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The Impact of Focused Transthoracic Echocardiography in Non-cardiac Anaesthesia and Surgery

by

David Jeffrey Canty

M.B.B.S (Hons) F.A.N.Z.C.A. PGDipEcho

Faculty of Medicine

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Dedication

To Susan, Byron and Zara,

without their understanding and support,

this journey would not have been made.

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

Swami Vivekananda

19th century Indian saint, philosopher

Abstract

Transthoracic echocardiography (TTE), usually performed by cardiologists, is increasingly used by physicians at the patient's bedside. Focused TTE is an abbreviated study used as part of clinical assessment to improve diagnostic accuracy and aid clinical decision-making in real-time. Cardiac disease is a leading cause of perioperative mortality, which may be contributed to by poor preoperative cardiac assessment. The hypothesis is that focused TTE influences cardiovascular diagnosis and management by anaesthetists.

An audit of focused TTE revealed changes to anaesthetist's management plans in 53% of 87 patients undergoing emergency surgery (75%), elective surgery (56%) and preoperative assessment clinic assessment (22%). TTE helped guide preoperative cardiology referral, anaesthetic technique, invasive monitoring and postoperative disposition. TTE was possible in 10 out of 24 patients with intraoperative haemodynamic instability, avoiding need for transoesophageal echocardiography and associated risk of oesophageal injury.

I conducted prospective observational studies of 100 patients attending the preoperative assessment clinic for elective surgery; and 99 patients requiring emergency surgery. In patients with clinically suspected cardiac disease or age ≥65 years, the anaesthetist's management plan was compared before and after TTE performed by an independent anaesthetist.

In elective surgery, the TTE findings triaged patients to those with significant cardiac pathology leading to a step-up in care (20%), and those without, leading to a step-down in care (34%). Management was also altered in asymptomatic patients aged over 65 years (step-up in 10%, step-down in 15%). An overall reduction in hospital resource use (cardiology referral, invasive monitoring and intensive care) and improved efficiency (less delays and hospital visits) resulted.

In emergency surgery, TTE revealed significant cardiac pathology in 75%, altering preoperative assessment in 67% leading to a higher step-up (36%) than step-down (8%) in treatment. Haemodynamic treatment changes (such as fluids and invasive monitoring) were more common (30%) than changes to surgical workflow and postoperative intensive care (14%).

In a retrospective cohort sub-analysis, the mortality of 64 hip fracture patients who received preoperative TTE was compared to a randomised retrospective control group with similar risk factors. Mortality was lower in the TTE group over the 30 days (4.7% v 15.2%, p=0.047) and 12 months after surgery (17.1% versus 33.3%, p=0.031). Hazard of death over 12 months was reduced after adjustment for known risk factors (hazard ratio 0.41, 95% CI 0.2 to 0.85, p=0.016).

In surgical patients at increased risk of cardiac disease, preoperative focused TTE by anaesthetists frequently changed management decisions and may reduce mortality.

Declaration

This is to certify that

This thesis comprises only original work completed by the author for the degree Doctor of Philosophy at the University of Tasmania.

1. This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.
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4. The thesis is less than 100,000 words in length, exclusive of tables, figure legends, bibliographies and appendices.

Dr. David Canty (candidate) Date

Statement of co-authorship

The following people and institutions contributed to the publication of work undertaken as part of this thesis:

Dr David Canty, School of Medicine, University of Tasmania

Professor Colin Royse, Department of Pharmacology, University of Melbourne

Professor David Kilpatrick, Department of Medicine, University of Tasmania

Professor Alistair Royse, Department of Surgery, University of Melbourne

Dr. Leigh Bowman, Department of Cardiology, The Royal Hobart Hospital

Dr. Andrea Bowyer, Department of Anaesthesia and Pain Management, The Royal Melbourne Hospital

A/Professor John Faris, Freemantle School of Medicine, University of Notre Dame

A/Professor Michael Veltnam, Department of Anaesthesia and Pain Management, Joondalup Hospital

Dr. Darsim Haji, Department of Emergency Medicine, Frankston Hospital

Paper 1 Located in chapter 2

Canty DJ, Royse CF. Audit of anaesthetist-performed echocardiography on perioperative management decisions for non-cardiac surgery. *British Journal of Anaesthesia* 2009; **103**: 352-8.

Candidate was the primary author (75%) and with author 2 (25%) contributed to the idea, its formalisation and development.

Paper 2 Located in chapter 3

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

Candidate was the primary author (70%) and with author 2 (20%) and 5 (5%) contributed to the idea, its formalisation and development. Candidate performed all data collection which was reviewed by author 4 (5%). Author 3 (5%) contributed to the manuscript.

Paper 3 Located in chapter 4

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.

Candidate was the primary author (70%) and with author 2 (15%) and 5 (10%) contributed to the idea, its formalisation and development. Candidate performed most of the data collection which was contributed to by author 2 and 5. Authors 3 and 4 (5%) contributed to the manuscript.

