AGING AND BURN: A FIVE-YEAR RETROSPECTIVE STUDY IN A MAJOR BURN CENTRE IN PORTUGAL

BRÛLURE DU SUJET ÂGÉ: UNE ÉTUDE RÉTROSPECTIVE SUR CINQ ANS DANS UN CTB PORTUGAIS

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SUMMARY. Aging is an important factor contributing decisively to the clinical outcome of burn patients. The aim of this study was to assess the characteristics of patients admitted to a Burn Unit and determine the impact of aging on mortality. A retrospective analysis of patients successively admitted to a major burn centre in Portugal from 1/1/2012 to 31/12/2016 was conducted. They were divided into 2 groups: "elderly" (≥65 years) and "non-elderly" (<65 years). A total of 736 patients were included, 324 of them classified as elderly with a mean age of 78.12±7.14 years. Most of the patients in the elderly group were female (59.6%), in contrast to the non-elderly group (35%; p<0.001). The elderly patients had a higher mean length of hospital stay (20.14±18.46 days; p=0.011). Most of the burns were caused by fire (58.3%) and scalding (36.1%) and mainly after home accidents. Elderly patients showed a higher mean of burn severity index (7.26; p<0.001) and 6.8% needed an amputation. Mortality rate was significantly higher in the elderly group (11.7%; p=0.001). Age (p<0.001; OR=1.169), a higher total burn surface area (p<0.001; OR=1.081), full-thickness burns (p=0.005; OR=11.985) and the need for mechanical ventilation (p<0.001; OR=16.856) were associated with a higher mortality risk and reached statistical significance after multivariate analysis. The functional and vital prognosis of patients admitted to a burn centre is affected by multiple factors. This study showed that age, higher TBSA, full-thickness burns and need for mechanical ventilation seem to increase the risk of mortality.

Keywords: burn, aging, epidemiology, mortality

RÉSUMÉ. *L'âge avancé est un facteur déterminant du devenir d'un patient brûlé. Le but de cette étude rétrospective était d'évaluer les caractéristiques des patients admis dans notre CTB entre le 1/1/2012 et le 31/12/2016 et de déterminer les conséquences de l'âge sur la mortalité. Il étaient divisé en groupe "senior", S ((≥65 ans) et "non senior", NS (< 65 ans). Trois cent vingt quatre des 736 patients étaient S. Dans ce groupe, l'âge moyen était de 78,12 +/- 18 ans. Dans le groupe S, les femmes étaient surreprésentées (59,6%) comparativement au groupe NS (35%, p < 0,001). Les patients S restaient plus longtemps à l'hôpital (20,14 +/- 18,46 j ; p = 0,011). Les brûlures par flamme (58,3%) étaient plus fréquentes que les ébouillantements (36,1%). Elles provenaient le plus souvent d'un accident domestique. L'ABSI (7,26) était plus élevé dans le groupe S (p < 0,001). L'âge (OR 1,169 ; p < 0,001), l'augmentation de la SB (OR 1,081 ; p < 0,001), la présence de brûlures profondes (OR 11,985 ; p = 0,005) et la nécessité de ventilation mécanique (OR 16,856 ; p < 0,001) étaient, en analyse multivariées, associés à la mortalité. Les pronostics vital et fonctionnel des patients admis en CTB sont associés à de multiples paramètres. Cette étude montre que l'âge, la surface brûlée, la présence de brûlures profondes et la nécessité de recours à la ventilation mécanique augmentent le risque létal.*

Mots-clés : *brûlure, vieillesse, épidémiologie, mortalité*

Introduction

Burn injuries are frequently associated with high mortality and morbidity. Although their incidence is higher in developing countries, they are responsible for about 3500 deaths/year in the USA and 800 to 1000 deaths/year in France.[1] Burns are also a source of important sequelae. About 10 million individuals/year will present with some associated physical impairment related to burn trauma.[1] The direct costs associated with treatment and complications, as well as the indirect costs for the population, represent a considerable challenge to any health care system.

Although their causative mechanism may be complex, thermal burns (by fire, hot liquids and/or explosives) associated with domestic accidents are the most common type of burn injuries. 15-20% of burns occur as a result of occupational accidents, 7% are self-inflicted and about 4% occur in the context of aggression.[2] Professionally active individuals are more likely to be injured by electrical and chemical burns.[3]

Statistics show that the prevalence of burn injuries is higher among elderly men, typically living in rural and poor areas.[4] Age is an important non-modifiable risk factor, with the elderly population presenting itself as a unique challenge in a Burn Unit. Older people have worst pre-morbid functional status, with associated medical morbidities and greater physical, psychological and social dependence, leading to specific needs during treatment and in the post-discharge period.[5] As the population ages, a rise in the number of accidents related to burns is expected.

