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Do clinical characteristics and outcome in nonagenarians with a hip fracture differ from younger patients?

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Aim: To compare clinical characteristics and outcome of nonagenarian hip fracture patients with younger patients aged 65–89 years.

Methods: This was a cohort follow-up study of admissions for a hip fracture between 2005–2010 (mean follow up of 3.5 years) in two teaching hospitals in the Netherlands; 230 nonagenarians and 1014 patients aged 65–89 years were included. Clinical characteristics, adverse events, mobility and mortality were compared.

Results: Nonagenarians were more likely to be female and anemic (both $P < 0.001$), and had more trochanteric fractures ($P = 0.005$). The number of American Society of Anesthesiologists III/VI classified patients did not differ between the two groups. During the hospital stay, adverse events were more frequently observed in nonagenarians compared with younger patients ($P < 0.001$). The length of stay was significantly longer in nonagenarians ($P < 0.001$), and the 90-day readmission rate was similar. Absolute mortality was higher in nonagenarians ($P < 0.001$), excess mortality, however, was comparable. Before admission, 40.0% of the nonagenarians lived in their own home, and 40.9% had returned 3 months postfracture. The rate of returning to their own home was lower compared with younger patients ($P < 0.001$). Prefracture mobility was worse in nonagenarians compared with the younger group, but 3 months after discharge, the number of patients that regained prefracture mobility was comparable in both age groups.

Conclusions: Nonagenarian hip fracture patients differ significantly from younger patients aged 65–89 years with respect to clinical characteristics and long-term outcome. However, almost half of the nonagenarians returned to their own home and more than half regained their prefracture level of mobility. Given these findings, prevention strategies for hip fracture and adverse events during hospital stay that focus particularly on frail nonagenarians are highly recommended. **Geriatr Gerontol Int 2013; 13: 190–197.**

Keywords: hip fracture, morbidity, mortality, nonagenarians.

Introduction

The number of nonagenarians is rapidly increasing and therewith the number of hip fracture patients aged 90 years and older.[1,2] Nonagenarian patients frequently suffer from comorbidities and functional impairment,[3–5] which have a huge impact on outcome after hip fracture treatment. Previous studies have shown that advanced age is associated with increased mortality rates and worse functional recovery after a hip fracture.[6–12]

Just two previous reports have compared clinical characteristics of nonagenarians with younger hip fracture patients;[13,14] other reports are based on case series of nonagenarians or include relatively small numbers of patients.[15–23] These studies show differences in clinical characteristics, number of adverse events, functional outcome and mortality rates.[13–23] The differences in outcome might be as a result of a large variation in cohort characteristics and incomparability of the outcome variables.

Detailed clinical characteristics of nonagenarian hip fracture patients and their outcome after fracture treatment become increasingly important as life expectancy

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has been growing extensively over the last decades.[24] The aim of the present study was to assess clinical characteristics and outcome in a large Dutch cohort of 230 nonagenarian patients with a hip fracture compared with a younger cohort of hip fracture patients aged 65–89 years.

Patients and methods

Patients

This was an observational cohort study including all consecutive patients with a hip fracture admitted to two middle-sized teaching hospitals in Delft (Reinier de Graaf Hospital) and The Hague (Bronovo Hospital), in the Netherlands from January 2005 to January 2010. In total, 230 patients aged 90 years and older, and 1014 patients aged 65–89 years were included. The study was prospective from January 2008 onwards. Exclusion criteria were a pathological hip fracture and high-energy trauma. Minimum follow up was 1 year, or to death. The mean (SD) length of follow up was comparable between the groups (65–89 years: 3.6 years [1.4], 90 years and older: 3.5 years [1.3]). Approval from the local ethical committee was not necessary, as no intervention was carried out and the study was an evaluation of standard usual care as part of good clinical practice. Furthermore, as data could not be traced back to the individual patient, no privacy nor ethical issues were at stake.

