

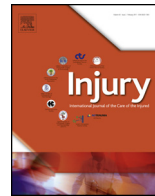


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Prediction of early mortality following hip fracture surgery in frail elderly: The Almelo Hip Fracture Score (AHFS)

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ABSTRACT

Background: Hip fractures are common in the elderly and have a high risk of early mortality. Identification of patients at high risk of early mortality could contribute to enhanced quality of care. A simple scoring system is essential for preoperative identification of patients at high risk of early mortality in clinical practice. Of risk models published, The Nottingham Hip Fracture Score (NHFS) shows the most promising results so far. However, there is still room for improvement.

Methods: A cohort study including 850 patients was conducted over a period of 5,5 yr. The NHFS was adjusted for cognitive impairment (NHFS-a) and tested. Patients who died within 30 days following hip fracture surgery (early mortality group) were compared to survivors. Independent risk factors for early mortality were assessed. A new hip fracture score for frail elderly was developed: the Almelo Hip Fracture Score (AHFS). The NHFS-a and the AHFS were compared for accuracy and predictive validity.

Results: Sixty-four (7.5%) patients died within 30 days following hip fracture surgery. The AHFS predicts the risk of early mortality better than the NHFS-a ($p < 0.05$). Using cut-off points of $AHFS \leq 9$ and $AHFS \geq 13$, patients could be divided into a low, medium or high risk group. The area under the curve improved with the AHFS compared to the NHFS-a (0.82 versus 0.72). The likelihood ratio test reveals a significantly better fit of the AHFS in comparison with the NHFS-a ($p < 0.001$).

Conclusions: The AHFS can identify frail elderly at high risk of early mortality following hip fracture surgery accurately. With the AHFS, the patient can be classified into the low, medium or high risk group, which contributes to enhanced quality of care in clinical practice.

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Introduction

Hip fractures are a significant health care problem in the elderly, affecting 1.5 million people per year worldwide. This number is expected to increase to 2.6 million by 2025 and 4.5 million by 2050 due to the aging population [1–3]. The consequences of a hip fracture can be serious; one-third of the patients die within the first year postoperative [3]. The mortality rate is highest in the early postoperative period, reaching up to 13.3% within the first 30 days after surgery [4].

Numerous risk factors for early mortality following hip fracture surgery have been reported, however study designs are inconsistent and the selection and definition of variables vary [3–8]. Given how common hip fractures are, it is important to obtain knowledge

about these risk factors in order to optimise quality of care. Identification of patients at high risk for early mortality is beneficial, to inform the patient about the prognosis of hip fracture surgery and to customize care. A simple scoring system is essential for such a preoperative identification in daily clinical practice [9].

Various risk models for early mortality following hip fracture surgery have been published [10,11]. The Nottingham Hip Fracture Score (NHFS) shows the most promising results so far. However, there is still room for improvement [10–12]. With the NHFS, more than 87% of the patients score a risk of 30-day mortality of 11.8% or lower [13]. These poor differentiating percentages are insufficient for clinical decision-making. An appropriate cutoff point defining a high risk group is useful, but has never been validated [14]. Besides that, external validation of the risk model outside the United Kingdom is limited [13,14].

The primary aim of this study was to determine risk factors for early mortality in order to improve identification of patients at

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high risk of early mortality following hip fracture surgery. Secondary aims were to assess the value of the NHFS in a cohort of frail elderly and to modify the risk model in order to enhance its performance in terms of predicting early mortality following hip fracture surgery.

Methods

Study population and setting

Patients aged ≥ 70 years with a hip fracture surgically treated by the Department of Trauma Surgery at Hospital Group Twente (ZGT) between April 1, 2008, and October 23, 2013, have been included. Patients with an indication for total hip replacement who were referred to the orthopedic service and those with pathological or periprosthetic fractures were excluded, as well as patients who died preoperatively. At ZGT, patients are admitted to the Centre for Geriatric Traumatology which uses an integrated orthogeriatric treatment model with a multidisciplinary approach and clinical care pathways [15].

