Can improved quality of care explain the success of orthogeriatric units? A population-based cohort study

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Abstract

Background: admission to orthogeriatric units improves clinical outcomes for patients with hip fracture; however, little is known about the underlying mechanisms.

Objective: to compare quality of in-hospital care, 30-day mortality, time to surgery (TTS) and length of hospital stay (LOS) among patients with hip fracture admitted to orthogeriatric and ordinary orthopaedic units, respectively.

Design: population-based cohort study.

Measures: using prospectively collected data from the Danish Multidisciplinary Hip Fracture Registry, we identified 11,461 patients aged ≥65 years admitted with a hip fracture between 1 March 2010 and 30 November 2011. The patients were divided into two groups: (i) those treated at an orthogeriatric unit, where the geriatrician is an integrated part of the multidisciplinary team, and (ii) those treated at an ordinary orthopaedic unit, where geriatric or medical consultant service are available on request. Outcome measures were the quality of care as reflected by six process performance measures, 30-day mortality, the TTS and the LOS. Data were analysed using log-binomial, linear and logistic regression controlling for potential confounders.

Results: admittance to orthogeriatric units was associated with a higher chance for fulfilling five out of six process performance measures. Patients who were admitted to an orthogeriatric unit experienced a lower 30-day mortality (adjusted odds ratio (aOR) 0.69; 95% CI 0.54–0.88), whereas the LOS (adjusted relative time (aRT) of 1.18; 95% CI 0.92–1.52) and the TTS (aRT 1.06; 95% CI 0.89–1.26) were similar.

Conclusions: admittance to an orthogeriatric unit was associated with improved quality of care and lower 30-day mortality among patients with hip fracture.

Keywords: hip fracture, orthogeriatric, quality of care, 30-day mortality, length of stay, older people

Introduction

Hip fracture is a major clinical and public health problem associated with increased mortality, disability and substantial health-care costs [1, 2]. Patients with hip fractures are often frail and have multiple comorbidities [2]. To deal better with the special needs of these patients, various models for collaborative orthogeriatric care of patients with hip fracture have been developed [3–5]. Systematic reviews of clinical trials have reported that hip fracture patients, who receive multidisciplinary inpatient rehabilitation, tend to achieve better outcomes, including a statistical non-significant lower mortality [4–9]. A recent observational study from Australia found statistically significantly lower 30-day mortality rates and longer length of stay in hospitals with an orthogeriatric service [10]. Yet, the underlying mechanisms explaining the apparently better outcomes of hip fracture patients receiving orthogeriatric care remain poorly understood.

In Denmark, all hip fracture patients are reported to a nationwide hip fracture-specific clinical registry with detailed data on the quality of care, which makes it possible, for the first time, to directly compare the quality of care offered at orthopaedic units with and without collaborative orthogeriatric care.

Aims

We examined the association between unit setting and quality of care, 30-day mortality, time to surgery (TTS) and length of hospital stay (LOS).
Methods

This study draws on individual-level record linkage of data from nationwide medical registries using the unique civil registration number assigned to all citizens, which permits unambiguous record linkage between registries [11]. The healthcare system provides free access to hospital care for all residents [12]. Treatment of hip fracture in Denmark is performed at the nearest public hospital (i.e., patients are not triaged according to health status, fracture severity or other characteristics). The study was approved by the Danish Data Protection Agency (journal number 2012-41-1274).

Data sources

The primary data source was the Danish Multidisciplinary Hip Fracture Registry (DMHFR). These data were supplemented by Charlson comorbidity index (CCI) data from the Danish National Registry of Patients (DNRP) and vital status from the Danish Civil Registration System [13, 14].

The DMHFR was established in 2003 to document and improve the quality of care and the registry includes data on all patients ≥65 years admitted with a hip fracture (including medial, pertrochanteric or subtrochanteric femoral fractures). Reporting is mandatory for all hospital units treating hip fracture patients. Data on care quality using specific process performance measures and on patient characteristics are collected upon hospital admission by the care staff [14].

