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McBrien, M. E., Heyburn, G., Stevenson, M., McDonald, S., Johnston, N. J., Elliott, J. R. M., & Beringer, T. R. O. (2009). Previously undiagnosed aortic stenosis revealed by auscultation in the hip fracture population - echocardiographic findings, management and outcome. *Anaesthesia*, 64(8), 863-870. DOI: 10.1111/j.1365-2044.2009.05960.x

Published in:
Anaesthesia

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Previously undiagnosed aortic stenosis revealed by auscultation in the hip fracture population – echocardiographic findings, management and outcome

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Summary

The 2001 Report of the National Confidential Enquiry into Perioperative Deaths recommended that an echocardiogram should be performed on patients with aortic stenosis prior to anaesthesia. In this study we present the patient details, management and outcome of the 272 hip fracture patients with a previously undiagnosed murmur and echocardiographically proven aortic stenosis admitted from 2001–2005 in our hospital. The patients with aortic stenosis were significantly older, and had significantly lower Abbreviated Mental Test Scores, than the control group of 3698 hip fracture patients without aortic stenosis. There were significant trends toward general anaesthesia over spinal anaesthesia, and use of invasive monitoring of blood pressure, as the severity of the aortic stenosis increased. There were no significant trends towards higher 30-day or 1-year mortality rates as the severity of the aortic stenosis increased. Resources for rapid pre-operative echocardiograms should be made available for hip fracture patients as the results have significant implications for their subsequent anaesthetic management.

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Accepted: 24 March 2009

Concerns about the assessment and management of patients with aortic stenosis undergoing anaesthesia and surgery were raised in the National Confidential Enquiries into Perioperative Deaths (NCEPOD) published in 1994/95 and 2001 [1, 2]. The 2001 report recommended that 'Whenever possible the anaesthetist of a patient with aortic stenosis should obtain a pre-operative echocardiogram of the aortic valve.' The report also recommends the use of invasive monitoring, intensive or high dependency care and excellent postoperative pain control for patients with aortic stenosis.

A recent survey of anaesthetists in the UK showed that only 20% of respondents would insist on an echocardiogram for a hip fracture patient presenting with a previously undiagnosed heart murmur [3]. Fifty-four per cent of the anaesthetists replied that they would only request an echocardiogram if the patient had suspicious signs or symptoms. This is despite the known difficulty in

accurately diagnosing the presence or degree of aortic stenosis from clinical findings [4, 5], especially in this group of patients in whom the classical triad of syncope, angina and dyspnoea may often be absent due to immobility from other reasons.

The fracture unit in the Royal Victoria Hospital, Belfast has had full time orthogeriatric input at ward level since 1997. It was decided soon after the implementation of this service that all patients with previously undiagnosed heart murmurs would have echocardiography performed prior to anaesthesia and surgery.

The aims of this study were to observe any influence of the echocardiographic findings obtained on hip fracture patients presenting with a previously undiagnosed murmur on their subsequent anaesthetic and surgical management, and to compare their 30-day and 1-year mortality rates with the rest of the hip fracture population admitted during the study period.

Methods

The patient details, fracture type, surgical management, 30-day and 1-year mortality rates for all hip fracture patients admitted to the fracture unit at the Royal Victoria Hospital, Belfast between March 2001 and February 2005 were obtained from the Fracture Outcomes Research Database (FORD). This database has been in operation in the hospital since 1999, and records patient data, surgical management and outcome at 30 days and 1 year obtained by telephone follow up to place of residence or to general practitioner.

The patient details included age, sex, Abbreviated Mental Test Score [6] on admission, pre injury Barthel score [7] and ASA status if the patient proceeded to operative repair of their hip fracture. The Abbreviated Mental Test Score is a ten-question test of cognitive function with a score of less than six suggestive of significant cognitive impairment. The Barthel score is an assessment of the patient's activities of daily living prior to injury with a range of 0–20, a higher score indicating greater levels of independence.

In the same period, details of all echocardiograms requested by the fracture unit for patients with hip fractures were obtained from the cardiology records within the hospital. The results of these echocardiograms were stored on a database, and then analysed according to the reason for request to identify those investigations made to assess a previously undiagnosed heart murmur prior to operation. Further analysis was necessary to identify those patients in whom the echocardiogram revealed aortic stenosis. Auscultation of the precordium was usually performed by a member of the orthogeriatric team in addition to the admitting junior doctor.

