Acta Biomed 2016; Vol. 87, N. 3: 275-281

Original article

Risks of subsequent contralateral fractures of the trochanteric region in elderly

Francesco Pogliacomi[1], Andrea Pellegrini[1], Fabrizio Tacci[1], Martina Francesca Pedrini[2], Cosimo Costantino[2], Alessio Pedrazzini[1], Giuseppe Pedrazzi[3], Fulvio Lauretani[4], Francesco Ceccarelli[1]

[1] Orthopaedics and Traumatology Clinic, Department of Surgical Sciences, University of Parma, Parma, Italy; [2] Graduate School of Physical and Rehabilitation Medicine, Department of Biomedical, Biotechnological and Translational Sciences, University of Parma, Parma, Italy; [3] Department of Neuroscience, University of Parma, Parma, Italy; [4] Internal Medicine and Critical Long-term Care Unit, University Hospital of Parma, Parma, Italy

Summary. *Background:* Fractures in elderly are always a dramatic event and the healing is often not complete. In a context of bone fragility, repeated fractures are a growing problem in the industrialized world, in which the mean age of population is increasing. The aim of this study was to identify those general factors which may increase the risk of subsequent trochanteric fractures after an initial lesion. *Materials and methods:* Three-hundred and thirty-one patients who underwent intramedullary fixation for trochanteric fractures between January 2012 and December 2013 were studied. Forty subjects yet alive (group 1), affected by a subsequent contralateral hip fracture, were compared with 202 patients (group 2) affected by isolated trochanteric fracture. Days of hospitalization before surgery, hospitalization, period of rehabilitation, type of discharge and comorbidities, that are reported in literature as possible risk factors for hip refracture, were analyzed. In addition, all patients were interviewed in order to assess if a therapy for osteoporosis was prescribed after the initial fracture and how their gait had been modified by fractures. *Results:* Days of hospitalization before surgery, hospitalization, period of rehabilitation and type of discharge were not predictive factors for subsequent fractures, as well as diabetes mellitus, hypertension and cardiac diseases. The presence of neurologic and respiratory diseases were associated to a higher risk of refractures, as well as the absence of specific medical treatment for osteoporosis. *Conclusions:* Neurologic and respiratory comorbidities and the absence of osteoporosis medical treatment are the variables associated to a higher risk of contralateral fractures. Physicians can do more in terms of prevention and strategies must consider these risk factors. (www.actabiomedica.it)

Key words: fracture, femur, fragility, osteoporosis, subsequent injury

Introduction

Osteoporosis is a systemic skeletal disease characterized by low bone mass and microarchitecture deterioration of bone tissue, with a consequent increase in fragility and susceptibility to fracture (1). Fractures of the proximal femur in elderly are always a dramatic event and the physical and psychological healing is often not complete.

Hip fractures are an important cause of death and disability among elderly (2, 3), who are characterized by decreased quality of life (4, 5) as well as walking restrictions, difficulty in climbing stairs and problems in self-care. In a context of bone fragility, refractures

are a growing problem in the industrialized world, in which the aging population is constantly increasing (6). Patients who have suffered hip fracture have an increased risk of subsequent fracture of the contralateral hip (second hip fracture) (7). The one-year risk of this complication varies from approximately 2% to 10% (8, 9). The lifetime risk of a second hip fracture has been estimated at 20% but may be as high as 55% (10). A second fracture necessitates further surgery and hospital care and may result in additional disability or death.

Given these clinical risks among individuals, as well as the economic costs related, it seems important to identity those subjects at greater risk for a second fracture so that they can be targeted for fracture prevention interventions.

Risk factors for first hip fracture have been well studied (11, 12) and may be divided as consequent to alteration of bone quality/integrity or falls.

Relatively less known are risks and protective factors for hip refracture. These may be categorized as related to specific bone quality disorders (e.g. type and grade of osteoporosis) or to more general conditions (demographic, clinic and therapeutic).

The aim of this study was to identify these general factors which may increase the possibility of a subsequent contralateral hip fracture.

Methods

Three hundred thirty-one patients, older than seventy years of age, underwent intramedullary fixation for fractures in the trochanteric region between January 2012 and December 2013 at the University Hospital of Parma.

