

Burn and Amputations: A Retrospective Analysis 379 Amputation out of 19,958 Burns in 10-year

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Received date: March 19, 2018; Accepted date: March 26, 2018; Published date: March 28, 2018

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Abstract

Objective: Amputation in burn injury is a physical and psychological sequelae and greater complexity for the rehabilitation. We sought to review our ten years' experience of amputation of burn to provide a basis for prevention, treatment and rehabilitation.

Methods: This is a retrospective study of burn patients admitted to the Hallym Burn Centre, during the period 2001-2010. Data were collected from medical records of 19,958 patients, and the amputation occurred in 379.

Results: The most common kind of burn was scald burn in 42.1%, followed by flame burn 33.6%, contact burn 10.8%, electrical burn 5.9%. The children under the age of 15 constituted about 29.1% (n=5818). Average hospital stay was 28.8 ± 0.9 days ($P < 0.05$), the longest stayed in electrical burns in 72.6 days, and the shortest 16.6 days in scald burn. The amputation occurred in 379 out of total 19,958, the amputation rate was 1.9%, which was slowly decreased in the last ten years, changing from 2.3-2.6% to 1.2-1.4%. The amputation rate was highest in the electrical burn in 19.2%. The most common level of amputation was finger amputation in 168 as 42.0%, the 2nd was toe amputation in 80 as 16.9%, and the third was transhumeral amputation in 35 as 15.3%. Major amputation was 158 cases in 38.9%, minor amputation was 248 cases in 61.1%.

Conclusion: The information in this investigation would be expected to be helpful to promote to reduce the incidence of burn amputation and to promote the outcomes of rehabilitation in burn amputee.

Keywords: Burns; Electrical burns; Amputation; Rehabilitation

Introduction

In a severe burn injury, to make decision of amputation is important to reduce morbidity and to enhance survival [1,2]. Although amputation is an inevitable procedure, the loss of limb is the most serious complication of burn injuries. The physical and psychological complication leads to big difficulty for rehabilitation [2]. These burned amputees are mostly men in working age and affected frequently in upper limbs, so rehabilitation program make essential importance to uplift function of daily life, labor activity and social joining [3]. So as to practice a good program about burned amputee, it is vital to focus on special issues

We surveyed our ten years' experience of amputation of burn injuries to outline the characteristics. This study was accomplished to details the incidence, epidemiology, extent of burn injury, hospital stay, amputation rate and amputation level. This study set the goal to afford a baseline for practical programming in prevention, management and rehabilitation in burned amputation [4]. A several special suggestion could be recommended founded on these findings. Our works are to look for reducing incidence of burned amputation and to promote the rehabilitation program [5].

Methods

After the approval of the author's institutional review board, the authors retrospectively reviewed database for patients who admitted Hallym Burn Centre, who underwent an amputation over a 10 year period (2001-2010). The Hallym Burn Center at Hangeang Sacred Heart Hospital is the biggest burn center in Korea. It is placed in a civic area in Seoul metropolis. This burn center plays role as a referral center from the whole country. The burn service team organizes a team of medical specialist including pulmonologist, cardiologist, burn surgeon, reconstructive surgeons, psychiatrists, anaesthetists, rehabilitation specialist, nutritional support, aesthetic pain specialist and social workers [5].

Medical records were reviewed and the data were collected about patients admitted to Hallym Burn Center from 2001 to 2010. During 10 years, 19,958 burned patients were admitted and amputation occurred in 379 burned patients [5].

Parameters included demographics, etiology, and a kind of burn, extent of burn, administrative data, hospital stay, and data of amputations. Amputations due to not burn were excluded. The kind of burns was classified into flame, scald, electrical, contact, spark, radiation and chemical burns. Total burn body surface area (%TBSA) was collected. The amputations were categorized to 'major' and 'minor' amputation, the 'minor' included finger and toe amputations, partial hand and partial foot amputations. 'Major' include amputations

performed above or below the supratrochlear or infra-trochlear and supra-condylar or infra-condylar levels [4].

Statistical analysis with SPSS Version 12.0 (SPSS, Chicago, IL) was performed. Significance of differences between groups was analysed with Student's t-test, χ^2 -test and repeated measures of ANOVA. Probability value of <0.05 was considered statistically significant. Chi square test was to compare categorical variables and Mann Whitney test for continuous variables [5].