The echocardiograms were all carried out at the bed side due to the difficulty of moving patients with a hip fracture to the cardiology unit. A handwritten entry in the patient notes was made by the cardiology technician performing the echocardiogram documenting the peak pressure drop across the aortic valve along with an assessment of left ventricular function. This was available immediately to assist in patient management. Aortic stenosis was defined as an abnormality of the aortic valve causing obstruction to left ventricular outflow. For analysis in this study, the aortic stenosis identified on echocardiogram was classified by a consultant cardiologist (NJ) as mild, moderate or severe according to the guidelines published by the Education Committee of the British Society of Echocardiography [8] (Table 1).

For all patients identified with aortic stenosis, the time from injury to obtaining an echocardiogram and from echocardiogram to the time of surgery was obtained from FORD.

Table 1 British Society of Echocardiography guidelines for aortic stenosis quantification.

	Normal	Mild	Moderate	Severe
Peak velocity (m.s ⁻¹)	< 1.7	1.7–2.9	3.0–4.0	> 4
Peak pressure drop (mmHg)	–	< 36	36–64	> 64
Mean pressure drop (mmHg)	–	< 25	25–40	> 40
Valve area (cm ²)	> 2.0	1.5–2.0	1.0–1.4	< 1.0

Details of the anaesthetic and surgical management of the patients in the aortic stenosis group were obtained from the Theatre Data Management System. This is a database of patient details, anaesthetic and surgical procedures undertaken, time recordings of all stages in the theatre suite, personnel involved and disposable equipment used in each procedure. All other hip fracture patients admitted to the hospital in the study period were analysed as a control group.

Statistical analysis was performed using SPSS version 15 for Windows (SPSS Inc., Chicago, IL, USA). Frequency data were analysed by chi-squared tests for trend or the equivalent exact test. Continuously distributed data were analysed either by analysis of variance with aortic stenosis severity as the grouping variable or using regression methods to test for trend. Kendall tau-B was used to analyse the association between ordinal variables. Analysis of variance or regression, where distributional assumptions within the aortic stenosis groups could not be justified, was performed using Kruskal–Wallis one way analysis of variance by ranks. A p value of < 0.05 was taken to indicate statistical significance.

Results

In the 4-year study period from March 2001 to February 2005, 3997 consecutive hip fracture patients were admitted to the hospital. Of the 1167 echocardiograms performed on hip fracture patients in the study period, 908 were requested to assess the cause of a previously undiagnosed heart murmur. Analysis of the echocardiograms by a consultant cardiologist (NJ) revealed 272 cases of previously undiagnosed aortic stenosis identified in the pre-operative period as a result of echocardiography to investigate a previously undiagnosed heart murmur in patients who proceeded to anaesthesia and surgery.

There were 27 patients identified with aortic stenosis as a result of echocardiographic examination performed for a reason other than to investigate a previously undiagnosed heart murmur. The reasons for performing their echocardiograms are shown in Table 2. Death within 30 days of injury occurred in one, one and two of these patients in the mild, moderate and severe groups respectively. All 27

Table 2 Reasons for requesting echocardiograms in the 27 patients where assessment was not triggered by a previously undiagnosed murmur. Data are expressed as number of patients.

	Mild <i>n</i> = 12	Moderate <i>n</i> = 9	Severe <i>n</i> = 6
To assess severity of known valve disease	9	4	4
To assess patient in atrial fibrillation/flutter	1	1	–
To assess left ventricular function	1	4	1
To assess ventricular function within one month of myocardial infarction	–	–	1
Reason not specified	1	–	–

patients were excluded from further analysis as the purpose of the study was to analyse the management and outcome of those patients who had a previously undiagnosed murmur revealed by auscultation. These 27 patients were also excluded from the control group, which left a total of 3698 patients in that group.

The patient details in each of the aortic stenosis groups and in the control group are shown in Table 3. The patients in each of the aortic stenosis groups were significantly older than in the control group ($p < 0.001$), but there were no significant differences between the aortic stenosis groups. An exact test for trend showed that the proportion of females:males increased significantly as the severity of the aortic stenosis increased ($p < 0.001$). The patients with aortic stenosis had significantly lower Abbreviated Mental Test Scores than the control group ($p = 0.005$), but there were no significant differences between each aortic stenosis group. There were no significant differences in the Barthel scores between the patients in the aortic stenosis and control groups.

The types of fracture and surgical procedures undertaken are shown in Table 4. There was an almost equal distribution of intracapsular and extracapsular fractures in all the groups, with no significant differences between them. There was a trend to performing proportionately fewer hemi-arthroplasty operations in the 'severe' group, but this did not reach statistical significance.

