CHARACTERISTICS AND GENDER INFLUENCE ON OUTCOMES OF BURNS IN ADOLESCENTS

INFLUENCE DU SEXE SUR LES CARACTÉRISTIQUES ET L'ÉVOLUTION DES BRÛLURES DE L'ADOLESCENT

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SUMMARY. The aim of this study was to investigate the characteristics and influence of gender difference on the outcome of adolescent burns. A retrospective study was conducted on 641 burn patients (10 - 19 years old) admitted to the Viet Nam National Burn Hospital over a three-year period (2016 – 2018). Demographic data, burn features and outcome including complications, length of hospital stay and mortality of male and female groups were compared. The results indicated that adolescents accounted for 6.5% of total admitted burn patients, with a predominance of males (69.3%). Higher proportions of burn due to dry heat (flame or hot surface contact) and electricity were seen in the male group ($p < .001$). No significant differences were seen between male and female groups in terms of age, admission time, season of burn and burn severity. Compared to females, males experienced more surgical interventions and stayed longer in hospital with higher LA50 (71.2% vs. 56.5% TBSA). It is necessary to conduct prevention and intervention to improve the outcome of adolescent burns, especially for female patients.

Keywords: adolescent burn, gender difference, outcomes

RÉSUMÉ. *Cet étude rétrospective, réalisée auprès de 641 patients de 10 à 19 ans hospitalisés dans l'hôpital brûlologique national du Vietnam entre 2016 et 2018, a pour but d'évaluer le rôle du sexe sur les caractéristiques et l'évolution des brûlures survenant dans cette tranche d'âge. Les données démographiques, les caractéristiques et l'évolution (survie, complications, durée d'hospitalisations) ont été comparées entre hommes et femmes. Les adolescents représentent 6,5% du total des admissions ; 69,3% des patients étant des hommes. Ils souffrent plus fréquemment ($p<0,001$) de brûlures par flamme/contact (« chaleur sèche ») et électricité. Il n'y a pas de différence, en termes d'âge, de saisonnalité, d'heure de survenue et de gravité, entre femmes et hommes. Les hommes ont besoin de plus d'interventions chirurgicales et sont hospitalisés plus longtemps que les femmes. Toutefois, la surface létale 50 est de 71,2% chez les hommes et de 56,5% chez les femmes. Il est nécessaire de développer des programmes de prévention des brûlures chez les adolescents, en ciblant plus précisément chez les adolescentes.*

Mots-clés *: brûlure, adolescence, sexe, évolution*

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Introduction

The World Health Organization defines an adolescent as any person between ages 10 and 19. Adolescents are not "older children" or "younger adults". This period is a transitional phase of growth and development, involving physical, sexual and psychological changes. These dramatic changes also lead to high risks for health disorder and accidents, including trauma and burn injuries.[1,2]

The impact of gender difference on outcomes of hospitalized patients has been a recent topic of interest. Experimental and clinical studies have demonstrated a lower mortality rate for female patients compared to males. This pattern has been observed for most causes of death, from chronic disease to sepsis and hemorrhage.[3,4,5] However, there is still significant controversy over gender differences and outcomes of trauma patients, including burn patients.[6,7]

Despite advances in resuscitation, early enteral nutrition, hypermetabolic modulation and surgical management, burn patient mortality is still high, especially in developing countries.[8,9] Currently, age, burn extent and inhalation injury have been considered to be independent predictive factors affecting the survival rate of burn patients.[10,11,12]

The influence of gender on burn outcome has also received attention recently. To date, few studies have reported about burn features and impact of gender in adolescent patients in developing countries. The purpose of this retrospective study was to determine characteristics and the association between gender and outcomes in adolescent burn patients treated at the National Burn Hospital, Hanoi, Vietnam.

Materials and methods

We conducted a retrospective study of all adolescent patients (10 - 19 years old) admitted to the Viet Nam National Burn Hospital over a period of three years (1/1/2016 - 31/12/2018). Patients were classified into a female and male group. Demographic parameters including age, gender, time of admission after burn accident, season and causal agents were collected. Burn features including burn extent, deep burn injury, deep burn area and inhalation injury were also recorded. Outcome measures included complication, length of stay in hospital, number of surgeries and mortality rate. Lethal area fifty percent (LA50) was calculated for total burn surface area and full thickness burn area using a Probit model. Data were analyzed and compared between two groups using Intercooled Stata version 14.0 software, and $p < 0.05$ was considered a significant level. The study was approved by the hospital's Ethics Committee.

