Transthoracic echocardiography in pregnancy
The new religion for the obstetric anaesthetist?

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Parkville, Australia

Monday 11th November 2013
Disclosures

Nil
Institutional ethics approval and participant written consent

Yes
Healthy term pregnant woman
Apical 4 chamber view
Healthy term pregnant woman
Apical 4 chamber view
Healthy term pregnant woman
Apical 4 chamber view
Healthy term pregnant woman
Apical 4 chamber view

Rate
Rhythm
Preload
Lusitropy
Contractility
Afterload
Healthy term pregnant woman
Parasternal short axis view
Healthy term pregnant woman
Parasternal short axis view
Healthy term pregnant woman
Parasternal short axis view
Healthy term pregnant woman
Parasternal short axis view

- Right ventricle
- Left ventricle

Ejection fraction
Cardiac output
Right ventricular pressure
Left ventricular end diastolic volume
Left ventricular end diastolic pressure
Valvular stenosis or regurgitation
Overview

1. Mortality and Morbidity

2. Diagnostic dilemmas and clinical improvement

3. Transthoracic echocardiography
   Application in pregnant women
   Education
Why do pregnant women die?

Mortality

- Cardiac disease
- Haemorrhage
- Sepsis
- Preeclampsia
- Thromboembolism
- Neurological conditions

Less access to resources
Less education
Less research
Why do pregnant women get very sick?

Morbidity
Risk of short term severe morbidity
1 in 200

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*Registered with General Registry Office for Scotland.


Figure 1. Rates of women with major obstetric haemorrhage and all other reported severe morbidities 2003–08.
Why do pregnant women get very sick?

Morbidity
Risk of short term severe morbidity
1 in 200

Long term morbidity
- Hypertension
- Ischaemic heart disease
- Stroke
- Renal disease
- Blood transfusions
- Psychological
- ? Cognitive function

Table 1. Numbers and rates of categories of severe maternal morbidity in Scotland: 2006–08

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Lack of recognition of disease
Lack of education in obstetric critical disease
Reduced skills by health care workers

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Improving health in pregnant women

Education
Skilled Multidisciplinary team
Access to resources
Clinical excellence

But diagnostic uncertainty can exist when faced with common clinical situations (Lewis 2007)

Why does diagnostic uncertainty exist?
Can we do better?

Diagnostic uncertainty

- lack of understanding of physiology and pathophysiology especially haemodynamics

- lack of clinical observations

- Lack of knowledge about maternal physiology and pathophysiology

Sometimes it is hard.....

But most of the time obtaining more data will enable us to make intervention choices based on facts.
Physiology, pathophysiology and haemodynamics

Healthy term pregnant woman
Apical 5 chamber view
Physiology, pathophysiology and haemodynamics

Healthy term pregnant woman
Apical 5 chamber view

Conscious state
Respiratory rate
Heart rate
Blood pressure
Body temperature
Fluid input
Urine output
Physiology, pathophysiology and haemodynamics

1. Is blood flow adequate and distributed appropriately to body organs?
Physiology, pathophysiology and haemodynamics

1. Is blood flow adequate and distributed appropriately to body organs?

2. Is blood flow adequate and distributed appropriately away from body organs?
Physiology, pathophysiology and haemodynamics

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3. Are organs systems functioning at their best?
Physiology, pathophysiology and haemodynamics

1. Is blood flow adequate and distributed appropriately to body organs?

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3. Are organs systems functioning at their best?

4. What therapeutic interventions can be administered to improve flow/distribution throughout the body and thereby lead to clinical benefit?

Cardiac output

Venous return

Dennis AT, Dyer RA Cardiac output monitoring in obstetric anaesthesia IJOA 2013 accepted manuscript
Can we do better?

• What is the cause of ongoing hypotension? Sepsis, hypovolaemia, cardiac failure, right heart failure

• What is the reason for unexplained tachycardia?

• Is intravenous fluid therapy beneficial in a woman with severe preeclampsia?

• What is the cause of acute chest pain during caesarean section?

