OUTCOME AND RISK FACTORS FOR DEATH OF ELDERLY BURN PATIENTS: A CASE SERIES IN VIETNAM

ÉVOLUTION ET FACTEURS DE RISQUE DE MORTALITÉ CHEZ LES BRÛLÉS ÂGÉS : UNE SÉRIE VIETNAMIENNE

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SUMMARY. The aim of this study is to investigate characteristics, outcome and risk factors for death among elderly burn patients. A retrospective study was conducted on 416 elderly (≥ 65 years old) burn patients admitted to the National Burn Hospital, Hanoi, Vietnam from 1/1/2016 to 31/12/2018. Data on demographics, comorbidity, burn severity, complications and mortality were recorded. Bivariate and multivariate analyses were conducted to determine independent risk factors for death. Results indicated that elderly burn patients accounted for 4.2% of total admitted patients with an average age of 74.7 ± 8.1 years old. Significantly higher burn surface area (12.4% vs. 7.3%; $p < .001$) and deep burn area (5.5% vs. 2.5%; $p < .001$) were seen in the female group when compared to the male group. Pre-existing medical conditions were recorded in 20.9% of patients, the highest proportion (13.2%) represented by cardiovascular disease followed by neurological and diabetic disease (8.7% and 7% respectively). Over half (51.5%) of the patients had suffered deep burn and 6.3% developed complications, the most common being multiple organ failure and pneumonia. Overall mortality rate was 9.9%. However, death rate was extremely high in patients with inhalation injury (92.9%), burn extent > 40% total body surface area (TBSA) and deep burn > 10% TBSA (61.2% and 62.5% respectively). Comorbidity was not an independent risk factor for death, unlike increased age, burn extent and presence of inhalation injury. In conclusion, we show that despite advances in management, severe burn and inhalation injury in the elderly remains a big challenge in Vietnam.

Keywords: elderly, burn injury, risk factor, mortality

RÉSUMÉ. *Le but de cette étude est d'évaluer les caractéristiques, l'évolution et les facteurs de risque de décès chez des personnes âgées brûlées. Il s'agit d'une étude rétrospective concernant 416 patients âgés (≥ 65 ans) hospitalisés dans l'hôpital brûlologique national de Hanoi entre le 1/1/2016 et le 31/12/2018. Les données démographiques, comorbidités, sévérité de la brûlure, complications et mortalité ont été recueillies. Des analyses uni- et multivariées ont été réalisées pour rechercher les facteurs de risque de mortalité. Les patients âgés (74,7 +/- 8,1 ans) représentent 4,2% des admissions. Chez les femmes, la surface atteinte (12,4 VS 7,3% ; $p < 0,001$) et la surface profonde (5,5 VS 2,5% ; $p < 0,001$) sont plus étendues que chez les hommes. Des antécédents ont été notés chez 20,9% des patients. Ils étaient le plus souvent cardio-vasculaires (13,2%), neurologiques (8,7%) et diabétiques (7%). Plus de la moitié (51,5%) des patients avaient des brûlures profondes et 6,3% d'entre eux ont subi des complications, le plus souvent pneumonie et défaillance multiviscérale. La mortalité globale était de 9,9%. Elle était considérablement plus élevée en cas d'inhalation de fumées (92,9%), quand la surface totale dépassait 40% (61,2%) et quand plus de 10% de surface était profonde (62,5%). En analyse multivariée, les comorbidités ne sortaient pas, à la différence de l'âge, de la surface brûlée et de l'inhalation de fumées. Malgré les progrès de prise en charge, les brûlures étendues avec inhalation de fumées restent un gros défi au Vietnam.*

Mots-clés : *vieillesse, brûlure, mortalité, facteurs de risque*
NDRLF: Âge + Surface + Fumées, c'est l'index de Baux modifié

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Introduction

Alongside advances in science and technology, population longevity has steadily increased, resulting in a rising elderly population. Previous studies have indicated that age is a major prognostic factor following injury, including burn injuries.[1,2] The worst outcomes are recorded for the elderly, followed by adults and children. The elderly are predominantly prone to trauma, including burn injury, due to their reduced reflex response and ability to escape from a harmful environment. Elderly people have thinning skin, impaired sensation and mental alterations, pre-existing medical conditions and impaired immune response, which result in worsened outcome after burn injuries.[3] Current reports reveal that mortality among elderly burn patients ranges from 7.4 to 66%.[4,5,6] Vietnam is a developing country with a population of 95 million and a growing ageing population. Few reports on elderly burn patients in developing countries have been published.[7,8,9] This study investigates characteristics, outcome and risk factors for death from burn injuries among elderly patients admitted to the Vietnam National Burns Hospital over three years (2016 - 2018).