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The key to reducing the number and the impact of burns in our society is to implement preventive measures across the population, taking into account the particularities of different age groups.

The aim of this study was to assess the characteristics of patients admitted to Coimbra Burn Unit (CBU) in Portugal with the diagnosis of burn injury, and to determine the impact of aging on mortality.

Materials and methods

In this retrospective observational study, the authors analyzed the medical records of all patients admitted to Coimbra Burn Unit with the diagnosis of burn injury, between 1st January 2012 and 31st December 2016. Incomplete records and records from patients who abandoned hospital against medical advice were excluded. CBU only admits patients aged 18 or older.

The patients were divided into two groups: "elderly" (≥ 65 years) and "non-elderly" (< 65 years) according to the definition of WHO.[6]

Demographic data, aetiology, context and mechanism of injury, total burn surface area (TBSA), abbreviated burn severity index (ABSI), depth of burns, amputations, ventilation status during hospitalization, length of hospital stay (LOS), destination after discharge and mortality were analyzed and a comparison was made between the groups. The presence of any active medical history or habit (tobacco or ethyl) was considered relevant as comorbidity.

All continuous variables were presented as mean±standard deviation (SD), and the frequencies of categorical variables as percentages. Statistical data were analyzed with the Mann-Whitney U and Chi-square tests, as appropriate. Both univariate and multivariate analyses were employed to determine the relative influence of the studied variables on mortality. A p value <0.05 was considered statistically significant.

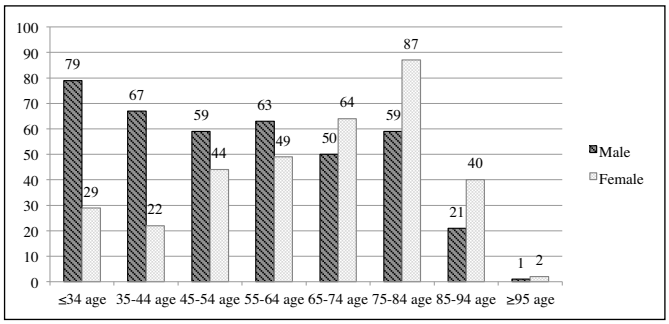

Fig. 1 - Gender and age distribution of patients with burns

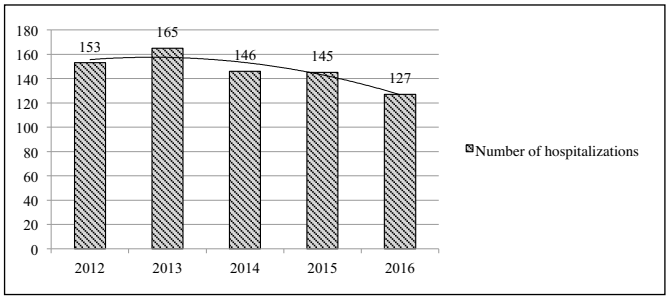

Fig. 2 - Number of hospitalizations during our study

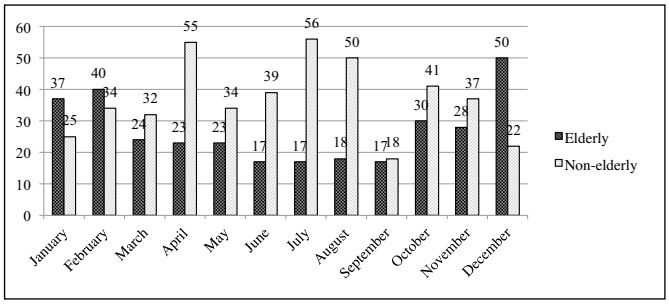

Fig. 3 - Period of hospitalizations

Results

During the 5-year study period, 736 patients were admitted to our unit, 44% (n=324) of whom were considered elderly. The majority of patients in the elderly group were women (59.6%) and the mean age in this group was 78.12±7.14 years. In the under 65s group (n=412), 65% of patients were men and the mean age was 44.18±12.92 years (*Table I*). Age and gender data are shown in *Fig. 1*. As expected, the patients in the elderly group had a higher prevalence of comorbidities in comparison to the non-elderly group (82.4% vs. 56.6%; p<0.001) (*Table I*).