Table 4 Type of fracture and surgical procedure. Data are expressed as number of patients.

	Mild	Moderate	Severe	Control
Type of fracture				
Intracapsular	99	24	15	1818
Extracapsular	79	40	15	1877
Type of surgery				
Dynamic hip screw	87	34	20	1658
Hemi-arthroplasty	84	29	9	1597
Intramedullary nail	6	1	0	143
Total hip replacement	1	0	0	24
Cable plating	0	0	1	59
No surgery	N/A	N/A	N/A	217
Total	178	64	30	3698

There were significant differences in anaesthetic management between the three aortic stenosis groups (Table 5). It was not possible with the resources available to collate and analyse the data for anaesthetic management of the 3481 patients in the control group who underwent surgery. There was a significant trend towards general anaesthesia over spinal anaesthesia as the severity of the aortic stenosis increased ($p < 0.001$). There was also a significant trend towards the use of invasive monitoring of blood pressure with an arterial line as the severity of the aortic stenosis increased ($p < 0.001$). Nerve blocks were used as adjuncts in the majority of patients in each group whether they received general or spinal anaesthesia, and there were no differences between the groups.

The ASA classification, 30-day mortality and 1-year mortality of the patients in the aortic stenosis and control groups are shown in Tables 6 and 7. For statistical analysis, ASA 1 and 2 were grouped together, as were ASA 4 and 5 creating a three aspect ordinal variable which, when cross tabulated with the severity of aortic stenosis and subjected to the relevant test for trend, revealed a significant positive association between ASA status and severity of aortic stenosis ($p < 0.001$).

There were no statistically significant trends towards higher 30-day mortality rates ($p = 0.5$) or 1-year mortality rates ($p = 0.11$) as the severity of aortic stenosis increased. Exact tests for trend were used to analyse this data because the expected values in some of the cells were too small to use chi-squared analysis. The 30-day

Table 3 Patient details. Data are expressed as mean (SD) or number of patients.

	Mild <i>n</i> = 178	Moderate <i>n</i> = 64	Severe <i>n</i> = 30	Control <i>n</i> = 3698	<i>p</i>
Age	83.92 (7.57)	84.76 (7.39)	86.07 (9.03)	78.39 (12.02)	< 0.001
Female/Male	145/33	57/7	28/2	2764/934	< 0.001
Abbreviated mental test score	6.90 (3.93)	6.73 (4.16)	6.90 (3.53)	7.56 (3.80)	0.005
Barthel score	15.02 (4.88)	14.98 (5.41)	16.50 (4.57)	15.67 (4.87)	NS

Table 5 Anaesthetic management. Data are expressed as number of patients (%).

	Mild n = 178	Moderate n = 64	Severe n = 30	p
General anaesthesia	23 (12.9)	29 (45.3)	20 (66.7)	< 0.001
Spinal anaesthesia	154 (86.5)	34 (53.1)	8 (26.7)	
Continuous spinal anaesthesia	1 (0.5)	1 (1.6)	2 (6.7)	
Arterial line used	24 (13.5)	20 (31.3)	21 (70)	< 0.001
Nerve block				
Femoral	19	11	5	
FICB*	86	31	15	
PCB†	1	1	0	
Total	106 (59.6)	43 (67.2)	20 (66.7)	

*FICB = Fascia Iliaca compartment block.

†PCB = Psoas compartment block.

Table 6 ASA classification. Data are expressed as number of patients (%).

	Mild n = 178	Moderate n = 64	Severe n = 30	Control* n = 3481
ASA 1	1 (0.6)	1 (1.6)	0 (0)	96 (2.6)
ASA 2	29 (16.3)	5 (7.8)	3 (10)	751 (20.3)
ASA 3	118 (66.5)	39 (60.9)	10 (33.3)	2060 (55.8)
ASA 4	30 (16.9)	19 (29.7)	16 (53.3)	568 (15.4)
ASA 5	0 (0)	0 (0)	1 (3.3)	6 (0.16)

*217 non operated hip fractures excluded.

mortality rate for the total hip fracture population admitted to our hospital in the 4-year period, including those patients who were managed without surgical fixation, was 7.3%. The median times from injury to

echocardiogram, and from echocardiogram to surgery for the patients with aortic stenosis are shown in Table 8, along with the times from injury to surgery in the control group. Again there were no significant differences between the groups.