Paper 4 Located in chapter 5

Canty DJ, Royse CF, Kilpatrick D, Bowyer A, Royse AG. The impact on cardiac diagnosis and mortality of focused transthoracic echocardiography in hip fracture surgery patients with increased risk of cardiac disease: a retrospective cohort study. *Anaesthesia* 2012; Nov;67(11):1202-9.

Candidate was the primary author (70%) and with author 2 (15%) and 5 (5%) contributed to the idea, its formalisation and development. Candidate supervised the data collection by research nurses and author 4 (5%). Author 3 (5%) contributed to the manuscript.

Paper 5 Located in chapter 1 and 6

Royse C, Canty D, Faris J, Haji D, Veltnam M, Royse A. Core review: Physician-performed ultrasound: the time has come for routine use in acute care medicine. *Anesthesia & Analgesia* 2012; Nov; 115(5):1007-28.

Author 1 (35%) and candidate (35%) equal primary authors who contributed to the idea, its formalisation and development. Authors 3 (10%), 4 (5%), 5 (5%) and 6 (5%) contributed to the manuscript

We the undersigned agree with the above stated "proportion of work undertaken" for each of the above published (or submitted) peer-reviewed manuscripts contributing to this thesis:

Signed: _____	_____	_____
Prof Colin Royse	Prof David Kilpatrick	Prof James Vickers
Supervisor	Supervisor	Head of School
School of Medicine	School of Medicine	School of Medicine
University of Melbourne	University of Tasmania	University of Tasmania
Date:_____	_____	_____

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I am indebted to both my parents for setting me on track and providing inspiration and support.

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Abbreviations

FAST	Focused Assessment with Sonography in Trauma.
FATE	Focused Assessed Transthoracic Echocardiography;
GA	General Anaesthesia;
HCU	Hand Carried Ultrasound
HDU	High dependency unit;
HEART scan	Haemodynamic Echocardiographic Assessment in Real Time;
ICU	Intensive Care Unit;
Intraop	During the surgical procedure
LV	Left Ventricle;
NBE	National Board of Echocardiography;
NOF	Neck Of Femur;
Postop	After the surgical procedure;
Preop	Before the surgical procedure;
PTEeXAM	Examination of special competence in advanced perioperative transoesophageal echocardiography;
RV	Right Ventricle;
TOE	Transoesophageal Echocardiography;
TTE	Transthoracic Echocardiography;
2D	Two-dimensional;

Preface

My first memorable experience with echocardiography was as in 2003 when Professor Colin Royse talked me through the basic 20 transoesophageal echocardiography (TOE) views during a cardiac surgery operation. In a subsequent patient, I discovered a previously undetected flail mitral leaflet, which prompted the surgeon to repair the valve. Never before had I encountered an intraoperative monitor have such a profound effect on the course of surgery. TOE was rapidly becoming standard of care in cardiac surgery and Professor Royse postulated this may occur in non-cardiac surgery. This encouraged me to further my echocardiography training via the specialty of cardiac anaesthesia.

I was disappointed that my initial consultant post did not include cardiac anaesthesia and I found it difficult to maintain my echocardiography skills, but serendipitously I was given finance to purchase a TOE machine for use in non-cardiac surgery. Technology had improved and I procured two laptop-sized machines with additional transthoracic echocardiography (TTE) probes. I was amazed at the high quality imaging of TTE which is possible in awake patients in a variety of settings. For the next few exciting weeks there were few patients that escaped my TTE probe!

When requested to perform preoperative TTE on an elderly fractured neck of femur patient, I was surprised to detect critical aortic stenosis with severe biventricular failure and pulmonary hypertension. This led to palliative treatment and may have avoided an intraoperative disaster. At that point I realised the potential for TTE in anaesthesia. Again I turned to Professor Royse who has shown me how to unlock and share this new knowledge in this research programme.

At the start of the doctorate I was only aware of a small number of anaesthetists performing TTE. By completion in 2012, over 20% of anaesthetists and intensivists in Australia and New Zealand have completed the University of Melbourne Certificate or Diploma in Ultrasound, which has changed focus from TOE to TTE and other surface-based ultrasound applications. The Australian and New Zealand College of Anaesthetist's professional document on TOE credentialing is under revision to include goal-directed TTE. TTE training is spreading beyond anaesthesia to both postgraduate and undergraduate medicine, as the concept of 'ultrasound-assisted examination' has applications in fields of medicine beyond anaesthesia and Professor Royse's initial predictions.

