

ORIGINAL ARTICLE

Prevalence, incidence and risk factors for foot pressure ulcers in hospitalized elderly patients. An observational and prospective study

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Abstract

Background: Incidence and clinical characteristics of foot pressure ulcers (FPU) in hospitalized elderly patients are not well known. The aim of the study was to determine the incidence of FPU during hospitalization, to describe main FPU characteristics and to assess main risk factors for FPU in hospitalised elderly subjects.

Methodology: An observational prospective study was performed in which patients 65 years or older admitted to Vascular Surgery, Orthopaedic or Geriatric departments were followed from admission to discharge. Trained nurses evaluated all recruited patients on a daily basis for possible FPU. Main characteristics of the patient (age, sex and co-morbidities) and the ulcer (location, grade) were registered.

Results: 299 patients were recruited (62.2% women, mean age 82.3 years, mean number of co-morbidities 2.8). Prevalence of FPU was 30.1% at admission and 73.9% at discharge. Incidence of FPU during hospitalization was 9.5 new FPU/100 person-day. 97.0% of the new FPU were grade 1 (erythema) and the most common locations were in the heel (57.6%), the external lateral part of the foot (13.1%), and the *hallux* of the first toe (11.8%). Apart from immobility, main risk factors for FPU are age, geriatric residence origin and not able to outdoor life.

Conclusions: FPU has a high incidence among hospitalised elderly patients; most of them are grade 1 and located in the heel. More attention must be paid in the prevention of pressure ulcers in hospitalized frail subjects.

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PALABRAS CLAVE

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Mayores

Prevalencia, incidencia y factores de riesgo de las úlceras por presión en el pie en los pacientes mayores hospitalizados. Estudio observacional y prospectivo

Resumen

Antecedentes: No se conocen bien la incidencia y las características clínicas de las úlceras por presión (UPP) en el pie en los pacientes mayores hospitalizados. El objetivo de este estudio fue determinar la incidencia de las UPP durante la hospitalización, describir sus principales características, y evaluar los principales factores de riesgo en los sujetos mayores hospitalizados.

Metodología: Se llevó a cabo un estudio prospectivo observacional en el que se realizó un seguimiento desde el ingreso al alta de los pacientes mayores de 65 años ingresados en las unidades de cirugía vascular, traumatología o geriatría. Las enfermeras experimentadas evaluaron diariamente a todos los pacientes reclutados en busca de una posible UPP. Se registraron las características principales del paciente (edad, sexo y comorbilidades) y de la úlcera (localización y grado).

Resultados: Se reclutaron 299 pacientes (62,2% mujeres, con una edad media de 82,3 años, y número medio de comorbilidades de 2,8). La prevalencia de UPP fue del 30,1% en el momento del ingreso, y del 73,9% al producirse el alta. La incidencia de UPP durante la hospitalización fue de 9,5 nuevas UPP/100 personas/día. El 97% de las nuevas UPP fueron de grado 1 (eritema), y las localizaciones más comunes fueron el talón (57,6%), la parte lateral externa del pie (13,1%) y el *hallux* del dedo gordo (11,8%). Aparte de la inmovilidad, los factores principales de riesgo de UPP fueron la edad, la residencia geriátrica como origen y la imposibilidad de realizar actividades en el exterior.

Conclusiones: Las UPP tienen una gran incidencia entre los pacientes mayores hospitalizados, siendo la mayoría de ellas de grado 1 con localización en el talón. Deberá prestarse más atención a la prevención de las UPP en los sujetos frágiles hospitalizados.

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Introduction

Pressure ulcers (PU) are skin lesions of ischaemic origin produced by the action of extrinsic and sustained pressure on a bone prominence or other hard surface, in combination with other factors such as friction or shear forces and humidity. Healing times for pressure ulcers are long, in many cases over a year. If the conditions leading to the PU are not rapidly corrected, the localized skin damage can spread to deeper tissue layers affecting muscle, tendon, and bone.¹ PU are classified in four different stages according to the depth of involved tissues,² with increasing negative impact on individual's health and quality of life.³ Open ulcers can become a source of pain, disability, and infection.⁴ This pathology increases the cost of healthcare mainly due to increased length of hospital stay⁵ and to the complications that may involve.⁶ Main risk factor for PU are immobility, the inability to make postural changes and under nutrition.^{7–9} These are modifiable risk factors, so PU are considered avoidable in most cases, reason why its prevention is considered a high priority by most organisms that watch to improve the quality of healthcare.¹⁰