During the study, there was a trend towards a reduction in the number of hospitalized patients, with a greater number of admissions in 2013 (n=165) and the lowest number in 2016 (n=127) (*Fig. 2*).

As shown in *Fig. 3*, burn injuries were more prevalent in the elderly population during the winter months (from December to February), as opposed to the non-elderly group in which the incidence of admissions was higher in warmer months (July and August).

The mechanism and context of injury were slightly different depending on the age group. In both groups, but mainly in the elderly, the majority of burns occurred in the context of home accidents (96.6% vs. 66.3% in the non-elderly group, p<0.001). However, in the non-elderly group 28.6% of the burns occurred as a work-related accident (vs. 0.6%: p<0.001). Burn injuries were mostly caused by fire and hot liquids. The third and fourth largest causes of burns in the non-elderly group were electrical burns and chemical burns, happening mainly as work-related accidents. In the elderly group, these types of burns represent less than 2% of all cases (*Table I*).

Mean TBSA was significantly lower in the over 65s group (11.00±13.13% vs. 13.10±14.22%; p=0.002). On the other hand, the mean value of ABSI was significantly higher in the elderly group (7.26 vs. 5.57; p< 0.001) as was the prevalence of patients with full-thickness burns (56.5% vs. 47.1%; p=0.007) (*Table I*).

Inhalation injury was more prevalent in the non-elderly group (15% vs. 9.3%; p=0.012). However, the need for endotracheal intubation and mechanical ventilation support was similar in both groups (*Table I*). Regarding the need for amputation during hospitalization, a statistically significant difference between the groups was not found. However, there was a trend towards a higher prevalence of amputation in the elderly. The most frequent amputations were transmetacarpal (n=9), followed by disarticulation of the wrist (n=3), transmetatarsal (n=3), transmetacarpal (n=3) and transfemoral (n=3) (*Table II*).

Statistically significant differences were found regarding destination after discharge. Most under 65s were discharged home (57.8% vs. 40.1%; p<0.001), followed by transfer to an-

Table I – Comparison between Elderly and Non-Elderly

	Elderly (n=324)	Non-elderly (n=412)	*P*
Gender			**<0.001**
Female (%)	59.6%	35.0%	
Male (%)	40.4%	65.0%	
Age	78.12±7.14	44.18±12.92	-
Comorbidities	82.4%	56.6%	**<0.001**
TBSA (%)	11.00±13.13	13.10±14.22	**0.002**
ABSI	7.26±1.71	5.57±1.93	**<0.001**
Full-thickness burn	56.5%	47.1%	**0.007**
LOS	20.14±18.46	16.89±16.61	**0.011**
Inhalation injury	9.3%	15.0%	**0.012**
Mechanical ventilation	20.4%	20.6%	N.S
Context			
Domestic accident	96.6%	66.3%	**<0.001**
Work-related	0.6%	28.6%	**<0.001**
Self-inflicted	1.5%	1.7%	N.S.
Others	0.9%	3.4%	N.S.
Etiology			
Fire	58.3%	55.8%	N.S.
Boiling liquid	36.1%	26.9%	**0.005**
Electric b.	0.6%	8.5%	**<0.001**
Chemical b.	0.9%	6.1%	**<0.001**
Others	4.0%	2.6%	N.S.
Destination			
Residence	40.1%	57.8%	**<0.001**
Hospital transfer	28.1%	27.2%	N.S.
Transfer to another service	14.2%	10.9%	N.S.
Homecare	5.9%	0.7%	**<0.001**
Mortality	11.7%	3.4%	**<0.001**
Amputation	6.8%	4.1%	N.S.

Table II – Summary of amputations required

Amputated structure	Elderly (n=22)	Non-Elderly (n=17)
Transhumeral	1	2
Wrist disarticulation	3	-
Transmetacarpal	9	11
Transfemoral	3	-
Transtibial	2	-
Ankle disarticulation	1	1
Transmetatarsal	3	3

other hospital (27.2%) and transfer to another service in the same hospital (10.9%). A significant number of over 65s were discharged to a nursing home facility (5.9% vs. 0.7%; p<0.001).

The elderly group had a significantly higher mortality rate (11.7% vs. 3.4%; p<0.001) and significantly longer hospital stays (p=0011) (*Table I*). Regarding mortality, there was a trend towards a decrease in the overall mortality rate during the study, being higher in the year 2012 (n=20) and lower in 2016 (n=6) (*Fig. 4*).