Results

Annual distribution of admissions

Annual numbers of burned patients had changed from the lowest 1637 in 2001 to the highest 2201 in 2003. Numbers of burned patients fluctuated during the investigation due to being built new local burn center in other province of Korea. The steady and slow tendency to rise took in this period (Table 1).

Year	Burn injury	Amputation	AR (%)
2001	1637	38	2.3
2002	1979	52	2.6
2003	2201	54	2.5
2004	2051	43	2.1
2005	1936	47	2.4
2006	1759	42	2.4
2007	1971	19	1
2008	2161	29	1.3
2009	2098	25	1.2
2010	2165	30	1.4
10 year	n=19,950	31.6	1.9

Table 1: Yearly distribution of admissions to the hospital due to burn injury. The steady and slowly rising trend took in this period (n=19,958). Amputation rate according to etiology of burn is slowly decreasing (AR: Amputation Rate).

The etiology of burn injury

Total number of burn patients were 19,958 from 2001 to 2010, the most common kind of burn was scald burn in 42.1%, followed by flame burn 33.6%, contact burn 10.8%, electrical burn 5.9%, and spark burn 2.8%. Scald burn and flame burn represented 75.7% of all admissions (Figure 1).

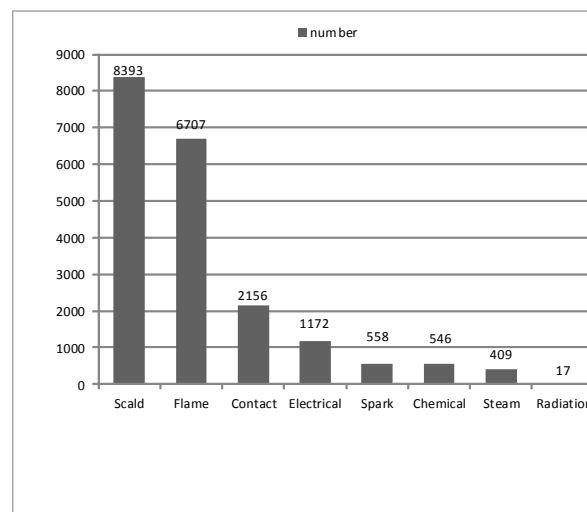


Figure 1: Etiology of burn injury and its distribution from 2001 to 2010.

Demographics

Children below the age 15 composed about 29.1% (n=5818). The highest incidence of burn was found in the first decade (n=4559, 22.80%). Most patients of adulthood were the third or fourth or fifth decades. Males are larger numbers than female in all decades to 65 years (M:F=66.2%:33.8%) (Figure 2). In toddler age with curiosity, scald burn due to hot soup, hot water, coffee pots and water purification device were common cause of burn injury in this age group. Other burn injuries contained electrical burns from electrical outlets, steam burns from rice cooker, and contact burns due to flat irons or hot cooking pan. In older age groups, flame burn due to fire and explosion was common reason of burn in industrial working (Figure 2).

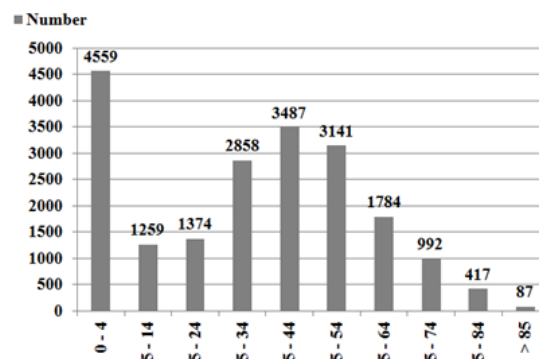


Figure 2: Distribution of incidence of burn injury based on age from 2001 to 2010 (n=19,958).

Duration of hospital stay

Mean period of admission of total burn patients was 28.8 ± 0.9 days ($P < 0.05$). The most patients admitted in the burn center for about a month. Among those, the patients of electrical burn stayed longest 72.6 days, and followed by flame burns for 38.4 days, contact burn 27.2 days, and scald burn shortest for 16.6 days (Figure 3).