Data acquisition were extracted from medical records of the hospital.

Eighty-nine subjects were excluded: 31 died within a year of the trauma, 40 were unable to walk before surgery and were not admitted to the rehabilitation program and in 18 was not possible to obtain the consent for the management of the personal data.

Forty patients (group 1) out of 242 available for the study, and all characterized by a sufficient preoperative walking ability, had another contralateral hip fracture. This first group was compared with 202 patients (group 2) affected by isolated femoral fracture.

It was assumed that all fractures in this study were the result of banal falls; pathological metastatic fractures and high-impact injuries (traffic accident or falls from more than sitting height) were not included.

In all cases age, gender, body mass index (BMI), days of hospitalization before surgery, hospitalization, period of rehabilitation, type of discharge (at home or in a rehabilitative institute) and comorbidities, that in literature (3) are reported as possible risk factors for subsequent fractures, were collected.

The latter included neurologic pathologies (cognitive impairment and dementia), diabetes mellitus, hypertension, cardiac diseases (myocardial infarction, angina pectoris, cardiac insufficiency, arrhythmia) and respiratory diseases [chronic obstructive pulmonary diseases (COPD) comprising chronic bronchitis and emphysema, asthma, interstitial pneumonia, chronic respiratory insufficiency].

In addition, these patients were interviewed by phone in order to assess if a specific therapy for osteoporosis was prescribed after the initial fracture and how their gait pattern had been modified after surgery. In particular, it was asked to describe how much the walking skills worsened after the trochanteric fracture of the femur in both groups and subsequent fracture in group 1.

These changes were quantified as follows:

- **unchanged**: if the fracture did not result in any change in the walking ability
- **slightly reduced**: if the ability to walk remained valid but limited
- **reduced**: if this ability was possible with the help of orthopaedics devices such as crutches
- **greatly reduced**: if after the fracture the patient could walk only with the help of another person.

Statistical analysis

Results were statistically analyzed using the SPSS Statistics software (version 20.0).

Quantitative variables (age, BMI, period of rehabilitation and hospitalization) were compared between groups by a two-tailed unpaired *t*-test. Differences in the categorical variables (gender and type of discharge)

were compared using the chi-squared test. The relation between the fracture and comorbidities was evaluated by the chi-squared test in a univariate analysis.

Furthermore, responses to phone interviews were analyzed using the chi-squared test. The differences were considered significant when p value was less than 0.05.

Results

Age, gender and BMI of group 1 and 2 are reported in table 1.

Table 1. General characteristics of the two groups of patients

	Group 1	Group 2	p value
Women (n. 202)	34	168	>0.05
Men (n. 40)	6	34	
Mean age (years)	84 (range: 70-99)	83.7 (range: 70-97)	>0.05
BMI	26.4 (range: 22.4-28.4)	26.6 (range: 23-28.2)	>0.05

Risk factor

The analysis of risk factors is illustrated in table 2 and 3. In particular days of hospitalization before surgery, hospitalization, period of rehabilitation, type of discharge and concomitant diabetes mellitus, hypertension and cardiac diseases were not predictive factors for subsequent fractures. Significant differences between the two groups regarding neurologic and respiratory diseases were observed. These 2 risk factors were more frequent in group 1.

Results of telephone interviews

In group 1 only seven patients had a specific therapy with bisphosphonate after the initial fracture, which was suspended in 2 cases after less than three months of treatment for side effects, and 1 received therapy with Vitamin D and Calcium (table 4).

In group 2 sixty subjects underwent a therapy with bisphosphonate and 31 had an empiric treatment with Vitamin D and Calcium (table 4).