Data collection

The following patient characteristics have been registered prospectively at baseline: age, gender, dementia (diagnosed by geriatrician/neurologist), cognitive frailty, history of malignancy, pre-fracture institutionalizing, number of comorbidities (Appendix A), American Society of Anesthesiologist (ASA) score, Barthel Index [16], Parker Mobility Score (PMS) [17], Charlson Comorbidity Index (CCI) [18], the Dutch Hospital Safety Management (VMS) Frailty score [19], fracture type and serum hemoglobin.

Patients score positive on cognitive frailty if they are diagnosed with dementia or if they experienced memory problems or an episode of confusion during illness (delirium). The Barthel Index [16] measures independence in activities of daily living (ADL), with a total score ranging from 0 (fully dependent in ADL) to 20 (fully independent in ADL). The PMS measures the mobility level before fracture, with a total score ranging from 0 (no walking ability) to 9 (fully independent walking ability) [20,21]. The VMS Frailty score, which is part of a nationwide screening program, measures frailty within hospitalized elderly [19]. At admission, patients aged ≥ 70 years are screened on the domains of physical limitations in ADL, previous falls, delirium and malnutrition. If patients score positive on a domain, specific interventions are started during hospitalisation.

Mortality data have been obtained from the municipal death registry. Early mortality is defined as mortality within 30 days following hip fracture surgery. Survival is defined as survival after 30 days following hip fracture surgery. The follow-up period of the patients in the survival group is one year.

The Nottingham Hip Fracture Score (NHFS)

The NHFS assesses the risk of 30-day mortality following hip fracture surgery in patients aged ≥ 65 years [12]. The risk model is based on seven variables: age, gender, serum hemoglobin, Abbreviated Mental Test Score (AMTS), number of comorbidities, pre-fracture institutionalisation and malignancy (see for definitions Appendix A). Between 0 and 4 points is scored for each variable, resulting in a sum score of the NHFS ranging from 0 to 10 points [12].

The NHFS was calculated in our cohort and the results were compared with the observed mortality. The AMTS has not been registered in our study. As it is impossible to calculate the AMTS retrospectively, we have used cognitive frailty to score cognitive

impairment. This resulted in an adjusted NHFS (NHFS-a). Two NHFS formulas were used to calculate the risk of early mortality (%): the formula of Moppett et al. (2012) and the formula of Marufu et al. (2016), labeled as NHFS-a(2012) and NHFS-a(2016) respectively [13,22].

Statistical analysis

Categorical variables are described as number with corresponding percentages. Continuous variables are described as mean with standard deviation, or in case of non-parametric data as median with interquartile range (IQR). In order to identify a subset of independent variables that are associated with early mortality following hip fracture surgery, differences in baseline characteristics between the early mortality group and the survival group were tested. Groups were compared using the Chi-square test (Fisher's exact tests if appropriate) for categorical data and Student's *t*-test or Mann-Whitney *U* test for continuous data. Variables associated with mortality ($p < 0.10$) were entered in a multivariate logistic regression model together with the total NHFS-a. Only variables without overlap with components of the NHFS-a were selected. Subsequently, variables with the highest *p*-value were removed step-by-step until the fit of the model decreased significantly (based on the likelihood ratio test).

Independent risk factors identified by multivariate logistic regression analysis were used as scoring items in the new risk model named the Almelo Hip Fracture Score (AHFS). The beta-coefficients (β) of all variables were divided by the value of the β of the NHFS-a, in order to set the value of the NHFS-a on its original NHFS value. Each item was assigned a weighed factor based on its β .

Summing the weighted factors of the items results in the total number of AHFS points, which should be entered into the AHFS formula to calculate the risk of early mortality (%).

The performance of the AHFS and NHFS-a was assessed using the area under the receiver operating characteristic (ROC) curve for discrimination and the Hosmer-Lemeshow test for calibration. The likelihood ratio test was performed to compare the performance of the two risk models.

A $p < 0.05$ was regarded as being statistically significant. All statistical analyses were carried out using the Statistical Package for the Social Sciences version 23 (SPSS Inc., Chicago, VS).

