Perioperative TTE
an under-utilised modality?

David Canty
Senior Lecturer
Department of Surgery, University of Melbourne
Cardiothoracic Anaesthetist
Disclosures

• Employed University of Melbourne
  • POC workshops, courses in clinical ultrasound Certificate, Diploma and Masters

• Equipment support
  – Ultrasound – Sonosite
  – Simulator – CAE

• Research funding – ANZCA

• ‘echo-virus’ positive, and contagious
“An invasion of armies can be resisted, but not an idea whose time has come.”

Victor Hugo
Anaesthesia is now safe!

- Review in anaesthesia related mortality in Australia and New Zealand 2009-2011
  - 1:58,039 anaesthetics

?
REASON Study 2010

- 4158 patients aged 70 years non-cardiac surgery

- Day 30: mortality 5%, complications 20%

- Patient factors important, not surgery
Victorian Consultative Council on Anaesthetic Mortality and Morbidity

• **Cardiac and respiratory disease** – leading cause
• **Other factors**
  – Medical comorbidities + Age
  – Preoperative assessment
  – Postoperative care

**Perioperative Medicine**
Surgery in Australia

- 2.4 million surgical operations 2011
  - Increase 3-4% per year last 5 years
  - Waiting times increased by 12.5%
Perioperative medicine

• Not many patients die in theatre

• Are anaesthetists *perioperative physicians*?
A good anaesthetist..

- Medical assessment
- Giving an anaesthetic
- Postoperative pain + fluid management
- Getting patients home safely?
• Preoperative ✓
• Intraoperative ✓
• Postoperative ?
• Long-Term Recovery X
How are anaesthetists going to achieve this?
A good anaesthetist..

- Medical assessment????????
We have know for many years..

That a medical student with echo is more accurate than a cardiologist with a stethoscope

Medical students 75% versus Cardiologists 49%

Medical students 75% versus Cardiologists 49%

Diagnostic accuracy of clinical assessment?
Conventional ‘Comprehensive’ TTE

- Performed by third part providers
  - E.g. outpatient TTE
  - Radiology scan – abdo/lung/DVT
- You act on a written report some time later
2005-2010 ‘Riding the ultrasound wave’

Vascular

Regional anaesthesia
Better diagnosis

- At the bedside when required
- Heart and lung pathology
Focused cardiac ultrasound

- Changes diagnosis and management in approx 50% time

Preoperative anaesthetic assessment

Intensive care

Emergency department
Focused cardiac ultrasound

- Most of what we want can be determined by focused echo in under 5 minutes
  - Haemodynamic state
    - Empty or full?
    - LV or RV failure?
    - Vasodilation?
    - Tamponade?
  - Valve assessment

Pattern Recognition
Evidence?
## Intensive Care – focused TTE

<table>
<thead>
<tr>
<th>Author / year</th>
<th>Patients</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vignon 1994</td>
<td>40 non-cardiac surgery</td>
<td>Changed management 16%</td>
</tr>
<tr>
<td>Jensen 2004</td>
<td>227 non-cardiac surgery</td>
<td>New findings 60%</td>
</tr>
<tr>
<td>Joseph 2004</td>
<td>100 shocked patients</td>
<td>Diagnostic in 63%</td>
</tr>
<tr>
<td>Manasia 2005</td>
<td>90 cardiac and non-cardiac</td>
<td>New findings 84%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Changed management 37%</td>
</tr>
<tr>
<td>Stanko 2005</td>
<td>126 cardiac and non-cardiac</td>
<td>Changed management 41%</td>
</tr>
<tr>
<td>Orme 2009</td>
<td>187 non-cardiac surgery</td>
<td>Changed management 51%</td>
</tr>
</tbody>
</table>
# Emergency Medicine – focused TTE

<table>
<thead>
<tr>
<th>Author / year</th>
<th>Patients</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hauser 1989</td>
<td>81 chest pain non-diagnostic ECG changes</td>
<td>Changed management 16%</td>
</tr>
<tr>
<td>Blaivas 2001</td>
<td>103 with dyspnoea</td>
<td>Pericardial effusion (13%) and disposition predicted with TTE</td>
</tr>
<tr>
<td>Breitkreutz</td>
<td>204 patients - 100 cardiac arrest, 104 shock</td>
<td>Changed diagnosis and management in 78%</td>
</tr>
<tr>
<td>Liu 2005</td>
<td>103 with cardiomegaly</td>
<td>Increased correct diagnosis from 50% to 80%</td>
</tr>
<tr>
<td>Haji</td>
<td>78 non traumatic hypotension</td>
<td>37% New diagnosis Change in treatment 50%</td>
</tr>
<tr>
<td>Haji</td>
<td>83 dyspnoea</td>
<td>38% New diagnosis 40% Changed management</td>
</tr>
</tbody>
</table>
## Anaesthesia - focused TTE