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CHAPTER 2
AUDIT OF ANAESTHETIST PERFORMED ECHOCARDIOGRAPHY
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Abstract
Intra-operative trans-oesophageal echocardiography is increasingly used for guiding intra-operative management decisions during non-cardiac surgery. Trans-thoracic echocardiography (TTE) equipment and training is becoming more available to anaesthetists, and its point-of-care application may facilitate real-time haemo-dynamic management and preoperative screening. Methods: We conducted an audit of trans-thoracic and trans-oesophageal echocardiograms, performed by an anaesthetist at a tertiary referral centre over a 9-month period, to identify the effect of echocardiography on clinical decision-making in patients undergoing non-cardiac surgery. The indications for echocardiography followed published guidelines. Results: Echo-cardiographic examinations of 97 patients included 87 trans-thoracic, and 14 trans-oesophageal studies. Of 36 studies conducted in the preoperative clinic, eight revealed significant cardiac pathology, necessitating cardiology referral or admission before surgery. Preoperative trans-thoracic echocardiograms performed on the day of surgery (n=39) led to two cancellations of surgery owing to end-stage cardiac disease, the institution of two unplanned surgical procedures (drainage of pleural and pericardial effusions), and to significant changes in anaesthetic and haemodynamic management, or both in 18 patients. Greater influence on management occurred with emergency surgery (75%) than elective surgery (43%). Intra-operative trans-thoracic (n=10) and trans-oesophageal (n=14) echocardiography also altered management (altered surgery in two patients, cancellation in one, and altered haemo-dynamic management in 18 patients). Conclusions: Anaesthetist-performed point-of-care TTE and thoracic ultrasound may have a high clinical impact on the peri-operative management of patients scheduled for non-cardiac surgery

CHAPTER 3
FOCUSED TTE IN THE PREOPERATIVE ASSESSMENT CLINIC
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ABSTRACT
This prospective observational study investigated the effect of focused transthoracic echocardiography in 99 patients who had suspected cardiac disease or were ≥ 65 years old, and were scheduled for emergency non-cardiac surgery. The treating anaesthetist completed a diagnosis and management plan before and after transthoracic echocardiography, which was performed by an independent operator. Clinical examination rated cardiac disease present in 75%; the remainder were asymptomatic. The cardiac diagnosis was changed in 67% and the management plan in 44% of patients after echocardiography. Cardiac disease was identified by echocardiography in 64% of patients, which led to a step-up of treatment in 36% (4% delay for cardiology referral, 2% altered surgery, 4% intensive care and 26% intra-operative haemodynamic management changes). Absence of cardiac disease in 36% resulted in a step-down of treatment in 8% (no referral 3%, intensive care 1% or haemodynamic treatment 4%). Pre-operative focused transthoracic echocardiography in patients admitted for emergency surgery and with known cardiac disease or suspected to be at risk of cardiac disease frequently alters diagnosis and management.

CHAPTER 4
FOCUSED TTE IN EMERGENCY SURGERY
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DOI: http://dx.doi.org/10.1111/j.1365-2044.2012.07118.x

ABSTRACT
This prospective observational study investigated the effect of focused transthoracic echocardiography in 99 patients who had suspected cardiac disease or were ≥ 65 years old, and were scheduled for emergency non-cardiac surgery. The treating anaesthetist completed a diagnosis and management plan before and after transthoracic echocardiography, which was performed by an independent operator. Clinical examination rated cardiac disease present in 75%; the remainder were asymptomatic. The cardiac diagnosis was changed in 67% and the management plan in 44% of patients after echocardiography. Cardiac disease was identified by echocardiography in 64% of patients, which led to a step-up of treatment in 36% (4% delay for cardiology referral, 2% altered surgery, 4% intensive care and 26% intra-operative haemodynamic management changes). Absence of cardiac disease in 36% resulted in a step-down of treatment in 8% (no referral 3%, intensive care 1% or haemodynamic treatment 4%). Pre-operative focused transthoracic echocardiography in patients admitted for emergency surgery and with known cardiac disease or suspected to be at risk of cardiac disease frequently alters diagnosis and management.

CHAPTER 5
FOCUSED TTE AND OUTCOME AFTER HIP FRACTURE SURGERY Published as:
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DOI: http://dx.doi.org/10.1111/j.1365-2044.2012.07300.x

Abstract

Hip fracture surgery is associated with a high rate of mortality and morbidity; heart disease is the leading cause and is often unrecognised and inadequately treated. Pre-operative focused transthoracic echocardiography by anaesthetists frequently influences management, but mortality outcome studies have not been performed to date. Mortality over the 12 months after hip fracture surgery, in 64 patients at risk of cardiac disease who received pre-operative echocardiography, was compared with 66 randomised historical controls who did not receive echocardiography. Mortality was lower in the group that received echocardiography over the 30 days (4.7% vs 15.2%, log rank p=0.047) and 12 months after surgery (17.1% vs 33.3%, log rank p=0.031). Hazard of death was also reduced with pre-operative echocardiography over 12 months after adjustment for known risk factors (hazard ratio 0.41, 95% CI 0.2-0.85, p=0.016). Pre-operative echocardiography was not associated with a delay in surgery. These data support a randomised controlled trial to confirm these findings.