However, PU, especially those located in the foot (FPU), are a very frequent pathology, especially in the context institutionalized patients, where its prevalence has been estimated from 8 to 27%,¹² depending on age, functionality, and other patient characteristics.^{11–13} Some studies report the heel as the second most common anatomical location for PU after sacrum, and that stages 1–2 represent nearly

half of all PU.^{12,14} However, most of these studies obtained these data from telematic surveys and clinical notes review, which raises the suspicion of a possible misclassification and under diagnosis.^{3,15}

The main objective of this study was to determine the incidence of FPU during hospitalization, as well as to assess main risk factors for FPU in hospitalised elderly subjects. Secondary objectives were to determine the prevalence of FPU at hospital admission and at hospital discharge, and to describe main FPU characteristics.

Material and methods

Study design and population

An observational prospective study was designed in which a cohort of patients 65 years of age or older were followed up from hospital admission to hospital discharge.

The study population included all patients ≥ 65 years old admitted in the orthopaedic, geriatric or vascular surgery departments in the hospital of Mataró (Barcelona, Spain). Patients with traumatic or surgical lesions on the foot at the time of admission or those with a hospitalization period of less than 72 h were excluded. All patients that fulfilled the selection criteria were consecutively recruited from March to July 2015. To obtain a minimum of 5 cases of FPU and assuming an incidence of approximately 3 cases/1000 person-days and an average hospital stays of 6 days, 280

patients were required. This sample size allows estimating an incidence rate with precision (95% CI) of ± 2 cases/1000 person-days. All participants gave their oral and written informed consent before recruitment and the study protocol was approved by the local ethics committee (CEIC CSdM 02/14).

Data gathering

FPU was diagnosed according to clinical criteria by well-trained and experienced nurses who registered the ulcer location (heel, back of the foot, *hallux* or internal or external faces of the foot) and its clinical classification according to the European Pressure Ulcer Advisory Panels (EPUAP)/National Pressure Ulcer Advisory Panel's (NPUAP) classification.¹⁶ It differentiates the following 4 stages: (a) stage I: erythema that does not disappear when the pressure stops, (b) stage II: clinker or fleecy skin, (c) stage III: loss of skin continuity or presence of scabies, and (d) stage IV: increase in the depth or extent of the ulcer or scar. Other study variables included socio-demographic characteristics (age, sex), risk of FPU according to the EMINA score, co-morbidities (such as diabetes, hypertension, heart attack, stroke, peripheral arterial disease, or chronic lung diseases), cardiovascular risk factors and physical examination on admission (weight, height, ankle-arm index). All recruited patients were followed and evaluated on a daily basis for possible new FPU from admission to discharge. No special intervention was done regarding the prevention of FPU as the aim of the study was to assess usual clinical practice, which, in our centre, includes the existence of specific prevention protocols, the availability of prevention measures (such as heel protectors), the use of risk assessment scales, and the training of personnel.

Statistical analysis

A descriptive analysis of the main characteristics of the study sample was done. As hospital stay was different for each patient, FPU incidence was estimated according to the density method with the formula: total number of new FPU observed/total person-day of hospitalization. The prevalence of FPU at admission and at discharge and their 95% CI were also estimated. These prevalence and incidence were estimated for the overall FPU and for the subtypes according to ulcer location and clinical degrees. To assess main risk factors associated with FPU, the *t*-test or the Mann–Whitney *U* test were used for numerical variables and the χ^2 test or the Fisher exact test were used for categorical ones. We used Odds Ratio (OR) as a measure of the association between FPU and different risk factors. OR were estimated through logistic regression analysis. A multivariate logistic regression analysis was performed to assess the independent effect of risk factors identified in the initial bivariate analysis. Statistical significance was stated at a $p < 0.05$. For the statistical analysis, the SPSS software was used (IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.).

Table 1 Main characteristics of the study sample.

