

Review Article

Focused Transthoracic Echocardiography in Hip Fracture Surgery Patients

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Abstract

Despite advances in medical care, hip fracture surgery remains one of the commonest and highest risk surgical procedures (10% in-hospital mortality and 25% at one year), representing a major economic cost to our community and a World health care burden. Hip fracture patients are usually elderly and chronic cardiovascular disease is common. Due to urgency of surgery, frequent patient cognitive impairment and limitations in health care resources, cardiac disease is often inadequately treated and remains the leading cause of mortality. Preoperative transthoracic echocardiography (TTE) performed in the echocardiography laboratory non-invasively alerts treating physicians to cardiac disease but may result in a delay which is associated with worse outcome and hence is usually restricted to selected patients. Anesthesiologists have been increasingly performing their own 'goal-focused TTE', an abbreviated examination which really forms an extension of clinical examination, which also alerts the anesthesiologist to abnormal hemodynamic states such as hypovolemia, ventricular failure and vasodilation, thus guiding appropriate hemodynamic treatment and monitoring before, during and after surgery. Recent published data showed a major influence of goal-focused TTE on management of patients requiring hip fracture and other non-cardiac surgery. Further proof of concept data has revealed that mortality may be reduced in hip fracture surgery patients who receive a preoperative focused transthoracic echocardiography by the anesthesiologist. This technology has the potential to drastically improve the medical care of patients at high risk of cardiac disease requiring non-cardiac surgery. Recently, several guidelines from learned societies of echocardiography have been published on recommendations for training and practice of focused TTE by non-cardiologists for ultrasound assisted examination. Focused TTE requires significant training and funding and to justify this important and rapid shift in medical practice, there is a need for high quality outcome studies to be performed. Equally important are efficient teaching methods and a robust mechanism to ensure minimum standards of proficiency to minimize the recognised potential harm from erroneous conclusions drawn from misinterpretation of data.

BACKGROUND

Hip fracture is a common serious injury that occurs mainly in older people and usually requires surgery[1]. It is a major world health care burden that is likely to worsen as our population ages [2,3].

Of all operations, surgery for hip fracture carries one of the highest mortality rates, although only one third is directly attributable to the fracture[1]. The event is often terminal, with 12-month mortality rates of up to 25% post surgery, which is four-fold higher than age-matched community-living controls. Survival from hip fracture surgery has improved from the period 1960-1980, but has plateaued since 1980 [4,5]. There is evidence that mortality is reduced with early surgery [6-9] (within 8-24 hours of admission) and if treated by experienced personnel in a specialized unit [10]. Hip fracture occurs mainly in the elderly, and for many of them it is a watershed event in their lives, as even if they survive, half suffer decreased mobility and independence following the fracture and only a third regain pre-fracture levels

of function [11]. The personal suffering of these patients and their families is high, and the cost to the community is considerable due to prolonged hospital admissions, and frequent need for higher dependency care following their accident. In the United Kingdom, approximately 77 000 hip fractures occur annually, which accounts for 1.5 million bed days and an inpatient cost of £0.785 billion [9]. The annual in-hospital expenses alone were approximately \$8 million in a representative Australian metropolitan health care service [12].

Heart disease, associated with advanced age, remains the most common cause of postoperative mortality [13,14]. In many cases, frailty and heart disease may have contributed both to the fall and fracture in the first instance. Furthermore, if patients suffer a postoperative cardiac complication (such as heart failure), their mortality increases to 65% at 30 days and 92% at 1 year [15]. If they have three or more comorbidities at the time of surgery, their hazard ratio for death is 2.5. Cardiovascular disease is often unrecognized in this age group because of age, general immobility, and high frequency of poor cognitive function

including dementia, which inhibits accurate medical assessment. Careful cardiac assessment and treatment is often missed because surgery is urgent and there is time-pressure to proceed to surgery to palliate their pain and get them out of hospital.

These patients often receive a lower priority in view of their advanced age and other considerations such as residence in a nursing home. They are often managed by junior doctors, who may not have the experience or confidence to adequately investigate and treat underlying cardiovascular disease prior to surgery.

Can Better Treatment Reduce Mortality?