Results

Over the period from 1/1/2016 to 31/12/2018, there were 9887 burn patients admitted to the National Burn Hospital. Of them, 4716 were children and 641 patients were from 10 to 19 years old, accounting for 6.5% of total admitted burn patients and 13.6% of childhood burns. Among the adolescent patients, males were predominant (69.3%) with an average age of 14.8 ± 3.1 years, and 61.3% patients were admitted to hospital during the first 24h after burn. In addition, 59.1% of cases were caused by dry heat (flame or hot surface contact), followed by scald, electricity and chemical agents. Regarding burn features, 81.4% patients had burn surface area < 20% total body surface area (TBSA) with average burn extent of 11.9% TBSA. Nineteen patients, accounting for 3%, suffered inhalation injury. It was noted that a higher proportion of burns due to dry heat and electricity were seen in the male group ($p < .001$). Apart from causal agents, no significant differences were seen between male and female groups in terms of age, admission time, burn season and burn features (*Table I*).

Outcomes of patients and gender distribution are indicated in *Table II*. As can be seen, males experienced more surgical interventions than females (1.4 vs. 0.9; $p < .01$). Length of stay in hospital was also significantly longer in the male group (19.5 days vs. 15.6 days; $p < .01$).

Table I - Patient characteristics and burn features

Criteria	Subgroup	Total (n=641)	Female (n=197)	Male (n=444)	p
Age, year		14.8 ± 3.1	14.6 ± 3	14.9 ± 3.1	.22
Admission time post burn	< 24h	393 (61.3)	117 (59.4)	276 (62.2)	.53
	≥ 24h	248 (38.7)	80 (40.6)	168 (37.8)	
Season	Spring	168 (26.2)	50 (25.4)	118 (26.6)	.24
	Summer	194 (30.3)	69 (35)	125 (28.2)	
	Autumn	135 (21.1)	33 (16.8)	102 (23)	
	Winter	144 (22.5)	45 (22.8)	99 (22.3)	
Causal agents	Scald	160 (25)	88 (44.7)	72 (16.2)	.001
	Dry heat	379 (59.1)	98 (49.8)	281 (63.3)	
	Electricity	92 (14.4)	10 (5.1)	82 (18.5)	
	Chemical agent	10 (1.6)	1 (0.5)	9 (2.0)	
Burn extent, n (%)	< 20	522 (81.4)	162 (82.2)	360 (81.1)	.21
	20 – 39	83 (13)	28 (14.2)	55 (12.4)	
	≥ 40	36 (5.6)	7 (3.6)	29 (6.5)	
	Average TBSA	11.9 ± 14.2	10.7 ± 12.9	12.5 ± 14.6	
Deep burn, n (%)		310 (48.4)	88 (44.7)	222 (50)	.22
Deep burn area, %TBSA	< 10	584 (91.1)	184 (93.4)	400 (90.1)	.19
	10 – 19	31 (4.8)	5 (2.5)	26 (5.9)	
	≥ 20	26 (4.1)	8 (4.1)	18 (4.1)	
	Average, TBSA	3.2 ± 8.6	2.6 ± 8.5	3.4 ± 8.9	
Inhalation injury, n (%)		19 (3)	4 (2)	15 (3.4)	.33

Table II - Outcomes and gender distribution

Criteria	Subgroup	Total (n=641)	Female (n=197)	Male (n=444)	p
Number of surgeries, n		1.2 ± 1.7	.9 ± 1.3	1.4 ± 1.8	.003
Hospitalization, day		18.3 ± 16.2	15.6 ± 11.5	19.5 ± 17.8	.005
Complication, n (%)		18 (2.8)	6 (3.1)	12 (2.7)	.86
Death, n (%)		11 (1.7)	4 (2)	7 (1.6)	.71
LA50, %TBSA	**For burn extent**	68.9	56.5	71.2	
	For deep burn	48.8	38	55.4	

Common complications (data not shown), including sepsis, septic shock and multiple organ failure were recorded in 18 (2.8%) patients, with an overall mortality rate of 1.7% and LA50 of 68.9% TBSA. There was no remarkable difference between the two groups in terms of complications and mortality rates ($p > .05$). Compared to males, LA50 was lower in the female group for both burn extent and deep burn area. In addition, among the patients who died, burn extent was larger in the male group but deep burn area was smaller. However, the differences did not reach significant level (*Table III*).