DNRP contains records of all patients admitted to Danish non-psychiatric hospitals since 1977, including data from all hospitalisations and diagnoses coded according to the International Classification of Diseases version 10 (ICD-10) [12]. The CCI is a well-established measure of comorbidity, which covers 19 diseases [15]. We calculated CCI by identifying the ICD-10 diagnoses for each patient during the past 10 years before admission with hip fracture [13].

The Danish Civil Registration System has maintained electronic records of changes in vital status and migration for the entire Danish population since 1968 [11].

Study population

We identified all hip fracture patients registered in the DMHFR with a discharge date between 1 March 2010 and 31 November 2011 (N = 12,516). Patients with multiple hip fractures during this study period were excluded (n = 406) along with patients whose admission date was erroneously recorded to be later than the hip fracture operation or the discharge date (n = 45). Furthermore, patients were excluded if they were transferred to a geriatric unit after 1–2 days at the orthopaedic unit following surgery (n = 604). Our study cohort therefore included 11,461 patients.

Hip fracture unit setting

In the traditional, orthopaedic care model, the orthopaedic surgeon assumes principal care responsibility, while medical queries and complications are handled by medical service on the surgeon’s demand. The orthogeriatric unit is established on a co-management basis with a geriatrician and an orthopaedic surgeon sharing responsibility and leadership from admission to discharge. The units were categorised according to a report from the Danish Geriatric Society [16].

Outcomes

Quality of care

The quality of care was assessed using six process performance measures: (i) daily systematic pain assessment using a visual analogue scale or a numeric rating scale at rest and during mobilisation [17], (ii) being mobilised within 24 h postoperatively, defined as assisting the patient from bed-rest to walking or rest in a chair, (iii) basic mobility assessment using a validated test such as Cumulated Ambulation Score, Barb et al. 20, Functional Recovery score or New Mobility score [18–20], (iv) post-discharge rehabilitation programme, including assessment of activities of daily living (ADL) with a validated test before the fracture and again before discharge, (v) initiation of treatment to prevent future fall accidents, including a fall risk assessment to account for co-existing medical conditions, medication, functional disability, symptoms from the central nervous system, musculoskeletal system and cardiopulmonary status and (vi) initiation of treatment with anti-osteoporotic medications. The patients were classified as eligible or ineligible for each individual process performance measure depending on whether the hospital staff identified contraindications (e.g., dementia that disabled the patients from reporting their level of pain during mobilisation).

30-Day mortality

Follow-up started on the day of hospital admission and ended after 30 days.

Time to surgery

The TTS was defined as the time in hours from hospital admission to operation.

Length of hospital stay

The LOS was defined as the time span from hospital admission to hospital discharge or from hip fracture occurrence if the patient was already hospitalised. The discharge date was defined as the date of discharge to home, a nursing home or death. If the patients were transferred between hospital units, the days spent in all units were included in the LOS.

Covariates

*A priori* identified potential confounders included age (65–74, 75–84, ≥85), gender, housing (own home, own home affiliated to an institution, institution, unspecified), body mass index (BMI) (≤19, 20–25, 26–30, >30 kg/m^2, unspecified), CCI
Systematic pain assessment were examined separately using binomial regression because the rare disease assumption was not fulfilled. Patient characteristics were not included as covariates in these analyses as only patients who were found eligible for the individual process performance measures were included. The association between unit setting and 30-day mortality was examined using multivariable logistic regression, adjusted for the covariates mentioned above. Furthermore, we repeated the mortality analysis with additional adjustment for process performance measures to examine whether they were intermediate between unit setting and mortality. Furthermore, we also repeated the analyses on mortality after stratifying the patients according to their predicted risk for 30-day mortality at the time of admission. The predicted mortality risk for each patient was estimated using multiple logistic regression conditional on all covariates observed at the time of admission. These analyses were done in order to explore whether the association between the type of unit and 30-day mortality differed according to the prognostic profile of the patients.