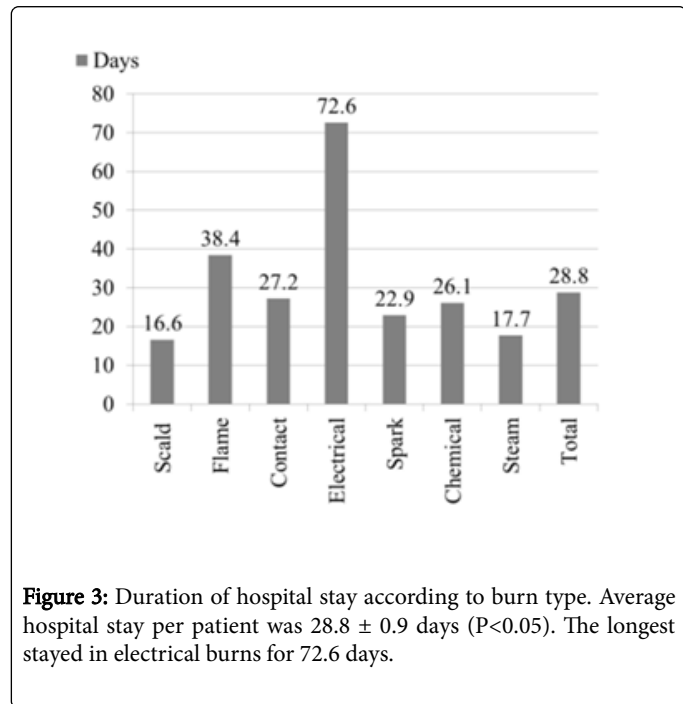


Figure 3: Duration of hospital stay according to burn type. Average hospital stay per patient was 28.8 ± 0.9 days ($P < 0.05$). The longest stayed in electrical burns for 72.6 days.

Amputation

Amputation rate

In a total burn patients of 19,958, the amputation occurred in 379 burn patients, the amputation rate was 1.9%. The amputation rate was slowly decreased in the last ten years, changing from 2.3-2.6% in the early period to 1.2-1.4% in the late period of last 10 years (Table 1)

Etiology of burn injury in amputation

The amputation rate was highest in the electrical burn in 19.2%, and the next was 11.8% in the radiation burn, and follows 2.5% in the contact burn, 1.1% in the flame burns, 0.7% in chemical burn, 0.7% in steam burn, and lowest as 0.2% in scald burn (Figure 4).

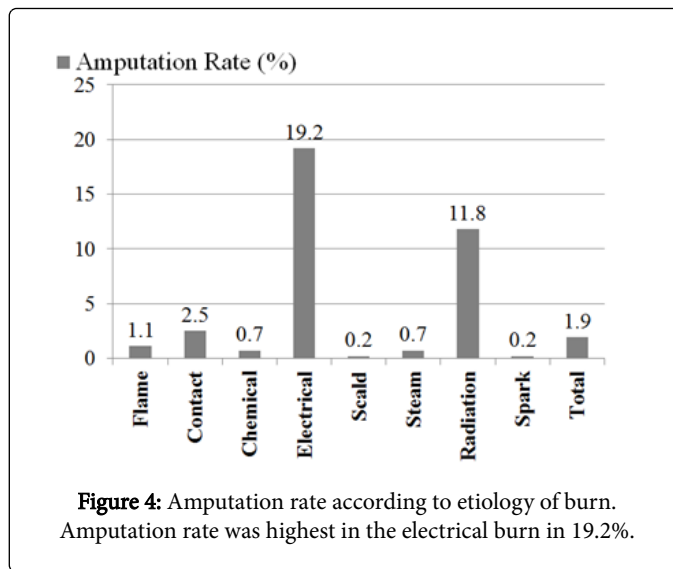


Figure 4: Amputation rate according to etiology of burn. Amputation rate was highest in the electrical burn in 19.2%.

Amputation level

In the burned patients, the most common amputation level was finger amputation in 168 as 42.0%, the 2nd was toe amputation in 80 as 16.9%, the third was transhumeral amputation in 35 as 15.3%, follows transtibial amputation in 35 as 9.8%, transradial in 24 as 5.5%, wrist or partial hand amputation in 11 as 2.9% (Table 2).