Table III - Distribution of parameters by gender among patients who died

Parameter	Female (n=4)	Male (n=7)
Age, year	14 ± 3.3	15.6 ± 3.9
Burn surface area, % TBSA	64.8 ± 25.4	75.9 ± 13.5
Deep burn area, % TBSA	48.5 ± 19.2	40.3 ± 34.6
Time from burn to death, days	16.3 ± 19.9	12.3 ± 14.1

Discussion

Worldwide reports indicate that there are nearly 1.2 billion adolescents (10 - 19 years old), the highest number of them in low and middle-income countries. It is estimated that 1.2 million adolescents die each year, largely from preventable causes overlooked and neglected in the health care system. Not prioritized like children's health, the rate of adolescent deaths is now greater than that of younger groups in some countries.[2]

To date, only a few studies have reported the incidence of burns in adolescence. In Brazil, a report by Fernandes and colleagues indicated that adolescent burn accounted for 16.3% of total admitted childhood burns.[13] In South Africa, Blom et al. showed that adolescents accounted for 8.9% of total burn patients and 15.3% of childhood burns, and 48.3% cases were males.[14] In our study, adolescent burns accounted for 6.5% of total admitted burn patients and 13.6% of total childhood burns. Recent study also showed a predominance of flame or contact with hot surface as the main cause of burns. Meanwhile, scald was reported as the main cause of burn in younger age.[8] Outcomes of adolescent burn patients were not well reported, the current data only reporting overall outcomes of childhood burns for all ages. Our study showed that the mortality rate of adolescents was 1.7%, with LA50 of 68.9% TBSA.

To date, clinical studies have demonstrated a higher mortality rate among males following trauma or sepsis, compared to females.[15,16,17] However, other studies have reported conflicting results. For example, Gannon and colleagues analyzed data from 26 trauma centers, which indicated that there was no association between females and lower mortality.[18] In 2019, Tounsi et al. showed that females required fewer surgeries than men and had lower unadjusted odds for mortality, although this was not significant in the adjusted analysis, compared to males.[19]

Regarding burn patients, a number of retrospective clinical studies have focused on gender differences and the influence of gender on outcome following burn injuries. Most reports

indicated a lower proportion of injuries, smaller burn extent and higher incidence of scald burn in women compared to men. For example, a study by Karimi et al. on 334 adult patients with >20% TBSA indicated that female patients accounted for 18%, with smaller burn size.[20] Works by McGwin and colleagues showed that female burn patients were more likely to be older and more likely to suffer flame and scald burns.[21] In the report by Kobayashi et al., 37% of the patients were female.[22] In our study, women accounted for 30.7% of cases. No significant differences were seen between male and female groups in terms of age, admission time after burn, burn season and burn features. Regarding hospitalization, Mohammadi et al. reported that length of hospital stay was significantly higher in the female group compared to the male group.[23] In our study, longer stay in hospital as well as a greater number of surgeries required were recorded among the males.

It is noteworthy that, unlike for trauma patients, most reports indicated a higher mortality rate in females after burn.[24,25,26] A study by McGwin et al. indicated that among burn patients up to the age of 60, female mortality rate was more than double that of males (OR = 2.3) with similar causes and timing of death.[21] Kerby et al. reported that female burn patients had a 30% increased risk of dying compared to men.[27] A study by Summers and coworkers concluded that females had a higher risk of organ failure and poor outcomes compared to males.[28] In our study, higher mortality rate with lower LA50 was seen in female groups. However, results are still controversial. For example, Kobayashi et al. reported that gender was not a risk factor for high mortality in any age group.[22] In addition, regarding time from burn to death, our results showed that male patients seem to die sooner than females (12.3 vs. 16.3 days after burn) although this result was not significant. This is opposed to a report by Karimi et al. (day 10 vs. day 4 post injury).[20] Conflicting clinical reports regarding the impact of gender on survival may in part be due to different study designs, sample size and other factors influencing outcomes.

It is noted that animal studies demonstrate that sex hormones influence inflammatory response to injury and some studies reported beneficial effects of estrogen for the central nervous system, the cardiopulmonary system, the liver, the kidneys, the immune system, and for the overall survival of the host.[29,30] Generally, female burn patients have more advantages, which include lower REE, higher levels of endogenous anabolic hormones, estrogen, attenuated stress hormones, and inflammatory markers compared to male patients, leading to better outcome and lower mortality. However, clinical data did not seem to reflect positive impact of these advantages on outcome of burn patients.[31,32] To date, we have not found any study that mentions profile and impact of sex hormones in adolescent burn patients. It should be emphasized that adolescents are not "older children" or "younger adults". We cannot apply effective health care provision for younger or adult groups to adolescents. Results from this study indicate that further prevention and intervention should be conducted to improve the outcome of adolescent burns, especially for the female group.

Conclusion

We have shown that adolescent burn accounted for 6.5% of total burn patients, with a male predominance, mostly caused by flame or contact with hot surface in the summer. No significant difference between genders in terms of demographic and burn characteristics was observed. However, males experienced more surgical interventions and stayed longer in hospital with higher LA50. It is necessary to conduct prevention and intervention to improve the outcome of adolescent burns, especially for female patients.

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