	N = 299
	Mean (SD)
Body mass index (BMI)	27.5 (15.5)
N° co-morbidities	2.8 (1.6)
	n (%)
Tobacco: Never smoker	190 (63.5%)
Ex-smoker	93 (31.1%)
Occasional smoker	10 (3.3%)
Regular smoker	6 (2.0%)
Autonomous walking	220 (73.6%)
Outdoors life	178 (59.5%)
EMINA: No risk	19 (6.4%)
Low risk	83 (27.8%)
Moderate risk	139 (46.5%)
High risk	58 (19.4%)
Normal ankle-arm index	180 (87.4%)

Results

A total of 299 hospitalized patients were recruited, 113 males (37.8%) and 186 females (62.2%), with a mean age of 82.3 years (SD 8.0). [Table 1](#) summarizes main characteristics of the study sample. At admission 190 FPU were detected in 90 patients, which represent a prevalence of 30.1% and a mean of 0.64 ulcers per patient. At discharge 472 FPU were detected in 221 patients, which represent a prevalence of 73.9% and a mean of 1.58 ulcers per patient. During hospitalization, 295 new FPU were diagnosed, resulting an incidence of 9.51 new FPU/100 hospital stay days. Among these incident FPU, 288 (97.6%) were classified as stage 1 and 7 (2.4%) as stage 2, and 57.6% were in the heel, 13.1% in the external face, 11.8% in the hallux of the first toe, 7.1% in the back of the foot, 5.05% in the hallux of the 5th toe, 4.7% in the internal face and 0.68% in the toes. [Table 2](#) presents the prevalence of FPU at admission and at discharge and the incidence of FPU during hospitalization by location and stage.

None of the co-morbidities considered (hypertension, cancer, renal insufficiency, chronic liver disease, osteoarthritis, asthma, diabetes, stroke, ischaemic heart disease, heart failure, Parkinson disease, chronic bronchitis, cardiac arrhythmias, dyslipidaemia and depression) were associated with an increased risk of developing a new FPU. Patient's smoking habit and the ankle-arm index ratio were neither related with the appearance of new FPU during hospitalization. On the other hand, the EMINA scale accurately discriminate those patients with a higher risk of pressure ulcers, and age, nursing home origin and impaired mobility were identified as risk factors for FPU, while outdoor life and hours walking a day were identified as protective factors (see [Table 3](#)). Results of the multivariate analysis showed an independent effect of nursing home origin vs home origin (OR = 10.7; $p = 0.023$) and reduced mobility vs autonomous (OR = 2.8; $p = 0.001$). No independent effect of age, sex or hours walking outdoors a day was observed.

Table 2 Prevalence and incidence of Foot Pressure Ulcers by location and type.

N= 299	Prevalence at admission N (%); (IC95%)	Prevalence at discharge N (%); (IC95%)	Incidence during hospitalization (new FPU/100 hospital-days) (IC95%)
<i>Overall</i>	90 (30.1%); (25.3, 34.9)	221 (73.9%); (70.9, 76.9)	9.51 (8.4, 10.6)
<i>By location:</i>			
Heel	53 (17.7%); (12.5, 22.9)	203 (67.9%); (64.6, 71.2)	5.48 (4.7; 6.3)
Back of the foot	9 (3.0%); (0, 8.7)	27 (9.0%); (3.5, 14.5)	0.67 (0.4, 1.0)
Hallux first toe	41 (13.7%); (8.3, 19.1)	71 (23.7%); (18.7, 28.7)	1.12 (0.7, 1.5)
Hallux fifth toe	12 (4.0%); (1.7, 9.7)	25 (8.4%); (2.9, 13.9)	0.48 (0.2, 0.7)
External face of the foot	22 (7.4%); (1.8, 13.0)	67 (22.4%); (17.3, 27.5)	1.25 (0.9, 1.6)
Internal face of the foot	8 (2.7%); (0, 8.4)	19 (6.4%); (0.8, 12.0)	0.45 (0.2, 0.7)
<i>By stage:</i>			
I	70 (23.4%); (18.3, 28.5)	194 (64.9%); (61.5, 68.3)	9.22 (8.2, 10.3)
II	15 (5.0%); (0.6, 10.6)	20 (6.7%); (1.1, 12.3)	0.22 (0.1, 0.4)
III	4 (1.3%); (0, 7.0)	2 (0.9%); (0, 7.6)	0 (0, 0)
IV	0 (0%); (0, 0)	1 (0.3%); (0, 5.8)	0 (0, 0)

FPU: foot pressure ulcer.

Discussion

This study indicates a high prevalence of FPU at hospital admission and also a very high incidence of FPU in elderly people hospitalized in geriatric, orthopaedic or vascular surgery departments. Most of these new ulcers are classified as stage 1 and more than half are located in the heel. Moreover, this study also identifies age and previous reduced mobility as the main risk factors for developing a new FPU.