Outcome parameters

Available characteristics for all patients were age, sex, American Society of Anesthesiologists (ASA) Physical State classification,[25] type of fracture, surgical treatment and anesthesia, time to surgery (since admittance in hospital), presence of anemia at admission (based on the criteria of the World Health Organization as hemoglobin level below 7.5 mmol/L [12 g/dL] in women and below 8.1 mmol/L [13 g/dL] in men),[26] need for blood transfusion, in-hospital adverse events (delirium, cardiac adverse events, urinary tract infection, surgical site infection, bleeding problems, pressure sores, minor/major strokes), length of hospital stay (LOS), discharge location, and 90-day readmission rate.

The national guideline from the Dutch Institute for healthcare Improvement (CBO) for red blood cell (RBC) transfusion was applied; a transfusion is indicated for patients aged 60 years or older if the hemoglobin level is lower than 5.0 mmol/L (8.0 g/dL) or 6.0 mmol/L (9.7 g/dL), if the patient has a serious cardiac condition or if anemia becomes symptomatic.[27]

Mortality of all patients was scored meticulously by repeated consultation of the population registers of the counties in the region of both hospitals, as well as the hospital's patient registration systems. In-hospital, 3-month and 1-year follow-up data for mortality were available for all patients; data on 2-year follow up were available for 198 (85.3%) nonagenarians and 827 (81.6%) patients aged 65–89 years due to inclusion in 2009.

Patients with prospective follow up

In January 2008, a new hip fracture protocol was implemented as part of the regular care in both hospitals. Since then, place of residence, the level of activities of daily living expressed with the Groningen Activity Restriction Scale (GARS),[28] and the level of mobility were reported at admission and 3 months thereafter during the routine follow-up visit at the outpatient clinic or by a questionnaire sent to the patient or caretakers in case of cognitive impairment.

The GARS assesses competence in abilities in 11 personal basic activities of daily living (ADL) and seven instrumental activities of daily living (IADL). A summed score was calculated for basic IADL ranging from 18, indicating the ability to carry out all activities without assistance or undue effort, to 72, indicating disability.[28]

Mobility was divided into four categories: mobile without use of an aid in- and outdoors, mobile in- and outdoors with the use of an aid, only mobile indoors (regardless the use of an aid) and immobile. A cane, crutch(es) or walker were considered an aid. Patients in a wheelchair were considered to be immobile.

Statistical analysis

Continuous data are presented as means, with standard deviations (SD). The independent Student's *t*-test was used to compare groups of continuous data. Categorical data are presented as the number of participants in the category, along with the percentages. The χ^2-test and Fisher's exact test were used for comparing groups of categorical data.

We compared the two age groups with respect to distribution of sex, ASA classification, presence of anemia, type of fracture, treatment and anesthesia, time to surgery, need for blood transfusion, in-hospital adverse events, LOS, 90-day readmission rate and mortality rates. Patients classified as ASA I or II and III or IV were combined into two groups, as the separate groups of patients with an ASA I or IV classification were too small to be analyzed separately. LOS was changed into a binary outcome; that is, ≤11 days or >11 days, based on the median LOS of the whole cohort. Both absolute mortality and excess mortality were compared between the two age groups. Excess mortality was defined as the mortality added by the hip fracture; that is, mortality of these groups minus the baseline mortality of the background Dutch population in 2005–2009, provided by the Central Bureau of Statistics.[29]

Within the group of nonagenarians, patients who died during hospital stay or those that had died in the first year postoperatively were compared with the survivors, with regards to the same parameters as aforementioned.

From January 2008 to January 2010, 77 nonagenarians and 347 patients aged 65–89 years were admitted. Both groups were compared with respect to place of residence at admission, hospital discharge location and at 3 months postfracture treatment, level of ADL (using the GARS) and pre- and postfracture level of mobility.

Analysis for likelihood of returning to place of residence was carried out only in patients living in their own home or in a residential home at admission. Nursing home patients were excluded, as they all returned to this location.

P-values lower than 0.05 were considered statistically significant. Relative risks (RR) are shown with a 95% confidence interval if the *P*-value <0.05. All data were analyzed in SPSS 17.0 (SPSS, Chicago, IL, USA).

Results

Clinical characteristics

Table 1 shows the characteristics of the study cohort. A total of 230 nonagenarians with a mean (SD) age of 93.5 years (2.6) were compared with 1014 patients aged 65–89 years (mean [SD] age 81.3 years [5.8]). Nonagenarian patients were more often female, suffered more frequently from anemia and trochanteric fractures, but had similar ASA classifications compared with the younger group. In the group of nonagenarians, surgery was less frequently carried out within 1 day after admittance to the hospital. LOS was more frequently longer than 11 days in nonagenarians compared with the younger group.