Regarding gait patterns after a trochanteric fracture, the results of both groups are summarized in table

Table 2. Days before surgical procedure, hospitalization, period of rehabilitation and type of discharge in group 1 and 2

	Group 1	Group 2	p value
Days before surgery (average)	2.9 (range 1 – 9)	3 (range 1- 7)	0.482
Hospitalization (days/average)	15.1 (range 7 – 35)	15 range (7 – 34)	0.593
Period of rehabilitation (days/average)	41.2 (range 35 – 50)	40.5 (range 36 – 48)	0.210
Type of discharge	• at home: 6 • to a rehabilitative institute: 34	• at home: 34 • to a rehabilitative institute: 168	0.607

Table 3. Comorbidities in group 1 and 2

	Group 1	Group 2	p values
Neurologic pathologies (cognitive impairment/dementia)	*21/40 (52.5%)*	*60/202 (29.7%)*	*<0.05*
Diabetes Mellitus	5/40 (12.5%)	25/202 (12.4%)	>0.05
Hypertension	19/40 (47.5%)	97/202 (48%)	>0.05
Cardiac diseases	12/40 (30%)	65/202 (32%)	>0.05
Respiratory diseases	*13/40 (32.5%)*	*23/202 (11.4%)*	*<0.05*

Table 4. Specific osteoporosis medical therapy in group 1 and 2

	Group 1	Group 2	p values
Specific osteoporosis therapy	*8/40 (20%)*	*91/202 (45%)*	*<0.05*

Table 5. Gait pattern after trochanteric fracture in group 1 and 2

Gait	Group 1	Group 2	Total
Unchanged	2	10	12
Slightly reduced	23	110	133
Reduced	7	41	48
Greatly reduced	8	41	49
Total	**40**	**202**	**242**

Table 6. Gait patterns after trochanteric fracture and subsequent contralateral femoral fracture in group 1

Gait	After trochanteric fracture	After subsequent contralateral femoral fracture
Unchanged	2	0
Slightly reduced	23	3
Reduced	7	10
Greatly reduced	8	27
Total	**40**	**40**

5. The analysis of these parameters did not show differences between group 1 and 2 (Chi Square = 0.2559, p = 0.8799).

The significant worsening of quality of gait of patients of group 1 after trochanteric fracture and following a contralateral subsequent femoral fracture is illustrated in table 6 (Chi Square = 9.983, p = 0.006797).

Discussion

Aging is associated with a progressive loss of bone-muscle mass and strength as well as of hormone production. This decline in mass and strength associated with concomitant diseases typical of the geriatric status (13) increases the risk of fall and consequent fragility fractures (14).

Among these, hip fractures are accompanied by a high disability and mortality rate. These complications are more frequent in those subjects who undergo to a subsequent contralateral injuries, as well demonstrated by results regarding the gait pattern of this study (7, 15, 16).

For these reasons these traumatic events represent an important problem in elderly and the identification of the modifiable risk factors and an adequate therapy become a research priority in Ortho-Geriatric Medicine in order to prevent first lesion and its possible recurrence (17).

Nevertheless, preventing initial hip fractures by treating osteoporosis and avoiding falls by the elderly living in the community is not easy. Many specialized physicians (including rheumatologists, orthopaedics, rehabilitators, geriatrics, gynaecologist and endocrinologist) and generalists (internal medicine practitioners) are involved in the management of patients who sustain fractures. These providers have different priorities and connectivity in the care process is often lacking (18).

As consequence, authors believe that it could be easier to prevent the second hip fracture, especially for an orthopedic surgeon who tends to overlook the importance of proper diagnosis and preventive therapy focusing in the healing of the "fracture" and not of the "patient" as a whole.

In this study, 40 out 242 subjects (16.5%) underwent a second contralateral trochanteric fracture. This rate is higher than the incidence of past retrospective studies (5.4-11.3%) (7, 8), probably because in this case series all patients were older than 70 years of age.

The observational period was of 3 years after trauma because, as reported in the literature, the refracture occurs within this time in 85.7% of the cases (7, 18-20).

It has previously been reported that age and female gender were important risk factors for hip fracture and recurrences (21, 22). However, some reports have indicated that there are no differences in age or gender between unilateral and second hip fractures (7, 8). In the present study an influence of age and gender on second hip fractures was not possible to find because group 1 and 2 were similar for these two parameters.

Fragility fractures may also be linked to BMI. This variable has a negative correlation with hip fracture, and some authors (18-20, 23) have reported that a second hip fracture is related to a lower BMI. In the present study it was not possible to demonstrate a re-

lation between BMI and second fracture because this parameter was similar in both group.

