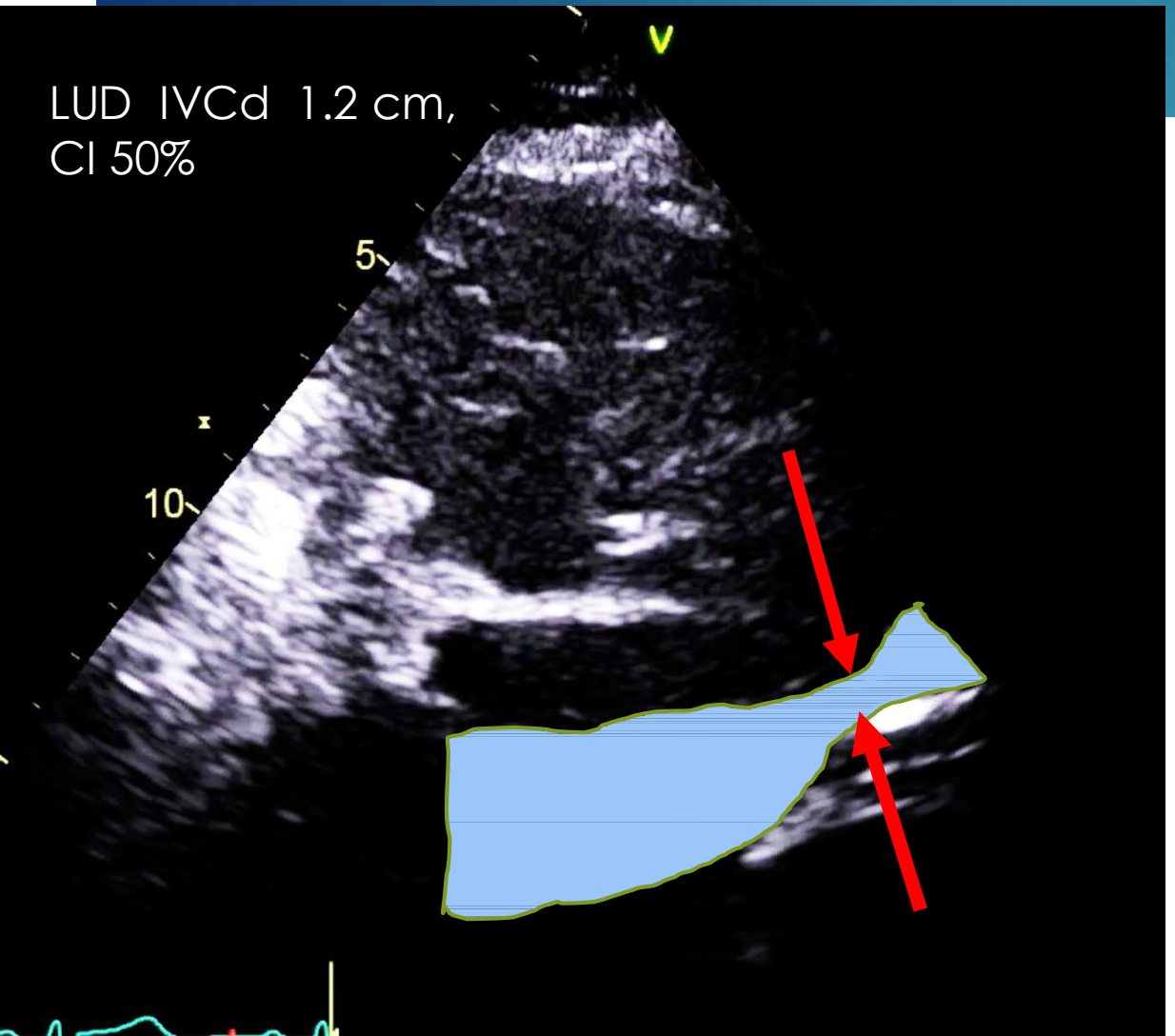
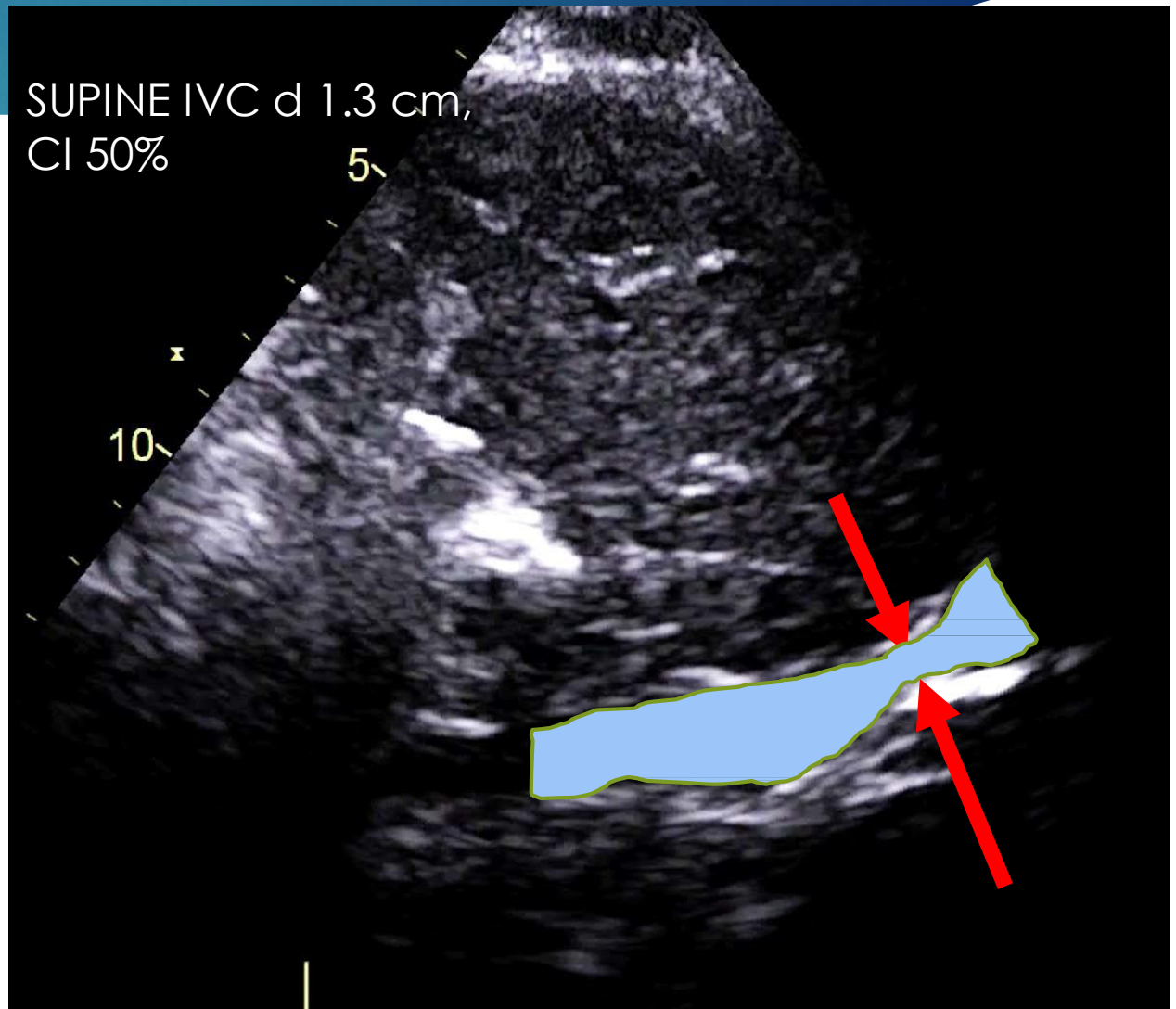
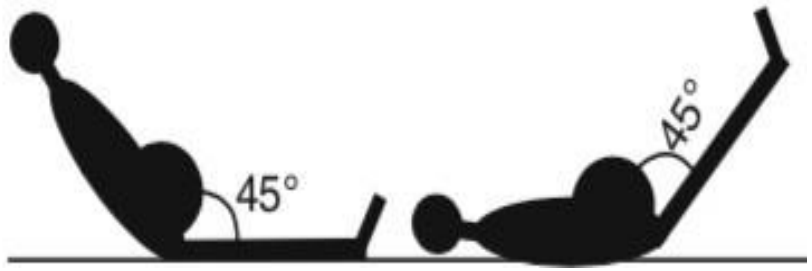