Clinical adverse events and readmissions

Table 2 shows adverse clinical outcomes during hospital stay. A total of 77.8% of the nonagenarians had one or more clinical adverse events during admission compared with 61% of the patients aged 65–89 years ($P < 0.001$). Blood transfusion need, delirium and cardiac adverse events were significantly more often observed in nonagenarians. None of the other adverse events were significantly different in both groups. The 90-day readmission rate was lower in the group of nonagenarians compared with the patients aged 65–89 years. A deep wound infection or a revision of a failed osteosynthesis was the reason for readmission in five out of the 13 (38.5%) nonagenarians, and in 38 of the 117 (32.5%) patients aged 65–89 years.

Mortality

Table 3 shows the all-cause mortality rate for both age groups. All cause mortality rates, except the 3–12-month interval, were significantly higher in the group of nonagenarians. The 1-year mortality rate of the Dutch background population from 2005–2009 was 3.8% for the patients aged 65–90 years and 26.5% for the nonagenarians. The excess 1-year mortality of both groups was comparable; 19.4% in the patients aged 65–90 years and 16.1% for the nonagenarians ($P = 0.29$).

Table 1 Clinical characteristics of patients aged 65–89 years and older than 90 years

	65–89 years *n* = 1014	≥90 years *n* = 230	*P*-value
Mean age, years (SD; range)	81.3 (5.8; 65–89.9)	93.5 (2.6; 90–103.5)	<0.001
Female	729 (71.9)	191 (83.0)	<0.001
ASA III/IV	322 (31.8)	80 (34.8)	0.38
Anemia	393 (38.8)	130 (56.5)	<0.001
Fracture type			0.01*
Neck of femur fracture	589 (58.1)	109 (47.4)	
(Inter-) Trochanteric fracture	397 (39.2)	112 (48.7)	0.005**
Subtrochanteric fracture	28 (2.8)	9 (3.9)	
Non-operative treatment	11 (1.1)	7 (3.0)	0.03
Surgery ≤1 day	855 (84.3)	176 (76.5)	0.005
Days to surgery, mean (SD)	0.86 (1.12)	0.97 (1.10)	0.18
Spinal anesthesia	938 (92.5)	207 (90.0)	0.71
LOS > 11 days	482 (47.5)	143 (62.2)	<0.001

**P*-value comparing three treatment groups, ***P*-value comparing (inter) trochanteric with neck of femur fracture. Values are given as number (percentage) if not given otherwise. ASA, American Society of Anesthesiologists Physical State classification; LOS, length of stay.

Table 2 Adverse events for hip fracture patients aged 65–89 years and older than 90 years

	65–89 years $n = 1014$	≥90 years $n = 230$	RR (95% CI)	*P*-value
Readmission <90 days	117 (11.5)	13 (5.7)	0.88 (0.30–0.87)	0.008
RBC transfusion for anemia	328 (32.3)	120 (52.2)	1.94 (1.54–2.44)	<0.001
Delirium	228 (22.5)	77 (33.5)	1.55 (1.21–1.97)	<0.001
Cardiac complications	104 (10.3)	44 (19.1)	1.75 (1.32–2.32)	<0.001
Urinary tract infection	111 (10.9)	34 (14.8)	1.31 (0.95–1.81)	0.10
Bleeding	52 (5.1)	18 (7.8)	1.42 (0.94–2.16)	0.11
Pneumonia	75 (7.4)	22 (9.6)	1.25 (0.85–1.84)	0.27
Surgical site infection	41 (4.0)	10 (4.3)	1.06 (0.60–1.88)	0.83
Pressure sores	35 (3.5)	12 (5.2)	1.40 (0.85–2.32)	0.21
Minor/major stroke	16 (1.6)	4 (1.7)	1.08 (0.45–2.62)	0.78

Values are given as number (percentage). CI, confidence interval; RBC, red blood cell; RR, relative risk.