Despite the enormity of the problem there are surprisingly few data on improving outcome in these patients in the anesthetic literature. There are several large audits of mortality in patients undergoing hip fracture surgery, reporting mortality rates from 5 to 25 % [16,17]. These audits do not present morbidity data. It is reasonable to estimate, however, that morbidity will be two to three times the incidence of mortality. Venn et al. [18] demonstrated an earlier hospital discharge in hip fracture surgery patients who had their fluid treatment managed with intraoperative esophageal Doppler compared with central venous pressure monitoring. Sinclair et al. [19] demonstrated faster recovery after hip fracture surgery utilizing esophageal Doppler-guided fluid management compared with standard fluid management, which should translate into reduced hospital length of stay and therefore reduced cost. Both studies were insufficiently powered to show a reduction in morbidity or mortality. At Cornell Medical Centre [10], a specialist orthopedic hospital, most fractured hip surgery patients are treated intensively (regional anesthesia, invasive monitoring, postoperative intensive care and rehabilitation) with a resulting much lower mortality rate (1.5% compared to the standard average of 10%) - this highlights that lives can be saved in this at-risk population if they are given intensive treatment (and not treated as "second class patients").

How Could Preoperative Goal-Focused Transthoracic Echocardiography Make a Difference?

Preoperative cardiac assessment, as recommended by the American and European Heart Associations [20,21], enables improved cardiac treatment and reduction of cardiac complications. However, despite a high incidence of cardiac disease [22] and dehydration in these patients [23], there is often reluctance to perform preoperative cardiac investigations such as echocardiography or to utilize intensive perioperative monitoring, due to the urgency of surgery and advanced patient age [24-28]. There have been several comprehensive guidelines published from multidisciplinary expert groups in recent years, and a common theme has been emphasis on minimizing delays to theatre, which is associated with worse outcome [29-31]. This has increased the pressure on anesthesiologists to 'skip' standard preoperative investigations, such as transthoracic echocardiography (TTE), to avoid an associated delay and perceived increase in poor patient outcome.

This has been exacerbated in the UK with the introduction of the Best Practice Tariff (BPT) for hip fracture surgery in April 2010, which penalizes hospitals by withdrawal of funding of

£1335 (€1706; \$2102) [32] if there is a delay in surgery of over 36 hours from the time of diagnosis [33]. These recommendations have led to considerable resistance from orthopedic surgeons to delay surgery for TTE, whose current recommendations are to avoid delays to surgery beyond 48 hours [31].

However, preoperative TTE in these patients remains controversial as some authors favour a low threshold for for this useful and non-invasive investigation [27,28,32], principally to identify asymptomatic severe aortic stenosis, which is associated with a marked elevation in poor outcome [34-36]. One group reported success of a routine preoperative focused TTE program by cardiac sonographers, which identified undiagnosed significant (moderate or severe) aortic stenosis in 8% [27]. Other reported benefits of preoperative TTE include risk stratification enabling a higher level of intraoperative hemodynamic monitoring, postoperative care and analgesia [37]. Operative risk is likely to be reduced by surgical management. Apart from recommending a higher level of seniority of surgeon and anesthesiologist [30], uncemented prostheses have been suggested to prevent bone cement implantation syndrome in patients at high risk, including older patients with impaired cardiopulmonary function [38]. A preoperative TTE may identify patients who may benefit from this practice before arrival of the patient into the operating room.

Good examples of patients who may benefit from preoperative TTE are those with aortic stenosis and hypovolemia. Severe aortic stenosis is associated with 4-10 fold increased mortality after non-cardiac surgery [34-36]. Aortic stenosis restricts the left ventricular stroke volume impairing the ability to cope with hemodynamic demands from anesthesia and surgery. If not appropriately managed, cardiac output may become irreversibly depressed and cardiac arrest may ensue. An example is spinal anesthesia, commonly used in hip fracture surgery, which may cause an uncontrollable decrease in systemic vascular resistance. Significant aortic stenosis was present in 8% of a large series of hip fracture surgery patients, but a detectable murmur was not found in one third [27]. Approximately 50% of patients with hip fracture have ejection systolic murmurs and 26--32% have some degree of aortic stenosis [39]. Confident diagnosis of aortic stenosis requires TTE which is associated with a delay in surgery and is often avoided resulting in the anesthesiologists managing the anesthesia and cardiac treatment based on "best guess" clinical assessment. This management approach is not ideal, as if severe aortic stenosis is presumed rather than proven, then patients without aortic stenosis may receive unnecessary invasive management (for example intra-arterial blood pressure and central venous pressure monitoring and postoperative intensive care). On the other hand, patients with severe aortic stenosis may not receive expensive postoperative high level care (from the orthopedic and geriatric medicine teams) as aortic stenosis was only 'presumed' by the anesthesiologist. With appropriate perioperative care patients should not die of this condition. However, inadequate treatment could result in hypotension, leading to organ failure and death. This is a preventable death.