CHAPTER 1 & CHAPTER 6
INTRODUCTION AND LITERATURE REVIEW & SUMMARY

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DOI: http://dx.doi.org/10.1213/ANE.0b013e31826a79c1

Abstract

The use of ultrasound in the acute care specialties of anesthesiology, intensive care, emergency medicine, and surgery has evolved from discrete, office-based echocardiographic examinations to the real-time or point-of-care clinical assessment and interventions. "Goal-focused" transthoracic echocardiography is a limited scope (as compared with comprehensive examination) echocardiographic examination, performed by the treating clinician in acute care medical practice, and is aimed at addressing specific clinical concerns. In the future, the practice of surface ultrasound will be integrated into the everyday clinical practice as ultrasound-assisted examination and ultrasound-guided procedures. This evolution should start at the medical student level and be reinforced throughout specialist training. The key to making ultrasound available to every physician is through education programs designed to facilitate uptake, rather than to prevent access to this technology and education by specialist craft groups. There is evidence that diagnosis is improved with ultrasound examination, yet data showing change in management and improvement in patient outcome are few and an important area for future research.

APPENDIX

Appendix 1 HEART scan protocol

Appendix 2 HEART scan report form

Appendix 3 Research questionnaires Preoperative assessment clinic study

Appendix 4 Research questionnaires Emergency surgery study

Appendix 5 Research presentations, grants and awards

APPENDIX 1 HEARTscan Protocol

Summarised from Faris[31] and Royse.[26,104,120]

Up to 3 windows used until adequate information obtained of:

1. Haemodynamic state

   Based on the left ventricular volume, systolic function and atrial pressure estimation (Table 1.3).

2. Valve and pericardium

   Haemodynamic significant lesions – that could cause haemodynamic compromise during or after anaesthesia and surgery. For valves this equates to moderate or severe severity as defined in guidelines from The American Society of Echocardiography.[168,169]

   Specific HEART scan positive criteria include:

Aortic stenosis

Leaflet separation < 1.5 cm in the Left parasternal long axis view OR

Heavy calcification and unable to see valve opening

Aortic regurgitation

Wall hugging jet

Jet extends into the ventricle > 25 mm

Jet:LVOT height >25%

Mitral stenosis

Reduced leaflet opening

"Hockey stick" appearance of either leaflet

PISA on the atrial side of the valve

Mitral regurgitation

Flail leaflet or ruptured papillary muscle

Regurgitant jet area > 20% of left atrial area

Wall hugging jet

Tricuspid regurgitation

Wall hugging jet

Central jet area > $5cm^2$

Pericardial effusion > 0.5cm

Suggested sequence

1. Parasternal window

   Left ventricular long axis

   a. 2D examination of the left and right ventricles, left atrium and pericardium.
   b. M-mode of the left atrial size and left ventricular end diastolic dimension (LV volume) and fractional shortening (LV systolic function)
   c. Colour flow Doppler of the aortic and mitral valves

   Right ventricular inflow view

   a. 2D and colour flow Doppler assessment of the tricuspid valve.

   Left ventricular short axis of the aortic valve

   a. 2D and colour flow Doppler assessment of the aortic, tricuspid and pulmonary valves
   b. Interatrial septum position and motion (estimation of left atrial pressure).

   Lef ventricular short axis midpapillary

   a. Left ventricular end diastolic area (left ventricular volume)
   b. Fractional area change (LV systolic function)