<table>
<thead>
<tr>
<th>Author / year</th>
<th>Patients</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canty 2009</td>
<td>87 non-cardiac, perioperative</td>
<td>Changed management 41%</td>
</tr>
<tr>
<td>Cowie 2011</td>
<td>170 non-cardiac, perioperative</td>
<td>Changed management 82%</td>
</tr>
<tr>
<td>Canty 2012</td>
<td>100 non-cardiac, preoperative clinic</td>
<td>Changed management 54%</td>
</tr>
<tr>
<td>Canty 2012</td>
<td>99 non-cardiac, emergency surgery</td>
<td>New findings 67%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Changed management 44%</td>
</tr>
<tr>
<td>Canty 2015</td>
<td>91 cardiac surgery, postoperative - For repeated monitoring</td>
<td>Changed diagnosis 67% Both cardiac and lung</td>
</tr>
</tbody>
</table>
Better diagnosis makes us smarter doctors
Preoperative clinic 2009

- 100 patients for non-cardiac surgery
- Suspected heart disease or Age > 65 years

Canty DJ, Royse CF, Kilpatrick D, Bowman L, Royse AG. The impact of focused TTE in the pre-operative clinic. *Anaesthesia* 2012; **67**: 618-25.
Preoperative clinic

TTE Changed Management 54%

Less resource use - referral
- invasive monitoring
- ICU
- less hospital visits

Savings of $200 per focused TTE

70 year old male for total knee replacement
Severe O.A. restricting mobility
Hypertension
Clinical examination unremarkable
LVH on ECG

Anaesthetic Plan:
- Routine non-invasive monitoring
- Spinal anaesthetic
- Disposition: ward

TTE:
Severe aortic stenosis

New Anaesthetic Plan:
- Cancel surgery for cardiology referral
55 year old female for total abdominal hysterectomy (cancer)  
PHx rheumatic fever and ‘leaky valve’  
Poor exercise tolerance

Anaesthetic Plan:  
- Cancel surgery for TTE  
- However TTE not available for 3 months

TTE: only mild mitral regurgitation and stenosis

New Anaesthetic Plan:  
- Proceed with non-invasive monitoring
Canty DJ, Royse CF, Kilpatrick D, Williams DL, Royse AG. The impact of pre-operative focused transthoracic echocardiography in emergency non-cardiac surgery patients with known or risk of cardiac disease.

*Anaesthesia* 2012; 67: 714-20.

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**Emergency Surgery**

**TTE Changed Diagnosis 61%**

- **Haemodynamic state**
  - clinical assessment wrong in 61%

- **Valve lesions (20)**
  - clinical assessment wrong in 65%
  - missed in 50%

### Emergency Surgery

**TTE Changed Management 44%**

**36%**
- cancel surgery for investigation
- invasive monitoring
- haemodynamic treatment
- HDU/ICU postoperatively

**8%**
- don’t cancel surgery
- less invasive monitoring
- less haemodynamic treatment
- no HDU/ICU postoperatively
90 year old female with globe perforation for repair
PHx cardiac failure treated by GP
Requiring nasal oxygen since admission
  • given frusemide by medical registrar + given ok to proceed

Anaesthetic Plan:
- Routine non-invasive monitoring
- General anaesthetic

TTE:
Critical aortic stenosis
Severe biventricular failure
Severe pulmonary hypertension

New Plan:
- Change surgery to removal of eye under local anaesthesia
Post-operative – cardiac surgery

New findings with ultrasound – total 67%

Cardiac 66%
- Cardiac dysfunction 42%
- Pericardial effusion 5%
- Valve dysfunction 1%
- Hypovolemia 1%

Lung 20%
- Pleural effusion >500mL 33%
- Pneumothorax 3%
- Consolidation 1%
- Acute pulmonary edema 3%

Cardiac and Lung 14%
Postoperative – cardiac surgery

Findings suspected clinically
EXCLUDED with ultrasound – 20%

Cardiac Disorders 5%
- Cardiac failure 1%
- Pericardial effusion 3%
- Valve dysfunction 1%

Respiratory Disorders 15%
- Pleural effusion > 500mL 14%
- Consolidation 1%
What about outcome?

- 64 patients had hip fracture surgery

**Results - Mortality**

<table>
<thead>
<tr>
<th></th>
<th>1 month</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTE group</td>
<td>4.7%</td>
<td>17.1%</td>
</tr>
<tr>
<td>Control group</td>
<td>15.2%</td>
<td>33.3%</td>
</tr>
</tbody>
</table>

1 month \( P = 0.047 \)

12 months \( P = 0.031 \)
How?