Results

Patient characteristics

The study population consists of 850 patients. Baseline characteristics are presented in Table 1.

The median (IQR) age is 83.0 (78.0–87.0) years and 26.4% ($n = 224$) of the patients are male. Severe comorbidity ($ASA \geq 3$) is seen in 78.4% ($n = 666$) of the patients. Cognitive frailty is seen in 34.5% ($n = 293$) of the patients. Of the patients, 7.5% ($n = 64$) died within 30 days following hip fracture surgery.

In the total study population, the median (IQR) risk of early mortality is 6.9% (4.4–11.0%) and 4.6% (2.8–7.4%), calculated with the NHFS-a(2012) and the NHFS-a(2016) respectively.

The NHFS-a(2012) predicts a median (IQR) risk of early mortality of 11.0% (6.9–16.0%) in the early mortality group and a median (IQR) risk of early mortality of 6.9% (4.4–11.0%) in the survival group ($p < 0.001$). With the NHFS-a(2016) a median (IQR) risk of early mortality of 7.4% (4.6–11.8%) in the early mortality group and a median (IQR) risk of early mortality of 4.6% (2.8–7.4%) in the survival group ($p < 0.001$) is predicted (Table 1).

Patients in the early mortality group are significantly older, more frequently institutionalised and score more often positive on

Table 1
Baseline characteristics.

	Total (n = 850)	Early mortality group (n = 64)	Survival group (n = 786)	P-value
Age in years; median (IQR)	83.0 (78.0–87.0)	86.0 (82.0–89.0)	83.0 (78.0–87.0)	0.002
Dementia; n (%)	177 (20.8)	16 (25.0)	161 (20.5)	0.392
ASA classification; n (%)				<0.001 ^a
1–2	184 (21.7)	2 (3.1)	182 (23.2)	
3	553 (65.1)	30 (46.9)	523 (66.5)	
4–5	113 (13.3)	32 (50.0)	81 (10.3)	
PMS ≤ 5; n (%)	376 (44.2)	49 (76.6)	327 (41.6)	<0.001 ^a
Barthel Index ≤ 9; n (%)	117 (13.8)	15 (23.8)	102 (13.0)	0.018
CCI; n (%)				<0.001
0–1	406 (47.8)	16 (25.0)	390 (49.6)	
2–3	304 (35.8)	13 (35.9)	281 (35.8)	
≥ 4	140 (16.5)	25 (39.1)	115 (14.6)	
VMS Delirium; n (%)	247 (29.1)	25 (39.1)	222 (28.2)	0.069
VMS Prior fall; n (%)	840 (98.8)	63 (98.4)	777 (98.9)	0.508
VMS Malnutrition; n (%)	162 (19.1)	19 (29.7)	143 (18.2)	0.022 ^a
VMS Physical limitations; n (%)	605 (71.2)	56 (87.5)	549 (69.9)	0.003 ^a
Fracture type; n (%)				0.828
Femoral neck	443 (52.1)	31 (48.4)	412 (52.4)	
Pertrochanteric	369 (43.4)	30 (46.9)	339 (43.1)	
Subtrochanteric	38 (4.5)	3 (7.5)	35 (4.5)	
Variables NHFS-a				
Age ≥ 86 years; n (%)	323 (38.0)	36 (56.3)	287 (36.5)	0.002
Male gender; n (%)	224 (26.4)	23 (35.9)	201 (25.6)	0.070
Serum hemoglobin ≤ 10 g/dl; n (%)	52 (6.1)	11.0 (17.2)	41 (5.2)	<0.001
Cognitive frailty; n (%)	293 (34.5)	30 (46.9)	263 (33.5)	0.030
Number of comorbidities ≥ 2; n (%)	450 (52.9)	46 (71.9)	404 (51.4)	0.002
Pre-fracture institutionalising; n (%)	249 (29.3)	32 (50.0)	217 (27.6)	<0.001
History of malignancy; n (%)	207 (24.4)	23 (35.9)	184 (23.4)	0.025
Total NHFS-a points; median (IQR)	5 (4–6)	6 (5–7)	5 (4–6)	<0.001 ^a
NHFS-a(2012) ^b (%); median (IQR)	6.9 (4.4–11.0)	11.0 (6.9–16.0)	6.9 (4.4–11.0)	<0.001
NHFS-a(2016) ^c (%); median (IQR)	4.6 (2.8–7.4)	7.4 (4.6–11.8)	4.6 (2.8–7.4)	<0.001