In all adjusted analyses, random effects models were used to account for potential clustering by units, because other measured and unmeasured characteristics at the healthcare provider level may be associated with orthogeriatric units. To evaluate the possible impact of missing data, the analyses were also repeated using multiple imputation, which is expected to yield unbiased and more precise estimates if data are missing at random conditional on measured variables [23]. We generated 20 complete datasets with imputed data based on measurements for age, gender, housing, BMI, CCI, type of fracture, fracture displacement, type of surgery, TTS, LOS and 30 day mortality.

We used a natural log transformation to correct for the right skewness in TTS and LOS, and the results were reported as ratios between geometric means. Estimates of associations between unit setting and TTS and LOS were analysed with linear regression with adjustment for age, gender, housing, BMI, CCI, type of fracture, fracture displacement type of surgery and patient volume. Estimates of the association between unit setting and LOS were stratified by TTS (<24 h, 24–48 h, >48 h) and only patients alive at discharged were included. Data were analysed using Stata 12.0 (StataCorp LP, College Station, TX, USA).

### Results

Patients in orthogeriatric units were often older, underweight, living at an institution and had more comorbidities compared with patients in ordinary orthopaedic units. In the ordinary orthopaedic units, however, there were more men, who are known to have an adverse risk profile at admission. (See the Supplementary data Table S1, available in Age and Ageing online, which summarises patient characteristics and missing data according to patient characteristics.)

As shown in Table 1, admission to an orthogeriatric unit was associated with a 1.13 times (95% CI 1.10–1.16) the chance of receiving systematic pain assessment and 1.04 times (95% CI 1.02–1.06) the chance of receiving basic mobility assessment, compared with ordinary orthopaedic units. Comparing orthogeriatric with ordinary orthopaedic units, the risk ratios (RR) for admission to post-discharge rehabilitation, anti-osteoporotic medication and prevention of future fall accidents were 1.07 (95% CI 1.05–1.09), 1.04 (95% CI 1.02–1.06) and 1.15 (95% CI 1.12–1.18), respectively. The chance of being mobilised before 24 h postoperatively was similar in the two unit types.

<table>
<thead>
<tr>
<th>Process of care</th>
<th>Eligible patients, n</th>
<th>Process received, %</th>
<th>Unadjusted RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systematic pain assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>7,542</td>
<td>5,529 (73.3%)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>1,416</td>
<td>1,171 (82.7%)</td>
<td>1.13 (1.10–1.16)</td>
</tr>
<tr>
<td>Mobilised &lt;24 h postoperatively</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>9,024</td>
<td>6,411 (71.0%)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>1,955</td>
<td>1,396 (71.4%)</td>
<td>1.01 (0.97–1.04)</td>
</tr>
<tr>
<td>Basic mobility assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>9,454</td>
<td>7,743 (81.9%)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>2,007</td>
<td>1,705 (85.0%)</td>
<td>1.04 (1.02–1.06)</td>
</tr>
<tr>
<td>Post discharge rehabilitation programme</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>8,828</td>
<td>7,615 (86.3%)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>1,882</td>
<td>1,738 (92.4%)</td>
<td>1.07 (1.05–1.09)</td>
</tr>
<tr>
<td>Anti-osteoporotic medication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>9,454</td>
<td>7,953 (84.1%)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>2,007</td>
<td>1,750 (87.2%)</td>
<td>1.04 (1.02–1.06)</td>
</tr>
<tr>
<td>Prevention future fall accidents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>9,454</td>
<td>6,717 (71.1%)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>2,007</td>
<td>1,635 (81.5%)</td>
<td>1.15 (1.12–1.18)</td>
</tr>
</tbody>
</table>
Improved quality of care at the orthogeriatric units