Regarding FPU prevalence, we observe a quite higher prevalence of FPU than some previously reported in other European countries, which ranges from 9 to 18%.^{17–21} However, other studies have reported a prevalence of up to 50%.²² These differences may be explained mainly because differences in the study populations. Our study population does not include all population admitted to a general acute hospital, but only those aged 65 years or older admitted in the Orthopaedic, Geriatric or Vascular Surgery departments, so the study was focused to high risk patients. Other explanation for these differences in FPU prevalence could be related with the difficulty to diagnose stage 1 pressure ulcers, with poor concordance between observers²³ because differences in diagnostic criteria, training, experience, or in the intensity of diagnostic search for ulcers. While in our study an active search for ulcers was done, most other

studies are based on revision of reported pressure ulcers in clinical notes according to usual clinical care assessments. When physicians or nurses look for ulcers, many more ulcers appear, especially stage 1 ulcer, which can be usually unnoticed. The observed prevalence agrees with the suspicious of some professionals that FPU is under diagnosed.

Regarding FPU incidence, we have also observed a high incidence rate during hospitalization that reaches 9.5 new cases per 100 hospital days. Obviously, the great majority of these incident (new) FPU are stage 1 ulcers, which not represent an imminent hazard or danger to health if they are identified and treated early, but that can rapidly evolve to more severe stages if not treated accurately. Other authors have assessed the incidence of pressure ulcers in hospitalized elderly patients. Campbell et al. reported an incidence of 13 new cases per 100 patients during hospitalization in elderly subjects submitted for elective orthopaedic surgery or treatment of hip fractures.²⁴ On the other hand, Forni et al. observed that 17.6% of patients treated with leg cast developed a pressure sore²⁵ and Okuwa et al. reported a FPU incidence of 16.8 new ulcers per 100 persons-year in bedfast older adult patients.²⁶ We consider that this is an unacceptable situation that requires urgent attention. Taking into account that pressure ulcers are considered preventable in most cases and that they affect patient's safety

Table 3 Risk factors for foot pressure ulcers in hospitalized elderly subjects.

	Patients without new FPU	Patients with new FPU	<i>P</i>	OR (95% CI)	RR (95%CI)
<i>Sex (% females)^a</i>	65(55.6%)	119 (66.1%)	0.067	1.56 (0.97–2.52)	3.23 (2.41–4.32)
<i>Age (years)</i>	80.5(7.3)	83.4 (8.2)	0.002	1.05 (1.02–1.08)	–
<i>Department:</i>					
Orthopaedics	67 (57.3%)	99 (55.0%)	0.516	1	1
Vascular surg.	14 (12.0%)	16 (8.9%)		0.77 (0.35–1.69)	0.57 (0.35–0.93)
Geriatrics	36 (30.8%)	65 (36.1%)		1.22 (0.73–2.04)	1.08 (0.95–1.23)
<i>Origin:</i>					
Home	110 (94.0%)	148 (82.2%)	0.003	0.29 (0.13–0.69)	0.90 (0.62–1.32)
Nursing home	7 (6.0%)	32 (17.8%)		1	1
Number of co-morbidities	2.9 (1.7)	2.8 (1.5)	0.602	0.94 (0.81–1.09)	–
Outdoor life	82 (70.1%)	96 (53.3%)	0.004	0.49 (0.30–0.80)	0.90 (0.67–1.21)
Hours walking/day	1.7 (1.5)	1.1 (1.6)	<0.001	0.76 (0.64–0.89)	–
<i>Mobility:</i>					
Autonomous	48 (41.0%)	29 (16.1%)	<0.001	1	1
Reduced	62 (53.0%)	136 (75.6%)		3.63 (2.09–6.29)	1.77 (1.19–2.63)
In bed	7 (6.0%)	15 (8.3%)		3.55 (1.29–9.73)	1.31 (0.58–2.97)
<i>EMINA:</i>					
No risk	13 (11.1%)	6 (3.3%)	<0.001	1	1
Low risk	45 (38.5%)	38 (21.1%)		1.83 (0.63–5.28)	1.48 (0.74–2.96)
Moderate risk	40 (34.2%)	98 (54.4%)		5.31 (1.89–14.9)	2.02 (1.03–3.96)
High risk	19 (16.2%)	38 (21.1%)		4.33 (1.42–13.2)	1.62 (0.24–10.72)
FPU at admission	40 (36.4%)	50 (29.2%)	0.212	0.72 (0.44–1.20)	0.81 (0.59–1.13)

FPU: Foot Pressure Ulcer. Numerical variables are expressed as means (SD) and categorical variables as *n* (%).^a Reference category: Men.

and quality of life, but also the quality of health care, we alert that this is a situation that clearly needs improvement. The first step to improve it could be increasing awareness about this health problem among professionals, and offering good training on this issue, especially in identifying and diagnosing pressure ulcers and on preventing measures. The high incidence of FPU observed may be explained by the infrequent use of preventive measures in high risk patients. Guidelines recommend the use of a valid risk assessment scale together with skin assessment¹⁶ on admission with reassessments when health condition changes during hospitalization. Bedridden patients must be daily reassessed. Strict implementation of such recommendations could probably reduce FPU incidence, complications and hospital stays.