ASA, American Society of Anesthesiologists physical status classification; PMS, Parker Mobility Score; CCI, Charlson Comorbidity Index; VMS, the Dutch Hospital Safety Management Frailty score; NHFS-a, adjusted Nottingham Hip Fracture Score; IQR, interquartile range; n, number of patients.

Differences in baseline characteristics between the early mortality group and survival group were tested.

^a Variables entered into the multivariate logistic regression model.

^b Risk of early mortality calculated by the NHFS-a(2012) [22].

^c Risk of early mortality calculated by the NHFS-a(2016) [13].

cognitive frailty. They are also physically frailer; they have more and severe comorbidities, lower functional scores and are more frequently undernourished.

Development of the Almelo Hip Fracture Score (AHFS)

The following variables have been selected for multivariate logistic regression analysis: NHFS-a, ASA score, PMS, VMS Physical limitations and VMS Malnutrition. For measuring independence in ADL, VMS Physical limitations was selected instead of the Barthel Index, based on clinical utility. The variables age in years, serum hemoglobin in g/dl, Charlson Comorbidity Index and VMS Delirium have been excluded as a consequence of similar variables that are already included in the NHFS-a (i.e. age ≥ 86 years, serum hemoglobin ≤ 10 g/dl, number of comorbidities ≥ 2 and cognitive frailty).

Multivariate logistic regression analysis identifies high NHFS-a (β 0.38, OR 1.47, 95% CI 1.16–1.86, p = 0.001), ASA > 2 (ASA 3: β 1.07, OR 2.92, 95% CI 0.67–12.69, p = 0.152; ASA 4–5: β 2.69, OR 14.70, 95% CI 3.30–65.62, p < 0.001) and PMS ≤ 5 (β 0.74, OR 2.10, 95% CI 1.09–4.05, p = 0.030) as independent risk factors for early mortality.

Beta-coefficients were divided by 0.38 in order to set the NHFS-a on its original value. Based on the outcome, a weighted score was assigned per independent risk factor. The AHFS formula was built with the weighted scores and the constant factor, which was also identified by multivariate logistic regression analysis.

The AHFS is presented in Fig. 1. Appendix A shows the definitions of the variables. To predict the risk of early mortality, the AHFS formula requires the total number of AHFS points to be entered:

$$\text{Risk of early mortality}(\%) = \frac{100}{1 + e^{(6.503 - (\text{AHFS} \times 0.383))}}$$

The AHFS ranges from 3 to 19 points, predicting a risk of early mortality ranging from 0.0 to 68.4% (Table 2). The median (IQR) risk of early mortality predicted by the AHFS is 4.5% (2.1–9.2%) in our total study population. The AHFS predicts a median (IQR) risk of early mortality of 17.9% (9.2–31.9%) in the early mortality group and a median (IQR) risk of early mortality of 3.1% (2.1–9.2%) in the survival group (p < 0.001).

Risk groups

The distribution of AHFS in the early mortality group and the survival group was assessed in order to set two cutoff points for defining low, medium and high risk groups (Fig. 2). The rate of patients in the survival group strongly decreased at an AHFS ≥ 13. Based on this, a cutoff point of AHFS ≥ 13 was set to identify the high risk group (Fig. 1). This cutoff point represents a sensitivity of 42.2%, a specificity of 92.5%, a positive predictive value (PPV) of 31.4% and a negative predictive value (NPV) of 95.2%, in comparison with the low and medium risk groups (Table 3).