• Can we understand disease mechanisms, maternal physiology and maternal pathophysiology better?
Clinical monitoring and scientific observation

- Safe
- Acceptable
- Appropriate
- Provide clinically useful information within the correct time-frame
- Impact positively on clinical care – does the device provide clinically relevant information from which the clinician will be able to make informed decisions?
Transthoracic echocardiography

Cardiologists
Emergency physicians
Intensive care physicians
Anaesthetists
Transthoracic echocardiography

*Gives the clinician who asks the clinical question the power to immediately answer that question at the point of clinical care*

**Advantages**
- non-invasive
- portable
- lightweight
- easy to use
- connectivity
- durable
- battery powered

**Versatile**
- birthing suite
- emergency department
- operating theatres
- Post-anaesthetic care unit
- Intensive care unit
- patient transport vehicles
- remote and rural settings
Transthoracic echocardiography

Gives the researcher the opportunity to answer haemodynamic questions relating to physiology and pathophysiology using the same observational tool in pregnant women that can be used in clinical practice thereby immediately translating research findings to clinical practice.

With research using transthoracic echocardiography in pregnant women the Bench is the Bedside
Transthoracic echocardiography

Indications for TTE:

1. Hypotension or haemodynamic instability of uncertain or cardiac aetiology
2. Initial investigation of suspected hypertensive heart disease
3. Initial evaluation of known or suspected heart failure including pulmonary oedema
4. Initial evaluation of known or suspected cardiomyopathy
5. Acute chest pain
6. Suspected aortic dissection
7. Respiratory failure or hypoxaemia of uncertain aetiology
8. Likely pericardial tamponade
9. Likely massive pulmonary embolism
Transthoracic echocardiography

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What are our clinical questions?

Table 2  Clinical scenarios in obstetric critical illness

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Dennis AT. Transthoracic echocardiography in obstetric anaesthesia and obstetric critical illness. IJOA 2011;20:160-8
What are our research questions?

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Disadvantages, pitfalls and cautionary notes for anaesthetists

Disadvantages of TTE

- Non-continuous
- Intraoperative application harder with IPPV/PEEP
- Subcostal views difficult in pregnancy
- Additional training required – few integrated educational programs with hospital based continuity
- Can be expensive or not easily available
Disadvantages, pitfalls and cautionary notes for anaesthetists

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- Additional training required – few integrated educational programs with hospital based continuity
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- Wrong or missed diagnosis by inexperienced or over confident operators

Oxorn D, Pearlman A. Physician-performed ultrasound: The time has come for routine use in acute care medicine. Anesthesia Analgesia 2012:115;1004-1006
Transthoracic echocardiography education

Level 3
specialist echo examinations, echo for invasive procedures, and majority of post in echo and echo research

Level 2
accept referrals from Level 1, perform comprehensive TTE & TEE, diagnose all cardiovascular abnormalities, optimise onward referral, teaching and research

Level 1
acquire all standard views (TTE, TEE), recognise abnormal vs normal, diagnose common abnormalities, recognise when referral indicated, understand echo vs other techniques

Emergency Echo (FEEL, FATE)
acquire standard TTE views in ALS compliant manner, recognise major causes of arrest/shock, recognise when referral for second opinion indicated,

Transthoracic echocardiography education

- **Level 3**: specialist echo examinations, echo for invasive procedures, and majority of post in echo and echo research.
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- **Emergency Echo (FEEL, FATE)**: acquire standard TTE views in ALS compliant manner, recognise major causes of arrest/shock, recognise when referral for second opinion indicated.

Minimally trained operator

- Large pericardial effusions
- Grossly abnormal left ventricular systolic function
- Right ventricular dilatation

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Transthoracic echocardiography education

As part of a broader Obstetric critical care curriculum including
Resuscitation
Hypertensive disease of pregnancy
Obstetric haemorrhage
Embolism
Sepsis
The future

Integrated obstetric critical care and echocardiography curriculum

- Minimum training requirements
- Documentation
- Supervision
- Quality Assurance
- Development and maintenance of professional standards

Echocardiography outreach services

Ongoing haemodynamic research using echocardiography
Is transthoracic echocardiography the new religion?

If seeing is believing then yes it is.
Thank you