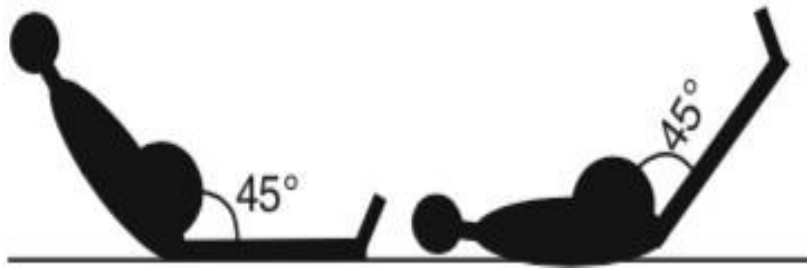
LVOT velocity time index
pre = 24 cm

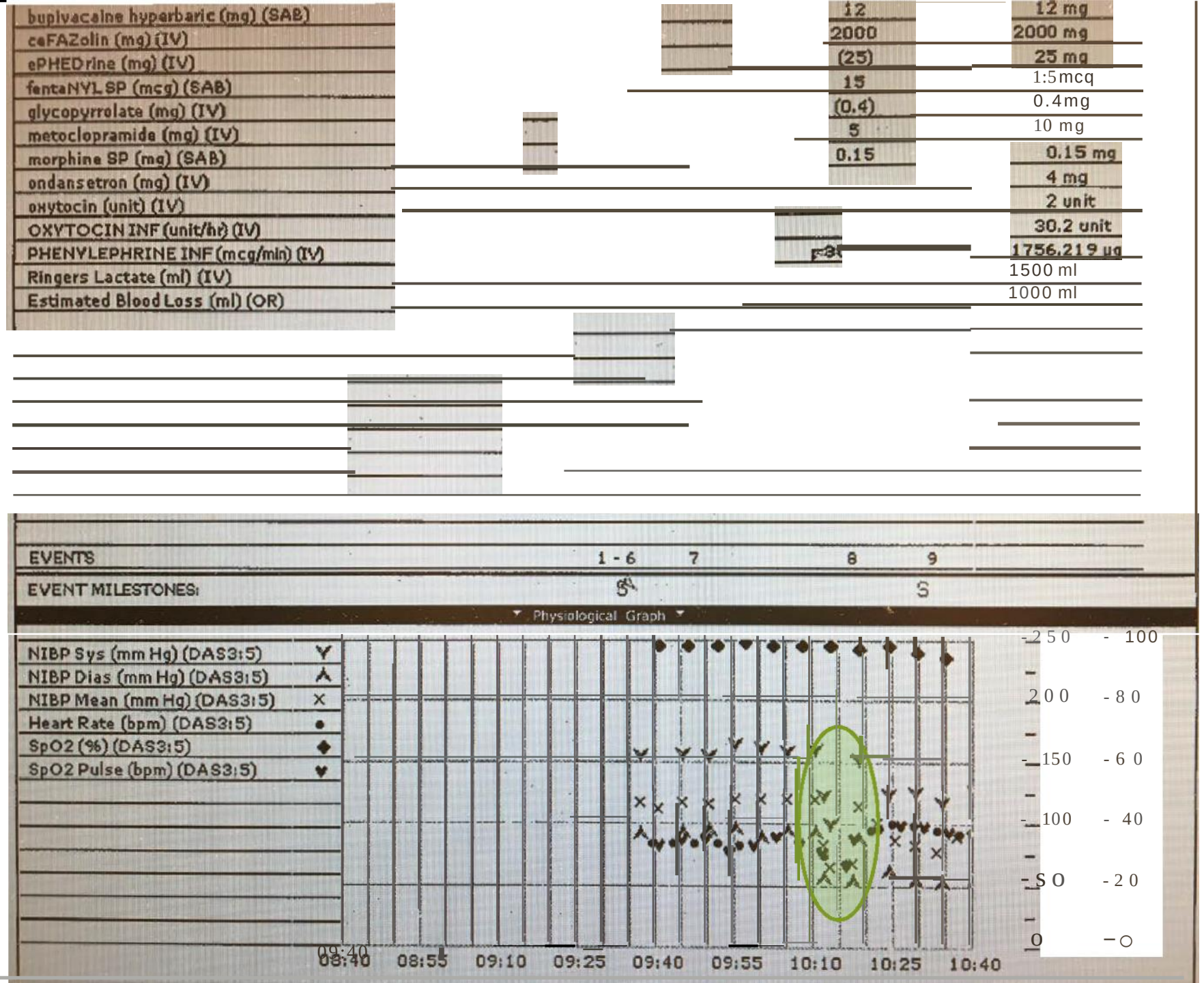


LVOT VTI **post** leg raise = 28 cm

dVTI = 28-24/28 x 100

dVTI = 14%




bupivacaine hyperbaric (mg) (SAB)
ceFAZolin (mg) (IV)
ePHEDrine (mg) (IV)
fentaNYL SP (mcg) (SAB)
glycopyrrolate (mg) (IV)
metoclopramide (mg) (IV)
morphine SP (mg) (SAB)
ondansetron (mg) (IV)
oxytocin (unit) (IV)
OXYTOCIN INF (unit/hr) (IV)
PHENYLEPHRINE INF (mcg/min) (IV)
Ringers Lactate (ml) (IV)
Estimated Blood Loss (ml) (OR)
12
2000
(25)
15
(0.4)
5
0.15
12 mg
2000 mg
25 mg
1:5mcq
0.4mg
10 mg
0.15 mg
4 mg
2 unit
30.2 unit
1756.219 ug
1500 ml
1000 ml
EVENTS
1 - 6
7
8
9
EVENT MILESTONES:
Physiological Graph
NIBP Sys (mm Hg) (DAS3:5)
NIBP Dias (mm Hg) (DAS3:5)
NIBP Mean (mm Hg) (DAS3:5)
Heart Rate (bpm) (DAS3:5)
SpO2 (%) (DAS3:5)
SpO2 Pulse (bpm) (DAS3:5)
250 - 100
200 - 80
150 - 60
100 - 40
50 - 20
0
08:40
08:55
09:10
09:25
09:40
09:55
10:10
10:25
10:40
09:40

Post C/S, preeclampsia, pulmonary edema and oliguria despite diuresis

24 year old with preeclampsia post CS day 1, pulmonary edema. Low urine output, without response to 1st dose of furosemide.

BP 147/95, HR 88, RR 26, SaO2 93% on 2L O2 by NP

Should we persist with diuresis?

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Post C/S, preeclampsia, pulmonary edema and oliguria despite diuresis

What is the hemodynamic profile contributing to pulmonary edema and oliguria?

- Decreased LV systolic function
- HFpEF (diastolic dysfunction) with high LV filling pressures but low intravascular volume
- Normal LV function with high intravascular volume and acute renal failure

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RVSP 50mmHg (normal<35)

LVEF 45-50%

Preeclampsia, oliguria and pulmonary edema

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Hemodynamic profile:

- Total intravascular volume was low/normal
- Mildly reduced LV systolic function + moderate diastolic dysfunction)
- Elevated LA pressures
- High systemic vascular resistance

Management?

Afterload reduction (amlodipine)

Further Lasix was held

She started to diurese within a few hours.

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TTE to guide therapy

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Hypertension

BRIEF REVIEW

Should Maternal Hemodynamics Guide Antihypertensive Therapy in Preeclampsia?

Kelsey McLaughlin, Ralph R. Scholten, John C. Kingdom, John S. Floras, John D. Parker

Hypertension. 2018;71:550-556
Originally published February 5, 2018

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Proof of concept is there, however …