THE ALMELO HIP FRACTURE SCORE (AHFS)
 Risk Score Form

Age	
<input type="checkbox"/> ≥ 86 years	4 points
<input type="checkbox"/> 70 – 85 years	3 points
Gender	
<input type="checkbox"/> Male	1 point
<input type="checkbox"/> Female	0 points
Admission serum hemoglobin	
<input type="checkbox"/> ≤ 10 g/dl	1 point
<input type="checkbox"/> > 10 g/dl	0 points
Cognitive frailty*	
<input type="checkbox"/> Yes	1 point
<input type="checkbox"/> No	0 points
Living in an institution	
<input type="checkbox"/> Yes	1 point
<input type="checkbox"/> No	0 points
Numbers of comorbidities	
<input type="checkbox"/> ≥ 2	1 point
<input type="checkbox"/> < 2	0 points
Malignancy	
<input type="checkbox"/> Yes	1 point
<input type="checkbox"/> No	0 points
Parker Mobility Score	
<input type="checkbox"/> ≤ 5	2 points
<input type="checkbox"/> > 5	0 points
ASA Score	
<input type="checkbox"/> 1 - 2	0 points
<input type="checkbox"/> 3	3 points
<input type="checkbox"/> 4	7 points
Sum of points (AHFS): ____ points	

RISK OF EARLY MORTALITY
 AHFS ≤ 9: Low risk
 AHFS 10 – 12: Medium risk
 AHFS ≥ 13: High risk

* Dementia, memory problems or delirium in the admission history.

Fig. 1. Risk score form for the Almelo Hip Fracture Score.

The rate of patients in the early mortality group strongly decreases at an AHFS ≤ 9. A cutoff point of AHFS ≤ 9 was therefore set to identify the low risk group (Fig. 1). This cutoff point represents a sensitivity of 78.1%, a specificity of 72.5%, a PPV of 18.8% and a NPV of 97.6%, in comparison with the medium and high risk groups.

Table 2
Final model produced by multivariate logistic regression analysis.

	β	OR	95% CI	P-value
NHFS-a	0.383	1.47	1.16–1.86	0.001
ASA 3 ^a	1.072	2.92	0.67–12.69	0.152
ASA 4–5 ^a	2.688	14.70	3.30–65.62	<0.001
PMS ≤ 5 ^b	0.741	2.10	1.09–4.05	0.030
Constant	–6.503			

ASA, American Society of Anesthesiologists physical status classification; PMS, Parker Mobility Score; VMS, the Dutch Hospital Safety Management Frailty score; NHFS-a, adjusted Nottingham Hip Fracture Score; β, beta-coefficient; OR, odds ratio; CI, confidence interval. Reference categories: ^aASA 1–2, ^bPMS > 5.

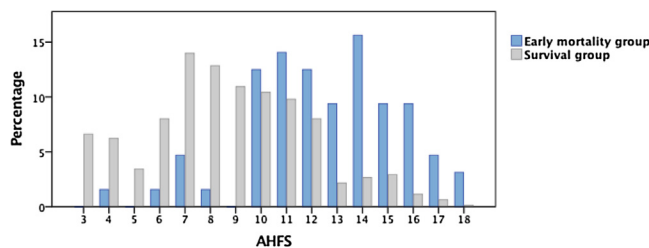


Fig. 2. Distribution of patients on the AHFS scale in the early mortality group versus the survival group.

Table 3
Risk of early mortality calculated with the Almelo Hip Fracture Score.

AHFS	Risk of early mortality (%)
3	0.0
4	0.0
5	1.0
6	1.5
7	2.1
8	3.1
9	4.5
10	6.5
11	9.2
12	12.9
13	17.9
14	24.2
15	31.9
16	40.7
17	50.2
18	59.7
19	68.4

Performance of the two models

The area under the ROC curves (SD) of the NHFS-a and the AHFS are respectively 0.72 (0.03) and 0.82 (0.02) (Fig. 3). Both score models reveal a good fit between observed and predicted values (p > 0.05, Hosmer-Lemeshow test). The likelihood ratio test reveals a significantly better fit of the AHFS in comparison to the NHFS-a (p < 0.001).