2. Apical window

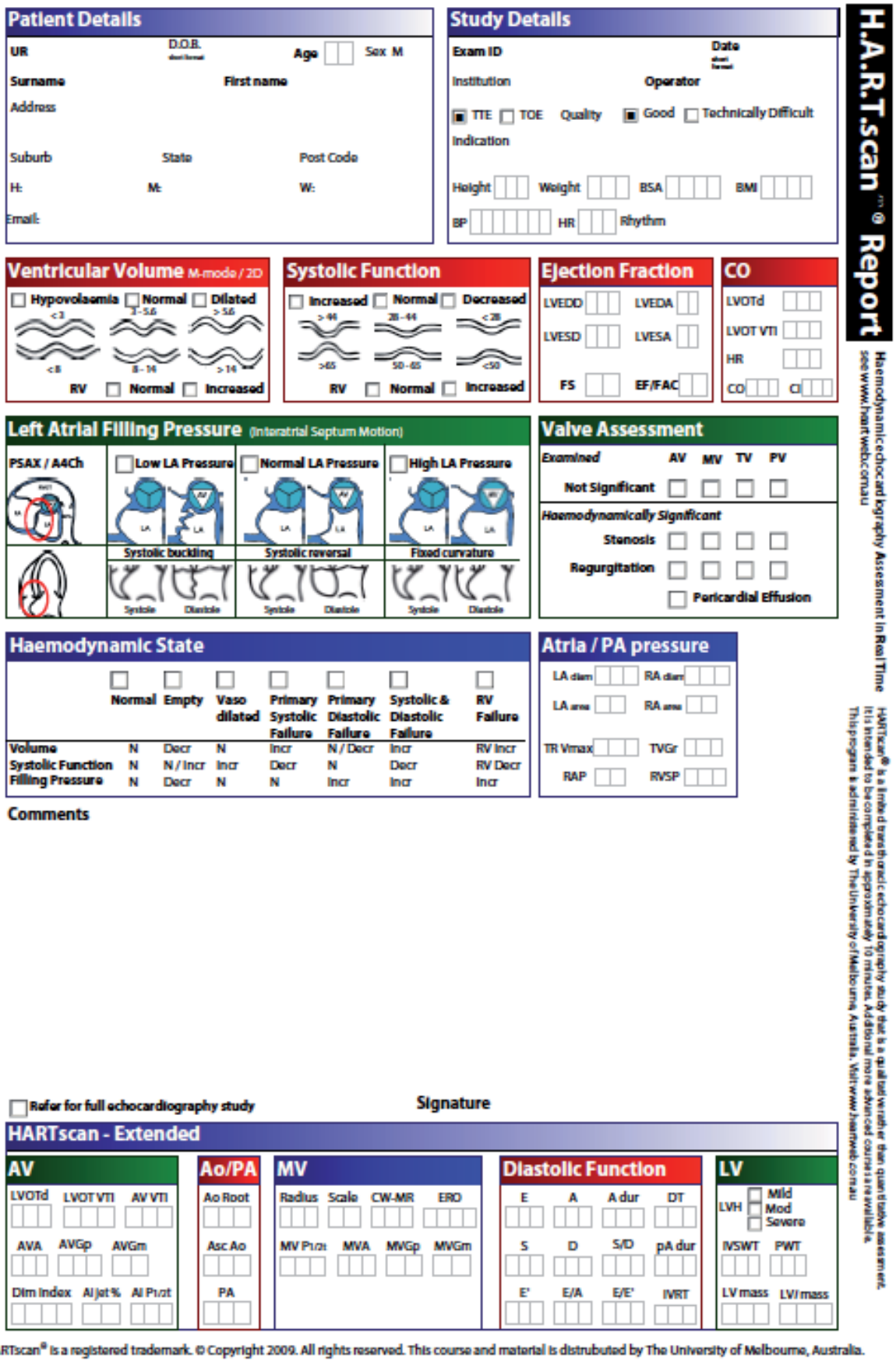
   4-5 chamber view

   a. 2D and colour flow Doppler assessment of the aortic, mitral and tricuspid valves.
   b. Cardiac output is optional

   2-3 chamber for confirmation of aortic and mitral valves, left ventricular systolic function (including regional wall motion abnormalities).

3. Subcostal window
   a. 2D and colour flow Doppler assessment of the aortic, mitral and tricuspid valves.
   b. Interatrial septal motion (left atrial pressure)
   c. Inferior vena cava size and collapsibility with sniffing or deep inspiration.

APPENDIX 2 HEARTscan report form.



H.A.R.T.scan™ Report

Haemodynamic echocardiography Assessment in Real Time
see www.heartweb.com.au

Patient Details

UR | D.O.B. | Age | Sex M
Surname | First name
Address
Suburb | State | Post Code
H: | M: | W:
Email:

Study Details

Exam ID | Date
Institution | Operator
TTE ☐ TOE | Quality ☐ Good ☐ Technically Difficult
Indication
Height | Weight | BSA | BMI
BP | HR | Rhythm

Ventricular Volume M-mode / 2D

☐ Hypovolaemia ☐ Normal ☐ Dilated
<3 | 3 - 5.6 | > 5.6
<8 | 8 - 14 | > 14
RV ☐ Normal ☐ Increased

Systolic Function

☐ Increased ☐ Normal ☐ Decreased
> 44 | 28 - 44 | < 28
>65 | 50 - 65 | <50
RV ☐ Normal ☐ Increased

Ejection Fraction

LVEDD | LVEDA
LVESD | LVESA
FS | EF/FAC

CO

LVOTd
LVOT VTI
HR
CO | CI

Left Atrial Filling Pressure (Interatrial Septum Motion)

PSAX / A4Ch

☐ Low LA Pressure	☐ Normal LA Pressure	☐ High LA Pressure
Systolic buckling	Systolic reversal	Fixed curvature

Systole | Diastole

Valve Assessment

Examined	AV	MV	TV	PV
Not Significant	☐	☐	☐	☐
Haemodynamically Significant				
Stenosis	☐	☐	☐	☐
Regurgitation	☐	☐	☐	☐

☐ Pericardial Effusion

Haemodynamic State

	☐ Normal	☐ Empty	☐ Vaso dilated	☐ Primary Systolic Failure	☐ Primary Diastolic Failure	☐ Systolic & Diastolic Failure	☐ RV Failure
Volume	N	Decr	N	Incr	N / Decr	Incr	RV Incr
Systolic Function	N	N / Incr	Incr	Decr	N	Decr	RV Decr
Filling Pressure	N	Decr	N	N	Incr	Incr	Incr