Discussion

Since their inception in 1982 the NCEPOD reports and recommendations have helped to improve and maintain standards of anaesthetic and surgical care throughout the UK. In 2001, part of the report focused on patients with aortic stenosis and their peri-operative risk which had been highlighted several years earlier in the 1994/95 report [1, 2]. The NCEPOD sample for the 2001 report included 22 patients who died within 30 days of surgery in whom aortic stenosis was present. Aortic stenosis was not diagnosed until post-mortem examination in two of these patients. The report made two recommendations in relation to patients with suspected aortic stenosis:

- 1 Whenever possible the anaesthetist of a patient with aortic stenosis should obtain a pre-operative echocardiogram of the aortic valve;
- 2 The availability of the echocardiography service for patients pre-operatively should be accorded an appropriate priority in the funding and development plans of hospitals.

This study reveals an incidence of previously undiagnosed aortic stenosis, as revealed by auscultation and confirmed by echocardiography, of 6.9% in patients with a hip fracture presenting to our hospital who undergo operative fixation of their fracture. The true incidence of aortic stenosis in our hip fracture population will be greater than this because of two limitations of our study:

Table 7 Thirty day and 1 year mortality rates. Data expressed as number of patients (%).

	Mild	Moderate	Severe	Total for mild, moderate and severe aortic stenosis	Control
Thirty-day mortality	7/178 (3.9)	4/64 (6.25)	3/30 (10.0)	14/272 (5.1)	275/3698 (7.4)
One-year mortality	45/178 (25.3)	14/64 (21.9)	11/30 (36.7)	70/272 (25.7)	820/3698 (22.2)

Table 8 Time from injury to echocardiogram and surgery. Data are expressed as median number of days (interquartile range).

	Mild n = 178	Moderate n = 64	Severe n = 30	Control n = 3481*
Injury to echocardiogram	2.0 (1.0–3.4)	2.4 (1.2–4.5)	2.4 (1.4–4.0)	N/A
Echocardiogram to surgery	3.0 (1.6–4.4)	2.7 (1.5–4.0)	3.0 (2.0–4.6)	N/A
Injury to surgery	5.1 (3.6–7.3)	5.0 (3.6–7.6)	5.5 (4.6–9.0)	5.0 (3.0–7.6)

*217 non-operated hip fractures excluded.

- 1 Patients with known aortic stenosis were not included in the analysis, nor were those who had aortic stenosis identified in an echocardiogram performed for a reason other than to investigate a previously undiagnosed murmur;
- 2 Patients with undiagnosed aortic stenosis may have remained undiagnosed due to failure to identify a murmur on auscultation.

The true incidence of aortic stenosis could only have been obtained by performing echocardiographic examination of all hip fracture patients, and this is an opportunity for a future study.

A further difficulty in diagnosing aortic stenosis in this elderly population arises because the triad of symptoms associated with the condition, namely syncope, angina and dyspnoea are often absent due to the poor mobility of the patients from other causes, or due to amnesia for syncope that has in fact taken place. The 2001 NCEPOD report includes the warning that an asymptomatic murmur in patients with aortic stenosis may still indicate significant cardiac disease [2].

Aortic stenosis was identified as an operative risk factor by Goldman in 1977 [9] but has since been removed from the Revised Cardiac Risk Index published by Lee et al. in 1999 [10], largely due to the fact that only five of the 4315 patients in their study used to develop this index had critical aortic stenosis which prevented statistical significance being attached to the outcomes measured. However, the authors highlighted the fact that this should not be taken as evidence that aortic stenosis is not a worrying prognostic indicator. In 1988 Torsher et al. [11] reported the outcome of 19 patients with known severe aortic stenosis undergoing 28 non-cardiac surgical procedures over a 5-year period. Two of the patients had complicated post operative courses and died. The authors argued that patients shown to have critical aortic stenosis were able to undergo anaesthesia and non-cardiac surgery with acceptable risk and they suggested that this was a result of more aggressive intraoperative monitoring and therapy. This is in contrast to the findings of Adunsky et al. [12] in 2008 who reported a significant increase in in-hospital mortality and major complication rates in 62 patients with aortic stenosis compared to an age and sex matched control group who were admitted with a hip fracture.

Our results show there were no significant differences in 30-day mortality rates between the aortic stenosis groups and the control group. This may have been because of alterations in anaesthetic, surgical and medical management in the peri-operative period made as a result of knowledge of the echocardiographic findings. The significantly greater age of the patients in the aortic stenosis groups compared to the control group makes this finding even more encouraging as we could have

expected greater mortality in the aortic stenosis groups as a consequence of increasing age alone. There were also no statistically significant differences between the 1 year mortality rates between the groups. A larger sample size may have revealed different findings, but we do present the complete data from a 4-year period in a hip fracture unit admitting almost 1000 hip fractures per year, so we stand by the clinical relevance of our results.