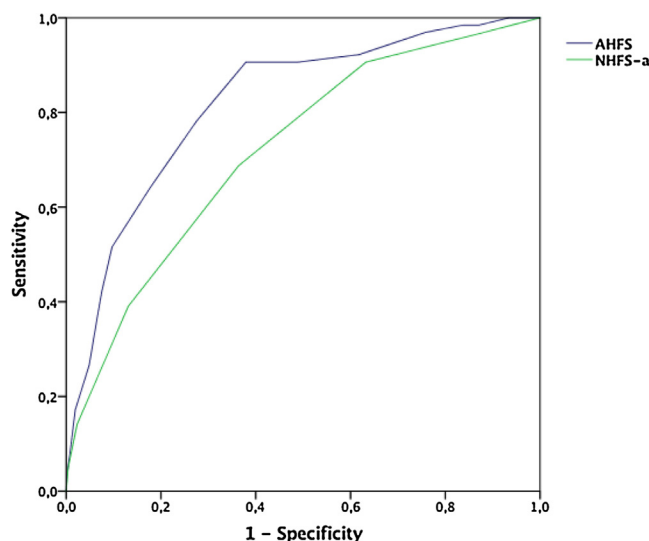


Fig. 3. The ROC curve of the NHFS-a and the AHFS.

Discussion

This prospective study demonstrates that increasing NHFS-a, a lower level of mobility (PMS) and a worse preoperative health status (ASA score) are independent risk factors for early mortality following hip fracture surgery in elderly. We developed the AHFS to identify frail elderly at high risk of early mortality following hip fracture surgery. Based on the area under the receiver-operating curve, the risk model has an excellent discriminative value. Overall the AHFS has an adequate predictive value, is useful in daily clinical practice and could also serve as case-mix adjustment after further validation.

In earlier studies of Marufu et al. (2015) and Karres et al. (2014) the NHFS has shown the best results in terms of predicting early mortality following hip fracture surgery so far [10,11]. However, the NHFS has limited discriminative power and inconsistent results of calibration [10–13,22]. Furthermore, in a recent study of Marufu et al. (2016) the NHFS predicts in more than 87% of the patients a risk of early mortality following hip fracture surgery of 12% or less and in our study the NHFS-a scores a low risk of early mortality of 11.0% and 7.4% in the high risk group (i.e. early mortality group). These poor differentiating percentages are insufficient for identifying the patients at high risk for early mortality [13].

A risk model has a better ability to predict on group level than on individual level. Therefore classifying patients in low, medium and high risk groups is preferred. We set $AHFS \leq 9$ and $AHFS \geq 13$ as cutoff points for defining the low, medium and high risk group. Based on the risk group, the patient can be informed correctly about the prognosis and the appropriate clinical pathway, in which for instance a higher level of care and discussing end-of-life care could be implemented.

The Almelo Hip Fracture Score (AHFS) identifies frail elderly at high risk of early mortality following hip fracture surgery more accurately than the NHFS-a. The AHFS has a better ability to discriminate and the risk model has a better fit than the NHFS-a.

Despite similar variables used, the AHFS differs in a number of ways from the NHFS. The NHFS has been developed in a cohort including patients aged ≥ 65 years, patients with an indication for total hip replacement and patients who are given usual treatment [12,22]. Opposed to that, our study population included patients ≥ 70 years who have been treated according to the CvGT treatment model [15]. Hip fracture patients with an indication for total hip replacement were excluded. As a result, the AHFS embraces an older and frailer population.

Besides that, the AHFS includes the PMS and the ASA score. Numerous previous studies already identified the PMS and the ASA score as independent predictors of mortality, which underlines the importance of these risk factors [4–7,17,20,21,23]. Clinical audits in the United Kingdom are already performing case-mix adjustment for the ASA score, which emphasizes the value of the score in hip fracture patients [24].