Approximately half of hip fracture patients who present for surgery are hypovolemic from bleeding, reduced oral intake, and a reluctance of medical staff to give fluids for fear causing pulmonary edema [23,40]. Hypovolemia and cardiac failure is

easily detectable with TTE enabling prompt and safe treatment prior to surgery. Unlike esophageal Doppler monitoring (as studied by Venn and Sinclair), TTE provides accurate intravascular volume assessment before surgery, allowing time for correction before anesthesia and surgery commences, which may help avoid hypotension and improve tissue perfusion. Additionally, TTE may prompt avoidance of fluid therapy when cardiac failure is identified.

Anesthesiologists assess all hip fracture surgery patients and optimize their cardiac treatment to cope with the stress of anesthesia and surgery. They are the principal physicians responsible for identifying high-risk patients, deciding whether to proceed or delay surgery and the level of intraoperative and postoperative cardiac treatment and monitoring that is required. Indicators of abnormal cardiovascular function are obtained by the anesthesiologist from the history (such as shortness of breath, chest pain, or hypertension), or from the examination (such as reduced blood pressure or increased heart rate; or evidence of poor tissue perfusion such as a cool periphery or reduced urine output). Additional hemodynamic monitoring (which is rarely used in these patients) can include central venous pressure, pulmonary artery pressure, or cardiac output. If abnormal, these parameters suggest that there is a cardiovascular disorder, but they do not indicate what the cause is. For example, a low blood pressure and increased heart rate could equally be caused by hypovolemia, heart failure, or severe aortic stenosis. The treatments and postoperative care required for these conditions are very different.

Goal-focused TTE utilizes the same echocardiography techniques as conventional comprehensive outpatient echocardiography performed by cardiology. The difference is that it is brief and limited, and the practitioner performing the study uses it to answer specific clinical questions. In a more generic term, it can be considered "ultrasound assisted examination". What the anesthesiologist needs to know to improve the safety of the procedure is:

- Is there a significant abnormal hemodynamic state of the patient? (eg. hypovolemia, cardiac failure, vasodilation or normal)
- Are there any heart valve abnormalities that could lead to hemodynamic instability? (eg. aortic or mitral stenosis)
- Are there any additional incidental findings that could contribute to hemodynamic instability? (eg. severe pulmonary hypertension or a large pleural or pericardial effusion)

Goal focused TTE is used as an extension of clinical examination of the primary treating physician at the patient's bedside and is used to guide diagnosis and treatment in real time. This is a different approach to the traditional wait for a comprehensive TTE to be performed hours to days after referral. Unlike comprehensive TTE, focused TTE is performed quickly so as not to delay clinical management and is directed at qualitative assessment rather than detailed quantitative assessment. Thus differentiating hemodynamically significant disease, such as moderate to severe ventricular dysfunction, or valvular stenosis or regurgitation, from mild dysfunction which is unlikely to

cause a hemodynamic problem during the stress of surgery and anesthesia. The focused TTE exam is directed at ventricular volume (direct assessment of preload), function, and the presence of other potential major causes of hemodynamic instability such as vasodilation, pericardial effusion and pulmonary hypertension. Due to limited training and time with which to perform the TTE, it is possible that cardiac pathology could be misinterpreted or missed. There exists a trade-off between comprehensive TTE which is used unlikely to miss pathology, but which is restricted in use to a selected few patients but unlikely to be used to guide immediate treatment, versus focused TTE which may miss pathology but provides useful hemodynamic information at the bedside when it is required, but is still much less likely to get the diagnosis wrong than clinical examination and may be used to benefit a much larger number of patients.