Table 3 Relative risks for mortality of patients aged 65–89 years and older than 90 years

Mortality	65–89 years $n = 1014$	≥90 years $n = 230$	RR (95% CI)	*P*-value
In-hospital	41 (4.0)	22 (9.6)	1.98 (1.38–2.84)	<0.001
1 month	70 (6.9)	35 (15.2)	1.95 (1.44–2.63)	<0.001
3 months	136 (13.4)	69 (30.0)	2.17 (1.71–2.76)	<0.001
3–12 months	99 (9.8)	29 (12.6)	1.26 (0.89–1.77)	0.200
1 year	235 (23.2)	98 (42.6)	2.03 (1.61–2.55)	<0.001
2 years	303 (29.9)	124 (53.9)	2.24 (1.78–2.82)	<0.001

Values are given as number (percentage). The patients aged 65–89 years are the reference category. CI, confidence interval; RR, relative risk.

Comparison of surviving and deceased nonagenarians

The mean age of nonagenarians that died during hospital stay was higher compared with surviving patients (94.7 *vs* 93.4 years, $P = 0.02$). The percentage of patients treated conservatively (13.6 *vs* 1.9%, RR 1.60, CI 0.84–3.04, $P = 0.02$) was higher in the deceased nonagenarians. The percentage of patients with a LOS >10 days was lower in those who died during admission compared with those that did not. (64.9 *vs* 36.4%, RR 0.89 CI 0.80 to 0.98, $P = 0.009$)

The frequency of cardiac complications (63.6 *vs* 14.4%, RR 1.40, CI 1.14–1.72, $P < 0.001$) and presence of pneumonia (40.9 *vs* 6.3%, RR 1.59, CI 1.12–2.25, $P < 0.001$) was significantly higher in the nonagenarians who died in hospital, contrary to other complications, which were similar between the age groups.

Compared with the surviving nonagenarians, nonagenarians who died in the first year after they sustained a hip fracture, the mean age was higher (94 *vs* 93.1 year, $P = 0.012$), the ASA classification was more often III/IV (48 *vs* 25%, RR 1.60, CI 1.20–2.13, $P < 0.001$) and patients were more often treated conservatively (6.1 *vs* 0.8%, RR 4.11, CI 0.67–25.33 $P = 0.04$). Cardiac complications (26.5 *vs* 18%, RR 1.50, CI 1.03–2.18. $P = 0.014$) and pneumonia (15.3 *vs* 5.3%, RR 1.89, CI 1.01–3.52, $P = 0.011$) were found significantly more often in nonagenarians who died in the first year compared with the survivors.

Patients with prospective follow up

Table 4 shows differences between nonagenarians and the patients aged 65–89 years that had a prospective follow up considering place of residence and level of ADL and mobility.

Place of residence

At admission, 40.0% of the nonagenarians lived in their own home and 46.7% lived in a residential home. Both at discharge and after 3 months, nonagenarians were less likely to return to their own home compared with the younger group of patients. At 3 months after admission, 40.9% of the nonagenarians

Table 4 Place of residence, mobility and nutritional status of the subgroup of patients aged 65–89 years and older than 90 years with a prospective follow up

	65–89 years *n* = 347	≥90 years *n* = 77	RR (95% CI)	*P*-value
Place of residence at admission				
In their own home	244 (70.5)	30 (40.0)	1.36 (1.18–1.58)	<0.001*
Residential home	66 (19.1)	35 (46.7)		<0.001**
Nursing home	36 (10.4)	10 (13.3)		
Discharge to an alternative location				
Home-based patients	156 (65.3)	26 (89.7)	1.13 (1.05–1.21)	0.008
Residential home-based patients	37 (59.7)	25 (83.3)	1.40 (1.08–1.81)	0.023
Alternative location at 3 months				
Home-based patients	52 (23.6)	13 (59.1)	1.19 (1.05–1.35)	<0.001
Residential home-based patients	15 (27.8)	8 (38.1)	1.15 (0.82–1.61)	0.38
GARS, mean (SD)	41.0 (18.0)	50.3 (15.4)	n/a	<0.001
Mobility at admission				
Mobile without an aid	134 (38.7)	12 (16.0)		
Mobile with aid	159 (46.0)	31 (41.3)	n/a	<0.001
Only mobile indoors	47 (13.6)	26 (34.7)		
Immobile	6 (1.7)	6 (8.0)		
Regained mobility at 3 months†	136 (45.0)	24 (52.2)	0.78 (0.46–1.34)	0.37
Mortality at 3 months	36 (10.4)	28 (36.4)	3.21 (2.20–4.70)	<0.001