Finally, the AHFS uses cognitive frailty to score cognitive impairment instead of the AMTS as suggested by the NHFS [25]. Patients score positive on cognitive frailty if diagnosed with dementia or if patients experienced memory problems or an episode of confusion during illness (delirium). The AMTS it is not widely used in countries outside the United Kingdom, for example in the Netherlands. In daily clinical practice, cognitive frailty is therefore a more practical score to assess cognitive impairment; it uses readily available and verifiable clinical information.

A limitation of this study is that we were not able to calculate the original NHFS in our population; instead we calculated a modified version of the NHFS in which cognitive frailty replaces the AMTS to score cognitive impairment. However, the frequency of patients scoring positive on the cognitive impairment with the

AMTS in earlier studies (34.2–40.0%) is comparable to the frequency of patients scoring positive on the cognitive impairment with cognitive frailty in our population (34.5%) [12,22]. Therefore, it is likely that the different way of scoring cognitive impairment has not seriously influenced the assessment of the value of the NHFS in our population.

In conclusion, the AHFS can identify frail elderly at high risk of early mortality following hip fracture surgery more accurately than the NHFS-a. Classifying patients in the low, medium or high risk group contributes to enhanced quality of care. The AHFS can therefore serve as a good clinical risk model (Fig. 1). Besides that, after further validation, it may also represent a viable method for case-mix adjustment in clinical audits in the Netherlands.

Conflict of interest statement

All authors disclose any financial and personal relationships with other people, or organisations, that inappropriately influenced (bias) their work, all within 3 years of the beginning the work submitted.

Acknowledgements

None.

Appendix A.

Definitions of variables used in the NHFS and AHFS

Variables defined by the NHFS [12]:

1. Age: patients aged 70–85 years score three points, patients aged 86 years or older score four points.
2. Gender: male patients score one point; female patients do not score a point on the item gender
3. Admission serum hemoglobin: the patient scores one point if its admission serum hemoglobin is 10 g/dl or less. Patients with a serum hemoglobin above 10 g/dl do not score a point on this item.
4. Comorbidities: the patient scores one point on this item if he/she has two or more of the following comorbidities, presented per tract: cardiovascular diseases (such as angina, atrial fibrillation, valvular heart disease, myocardial infarction or hypertension), cerebrovascular diseases (any cerebrovascular event or transient ischemic attack), respiratory diseases (such as chronic obstructive pulmonary disease or asthma, but not acute infections), renal disease (pre-existing, not acute renal impairment), diabetes.
5. Living in an institution: the patient scores one point if he/she lives in a care home or skilled nursing home. Patients living with relatives/careers or in warded aided housing do not score a point on this item.
6. Malignancy: if the patient has any malignancy (other than non-invasive skin cancer) within the last 20 years, he/she score one point for malignancy. Cancers that were treated curatively over 20 years ago and have not shown any sign of recurrence do not score a point on the item malignancy.

Variables added to the Almelo Hip Fracture Score (AHFS):

1. Cognitive frailty: the patient scores one point on cognitive frailty if he/she was previously diagnosed with dementia (diagnosed by specialist), experienced memory problems or has delirium in the history.
2. Parker Mobility Score (PMS) [20]: the patients is asked how to perform indoor walking, outdoor walking, and shopping before the hip fracture, providing a score between 0 and 3 (0 = not at all, 1 = with help from another person, 2 = with an aid, and 3 = no difficulty and no aid) for each function. Patients score two points if

the sum of the score is 5 or less; patients with a PMS of 6 or higher do not score a point.

3. American Society of Anesthesiologists (ASA) Physical Status Classification (ASA score): patients with an ASA score of 1 or 2 score no points, patients with an ASA score of 3 score three points and patients with an ASA score 4 or 5 score seven points.

Appendix B.

Glossary of abbreviations and acronyms

ADL Activities of daily living
AHFS Almelo Hip Fracture Score
AMTS Abbreviated Mental Test Score
ASA American Society of Anesthesiologist
CCI Charlson Comorbidity Index
CvGT Centre for Geriatric Traumatology
NHFS Nottingham Hip Fracture Score
NHFS-a Adjusted Nottingham Hip Fracture Score
PMS Parker Mobility Score
VMS Dutch Hospital Safety Management

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