Aortic stenosis in the hip fracture population most commonly results from degenerative calcific stenosis of the valve. This is associated with many of the risk factors for coronary artery disease including hypertension, hypercholesterolaemia, smoking and diabetes. Rapid progression of mild to moderate or severe aortic stenosis may occur in a short time period [13]. Aortic stenosis in this patient population may also result from a congenital bicuspid aortic valve, or may be secondary to rheumatic heart disease but this is becoming less common in the UK. The incidence of aortic stenosis increases with age due to valve degeneration, and is more common in males than females [5]. The demographic analysis of our hip fracture population with previously undiagnosed aortic stenosis showed a significantly increased age compared to the control group. With the predominance of females over males presenting with a diagnosis of hip fracture, the proportion of males with undiagnosed aortic stenosis in our study was much less than would be expected in the population as a whole. We also found a significant trend towards an increase in the proportion of females:males with increasing severity of the aortic stenosis identified.

The finding in our study of previously undiagnosed aortic stenosis of differing severity had significant implications for the anaesthetic management of patients undergoing surgery. There were highly significant trends towards general over spinal anaesthesia, and towards the use of invasive blood pressure measurement intra-operatively, as the severity of the aortic stenosis increased. This is in marked contrast to an audit by Guryel et al. [14] published in 2004 which looked at the impact of the 2001 NCEPOD recommendations in relation to patients with aortic stenosis undergoing operative repair of their hip fracture. They reported that of the four patients undergoing echocardiography prior to surgery for repair of a hip fracture following implementation of the NCEPOD recommendations, anaesthetic management was not influenced by the result of the investigation. Likewise, the review of hip fracture patients with aortic stenosis by Adunsky et al. [12] reported no statistically significant differences between the anaesthetic management of patients with aortic stenosis compared to those who did not, or between patients with different severity of aortic stenosis.

Although spinal anaesthesia is not absolutely contraindicated for patients with aortic stenosis [15], these patients are more susceptible to the potential hazard of sudden hypotension as a result of the reduced systemic vascular resistance caused by sympathetic blockade from spinal anaesthesia precipitating a vicious circle of reduced coronary perfusion, impaired ventricular function secondary to myocardial ischaemia, and worsening hypotension that may fail to respond to vasopressor treatment if not implemented rapidly. No randomised studies have been performed to compare general vs spinal anaesthesia in patients with aortic stenosis undergoing non-cardiac surgery, and it is unlikely that one will ever be performed. In 1995 Collard et al. [16] described two case reports of hip fracture patients in whom graduated continuous spinal anaesthesia was successfully used to avoid this complication, and indeed our study revealed four cases where this technique was used for patients across the three aortic stenosis groups.

The critical issue is not whether a regional or general anaesthetic technique is used, but how the technique is administered in order to avoid precipitous falls in blood pressure. One essential element to prevent this occurrence is the use of invasive arterial monitoring in order to provide beat to beat measurement and enable rapid correction of falls in blood pressure. The more severe the aortic stenosis, the more critical it is to maintain cardiovascular stability which was reflected in the significant trend towards the use of invasive arterial pressure monitoring as the severity of the aortic stenosis increased in our study. This is in keeping with the recommendation from the 2001 NCEPOD report [2].

The 2001 NCEPOD report also recommended excellent postoperative pain control for patients with aortic stenosis [2]. We found that nerve blocks were used in the majority of patients in all three aortic stenosis groups to provide postoperative analgesia with no significant differences between them, and we believe that all hip fracture patients should now receive nerve blockade for postoperative analgesia unless otherwise contraindicated.

The echocardiographic findings in the patients with previously undiagnosed aortic stenosis may also have implications for surgical management of the hip fracture. Despite hip fractures in the aortic stenosis and control groups being evenly distributed between intracapsular and extracapsular fractures, there was a non-significant trend towards performing proportionately fewer hemi-arthroplasty operations in the 'severe' group. This may indicate that on occasions decisions were made to treat intracapsular fractures in patients with severe aortic stenosis using internal fixation as it was considered a lesser surgical insult to the patient. A recent review of the bone cement implantation syndrome suggested that uncemented

prostheses should be used in patients at high risk of developing the syndrome, including older patients with impaired cardiopulmonary function [17]. The information revealed by a pre-operative echocardiogram may help in making this decision.