Table 2. 30-Day mortality according to unit settings

<table>
<thead>
<tr>
<th></th>
<th>Patients, n</th>
<th>Dead, n (%)</th>
<th>Unadjusted OR (95% CI)</th>
<th>Adjusted ORa (95% CI)</th>
<th>Adjusted ORb (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthopaedic units</td>
<td>9454</td>
<td>1137 (12.0)</td>
<td>1 (reference)</td>
<td>1 (reference)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric units</td>
<td>2007</td>
<td>188 (9.4)</td>
<td>0.76 (0.64–0.89)</td>
<td>0.69 (0.54–0.88)</td>
<td>0.77 (0.62–0.96)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.69c (0.57–0.84)</td>
<td>0.80 (0.64–0.99)</td>
</tr>
</tbody>
</table>

aAdjusted for age, gender, housing, BMI, Charlson Comorbidity Score, fracture displacement, type of fracture, type of surgery and surgical delay.
bAdjusted for age, gender, housing, BMI, Charlson Comorbidity Score, fracture displacement, type of fracture, type of surgery, surgical delay and process performance measures.
cBold values indicate adjusted analysis in imputed dataset.

Table 3. 30-Day mortality by risk stratification according to unit setting

<table>
<thead>
<tr>
<th>Risk of baseline outcome</th>
<th>Patients, n</th>
<th>Dead (%)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>7,971</td>
<td>694 (8.71)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>1,671</td>
<td>112 (6.70)</td>
<td>0.75 (0.61–0.93)</td>
</tr>
<tr>
<td>21–40% baseline outcome risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>1,311</td>
<td>358 (27.31)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>291</td>
<td>62 (21.31)</td>
<td>0.72 (0.53–0.98)</td>
</tr>
<tr>
<td>&gt;40% baseline outcome risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopaedic unit</td>
<td>172</td>
<td>85 (49.42)</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Orthogeriatric unit</td>
<td>45</td>
<td>14 (31.11)</td>
<td>0.46 (0.23–0.93)</td>
</tr>
</tbody>
</table>

Risk of 30-day mortality was 12.0% for patients admitted to an orthopaedic unit and 9.4% for patients admitted to an orthogeriatric unit, which corresponded to an adjusted odds ratio (OR) for 30-day mortality for patients admitted to an orthogeriatric unit of 0.69 (95% CI 0.54–0.88). After further adjusting for differences in process performance measures, the OR for 30-day mortality shifted upward to 0.77 (95% CI 0.62–0.96) (Table 2). The multivariable logistic regression analysis based on the imputed dataset provided results that were comparable with the primary analysis. When we stratified according to the patients predicted risk for 30-day mortality at the time of admission, the association between hip fracture unit setting and 30-day mortality was consistent (Table 3).

The TTS was 22.0 and 23.4 h patients admitted to orthopaedic units and orthogeriatric units, respectively. No differences were found in TTS (adjusted relative time of 1.06; 95% CI 0.89–1.26).

The LOS was 8.5 days for patients admitted to orthopaedic units, and 10.5 days for patients admitted to orthogeriatric units. However, the difference did not reach statistical significance in the adjusted analysis (adjusted relative LOS of 1.18; 95% CI 0.92–1.52). When restricted to patients with a TTS longer than 48 h, the results were similar. (See Supplementary data S2, available in Age and Aging online, which shows the association between unit setting and LOS stratified by TTS.)

Discussion

In this nationwide study of hip fracture patients, we found that patients admitted to orthogeriatric units received a higher quality of care and had lower mortality rates. The quality of care was demonstrated to be a likely mediator of the lower 30-day mortality in patients admitted to orthogeriatric units. No differences in TTS were observed; however, a non-significantly longer LOS was observed among patients from orthogeriatric units.

Our study’s strengths include the population-based design with prospective data collection and complete follow-up, which minimised the risk of selection and information bias. Furthermore, we aimed to minimise the risk of confounding by adjusting for a range of well-established prognostic factors. However, we cannot exclude the possibility that our findings remain influenced by unmeasured and residual confounding (e.g., lack of information on preoperative functional level, preexisting dementia or socioeconomic factors) [21, 22]. There appear to be differences in the distribution of patient characteristics according to the categorisation of the units. However, those differences were in general in favour of the orthopaedic unit, indicating that the favourable results observed among patients admitted to orthogeriatric units would likely not be explained by unmeasured confounding.

A limitation of this study is the reliability of the data, as it was collected by a large number of clinicians during routine clinical work. Major efforts including dissemination of detailed written instructions for reporting of data to the DMHFR and regular clinical audits have been carried out to ensure validity of the data. Regardless, misclassification would most likely be unrelated to categorisation of units because registration is mandatory, updated on a daily basis, and all units have substantial experience with data collection.