Materials and methods

A retrospective study was conducted on 416 elderly burn patients (≥ 65 years old) among the 9946 burn patients admitted to the National Burn Hospital in Hanoi, Vietnam from 1/1/2016 to 31/12/2018. Demographic data including age, gender and residential location (rural or urban area), burn surface area and full thickness burn area were recorded. Burn severity was classified using American Burn Association (ABA) criteria.[10] Comorbidity was classified as cardiovascular disease (hypertension, myocardial infarction, arrhythmia...), diabetes, neurological disease (stroke, epilepsy, spinal diseases and post trauma…), respiratory disease and others. Outcomes measured included complication and mortality. Data were collected and tabulated then bivariate and multivariate analyses were conducted to determine independent risk factors for death using Stata software version 11.0, with p value < .05 regarded as the significant level. This study was approved by the hospital's Committee for Human Research Ethics.

Results

Over three years from 2016 to 2018, 9946 burn patients were admitted to the National Burn Hospital. A total of 416 of these patients were 65 years old and over, accounting for 4.2%, the average age being 74.7 ± 8.1, ranging from 65 to 99 years old. Half of the patients were male and 60.8% lived in the countryside. Minor and moderate burns (burn surface area less than 10%) were recorded in 72.6% of the patients and 51.5% of the elderly patients suffered from deep burn injury (*Table I*). In addition, inhalation injury was diagnosed in 14 (3.4%) patients and comorbidity was recorded in 87 (20.9%) patients with an overall mortality rate of 9.9%. The most common causal agent was dry heat (48.3%) followed by humid heat (39.9%), electricity and chemical agents. Burn occurred more often in the spring and the winter (30.5% and 28.1% respectively). Length of hospital stay for survivors was 16.1 ± 13.3 days.

There was no remarkable difference in incidence of inhalation injury between male and female patients *(Table II)* but significantly higher burn surface area (12.4% vs.7.3%; p < .001) and deep burn area (5.5% vs. 2.5%; p < .001) were recorded among the female group.

Regarding pre-existing medical conditions, the highest proportion (13.2%) was represented by cardiovascular disease (hypertension, cardiac fraction…) followed by neurological diseases and diabetes (8.7% and 7% respectively). In addition, 16 patients, accounting for 3.9% of the total, suffered from at least 2 medical conditions at the time of admission *(Table III)*.

Among the 416 elderly patients, 26 (6.3%) developed complications, the most common (data not shown) being multiple organ failure (4.1%), pneumonia (4.1%) and septic shock (2.9%). More complications were recorded amongst patients

over 80 years old (12.4% vs. 4%; p = .002), with inhalation injury (57.2% vs. 4.5%; p < .01), increased burn extent and deep burn area (p < .01). Gender and comorbidity did not remarkably affect death rate (*Table IV*).

The relationship between mortality rate and patient demographics, burn severity and morbidity is indicated in *Table V*. A significantly higher mortality rate was recorded in the group of patients ≥ 80 years old (18.6% vs. 6.6%; p = .001), male

Table I - Patient demographic data (n = 416)

Criteria	Subgroup	N	%
Gender	**Female**	208	50
	Male	208	50
Residential location	**Rural area**	253	60.8
	Urban area	163	39.2
Causal agents	**Humid heat**	166	39.9
	Dry heat	201	48.3
	Electricity	41	9.9
	Chemical agents	8	1.9
Season	**Spring**	125	30.5
	Summer	82	19.7
	Autumn	92	22.1
	Winter	117	28.1
Age (years)	**65 – 79**	303	72.8
	80 – 99	113	27.2
	Mean	74.7 ± 8.1 (65 – 99)	
Burn surface area, % TBSA	**≤ 10**	302	72.6
	11 – 20	58	13.9
	21 – 40	38	9.1
	> 40	18	4.3
	Mean	9.9 ± 14.5	
Deep burn surface area, % TBSA	**Partial injury**	206	49.5
	1- 5	131	31.5
	6 – 10	31	7.5
	> 10	48	11.5
	Mean	4 ± 9.2 (0 – 90)	
Inhalation injury		14	3.4
Pre-existing medical condition		87	20.9
Hospitalization, day (min – max)		16.1 ± 13.3 (5 – 92)	
Death		41	9.9

TBSA = total body surface area

Table II - Distribution of burn extent and inhalation injury by patient gender

Criteria	Female	Male	P
Burn surface area, %	7.3 ± 9.1	12.4 ± 18.1	.001
Deep burn area, %	2.5 ± 5.0	5.5 ± 11.8	.001
Inhalation injury, n (%)	4 (1.9)	10 (4.1)	.10

(13.5% vs. 6.4%; p = .014). Moreover, death rate also proportionally increased with increased burn surface area and deep burn area (p < .01). In addition, mortality rate was extremely high in patients with inhalation injury (92.7% vs. 7%; p = .001) or burn extent > 40% or deep burn area > 10% TBSA. Residential location as well as admission comorbidity did not significantly influence mortality rate (p > .05).