In relation to the risk factors for FPU, the present study has identified age, nursing home origin, no outdoor life, poor physical activity and poor mobility main risk factors for pressure ulcers. These results clearly agree with the well-established knowledge indicating that pressure ulcers occur in patients with reduced mobility in who a pressure is exerted on the skin, generally on a bony prominence, for prolonged time, resulting an obstructed blood flow and necrosis. These results reinforce the importance of mobilizations in those patients with reduced mobility. This is an observational study in which the use of foot protectors has not been registered, so its effect on the incidence of FPU has not been assessed. However, some evidence indicate that the use of protectors and other devices to reduce the pressure in skin risk areas may be effective to prevent pressure ulcers.^{27,28} All risk factors identified in this study are related with and are indicative of frailty, a geriatric syndrome characterized by a functional decrease of different organs and systems that lead to an increased vulnerability to external stressors or aggressions.²⁹ Frail elderly subjects are more likely to suffer pressure ulcers, which can be especially difficult to treat and prevent when impaired mobility is present. On the other hand, pressure ulcers occurred in elderly subjects because a relatively short period of bedding may reduce physical activity because of pain, favouring frailty. The relationship between pressure ulcers and frailty has been poorly studied and requires further attention. It should be noted that, in the present study, co-morbidities and the ankle-arm index were not related with FPU, suggesting that pressure ulcers cannot be attributed to previous ischaemic pathology but other personal and health care factors. Hospital care must put more attention to meet the needs of vulnerable patients.^{30,31} The most frequent location for FPU is the heel. This is consistent with the literature and is explained by the usual patient's position when lying or sitting with the heels in contact with the bed or the ground suffering the pressure of the lower limbs weight. The heel is a fundamental area to protect but not the only one, since more than 40% of the FPU are located in other foot areas. The second most frequent location is in the external lateral face, followed by the hallux of the first toe. The ulcers located in the back of the foot represent 7% of the FPU. They are considered iatrogenic and due to a tight closure on the protector's subjection system. There is an urgent need for new foot protector designs, which protect all the foot and minimizes iatrogenia.

Main study limitations include: (a) the relative small sample size, which compromise the statistical power to detect the effect of some factors such as sex or physical

exercise with p values between 0.05 and 0.10, or arterial hypertension, ischaemic heart disease, dyslipidemia or lack of autonomy to walk, with p values between 0.10 and 0.20; (b) the study population is restricted to patients ≥ 65 years old admitted in the Orthopaedic, Geriatric or Vascular Surgery departments, considered high risk patients, so results cannot be extrapolated to all ≥ 65 years old hospitalized patients and even less in general population ≥ 65 years old, (c) the reduced number of risk factors considered and especially the lack of registration of the use of foot protectors or other preventive measures, which do not allow to assess their effect on FPU prevention, and (d) the assessment and diagnosis of pressure ulcers, especially those of grade 1, may depend on the experience and training of healthcare professional. The existence of two independent evaluators and the assessment of the agreement between them would be desirable, but this procedure was not performed in the study. Even so, since evaluators were expert nurses, with experience and specific training in the diagnosis of pressure ulcers, we believe that FPU miss-classifications were minimal.

In conclusion, incidence of FPU in hospitalised high-risk elderly subjects is still very high. With an active search of cases, our study has found an unacceptably incidence rate, mainly at the expense of grade 1 ulcers. This suggests that without a proactive attitude it is possible that many of these ulcers go unnoticed and are not diagnosed, and that more attention must be paid in the prevention of pressure ulcers in hospitalized frail subjects. This study also corroborated that nursing home residence and lack of mobility, physical exercise and outdoor life are risk factors for FPU. Further research is needed to design and assess new preventive strategies.

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Conflict of interest

All authors declare that they have no conflict of interest in relation with the present study.

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