With this wide range of implications for anaesthetic and surgical management of hip fracture patients identified as having aortic stenosis from echocardiograms to investigate previously undiagnosed heart murmurs, why did only 20% of anaesthetists in a recently published survey state that they would insist on an echocardiogram if such a patient was under their care [3]?

The major reason may be that there is a lack of facilities, or awareness of facilities, in hospitals in the UK to perform an echocardiogram without delaying anaesthesia and operative fixation of the fracture. If this is the case it would be disappointing since it is now seven years since the 2001 NCEPOD recommendation that this service was made available [2]. Targets for the management of hip fractures aim for repair within 48 h of admission [18, 19]. During the time period of this study our median delay from injury to surgery greatly exceeded this target, but there was no significant difference between those who had an echocardiogram performed and those who did not. However, the 30 day mortality rates for our entire hip fracture population, including those who were not operated on, of 7.3% for that time period compares favourably with the latest published figures from the Scottish Hip Fracture Audit which reported an overall 9% 30 day mortality rate for 2007 [20]. While all hip fracture patients must be treated rapidly for humanitarian reasons, we believe that delay to surgery must be viewed along with other outcome measures and not become an end in itself in hip fracture management. Since 2005 the times from admission to theatre for all fracture patients admitted to our hospital have markedly reduced, and the current target set by the Department of Health, Social Services and Public Safety in Northern Ireland is that by March 2009 95% of patients will, where clinically appropriate, wait no longer than 48 h for inpatient treatment [21]. It will be interesting to observe any impact this has on our 30 day mortality rate. An increase in this rate may support an opinion that it is better to use time pre-operatively to assess, stabilise and improve the medical condition of elderly, high risk patients rather than proceed immediately to surgery following their presentation to hospital.

The cost of performing a bedside echocardiogram is small in comparison to the total cost of care for a hip fracture patient. To deny this bedside investigation to patients because of a lack of resources is not acceptable. We believe anaesthetists do not do justice to themselves or their patients by failing to insist that this resource is

made readily available and the information obtained prior to surgery. This should not result in delay to surgery if proper resources are allocated, but it is up to anaesthetists to highlight the clinical implications of echocardiography, as demonstrated in our study, to support their demands. It has been suggested that anaesthetists could become proficient in echocardiography and thereby prevent delays due to unavailability of a technician or cardiologist to perform the investigation [3].

Anaesthetists may also be reluctant to request an echocardiogram as in their risk assessment they may believe that peri-operative complications or death will not happen to a patient with aortic stenosis under their care. The 2001 NCEPOD report estimated that there were around 220 deaths each year in the UK of patients with aortic stenosis within 30 days of undergoing non-cardiac surgery, or the equivalent of approximately one patient per treating hospital per year [2]. Therefore, an individual anaesthetist may be correct in believing that this event is unlikely to happen to a patient under their care. However, is that a satisfactory reason to deliver a substandard service to this elderly population who lack the ability to demand improvements in the care offered to them? Intense peri-operative care is warranted for hip fracture patients, as highlighted in an editorial by Sharrock [22] in 2000, and we believe that bedside echocardiography should be readily available to provide information on previously undiagnosed murmurs as part of the care package.

One of the six targets in 'The care of the patients with fragility fracture' published by the British Orthopaedic Association and the British Geriatrics Society in 2007 [19] is that all patients admitted with such a fracture undergo multidisciplinary assessment to prevent future falls. For a patient presenting with a previously undiagnosed murmur this will inevitably require an echocardiogram to be performed during their admission to meet this target. There is no rational reason for delaying this investigation until after operative repair of the fracture. If performed pre-operatively the information obtained will not only influence anaesthetic and possibly surgical management, but also assist medical management in the peri-operative phase, especially in relation to cardiovascular and fluid management.

Limitations of our study not already mentioned include its retrospective design and the limited information obtained from beside echocardiography. However, with the information we have obtained from the 272 patients identified with previously undiagnosed aortic stenosis revealed as a result of cardiac auscultation in a 4 year period from 2001–2005, we believe we have reported the largest series in the literature of those with aortic stenosis undergoing non-cardiac surgery.

The information we present supports the recommendations of the 2001 NCEPOD report in relation to patients with aortic stenosis undergoing operative repair of a hip fracture. We advocate that resources are made available to implement widespread adoption of these recommendations so that echocardiography is made available to assess patients with suspected or known aortic stenosis prior to anaesthesia for repair of their hip fracture, without causing delay to surgery.

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