Table VI indicates the results of multivariate logistic analysis for death and selected variables including age, gender, burn extent, deep burn area and inhalation injury. Apart from gender, all the mentioned variables were independent risk factors affecting mortality rate amongst elderly patients. Each year of increased age, burn surface area, and deep burn area resulted in increased probability of death of 0.12, 0.07 and 0.12 units respectively. Presence of inhalation injury resulted in a 4.18 probability unit of death with p < .0001.

Discussion

The World Health Organization has defined 'elderly' as being 65 years old or over.[1] In developed countries, the elderly is one of the fastest growing populations, and it could double within the next 20 years. Currently, the elderly account for approximately 30% of patients in hospitals, with sig-

Table III - Details of pre-existing medical condition (n = 416)

List of pre-existing medical conditions	N	%
Cardiovascular disease	55	13.2
Diabetic	29	7
Neurological disease	36	8.7
Respiratory disease	16	3.9
Other	04	.9
More than one presenting disease	16	3.9

Table IV - Distribution of complication by age, gender, comorbidity and burn severity

Criteria	Subgroup	Complication (n=26)		p
		No	Yes	
Age, n (%)	**65 - 79**	291 (96)	12 (4)	.002
	80 - 99	99 (87.6)	14 (12.4)	
Gender, n (%)	**Female**	199 (95.7)	9 (4.3)	.11
	Male	191 (91.6)	17 (8.4)	
Comorbidity, n (%)	**No**	311 (94.5)	18 (5.5)	.2
	Yes	79 (90.8)	8 (9.2)	
Inhalation injury, n (%)	**No**	384 (95.5)	18 (4.5)	.001
	Yes	6 (42.9)	8 (57.2)	
Burn surface area, %TBSA		8.2 ± 11.9	34.6 ± 24.6	.001
Deep burn area, %TBSA		2.8 ± 7.3	21.1 ± 16.1	.001

Table V - Bivariate analysis results

Parameter	Subgroup	Survived	Death	p
Age, n (%)	65 - 79	283 (93.4)	20 (6.6)	.001
	≥ 80	92 (81.4)	21 (18.6)	
	Mean	74.1 ± 7.8	79.6 ± 9.8	
Residential location, n (%)	Countryside	225 (88.9)	28 (11.1)	.30
	City	150 (92)	13 (8)	
Gender, n (%)	Female	195 (93.6)	13 (6.4)	.014
	Male	180 (86.5)	28 (13.5)	
Burn surface area, %TBSA	≤ 10	299 (99)	03 (1)	.001
	11 – 20	49 (84.5)	09 (15.5)	
	21 – 40	20 (52.6)	18 (47.4)	
	> 40	07 (38.9)	11 (61.1)	
	Mean	7.1 ± 9.7	35.5 ± 23.9	
Deep burn surface area, %TBSA	Partial injury	200 (97.1)	6 (2.9)	.001
	1- 5	131 (100)	0	
	6 – 10	26 (83.9)	5 (16.1)	
	> 10	18 (37.5)	30 (62.5)	
	Partial	2.1 ± 4.5	21.3 ± 18.8	
Inhalation injury, n (%)	No	374 (93)	28 (7)	.001
	Yes	01 (7.1)	13 (92.9)	
Comorbidity, n (%)	No	299 (90.9)	30 (9.1)	.33
	Yes	76 (87.4)	11 (12.6)	

Table VI - Multivariate logistic analysis for death and variables

Parameter	Coef.	Std. Err.	P > |z|	95% Conf. Interval
Age	0.12	0.03	0.000	0.05 ÷ 0.18
Gender	0.01	0.54	0.988	-1.05 ÷ 1.07
Burn surface area	0.07	0.02	0.000	0.03 ÷ 0.09
Deep burn area	0.12	0.29	0.000	0.16 ÷ 0.17
Inhalation injury	4.18	1.22	0.001	1.79 ÷ 6.56
Cons.	-13.40	2.74	0.000	-18.79 ÷ -8.02

nificant burden on health care systems, economic and social conditions.[3] It is noted that alongside an aging population, the prevalence of burns in the elderly is increasing.[11,12] A literature review revealed that the elderly account for about 20% of burn cases in developed countries.[13,14,15] However, over the past several decades little progress has been made in improving the outcome of elderly burn patients. The LD50 for the elderly is around 30 to 35% TBSA burn, and this figure has not changed much.[16,17,18] In developing countries, various incidences of elderly burn have been reported.[19,20] It was 2.3% of total admitted burn patients in Egypt.[9] In China, the country with the biggest population in the world, 8.5% of burn admissions were elderly.[7] Currently, there are around 10.1 million elderly people in Vietnam, accounting for 11% of the total population, and it is estimated that by 2030 this will rise to 18% and then 26% by 2050. In our study, elderly burn patients repre-

sented 4.6%, which is a lower proportion than that recorded in some worldwide reports, but this figure will increase in the near future alongside the growing aging population.