Days before surgery and rehabilitation period were not statistically different between the groups in this study as previously observed in other reports (2, 7, 9). In the University Hospital of Parma rehabilitation following trochanteric fractures is offered in the same way in all collaborative patients regarding walking ability. The rehabilitation program is always administered by a physiotherapist, started the day after the surgical procedure and continues at home or in a rehabilitation ward at least for 25-30 days.

In this study, it was initially hypothesized that discharge to a rehabilitative institute could diminish the possibility of a second fracture, but a statistically significant difference was not found. This was probably the consequence of the same rehabilitation protocol that was applied in both type of discharge. Furthermore, the admission of the patients in these dedicated structures is decided by specialized physicians who analyse in each subject several variables including architectural barriers in their apartments (presence of stairs and elevator and rooms distribution and measures), family dynamics and physical and psychiatric functions.

Regarding comorbidities, in this report cognitive impairment/dementia and respiratory diseases were important risk factors for trochanteric refractures. In the literature some authors confirm this result (7, 18-20) but others did not demonstrate this relation. However, neurologic problems decrease quality of life as well as walking ability and capacity of climbing stairs, thus facilitating the risk of recurrent falls.

In the same way, patients affected by impaired respiratory function have these problems with higher risk of subsequent fractures.

Furthermore, in subjects with chronic obstructive pulmonary disease the progression of osteoporosis has been demonstrated (24), thus worsening bone resistance and increasing its fragility.

For these reasons, when elderly patients have neurologic or respiratory disease, they should be carefully monitored and managed. The basic strategy for preventing a second trauma should be the fitting of hip protectors (25) and modifications to the home. For an elderly person with a respiratory disease, improving activity by pulmonary rehabilitation and aerobic exercises are recommended.

In addition, administration of osteoporosis medication should be considered as a preventive strategy.

Many studies examined the effects of different types of pharmacotherapy on the risk of subsequent fracture (2, 3, 26). When compared with no treatment or placebo, all pharmacologic interventions examined showed evidence of a protective effect for subsequent fracture, even relatively low doses of calcium and vitamin D (2, 3, 26, 18-20).

Unfortunately, it is well documented that osteoporosis itself is undertreated among patients in general, including individuals post hip fracture (27-29), and, among patients who do receive treatment, many have difficulty continuing with treatment on a long-term basis (18,19).

The findings of this study confirm that osteoporosis medications have a protective effect on fragility fractures. Authors underline the importance of treating osteoporosis and suggest that individuals post hip fracture who cannot tolerate, or have contraindications for certain medications (e.g. bisphosphonates, high-dose vitamin D) be encouraged to try others (e.g. lower dose vitamin D, calcium).

The present study was limited fragility by the small number of cases. However, its population was similar to other reports of the literature as well as the results obtained. For these reasons authors consider this case series valid and reliable.

It is therefore evident how the diagnostic-therapeutic management of fractures of the proximal femur is not simple, and it requires a multi-disciplinary approach including orthopaedic surgeon, geriatrics and physicians specialized in rehabilitation, as well demonstrated in several pathologies (30-33).

Conclusion

Fragility fractures of the trochanter region are a complex and multidisciplinary disease affecting elderly. Subsequent contralateral hip fractures are not infrequent and may be a devastating event for the patient. Neurologic and respiratory diseases, as well as the absence of osteoporosis medical therapy, are associated

to a greater risk of contralateral refractures. Prevention strategies have to improve and they must take in consideration these observations.