As a significantly higher mortality rate was found in the elderly group, the authors decided to evaluate the risk factors for death in this group. In the elderly patients, mean age (82.00±5.95 vs. 77.60±8.19) and TBSA (30.01±23.82 vs. 8.48±8.19) were significantly higher in deceased patients compared to survivors (p<0.001). Patients with inhalation injury (p<0.001, RR 5.018), with deeper depth of burn (p<0.001;

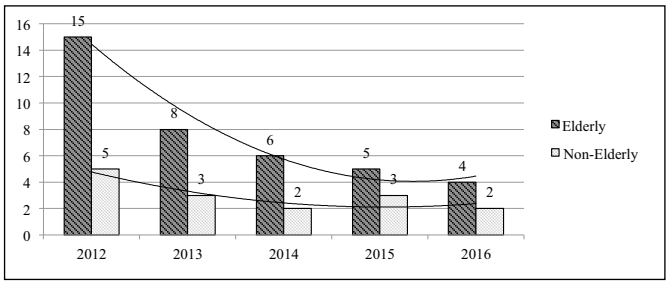

Fig. 4 - Mortality during our study

RR=1.843) and patients who needed mechanical ventilation support during hospitalization (p<0.001; RR=6.667) had a higher mortality risk. A similar conclusion can be made regarding patients who suffered from burns by fire (p<0.001: RR 8.333) (*Table III*).

When we assessed the impact of the variables independently and after adjusting for the variables studied, through logistic regression, we found that the mortality risk was higher in older patients (p<0.001; OR 1.169), in patients with higher TBSA (p<0.001; OR 1.081), with full-thickness burns (p=0.005; OR=11.985) and who needed mechanical ventilation (p<0.001; OR=16.856) (*Table IV*).

Table III – Risk factors for mortality in the elderly

	Survivors (n=286)	Deaths (n=38)	*P*	RR
Gender			N.S	-
Female (%)	60.1%	55.3%		-
Male (%)	30.9%	44.7%		-
Age	77.60±7.14	82.00±5.95	**<0.001**	-
Comorbidities	83.2%	76.3%	N.S	**-**
TBSA (%)	8.48±8.19	30.01±23.82	**<0.001**	**-**
ABSI	6.91±1.20	9.84±2.59	**<0.001**	**-**
Full-thickness burn	51.4%	94.7%	**<0.001**	**1.843**
Inhalation injury	6.3%	31.6%	**<0.001**	**5.018**
Mechanical ventilation	12.2%	81.6%	**<0.001**	**6.666**
Context				
Domestic accident	96.9%	97.4%	N.S	**-**
Work-related	0.7%	-	-	**-**
Self-inflicted	1.4%	2.6%	N.S.	-
Others	1.0%	-	-	-
Etiology				
Fire	53.8%	92.1%	**<0.001**	**8.333**
Boiling liquid	40.2%	5.3%	**<0.001**	**0.098**
Electric b.	0.7%	-	-	**-**
Chemical b.	1.0%	-	-	**-**
Others	4.1%	2.6%	N.S.	-

Table IV – Mortality Risk Factors: multivariate analysis

	P Value	Adjusted OR
Age	<0.001	1.169
TBSA	<0.001	1.081
Full-thickness burn	0.005	11.985
Inhalation injury	0.109	2.957
Mechanical ventilation	<0.001	16.856
Fire burns	0.235	2.728

Discussion

In the present sample, the prevalence of admissions among the elderly population was 44%, which was higher when compared to other studies.[7,8] Although traumatic injuries, including burns, typically occur in younger and active individuals, the deficits associated with aging are related to a greater exposure to precipitating factors of trauma. The effects of age on neurological function, vision and mobility cause a decrease in alertness and in the response to sensitivity stimuli, which lead to a high risk of burn injury in the elderly.[9,10] The aging of the population in developed countries will certainly make this reality more evident in the near future and will become a real public health issue. In Portugal, the elderly population has practically tripled in the last 50 years, reaching 19% in 2011.[11]

Elderly women presented a higher incidence of burns (59.6%), which is in line with the results of Herd et al.[10] The longer life expectancy of women associated with the aging process may result in a greater risk of injury. On the other hand, in the non-elderly population, men were burned in a higher proportion, probably reflecting their greater exposure to risky activities.[12] Despite the fact a significant number of elderly patients with comorbidities (82.4%) was found, surprisingly no significance in their relationship with mortality was detected, most likely due to the number of deceased patients (n=38) and to the very high prevalence of comorbidities in the general elderly population.