**P*-value comparing three groups. ***Relative risk (RR) and *P*-value comparing residential home patients with patients living in their own home. †Information was missing in five of the patients aged ≥90 years and in nine of the patients aged 65–89 years. Values are given as *n* (percentage) if not given otherwise. CI, confidence interval; GARS, Groningen Activity Restriction Score; RR, relative risk.

that lived in their own home and 62.8% of those living in a residential home at admission had returned to their original place of residence.

Level of ADL and mobility

The level of ADL at admission was significantly lower in the nonagenarians compared with the younger group. A total of 57.3% of the nonagenarians were still mobile both in- and outdoors. The prefracture level of mobility was significantly worse compared with the younger group. At 3 months postfracture, 52.2% of the nonagenarians had regained their prefracture level of mobility, which was not significantly different from the patients aged 65–89 years.

Discussion

In the present study, nonagenarian hip fracture patients were more often female and anemic, and suffered more often a trochanteric fracture than patients aged 65–89 years. Furthermore, more adverse events, higher mortality rates, a lower level of mobility and a higher percentage of patients not returning to their own home were found in the group of nonagenarians compared with the patients aged 65–89 years. Excess mortality (because of the hip fracture), however, was comparable between both age groups. Before admission, almost half of the nonagenarians lived in their own home and the majority was able to walk in- and outdoors. At 3 months, approximately half of the nonagenarians regained their prefracture mobility and had returned to their original place of residence.

Just two other studies compared nonagenarians with a younger age group with respect to clinical characteristics, such as age, fracture type, ASA classification and mortality after a hip fracture: a smaller USA-based study with comparable age of the patient groups to the present study and a very large Scottish study of patients aged 95 years and older compared with patients aged 75–89 years.[13,14] In line with the present study, patients were more often female in the latter study.[14]

We found a similar distribution of the ASA classification between both age groups, contrary to both former studies that found significantly more ASA III and IV patients at older ages.[13,14] Regional differences in health status and socioeconomic background might account for these differences.

In concordance with the literature, most nonagenarians suffered from a trochanteric fracture.[13,14,17–20,22,23] Trochanteric fractures are associated with older age and female sex, probably because of differences in the type

and rate of bone loss in the sexes, or the changing rate and pattern of falling with aging.[30–32]

Timing of surgery in the oldest older patients with comorbidities might influence the outcome, as early surgery might prevent adverse events, such as pneumonia and pressure sores, but postponing surgery to optimize patients with comorbidities might improve their outcome. This is still at the center of debate.[33,34] In the Netherlands, surgery within 24 h is a quality indicator, used to assess surgical care by the government. The latter might explain our relative short time to surgery (0.97 days) compared with non-Dutch studies (1.3–5.7 days).[15,19,23] It is, however, comparable with another Dutch cohort.[17]

The LOS in the present study was shorter than in previous reported studies.[17,19,21,23] LOS is a frequently reported outcome variable in literature indicating quality of care. However, LOS might not be the best parameter to compare the outcome of different cohorts, as it is influenced by many factors, of which several are non-medical. The difference in LOS between studies is likely not to be explained by differences in patient characteristics, such as adverse event rates. They show differences in organization of after-care and rehabilitation, and differences in social home environment between the different countries.[35]

The 90-day readmission rate of nonagenarians was lower compared with the younger group. Only one previous study on nonagenarians reported readmission rates being higher compared with the present study population, which might be a result of a higher number of ASA III/IV-classified patients in that study.[23]

Delirium, cardiac adverse events and postoperative anemia requiring a blood transfusion were significantly more often reported adverse events in the nonagenarians. Receiving blood products can be a risk factor for developing delirium.[36] As the number of patients receiving a blood transfusion was higher in nonagenarians, this might partly explain the difference in delirium incidence. Other reasons might be multimorbidity and polypharmacy; however, these factors were not registered in the present study. The higher number of blood transfusions can be explained by the higher prevalence of anemia at admission. The reported rate of adverse events in literature differ widely between 14.6 and 100%, most probably because of differences in the thoroughness of registration and definition of an adverse event.[13,15,18,19,23] Type of adverse events were mentioned in just two reports.[18,19]