Hemodynamic State and Consequences for Treatment

The concept of hemodynamic state assessment is to categorize hemodynamic disturbance into seven broad conditions indicative of underlying disease [41]. This gives the anesthesiologist much better understanding of the cardiovascular disorder. Therapeutic strategies can then be better targeted to treat the underlying disorder early and proactively (such as fluid transfusion for hypovolemia) rather than simply reacting to hypotension during surgery. Transthoracic echocardiography is used to assess left ventricular volume, left ventricular systolic function, and estimate left atrial pressure [41]. The three components when put together provide a guide to the primary hemodynamic state (Table 1) and suggest the appropriate treatment (eg. fluids for hypovolemia, vasopressor for vasodilation). Importantly, hemodynamic state assessment using ultrasound can be obtained rapidly and from limited views.

Hemodynamically Important Valve Lesions and Effusions

Because of the advanced age of these patients, moderate to severe valve lesions are common and are frequently undiagnosed at the time of surgery. Severe aortic stenosis is a classic example of a valve lesion that can lead to death if not properly managed during the perioperative period. If diagnosed, anesthesiologists will step-up their level of care and adjust the anesthetic technique to maintain cardiovascular stability. This may involve the use of invasive monitoring, vasopressor agents, careful optimization of fluid therapy and postoperative analgesia and a decision to send the patient to a high dependency or intensive care environment after surgery, where closer hemodynamic monitoring and treatment is sustained. A warning to the surgeon of high patient cardiac risk may prompt more efficient surgery and less blood loss and consideration of less invasive techniques such as no-cement. Preoperative goal focused TTE provides the treating anesthesiologists with a higher level of knowledge about the patient, upon which they can base more rational therapy.

What Evidence is there that Preoperative Goal-Focused TTE Makes a Difference?

The core of the problem of preoperative TTE lies in the lack of resources available to provide prompt service in time before surgery. In most reports, preoperative TTE before hip fracture surgery was provided by cardiology or radiology

departments, who provide a comprehensive and thorough echocardiography examination but at the cost of an average delay to surgery of 3 days [25-27]. It has been suggested that perhaps anesthesiologists should learn to perform TTE to provide timely TTE in these patients [24]. Subsequently, there have been reported observational studies of anesthesiologist-performed preoperative 'focused TTE' demonstrating a major impact on anesthetic and surgical management, not only in hip fracture surgery patients but also before other emergency non-cardiac surgery and in elective surgery patients presenting to the preoperative clinic (Table 2). In patients who have or are at risk of cardiac disease, clinically significant pathology detected by preoperative focused TTE is in the order of 25% [42,43], which frequently leads to changes in perioperative management. In prospective observational studies by Canty et al. [42,44,45] and Cowie [43] on 456 surgical patients, a high degree of therapeutic impact from focused TTE was demonstrated (39% to 82%). The anesthetic management plan was compared before and after a focused TTE performed by an anesthesiologist not involved in care of the patient who was suitably proficient in focused TTE. In these studies, TTE was predominately performed before anesthesia (90%) for noncardiac surgery, but also during and after surgery in mechanically ventilated patients. The ability of useful information from TTE in mechanically ventilated patients, traditionally poor, is likely to reflect significant improvements in echocardiography technology. In the studies reported by Canty et al., although the highest impact on important management changes occurred after identification of significant cardiac pathology, thus declaring high cardiac risk patients and alteration in preoperative assessment and level of postoperative care

(10%–15%), surgery was also changed for a small proportion of patients (2%) as a result of the new information from TTE. Most changes were in hemodynamic management (30%–40%), including more rational use of invasive monitoring and fluid and vasopressor use. Canty et al. [42], reported that in a prospective study of goal-focused TTE used in the preoperative clinic, the overall effect was to step down planned treatment (based on a reassurance from normal TTE findings) in more patients than to step up treatment based on clinically significant pathology. This resulted in reduced intensity of preoperative, intraoperative and postoperative treatment and resource use. This, however, has not yet been subjected to economic or outcomes analysis. The overall finding of these studies is that clinical examination is unreliable, as it is proved incorrect approximately 50% of the time by TTE.