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- **Is this normal?** - many measurements not yet validated in pregnancy

- Full scope of TTE capabilities is not available to those with limited expertise
  - POCUS/FoCUS require relatively basic skill level
  - Advanced skills required for diastology, valvular lesions, myocardial ischemia

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Perioperative Echocardiography Training and Certification

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- **TRAINING**
  - **Commercial online courses for FoCUS**
  - **CanPOCUS – guidelines, traiing, certification for EM/FM**
  - **Fellowship opportunities**
  - **Conference workshops + self guided**

- No current formal training/credentialing requirement
- ACC/AHA and CCS/CSE - Level 1 expertise may be attainable by the average anesthesiologist

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Transthoracic Echocardiography in Anesthesia

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2010 CCS/CSE Guidelines

for Training and Maintenance of Competency in Adult Echocardiography

http://www.csecho.ca/pdf/CCS-CSE-Echo-ExecSum.pdf

CCS/CSE
Level 1 Echocardiographer

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- An introductory level of training
- The training for **LIMITED echocardiographic examination**
  - Must be supervised by trained sonographer or Level 3 expert
  - 4W duration
  - Min **40** exams performed/interpreted, **90** reviewed

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EnABLE Course

Echocardiography for Anesthesiologists Blended Learning Course

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- IWK W&O group planned and developed
- Basic Echocardiography with advanced primer
- Online learning and hands on workshops
- Emphasis on regular practice
- Longitudinal local expert support

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Conclusion

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- Further research is needed
- TTE is the advanced modality of choice
- Technology is more portable and accessible
- There are several training options
- Find an ENTHUSIASTIC local expert

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Conclusion

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Obstetrics & Gynaecology
UNIVERSITY OF TORONTO

Mount Sinai Hospital

We should OWN maternal hemodynamics

2018
Hemodynamics in Pregnancy

CAS 2018

MERCI!

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Questions?

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