References

1. Kani JA, McCloskey EV, Johansson H, Cooper C, Rizzoli R. European guidance for the diagnosis and management of osteoporosis in postmenopausal women. Osteoporos Int 2013; 24: 23-57.
2. Egan M, Jaglal S, Byrne K, Wells J, Stolee P. Factors associated with a second hip fracture: a systematic review. Clinical Rehabilitation 2008; 22: 272-82.
3. Kannus P, Parkkari J, Sievanan H, Heinonen A, Vuori I, Jarvinen M. Epidemiology of hip fractures. Bone 1996; 18 (suppl): 57S-63S.
4. Randell AG, Nguyen TV, Bhalerao N, Silverman SL, Sambrook PN, Eisman JA. Deterioration in quality of life following hip fracture: a prospective study. Osteoporos Int 2000; 11: 460-66.
5. Hallberg I, Rosenquist L, Kartous L, Lofman O, Wahlstrom O, Toss G. Health-related quality of life after osteoporotic fractures. Osteoporos Int 2004; 15: 834-41.
6. Scaglione M, Fabbri L, Di Rollo F, Bianchi MG, Dell'Omo D, Guido G. The second hip fracture in osteoporotic patients: not only an orthopaedic matter. Clin Cases Miner Bone Metab 2013; 10(2): 124-8.
7. Mitani S, Shimizu M, Abo M, Hagino H, Kurozawa Y. Risk factors for second hip fractures among elderly patients. J Orthop Sci 2010 Mar; 15(2): 192-7.
8. Dretakis E, Kritsikis N, Economou K, Christodoulou N. Bilateral non-contemporary fractures of the proximal femur. Acta Orthop Scand 1981; 52: 227-9.
9. Yamanashi A, Yamazaki K, Kanamori M, Mochizuki K, Okamoto S, Koide Y, Kin K, Nagano A. Assessment of risk factors for second hip fractures in Japanese elderly. Osteoporos Int 2005; 16: 1239-46.
10. Formiga F, Rivera A, Nolla JM, Coscujuela A, Sole A, Pujol R. Failure to treat osteoporosis and the risk of subsequent fractures in elderly patients with previous hip fracture: a five-year retrospective study. Aging Clin Exp Res 2005; 17: 96-9.
11. Baron JA, Farahmand BY, Weiderpass E, Michaëlsson K, Alberts A, Persson I, Ljunghall S.Cigare tte smoking, alcohol consumption, and risk of hip fracture in women. Arch Intern Med 2001; 161: 983-88.
12. Farahmand BY, Michaelsson K, Baron JA, Persson PG, Ljunghall S. Body size and hip fracture risk. Swedish Hip Fracture Study Group. Epidemiology 2000; 11: 214-19.
13. Ferrucci L, Baroni M, Ranchelli A, Lauretani F, Maggio M, Mecocci P, Ruggiero C. Interaction between bone and muscle in older persons with mobility limitations. Curr Pharm Des 2014; 20 (19): 3178-97.
14. Kalyani RR, Corriere M, Ferrucci L. Age-related and disease-related muscle loss: the effect of diabetes, obesity, and other diseases. Lancet Diabetes Endocrinol 2014 Oct; 2(10): 819-29.
15. Keene GS, Parker MJ, Pryor GA. Mortality and morbidity after hip fractures. BMJ 1993; 307: 1248-50.
16. Cooper C, Atkinson EJ, Jacobsen SJ, O'Fallon WM, Melton LJ 3rd. Population-based study of survival after osteoporotic fractures. Am J Epidemiol 1993; 137: 1001-5.
17. Cederholm T, Cruz-Jentoft AJ, Maggi S. Sarcopenia and fragility fractures. Eur J Phys Rehabil Med 2013 Feb; 49(1): 111-7.
18. Yusuf AA, Matlon TJ, Grauer A, Barron R, Chandler D, Peng Y. Utilization of osteoporosis medication after a fragility fracture among elderly Medicare beneficiaries. Arch Osteoporos 2016 Dec; 11(1): 31.
19. Bynum JP, Bell JE, Cantu RV, Wang Q, McDonough CM, Carmichael D, Tosteson TD, Tosteson AN. Second fractures among older adults in the year following hip, shoulder, or wrist fracture. Osteoporos Int 2016 Jul; 27(7): 2207-15.
20. Aurégan JC, Frison A, Bégué T, Hannouche D, Bosser C, Bensidhoum M, Hoc T. Contra-lateral hip fracture in the elderly: are decreased body mass index and skin thickness predictive factors? Int Orthop 2016 Aug 9. [Epub ahead of print]
21. Rizzoli R, Reginster JY, Boonen S, Breart G, Diez-Perez A, Felsenberg D, Kaufman JM, Kanis JA, Cooper C. Adverse reactions and drug-drug interactions in the management of women with postmenopausal osteoporosis. Calcif Tissue Int 2011; 89: 91-104.
22. Kanis JA, Johnell O, Oden A, Johansson H, McCloskey E. FRAX and the assessment of fracture probability in men and women from the UK. Osteoporos Int. 2008; 19: 385-97.
23. Berry SD, Samelson EJ, Hannan MT, McLean RR, Lu M, Cupples LA, et al. Second hip fracture in older men and women: the Framingham Study. Arch Intern Med 2007; 167: 1971-6.
24. Graat-Verboom L, Smeenk FW, van den Borne BE, Spruit MA, Jansen FH, van Enschot JW, Wouters EF. Progression of osteoporosis in patients with COPD: a 3-year follow up study. Respir Med 2012 Jun; 106 (6): 861-70.
25. Koike T, Orito Y, Toyoda H, Tada M, Sugama R, Hoshino M, Nakao Y, Kobayashi S, Kondo K, Hirota Y, Takaoka K. External hip protectors are effective for the elderly with higher-than-average risk factors for hip fractures. Osteoporos Int 2009; Sep 20 (9): 1613-20.
26. Reed SD, Newton KM, LaCroix AZ. Indications for hormone therapy: the post-Women's Health Initiative era. Endocrinol Metab Clin North Am 2004; 33: 691-715.
27. Schilcher J, Koeppen V, Aspenberg P, Michaëlsson K. Risk of atypical femoral fracture during and after bisphosphonate use. N Engl J Med. 2014 4; 371 (10): 97-6.
28. Adachi JD, Saag KJ, Delmas PD, Liberman UA, Emkey RD, Seeman E, Lane NE, Kaufman JM, Poubelle PE, Hawkins F, Correa-Rotter R, Menkes CJ, Rodriguez-Portales JA, Schnitzer TJ, Block JA, Wing J, McIlwain HH, Westhovens R, Brown J, Melo-Gomes JA, Gruber BL,