In 2012, Canty et al. published the first and only existing report that suggests that echocardiography may result in improved postoperative survival [47]. In this retrospective analysis of two reported prospective observational studies [44,45], 64 patients from two centers were identified who received anesthesiologist-performed focused TTE before hip fracture surgery in patients who were deemed to be at increased cardiac risk by the treating anesthesiologist, but in whom had not received a preoperative TTE in the previous 12 months. The mortality over 12 months was compared to a randomised cohort with similar cardiac risk who did not receive preoperative TTE. This control group was generated by randomly selecting patients from the hospital surgical databases with ASA score greater than 2 and age greater than 60 years, and on subsequent analysis, the two groups (TTE

Table 1: Transthoracic echocardiography hemodynamic state classification [41].

Echo parameter	Normal	Empty	Primary diastolic failure	Systolic failure	Systolic +diastolic failure	Vasodilation	Right Ventricular failure
LV Volume	N	↓	N /↓	↑	↑	N	RV↑
LV Systolic function	N	N/↑	N	↓	↓	↑	RV↓
LV Filling pressure	N	↓	↑	N	↑	N	↑

LV is left ventricle, RV is right ventricle, and arrows are increased or decreased.

Table 2: Summary of prospective observational studies on the impact of transthoracic echocardiography on decision-making and outcome in non-cardiac anesthesia.

Study	Methodology	Influence of TTE on management	Comments
Canty 2009 [44]	87 patients in whom TTE was requested by the treating anesthesiologist.	Medical management changed in 34% (hemodynamic management, anesthetic technique and postoperative care) and surgical management in 7% (surgery altered in 2% and deferred in 5%).	TTE performed by single anesthesiologist (HEART scan*). Changes occurred in the preoperative assessment clinic (9%), operating room: preoperative (25%), intraoperative (10%) and post anesthesia recovery unit (2%).
Cowie 2011 [43]	170 patients. Indications for TTE included murmur (58%), hemodynamic instability, ventricular function, dyspnea, and poor functional capacity.	Management changed in 82% including postponed surgery for cardiology TTE (20%), cancelled surgery (4%), perioperative hemodynamic changes (51%) and level of postoperative care (7%).	TTE performed by multiple anesthesiologists. Significant aortic stenosis identified in 11%, pulmonary hypertension in 14%. Findings confirmed by a cardiologist in 92%.
Canty 2012 [42]	100 patients seen in the preoperative assessment clinic. Indications included suspected cardiac disease or age>65 years.	Management changed in 54% including changed surgery in 2%. Changes included a step-up in treatment in 36% and a step down in treatment in 8%.	TTE performed by a single cardiac anesthesiologist (HEART scan*). Findings confirmed by a cardiologist in 92% .
Canty 2012 [45]	99 emergency non-cardiac surgery patients. Indications included suspected cardiac disease or age≥ 65 years.	New findings were found in 67% and management was changed in 44% including changed surgery in 2%. Changes included a step-up in treatment in 20% and a step down in treatment in 34%.	TTE performed by multiple anesthesiologists (HEART scan). Procedural changes in 14% (preoperative referral, surgery type or level of postoperative care) and hemodynamic management changes in 30% (invasive monitoring, fluid and vasopressor and anesthetic technique).

*HEART scan, Hemodynamic transthoracic Echocardiographic Assessment in Real Time (University of Melbourne)[46]

and control) had very 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, $p=0.016$). Thus mortality was halved in the patients who received preoperative focused TTE and this persisted to 12 months after surgery. Diagnosis and management were changed in the majority of the 64 hip fracture patients after goal- focused TTE (Figure 1). This provides a plausible mechanism of effect of the association in reduced mortality in patients who received preoperative focused TTE. The anesthesiologists were not only alerted to identification of patients with significant cardiac disease, the TTE also provided the hemodynamic state (eg. hypovolemia, ventricular failure or vasodilation) which assisted the anesthesiologist in more rational hemodynamic treatment. Because the TTE was performed before commencement of anesthesia, this enabled TTE-guided hemodynamic treatment to be commenced before the hemodynamic stress of anesthesia and surgery, perhaps reducing the degree of perioperative hemodynamic compromise that is so common in these patients. Furthermore, as the hemodynamic and cardiac status were defined before anesthesia, the anesthesiologist is likely to have been better prepared for management of any subsequent hemodynamic instability. TTE identified significant disease in a third of patients where clinical assessment had indicated that there was no cardiac disease present, highlighting not only the inaccuracy of clinical examination but the high incidence of occult cardiac disease in this elderly population. Unlike previous reports [25-27], there was no delay before surgery associated with performance of preoperative TTE (1.7 ± 1.9 mean days before surgery) compared with patients who did not receive preoperative TTE (1.4 ± 1.2 days, $p=0.41$). Due to the retrospective nature of this study the

findings of this study need to be considered as proof of concept only but it represents strong pilot data that supports a large prospective randomised controlled trial.