Atria / PA pressure

LA diam | RA diam
LA area | RA area
TR Vmax | TVGr
RAP | RVSP

Comments

☐ Refer for full echocardiography study

Signature

HARTscan - Extended

AV

LVOTd | LVOT VTI | AV VTI
AVA | AVGp | AVGm
Dim Index | AI jet % | AI P1/2t

Ao/PA

Ao Root
Asc Ao
PA

MV

Radius | Scale | CW-MR | ERO
MV P1/2t | MVA | MVGp | MVGm

Diastolic Function

E | A | A dur | DT
S | D | S/D | pA dur
E' | E/A | E/E' | IVRT

LV

LVH ☐ Mild ☐ Mod ☐ Severe
IVSWT | PWT
LV mass | LVI mass

HARTscan® is a limited transthoracic echocardiography study that is a qualitative rather than quantitative assessment. It is intended to be completed in approximately 10 minutes. Additional more advanced courses are available. This program is administered by The University of Melbourne, Australia. Visit www.heartweb.com.au

APPENDIX 3 Research questionnaires - Preoperative clinic study

Question sheet 1 - PRIOR TO ECHOCARDIOGRAPHY

Date ___ / ___ / 2009
Study number _____
Listed operation _____

Indication for TTE (select most important indication)

- ☐ asymptomatic >65 y.o.
- ☐ known cardiac disease
- ☐ cardiac symptoms
- ☐ murmur
- ☐ abnormal cardiac test
- ☐ unable to exercise
- ☐ suspected pulmonary hypertension or R heart failure
- ☐ previous perioperative cardiac complications

If the patient was *not* involved in the study would you:

☐ Y ☐ N order a TTE preop?
☐ Y ☐ N request a cardiology consultation preop?
☐ Y ☐ N delay surgery for other reasons - please specify

If no echo is available prior to surgery please indicate your anaesthesia plan:

Anaesthesia Plan

- ☐ General anaesthesia
- ☐ Regional anaesthesia
- ☐ Combined GA/regional
- ☐ other - specify:

Airway

- ☐ LMA
- ☐ ETT
- ☐ supplemental oxygen
- ☐ other - specify:

Induction

- ☐ intravenous
- ☐ inhalational
- ☐ other - specify:

Maintenance

- ☐ TIVA
- ☐ inhalational agent
- ☐ other - specify:

Regional anaesthesia

- ☐ local infiltration
- ☐ peripheral nerve block
- ☐ peripheral nerve catheter
- ☐ spinal
- ☐ epidural
- ☐ other specify:

Additional haemodynamic support

- ☐ vasopressor infusion
- ☐ inotrope infusion
- ☐ other - specify:

Intraoperative monitoring

- ☐ standard non-invasive monitoring only (SpO2, 3 lead ECG, NIBP, ETCO2)
- ☐ arterial line
- ☐ central venous pressure
- ☐ 5 lead ECG
- ☐ pulmonary artery catheter
- ☐ transoesophageal echocardiography
- ☐ transthoracic echocardiography
- ☐ other (specify):

Postoperative Care

- ☐ Standard ward
- ☐ Increased observations on standard ward (eg. FOU, SHU, ward+telemetry)
- ☐ High Dependency unit (HDU)
- ☐ Intensive Care unit (ICU)

Question sheet 2 - AFTER ECHOCARDIOGRAPHY

After reviewing the HEARTscan results would you:

☐ Y ☐ N request a cardiology consultation preop?
☐ Y ☐ N request a cardiology consultation postop?
☐ Y ☐ N request another specialist consultation? (eg. respiratory cause of symptoms)
☐ Y ☐ N where you reassured of no siginicant cardiac pathology on echo?

Did the TTE affect the surgery?

☐ Y ☐ N cancel the procedure eg. too high cardiac risk
☐ Y ☐ N change the operation eg. perform less invasive procedure
☐ Y ☐ N additional procedure eg. drain effusion or cardiac surgery
specify:

Please fill in your current anaesthesia plan given the echo findings:

Anaesthesia Plan

- ☐ General anaesthesia
- ☐ Regional anaesthesia
- ☐ Combined GA/regional
- ☐ other - specify:

Airway

- ☐ LMA
- ☐ ETT
- ☐ supplemental oxygen
- ☐ other - specify:

Induction

- ☐ intravenous
- ☐ inhalational
- ☐ other - specify:

Maintenance

- ☐ TIVA
- ☐ inhalational agent
- ☐ other - specify:

Regional anaesthesia

- ☐ local infiltration
- ☐ peripheral nerve block
- ☐ peripheral nerve catheter
- ☐ spinal
- ☐ epidural
- ☐ other specify:

Additional haemodynamic support

- ☐ vasopressor infusion
- ☐ inotrope infusion
- ☐ other - specify:

Intraoperative monitoring

- ☐ standard non-invasive monitoring only (SpO2, 3 lead ECG, NIBP, ETCO2)
- ☐ arterial line
- ☐ central venous pressure
- ☐ 5 lead ECG
- ☐ pulmonary artery catheter
- ☐ transoesophageal echocardiography
- ☐ transthoracic echocardiography
- ☐ other (specify):

Postoperative Care

- ☐ Standard ward
- ☐ Increased observations on standard ward (eg. FOU, SHU, ward+telemetry)
- ☐ High Dependency unit (HDU)
- ☐ Intensive Care unit (ICU)

Question sheet 3 - AFTER SURGERY

Date ___ / ___ / 2009
Study number _____

☐Y ☐N Was surgery delayed?
if yes: why?

☐Y ☐N Did the HEARTscan echo change management in theatre?
if yes: how?

☐Y ☐N **Was there a haemodynamic problem in theatre requiring more than usual treatment expected for the anaesthesia and surgery?**

problem(s):
- ☐ hypotension
- ☐ tachycardia
- ☐ dysrhythmia
- ☐ other-specify:

treatment(s):
- ☐ fluids
- ☐ vasoconstrictor
- ☐ inotrope
- ☐ additional invasive monitoring
- ☐ other -specify:

☐Y ☐N **Was there a haemodynamic problem postop requiring more than usual treatment expected for the anaesthesia and surgery?**

problem(s):
- ☐ hypotension
- ☐ tachycardia
- ☐ dysrhythmia
- ☐ other-specify:

treatment(s):
- ☐ fluids
- ☐ vasoconstrictor
- ☐ inotrope
- ☐ additional invasive monitoring
- ☐ upgrade in postop care eg. HDU
- ☐ other -specify:

Anaesthesia management
- ☐ General anaesthesia
- ☐ Regional anaesthesia
- ☐ Combined GA/regional
- ☐ other - specify:

Airway
- ☐ LMA
- ☐ ETT
- ☐ supplemental oxygen
- ☐ other - specify:

Induction
- ☐ intravenous
- ☐ inhalational
- ☐ other - specify:

Maintenance
- ☐ TIVA
- ☐ inhalational agent
- ☐ other - specify:

Regional anaesthesia
- ☐ local infiltration
- ☐ peripheral nerve block
- ☐ peripheral nerve catheter
- ☐ spinal
- ☐ epidural
- other - specify:

Intraoperative monitoring
- ☐ standard non-invasive monitoring
- ☐ arterial line
- ☐ central venous pressure
- ☐ 5 lead ECG
- ☐ pulmonary artery catheter
- ☐ TOE
- ☐ transthoracic echocardiography
- ☐ other (specify):

Postoperative Care
- ☐ Standard ward
- ☐ Increased observations on standard ward (eg. FOU, SHU, ward+telemetry)
- ☐ High Dependency unit (HDU)
- ☐ Intensive Care unit (ICU)

APPENDIX 4 Research Questionnaires - emergency surgery study

Question sheet 1 - PRIOR TO ECHOCARDIOGRAPHY

Indication(s) for TTE

You may tick more than one option

- ☐ haemodynamic instability
- ☐ cardiac disease signs
- ☐ cardiac disease symptoms
- ☐ murmur
- ☐ asymptomatic, >65 y.o.
- ☐ abnormal cardiac test
- ☐ can't assess functional state, suspect cardiac dx
- ☐ known cardiac disease, ?deterioration
- ☐ previous perioperative cardiac complications

In your opinion what is the most important indication?

- ☐ haemodynamic instability
- ☐ cardiac disease signs
- ☐ cardiac disease symptoms
- ☐ murmur
- ☐ no significant cardiac disease suspected, >65 y.o.
- ☐ abnormal cardiac test
- ☐ can't assess functional state, suspect cardiac dx
- ☐ known cardiac disease, ?deterioration
- ☐ previous perioperative cardiac complications

What is the principle haemodynamic state?

- ☐ Normal
- ☐ Empty
- ☐ Vasodilated
- ☐ LV Systolic
- ☐ Primary LV diastolic failure
- ☐ LV Systolic and diastolic failure
- ☐ RV failure
- ☐ Unsure

Do you think there is a valvular or other sig. cardiac abnormality?

☐ Yes ☐ No

	haemod. significant		NOT significant
Aortic	AR ☐	AS ☐	☐
Mitral	MR ☐	MS ☐	☐
Tricuspid	TR ☐	TS ☐	☐
Pulmonary	PR ☐	PS ☐	☐
Pericardial effusion	☐		☐
Pulmonary embolus	☐		☐
Other	☐		

please specify:

Question sheet 2 - PRIOR TO ECHOCARDIOGRAPHY

What is your preop plan?