Yanover MJ, Leite MO, Siminoski KG, Nevitt MC, Sharp JT, Malice MP, Dumortier T, Czachur M, Carofano W, Daifotis A.Two-year effects of alendronate on bone mineral density and fracture in patients on glucocorticoids. Arthritis and Rheum 2001; 44: 202-11.
29. Black DM, Cummings SR, Karpf DB, Cauley JA, Thompson DE, Nevitt MC, Bauer DC, Genant HK, Haskell WL, Marcus R, Ott SM, Torner JC, Quandt SA, Reiss TF, Ensrud KE. Randomised trial of effect of alendronate on risk of fracture in women with existing vertebral fractures. Lancet 1996; 348: 1535-41.
30. Pogliacomi F, Pedrini MF, Pourjafar S, Pellegrini A, Paraskevopoulos A, Costantino C, Ceccarelli F. Pubalgia and soccer: real or overestimated problem? Medicina dello Sport 2015; 68 (4): 651-62.
31. Pogliacomi F, Pedrini MF, Pourjafar S, Pellegrini A, Ceccarelli F, Costantino C. Chronic low back pain in high level cyclists: Comparison between two different treatments. Medicina dello Sport; 69 (3), 435-46.
32. Pogliacomi F, Costantino C., Pedrini MF, De Filippo M, Ceccarelli F. Anterior groin pain in athletes as a consequence of bone diseases: etiopathogenesis, diagnosis and principles of treatment. Medicina dello Sport; 67 (1), 1-26.
33. Pogliacomi F, Costantino C, Pedrini MF, Pourjafar S, De Filippo, M, Ceccarelli, F. Anterior groin pain in athletes as a consequence of intra-articular diseases: etiopathogenesis, diagnosis and principles of treatment. Medicina dello Sport; 67 (3), 341-68.

Received: 14 November 2016
Accepted: 15 November 2016
Correspondence:
Andrea Pellegrini, MD
Orthopaedics and Traumatology Clinic
Department of Surgical Sciences, University of Parma
Via Gramsci 14, 43126 Parma (Italy)
Tel. 00390521702850
Fax: 00390521290439
E-mail: fpogliacomi@yahoo.com