Focused echocardiography is more accurate than clinical examination alone [48-50] and this could explain the difference in short-term mortality by correct diagnosis of life-threatening cardiac pathology, leading to changes in peri-operative management. A possible reason for the persistent reduction in mortality at after 12 months is that detection of significant cardiac pathology using TTE may have led to better post-hospital management of cardiac disease, which may then have led to a further reduction in mortality. If patients survive surgery, but suffer cardiac failure in the peri-operative period [15], they then have a 92% mortality at 12 months, indicating that cardiovascular morbidity at the time of surgery is an important contributor to longer-term mortality. It is possible that preventing cardiovascular complications at the time of surgery may help reduce long-term mortality.

Potential Harm of Focused TTE

Transthoracic echocardiography is considered by many as non-invasive however, this term probably only applies to the physical effects of surface application of the probe to the patient, compared to of transesophageal echocardiography (TEE) which occasionally causes esophageal perforation with potentially serious consequences. Transesophageal echocardiography also requires sedation or general anesthesia with its associated morbidity including airway complications such as airway obstruction, respiratory failure and pulmonary aspiration of gastric contents. One of the principal risks of TEE identified by learned societies of echocardiography include misinterpretation of acquired data, which can result in

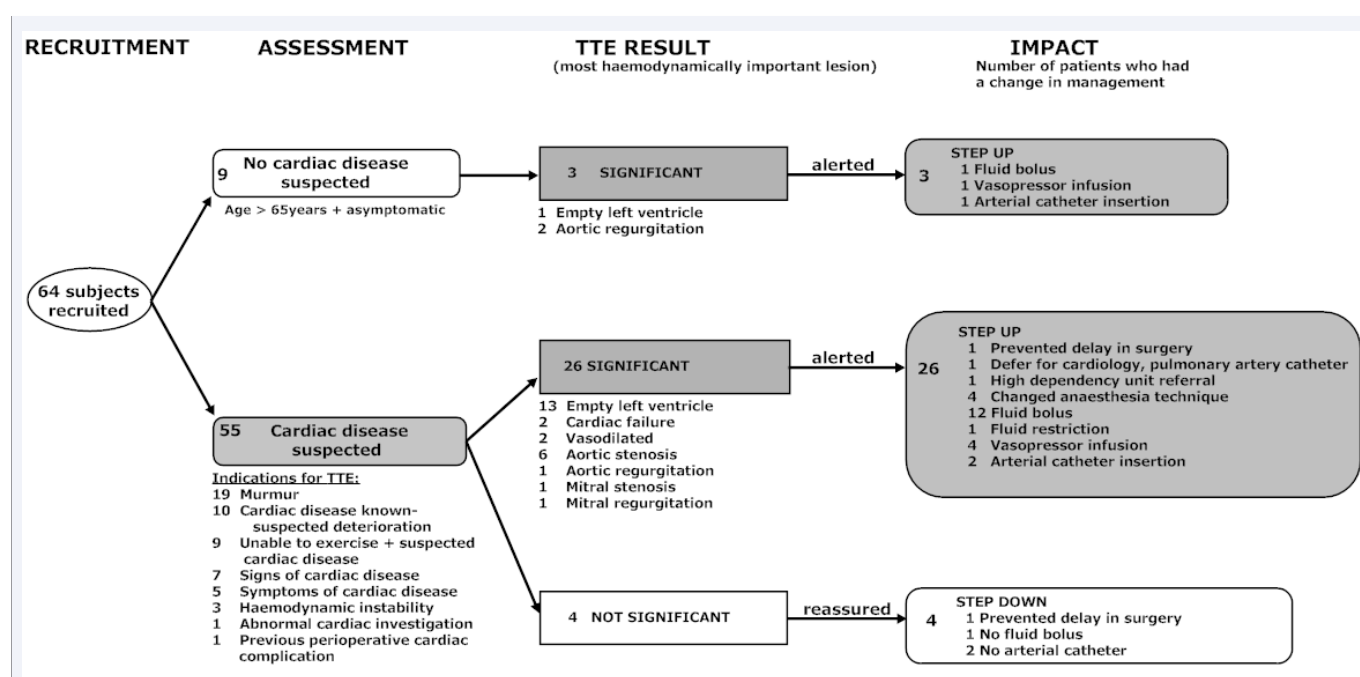


Figure 1 Changes in diagnosis and management by the treating anesthesiologist after preoperative focused TTE in 64 hip fracture surgery patients combined from two cohorts.

inappropriate patient treatment and harm [51]. This is a key reason for the considerable effort in position statements and guidelines from echocardiography societies on minimum standards of training, assessment and credentialing in echocardiography in both the cardiology and non-cardiology medical specialties (including anesthesia and other critical care specialties) [51]. In June 2013, an expert consensus statement was published by The American Society of Echocardiography (ASE) defining the recommendations of training and competence for focused cardiac ultrasound (TTE) [52]. This represents a significant shift in policy, which has traditionally considered echocardiography to be the remit of cardiology or radiology physicians. In this statement it is recognised that there is likely to be a significant benefit to patients when focused TTE is performed and interpreted by non-cardiology physicians at the patient's bedside to augment real-time decision making, rather than waiting for a report from the echocardiography laboratory. At the same time a similar expert consensus was released from the ASE and Society of Cardiovascular Anesthesiologists providing recommendations and guidelines for training and proficiency in basic TEE for non-cardiac surgery [53]. Remarkably at the same time, The Australian and New Zealand College of Anaesthetists (ANZCA) released an update of the guidelines