- ☐ Proceed regardless of TTE
- ☐ Defer for further investigations or consultations
- ☐ Cancel surgery
- ☐ Proceed with a change in the operation:
  specify:

Anaesthesia Plan

- ☐ General anaesthesia
- ☐ Regional anaesthesia
- ☐ Combined GA/regional
- ☐ other - specify:

Airway

- ☐ LMA
- ☐ ETT
- ☐ supplemental oxygen
- ☐ other - specify:

Induction

- ☐ intravenous
- ☐ inhalational
- ☐ other - specify:

Maintenance

- ☐ TIVA
- ☐ inhalational agent
- ☐ other - specify:

Regional anaesthesia

- ☐ local infiltration
- ☐ peripheral nerve block
- ☐ peripheral nerve catheter
- ☐ spinal
- ☐ epidural
- ☐ other specify:

Additional haemodynamic support

- ☐ fluid bolus pre induction
- ☐ inotrope infusion
- ☐ GTN/vasodilator
- ☐ vasopressor infusion
- ☐ vasopressor boluses PRN
- ☐ other - please specify:

Additional Intraoperative monitoring

- ☐ arterial line
- ☐ central venous pressure
- ☐ TOE
- ☐ TTE
- ☐ 5 lead ECG
- ☐ pulmonary artery catheter
- ☐ other (specify)

Postoperative Care

- ☐ Standard ward
- ☐ High Dependency unit (HDU)
- ☐ Intensive Care unit (ICU)

Question sheet 3 - AFTER ECHOCARDIOGRAPHY

What is your preop plan given the echo information?

- ☐ Proceed
- ☐ Defer for further investigations or consultations
- ☐ Cancel surgery
- ☐ Proceed with a change in the operation:
  specify:

Anaesthesia Plan

- ☐ General anaesthesia
- ☐ Regional anaesthesia
- ☐ Combined GA/regional
- ☐ other - specify:

Airway

- ☐ LMA
- ☐ ETT
- ☐ supplemental oxygen
- ☐ other - specify:

Induction

- ☐ intravenous
- ☐ inhalational
- ☐ other - specify:

Maintenance

- ☐ TIVA
- ☐ inhalational agent
- ☐ other - specify:

Regional anaesthesia

- ☐ local infiltration
- ☐ peripheral nerve block
- ☐ peripheral nerve catheter
- ☐ spinal
- ☐ epidural
- ☐ other specify:

Additional haemodynamic support

- ☐ fluid bolus pre induction
- ☐ inotrope infusion
- ☐ GTN/vasodilator
- ☐ vasopressor infusion
- ☐ vasopressor boluses PRN
- ☐ other - please specify:

Additional Intraoperative monitoring

- ☐ arterial line
- ☐ central venous pressure
- ☐ TOE
- ☐ TTE
- ☐ 5 lead ECG
- ☐ pulmonary artery catheter
- ☐ other (specify)

Postoperative Care

- ☐ Standard ward
- ☐ High Dependency unit (HDU)
- ☐ Intensive Care unit (ICU)

APPENDIX 5 Research Grants, Presentations and awards

Research Grants

1. Australian and New Zealand College of Anaesthetists Project grant and scholarship

   $140,000 over 3 years 2011-2013

Oral presentations

1. Invited speaker, ANZCA Rural Anaesthesia Special Interest Group 8/7/2012
   Torquay, Victoria, Australia

   "Guiding perioperative management decisions with echo"
2. PhD presentation, University of Melbourne Cardiovascular Research Domain 22/6/2012
   University of Melbourne, Parkville, Victoria, Australia

   "The Impact of Focused Transthoracic Echocardiography in Non-cardiac Anaesthesia and Surgery."

Poster presentations

1. Prize for best student scientific poster, ANZCA Cardiothoracic, Vascular and Perfusion Special Interest Group Biennial Meeting (CVP SIG) 6/10/09
   Noosa, Queensland, Australia

   "Audit of anaesthetist-performed echocardiography on perioperative management decisions for non-cardiac surgery."
2. Prize for best student scientific poster, Melbourne Health Research Week 17/6/2010
   Royal Melbourne Hospital, Parkville, Victoria, Australia

   "The impact of transthoracic echocardiography performed by anaesthetists immediately prior to emergency surgery, on perioperative decision-making.
3. Poster presentation, ANZCA CVP SIG Biennial Meeting 3/10/2011
   Hamilton Island, Queensland, Australia

   "The impact of anaesthetist performed transthoracic echocardiography in a preoperative clinic on perioperative decision-making."

4. Poster presentations, Combined meeting of the 13th International Congress of Cardiothoracic and Vascular Anesthesia/ANZCA/New Zealand College of Anaesthetists 17/11/2012.

   Auckland, New Zealand

   i) "The impact of focused transthoracic echocardiography in the pre-operative clinic"

   ii) "The impact of pre-operative focused transthoracic echocardiography in emergency non-cardiac surgery patients with known or risk of cardiac disease"

   iii) "The impact of preoperative focused transthoracic echocardiography in fractured neck of femur surgery: a retrospective cohort study."

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