As mentioned above, the elderly have reduced reflex response and ability to escape from a harmful environment. In addition, elderly people have thinning skin, impaired sensation and mental alterations.[14,15] As a result, clinical reports reveal higher rates of deep burn injuries in this group. For example, a report by Albornoz et al. indicated that the proportion of deep burns is higher in the elderly than in younger patients (41% vs. 23.3%; $p < .001$).[21] Costa Santos et al. reported that deep burn presented in 17.1% of elderly patients compared to 5% in the younger group.[3] In our study, deep burn accounted for 51.5% of total elderly patients. This was higher than in other reports and the reason could be the main causal agents of dry heat and electricity (58.3%).

Some studies have indicated that mortality from less extensive burns is very low in the elderly group.[3] Our results were consistent with this statement, giving a mortality rate for minor and moderate burns of less than 5% and overall mortality rate only 9.9%. However, mortality rate was extremely high in patients with inhalation injury (92.9%) or burn extent > 40% or deep burn area > 10% TBSA (61.2% and 62.5%, respectively). Jeschke et al. strongly suggested that healthcare providers should be careful if an elderly patient sustains even a 25% TBSA burn, as the risk of mortality is 50% despite the implementation of modern burn care.[22]

Age is known to be one of the independent prognostic factors affecting the outcome of burn patients. Elderly patients are at higher risk for complications such as pulmonary edema, congestive heart failure and pneumonia.[23] Altered immune and inflammatory response associated with aging contributes to morbidity and mortality in elderly burn patients.[23] Our study did not compare elderly and younger groups, but it did indicate that amongst elderly burn patients age too is an independent risk factor for death besides burn severity and inhalation injury, like in other previous reports.[4,14]

Gender may affect outcome in elderly burn patients.[24,25] Chang and colleagues found that elderly women had smaller and less severe injuries, but mortality rate did not differ from that for elderly men.[7] In our study, there was no difference in mortality rate between the male and female groups, but significantly higher burn surface areas and deep burn areas were seen in elderly male patients ($p < .001$).

Pre-existing medical conditions are common in elderly patients.[25,26] The elderly have more comorbid medical conditions and double the mortality following a major burn injury than those under 65 years of age. Some reports have indicated that COPD is the most common, while others have reported stroke, diabetic or cardiovascular disease affecting the outcome of severe burn in the elderly subpopulation.[3] Knowlin et al. determined the effect of comorbidities on burn mortality, using the Charlson Comorbidity Index (CCI). They found that there was a linear increase in the likelihood of death with an increase in CCI, and concluded that preexisting comorbidities have a significant effect on burn injury mortality in all age groups.[27] In this study we found that the most common comorbidity among elderly burn patients was cardiovascular disease, followed by diabetic and neurological disease. However, the comorbidity did not affect the outcome of the elderly patients in our study. The same situation was reported by Mahar et al.[28] The reason for differing results may be that the criteria for admission to the various burn facilities differed.

One issue of debate regarding care for elderly burn patients is the timing of surgical intervention.[29,30] Investigations by Kara et al. indicated that early surgical excision results in fewer episodes of infection and a reduction in hospital stay but does not significantly improve survival among elderly burn patients.[29] Meanwhile, a study by Kim and Luce reported that the management of elderly patients with early excision and grafting did not have any benefit and may have resulted in a higher mortality rate.[31] In our series, most of the patients underwent first excision and skin grafting more than one week post burns due to the need to first stabilize the patients, fixing respiratory and cardiovascular

problems in particular. In addition, withdrawal of life support after burn injury is another issue that can lead to high rates of mortality and complications in elderly burn patients.[12] Bartley and coworkers found that withdrawal was associated with pre-existing comorbidities, age, burn extent and inhalation injury.[32]

Conclusion

We have shown that elderly burn incidence in Vietnam is 4.2%, with over half of the patients suffering from deep burn injury. While the overall mortality rate was only 9.9%, death rate was extremely high for patients with inhalation injury or extensive burn.

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