• Earlier + better diagnosis changes *behaviour*

Reactive: treat hypotension/hypoxia

Proactive: PREVENT hypotension/hypoxia
The reactive therapist

Patient OK

Consider cause

More fluids

More hypotension

Hypotension

Fluids and vasopressors
The proactive therapist

TTE shows AS

Planned ICU

Plan – arterial line, CVC vasopressor infusion

Monitor
Appropriate therapy

No hypotension
Lets look at another case
80 year old female with #NOF
No known past medical history
Ejection systolic murmur

Anaesthetic Plan:
- Delay surgery for TTE – likely minimum 3 days wait
Just do it!
80 year old female with #NOF
No known past medical history
Ejection systolic murmur

Anaesthetic Plan:
- Delay surgery for TTE – likely minimum 3 days wait

New Plan:
- Art-line, GA

TTE
Severe aortic stenosis
Right ventricular failure
Pulmonary hypertension

Revised New Plan:
- Art-line, central line
- Noradrenaline and dobutamine infusion
- Intensive Care
Still not convinced?
Lung ultrasound

Compared to CT in respiratory distress

<table>
<thead>
<tr>
<th>Condition</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax</td>
<td>81%</td>
<td>100%</td>
</tr>
<tr>
<td>Consolidation</td>
<td>89%</td>
<td>94%</td>
</tr>
<tr>
<td>Pulmonary oedema</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma/COPD</td>
<td>89%</td>
<td>97%</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>81%</td>
<td>99%</td>
</tr>
</tbody>
</table>
Lung ultrasound

Compared to CT in respiratory distress

- Pneumothorax: 81% sensitivity, 100% specificity
- Consolidation: 89% sensitivity, 94% specificity
- Pulmonary oedema: 89% sensitivity, 97% specificity
- Asthma/COPD: 89% sensitivity, 97% specificity
- Pulmonary embolus: 81% sensitivity, 99% specificity

- saves time
- no radiation or transfer to CT

Collapse lower lobe (atelectasis)

Diaphragm

Effusion
65 year old male day 2 after total knee replacement
-In pain, anxious, short of breath, SpO2 92% with nasal oxygen, BP 95/60
-Past history cardiac failure, OE: insp crackles

Plan:
- Frusemide
- Morphine patient controlled analgesia
- ?ICU review
Lung ultrasound

Consolidation

Collapse

Liver
65 year old male day 2 after total knee replacement
- In pain, anxious, short of breath, SpO2 92% with nasal oxygen, BP 95/60
- Past history cardiac failure, OE: insp crackles

**Plan:**
- Frusemide
- Morphine patient controlled analgesia
- ?ICU review

**Ultrasound:**
- normal LV function, hypovolaemia
- no pulmonary oedema
- right lower lobe consolidation

**New Plan:**
- Intravenous antibiotics
- Chest physiotherapy
Ultrasound Guided + Perioperative medicine = Ultrasound Guided Perioperative medicine
Ultrasound Guided Perioperative medicine

Perioperative Physicians

- Identify and quantify cardiac + lung disease
- Identify cause of shock and hypoxaemia
- Diagnosis AND intermittent monitoring
- Early referral for cardiac care – medication/procedures

Preoperative

Intraoperative

Postoperative

Follow up
If it is so good, why isn’t everybody doing it?
Education

• Who is going to train everyone?
How do we achieve TTE for everyone?

• Basic training for most
• More advanced training for some
Restrictions to learning

• Effort required
• Trainers/supervision
• Pathology
How do we achieve TTE for everyone?

- Endorsement
- Equipment
- Education
- Mandatory training
PERSUASION
Because sometimes saying "please" is not enough.
Endorsement

PS46 2013

Australian and New Zealand College of Anaesthetists (ANZCA)

Guidelines on Training and Practice of Perioperative Cardiac Ultrasound in Adults

EXPERT CONSENSUS STATEMENT

Focused Cardiac Ultrasound: Recommendations from the American Society of Echocardiography

Kirk T. Spencer, MD, FASE, Bruce J. Kimura, MD, Claudia E. Korcarz, DVM, RDCS, FASE, Patricia A. Pellikka, MD, FASE, Peter S. Rahko, MD, FASE, and Robert J. Siegel, MD, FASE, Chicago, Illinois; San Diego and Los Angeles, California; Madison, Wisconsin; Rochester, Minnesota

Anaesthetic College ✓

Cardiologists ✓
Equipment

Multiplying like rabbits ...
Apprenticeship model
Simulation
Focused Cardiac Ultrasound Simulation Education TTE Course
Conclusion

TTE performed by the anesthetist

Improves diagnosis and changes management

May improve outcome

Is under-utilised

Simulation-based self-education may be the answer
Acknowledgements

Colin Royse

Alistair Royse
Indian saint, philosopher, Swami Vivekananda

“A new idea is first condemned as ridiculous and then dismissed as trivial, until finally, it becomes what everybody knows”