on training and practice of intraoperative TEE [54]. This now incorporates goal-focused TTE and TEE, and is renamed "Guidelines on Training and Practice of Perioperative Cardiac Ultrasound in Adults", thus cementing these modalities in the scope of practice for anesthesiologists. This was predicted by the Cardiac Society of Australian and New Zealand Guidelines for Training and Performance in Adult Echocardiography in 2012: "The importance of these guidelines will increase with the inevitable migration of echocardiography from the province of cardiology to radiology, emergency medicine, intensive care and anaesthesia." [55]. These recently published guidelines aim to set benchmarks for anesthesiologists to attain in both cognitive and practical components of learning, but do not serve as a certification process. Currently in Australia, the responsibility of certification (credentialing) of anesthesiologists in echocardiography probably rests with the hospitals in which the practice is performed, to which the expert consensus statements and ANZCA policy documents are clearly influential.

CONCLUSION

Although surgery for fractured neck of femur is possibly the highest risk commonly performed surgery in medicine, there are very few data investigating treatment strategies to reduce the risk. This is an elderly and frail group of patients that place a very high burden on the health care system, and measures to improve their treatment could help improve their survival, quality of recovery and reduce the health care burden. Preventable deaths should be a target for health professionals irrespective of age. Goal-focused echocardiography is a relatively simple investigation performed at the patient bedside and is non-invasive. It is about giving the treating doctors the best possible knowledge on which to base their management plans. With the development of powerful miniaturized TTE machines that fit in the pocket or hand, the concept coined by Professor Royse of "ultrasound assisted examination" [56] is becoming a reality and focused ultrasound is becoming the stethoscope of the 21st century.

However, implementation of routine preoperative focused TTE by anesthesiologists involves a considerable cost in terms of training and ensuring adequate levels of proficiency. To justify this expense, Level 1 evidence by an appropriately powered multicenter randomized controlled trial is desirable. If focused TTE makes an impact on outcome after hip fracture surgery, it is likely that patients with high cardiac risk will benefit when undergoing other types of surgery. However, as with the rapid establishment of TEE as standard of care for patients undergoing cardiac surgery, it is likely that anesthesiologists won't wait for this Level 1 evidence and will endeavour to train themselves in TTE to improve their patient care. The increasing age and incidence of heart disease in our community is likely to support this movement. Perhaps the focus of research should be extended to ways to facilitate the efficiency of teaching focused TTE and ensuring adequate proficiency and competency to reduce any potential harm on patients from erroneous echocardiography assessment.

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