Process performance measures reported to the DMHFR are proxy measures for processes believed to influence the prognosis and mortality among patients with hip fracture. Process performance measures can only describe whether the patient has been assessed but does not provide information concerning whether patients actually were treated appropriately according to results of the assessments [14]. This is consistent with a previous Danish study which showed an inverse dose–response between five process performance measures: systematic pain scoring, nutritional screening, assessment of Activities of Daily Living before hip fracture and again before discharge, anti-osteoporotic medications and 30-day mortality [24].

A meta-analysis showed an OR for in-hospital mortality for patients admitted to orthogeriatric units of 0.66 (95% CI 0.42–1.04), which is comparable with our OR of 0.69 (95% CI 0.54–0.88) [6]. The non-significant result in the meta-analysis
may be due to the inclusion of randomised controlled trials that included patients with low mortality risk. In-hospital mortality in one randomised controlled trial was 1.4 versus 0% compared with our study which have a 30-day mortality of 12 versus 9.7% [25]. The lower mortality in the trial may be due to exclusion of nursing home residents, patients with dementia and patients with specific other comorbidities, which are associated with higher mortality. Our results are in accordance with a recent observational study from Australia including 9,601 patients, which showed an adjusted 30-day mortality of 8.4 and 6.2% for hospitals without and with orthogeriatric service. The higher 30-day mortality rate in our study may partly be explained by a higher incidence of comorbidities in our population.

Orthogeriatric intervention is often reported to reduce waiting time for surgery and LOS [26–28]. In our study, however, TTS was similar across unit settings and there was a statistical non-significant longer LOS at orthogeriatric units. A likely explanation is that the geriatrician assessed all relevant disorders and disabilities and not only those precipitating the hospital admission which probably is more time-consuming. This is supported by Zeltzer et al., which median LOS was longer at hospitals with orthogeriatric service compared with hospitals that did not have an orthogeriatric service [10].

In conclusion, patients admitted to an orthogeriatric unit had lower mortality rates and received higher quality of care, as reflected by the process performance measures. Lower mortality rates among patients in orthogeriatric units were consistent in all subgroups independent of patient risk profiles. Waiting time for surgery and LOS were similar by unit type. Differences in assessed process performance measures appeared to explain, in part, the lower 30-day mortality in orthogeriatric units. Continued efforts are warranted to clarify the mechanisms leading to better outcomes for hip fracture patients treated in orthogeriatric setting.

**Key points**

- Admission to an orthogeriatric unit was associated with lower 30-day mortality.
- Admittance to orthogeriatric units was associated with a higher quality of care.
- TTS was similar by unit type.
- Lower mortality rates among patients in orthogeriatric units were consistent in all subgroups independent of patient risk profile.
- Differences in assessed quality of care appeared to explain, in part, the lower 30-day mortality in orthogeriatric units.

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**Conflicts of interest**

None declared.

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**References**

Continuous monitoring of emergency admissions of older care home residents to hospital

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Abstract

Background: evidence from inspection programmes suggest that the quality of care provided by individual care homes for older people is very variable. Aside from periodic inspection, there is limited information that is routinely collected and can be used to monitor quality.

Objectives: to describe a method for using routine hospital data on admissions of older people as means for monitoring quality of care within a care home. To explore how this might be applied and used.

Methods: we linked hospital admissions to care homes using postcode matching and analysed hospital admission data as a time series, using the Cumulative Sum (CUSUM) technique to detect unusually high rates of admission.

Results: if we develop the CUSUM so that the number of times it falsely signals a high rate of admissions is limited to a rate of 0.1% per year, the chances of successfully detecting a doubling of the admission rate within 2 years will range from 48% for the smaller homes to 96% for the larger homes.

Conclusion: monitoring tools using data on admissions to hospital are both possible and feasible, particularly for the larger homes. However, due to data limitations, users need to be careful about how they interpret triggers and thus ensure follow-up...