In-hospital mortality of nonagenarian hip fracture patients was comparable with recent studies (6–11.6%),[13,17,19–23] whereas older studies showed higher mortality rates (18–24%),[15,18] most probably as a result of a longer LOS. In the Netherlands, 1-year mortality for women aged 90–94 years is reported to be 21%, which is half of the percentage of the nonagenarian hip fracture population (42.6%) in the present study.[29] In a large series from the Scottish Hip Fracture Audit (SHFA), mortality in patients aged 85 years and older returned to that of the background population within 2–5 years.[37] These findings differ strongly from Alarcon *et al.*, showing that excess mortality had disappeared after 2 months.[23] However, they compared an older cohort (1961–1970) of younger patients (mean age 73.9 years) as a reference.[23,38] There was no difference in the excess mortality between both age groups in this cohort. The two age groups-comparing papers did not compare excess mortality.[13,14] This is a very interesting finding; the negative impact of a hip fracture on mortality is apparently the same in younger patients as it is in nonagenarian patients. Previously reported higher mortality rates in nonagenarians might therewith simply be caused by the effect of chronological aging.[13,14]

The frequency of cardiac complications and pneumonia was significantly higher in nonagenarians who died during hospital stay or in the first year after the hip fracture, compared with the surviving nonagenarians. A large series of younger patients from the UK (2448 patients, mean age 82 years) reported a higher 1-year mortality in patients with these same complications as well.[39]

Almost half of the nonagenarians still lived in their own home before admission and more than half of them had returned to their own home 3 months postfracture. Half of the nonagenarians lived in a residential home. None of the other studies mentioned a residential home as a place of residence. Either their own home or a nursing home was reported as a possible place of residence. In the Netherlands, a residential home is a very heterogeneous form of living, ranging from an apartment in a complex with the availability of support to a location with full support for ADL. Because of large differences between countries in types of housing and traditions for homes for elderly people, the place of residence is hard to compare between studies.[40] This is reflected in the wide range of numbers of patients living in a nursing home before admission in the other studies (4.7–28.1%).[20,21,23]

The lower level of mobility of the nonagenarians in comparison with the patients aged 65–89 years is in line with another report.[13] Approximately half of the nonagerians regained their prefracture mobility after, which is also in concordance with previous studies.[13,16,19–21,23] Compared with a cross-sectional cohort of Dutch people aged 85 years and older that lived in their own home, a slightly reduced level of ADL at admission in nonagenarians was found, showing the higher daily dependence of the studied population.[41]

The strengths of the current study are its sample size, without bias as a result of exclusion criteria, except for pathological fractures and high-energy trauma fractures, and the meticulous registration of all variables

including mortality. Limitations were the retrospective collection of a part of the data, and the relative smaller number of patients used for evaluation of mobility and place of residence. Furthermore, we did not have detailed information for all patients on medication and number of comorbidities, and no data on cognitive assessment were available. Significant differences were found between both age groups, most of which were most probably as a result of the effect of aging and not specific to hip fracture patients as such.

Most of our outcomes confirm the percentages previously presented in the literature. However, as the number of nonagenarians is rapidly growing, it is of importance to have reliable and reproducible data on clinical characteristics of these elderly patients.

Our data are valuable for not only the research community, but also for daily clinical practice, even if one does not find large new issues. With independent data, the latter also underscores the importance of predictive factors for morbidity in this category of patients. Furthermore, former studies came from the USA and UK, with very different healthcare systems and differences in society compared with the Netherlands.[13,14]

To conclude, nonagenarian hip fracture patients differ significantly from patients aged 65–89 years with respect to clinical characteristics and long-term outcome. However, almost half of the nonagenarians returned to live in their own home and more than half regained their prefracture level of mobility. Given these findings, hip fracture prevention strategies and prevention of adverse events during hospital stay that focus particularly on the group of frail nonagenarians are highly recommended.

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