The context and nature of burns also differed between the elderly and non-elderly population. In the elderly population, burns requiring hospitalization were more common in the fall and winter months, mainly due to accidents at home caused mostly by fire and scalding. The longer time spent at home associated with domestic activities, such as cooking, bathing and fireplace manipulation, can help explain this fact. On the other hand, in the younger population, the majority of burns occurred in the spring and summer period, with a significant percentage occurring in the workplace. These burns were caused mainly by fire (55.8%), hot liquids (26.9%), electricity (8.5%) and chemical derivatives (6.1%). These results are supported by the literature, which relates the occurrence of forest fires and the more frequent use of electrical equipment as responsible for the increase in the incidence of burns in the warmer months among the active population.[12-15]

This study demonstrated a decrease, albeit slight, in the number of hospitalizations from 2012 (n=153) to 2016 (n=127), which may reflect the implementation of population-based education and information programs. The elderly group had a significantly longer length of hospital stay in comparison to the non-elderly group, and despite having a lower mean TBSA, the majority presented greater depth of burns. This may be explained by several factors: decreased functional capacity, associated with greater physical and psychological dependence, leads to a lesser response to injury and greater difficulty of recovery, suggesting that the lesions may be more aggressive in the elderly.[16] In addition, greater need for nursing care and rehabilitation programs makes this population susceptible to longer and more expensive hospitalizations with higher risk for complications. These data are consistent with other reports in the literature.[17]

One of the most serious complications in the burn patient, with great impact on functionality, is the need for amputations. The overall amputation rate was 5.3% in this sample, being higher in the elderly men. This value is higher than the one found in international studies in which the amputation rate varies between 1.9%-2%.[18] This may be explained by the large number of elderly patients with relevant co-morbidities.

Although 40.1% of patients over 65 years old were discharged home, a significant number of elderly people (5.9%) were discharged to a nursing care facility. These findings were already suggested in studies from other countries.[19,20] Abu-Sittah et al. show that elderly people discharged to nursing care facilities have higher rates of rehospitalization and long-term complications.[21]

In this study, mortality decreased from 2012 (n=12) to 2016 (n=6), probably reflecting the improvement in health care and preparation for treatment of the burn patient. The most affected population was the elderly one, with a mortality rate of 11.7%, a value that is in line with the rates described in several international studies, in which mortality varies between 0.9-54.2%. However, mortality rate in the elderly group was lower than that found in another study carried out in Portugal (24.6%).[22,23] The higher mortality in the elderly when compared to the general population for a given percentage of burn is well known.[12,24]

Burns by fire and inhalation injury appear to be related to mortality, although they did not reach statistical significance after logistic regression. Mabrouk et al. reported that 23.7% of the elderly collapsed when burned by fire, which translated into an increased risk for mortality.[7] The relationship between inhalation injuries and respiratory failure and mortality is also known.[16] Shirani et al. estimate that mortality increases by 20% compared to patients without inhalation injury.[25]

The deceased elderlies were significantly older and had a higher mean TBSA and higher prevalence of full-thickness burns when compared to survivors. A risk increase of 1.169 for each year of age was found in those over 65 years old, of 1.081 for each 1% increase in TBSA and a risk increase of 11.985 in patients with deeper lesions, after adjustment. These facts are consistent with those found in other studies.[10,21,26] Greater extent and depth of burns is related to their higher aggressiveness and, as such, to greater complications, as suggested by Albornoz et al.[27]

A similar conclusion can be made for the elderly who needed mechanical ventilation during their hospital stay. Its use requires rigorous clinical criteria. If in an initial phase its use could be life-saving, its indiscriminate use could translate into high mortality in the elderly.[28]

The main limitations of this study are its retrospective character, and the fact that follow-up was not performed in order to obtain information about delayed complications and adverse effects of burn injury on the quality of life.

Conclusion

The effects of burns are more significant in the elderly patient, being associated with longer hospitalization periods and complications such as amputations and mortality. The prognosis of an elderly burn patient is essentially related to their age, extent and depth of burns, and the use of mechanical ventilation. The epidemiological and etiological differences found between elderly and non-elderly patients showed the need to apply and reinforce educational programs for the prevention of burns, specified for the different age groups.

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Conflict of interest. The authors certify that they have no conflict of interest to declare.