Amputation	No	%
Finger	168	41.4
Toes	80	19.7
Transhumeral	35	8.6
Transtibial	35	8.6
Transradial	24	5.9
Tansfemoral	12	3
Wrist	6	1.5
Hand	5	1.2
Foot	4	1
Knee	3	0.7
Shoulder	2	0.5
Major amputation	158	38.9
Minor amputation	248	61.1

Table 2: Amputation level in burn injury.

Amputation was considered minor and major, the minor means if it included fingers and toes amputation, all digital and partial hand amputation and all toes or partial foot amputations include to minor amputation. Major amputation means if it was performed transhumeral or trans-radial, trans-femoral or trans-tibia levels. Major amputation indicates proximal of the wrist joint in upper limb and proximal of the ankle joint in lower extremities. In this search, major

amputation was 158 cases in 38.9%; minor amputation was 248 cases in 61.1%. In major amputation, transhumeral amputation and transtibial amputation was the most common in 35 as 8.6% (Table 2).

Discussion

This study provides an extensive overview concentrating on burn amputation from 10-year duration in a single burn center. We accept that this is a center based study, not a population based study. Nevertheless, these results describe specific characteristics of burn patients in Korea [5]. Age and sex seem to be the distinctive features. The two fold peaks of age distribution represent different forming of burns in childhood and adulthood. Children below the age five are the highest risk in all age groups. This is expected to come from the developmental stage of children in motor and cognitive function. Luce also reported close results to this point that children at risk of burn are younger than 4 years [6-9]. The unique Korean food culture also has an effect on the type of burn injuries. In children below age 10, the most common burn was scalds in 42.1%. The scalds attribute to hot soup and hot broth of Korean food. The hot water comes from an electrical purifier at home and workplaces [5]. In adulthood, burn injuries were chiefly occurred in the fourth and fifth decades of males as labor injuries. The electrical burns with high-voltage electric shock associated to more serious burns and related to longer hospital admission. This suggests the need of education for safety from electric shock [5].

The amputation rate in this burn center was 1.9%, which was close to those in other publications. There are rare reports about the amputation in burn. Only one center reported an amputation rate about 2% [1]. Although the amputation rate is not high, physical and psychological factors resulting in complicated feature for rehabilitation [10,11]. This amputation rate rises to 20-50% in electrical burns [3,12]. In this research, the amputation rate was highest in the electrical burn in 19.2%, and follows 2.5% in contact burns, and 1.1% in flame burns. In another research, eleven of the 51 patients (21.6%) with high voltage injury counted 18 major amputations [2]. Holliman et al reviewed 80 electric injuries, of which 27 were major amputations [13]. Parshley et al. reviewed 75 patients with electrical injury of which 11 patients (25.6%) experienced 17 amputations [14]. More recently Shen et al, reviewed 90 patients with electric injury, 45 of the limbs (39.4%) were amputated [15]. Therefore, it appears that high voltage electric injury results in major amputations, and amputation rates ranging from 20 to 50%. Variations between reports are likely to be responsible for different people, burn severity, industrial development, and cultural types [5,12,16,17]

Soto et al. reported that amputations were done more in thermal rather than in high-voltage electrical burns [4]. Fifty-three percent of amputees underwent fire burns (n=34) and 36% had electrical burns (n=23) and 11% (n=7) from scald [4]. But, only 4.1% of fire burned patients needed an amputation, this contrasts with 32.4% of electrical burns amputated [3,4]. Multivariable analysis recognized variables that were positively related with amputation: male gender, electrical burns, consciousness impairment. Male were two times to have an amputation than female. Patients with electrical burns were 13 times to need amputation than other burns [17]. The best way to keep from amputation will be to keep from electrical burns. Electrical burns are largely from labor accidents. In labor accidents, prevention is responsibility of the companies as well as governments. Their task should be trained with safety education to reduce the risk of accidents [18].

In many cases, burned amputees have chronic issues such as grafted and fragile stump, hypertrophic scar, and heterotopic ossification. Additional limiting factors for rehabilitation are joint contracture, decreased muscle strength, terminal bony overgrowth, and myelopathy [19-22]. Burned amputees may not use their prostheses because of stump problem or limiting factors [23]. Electrical burns can bring up damage to the nervous system. Myelopathy is a complication that occurs in electrical burn injuries [19]. However, early recognition of myelopathy could be important to begin rehabilitation as early as possible [24]. Electrical burns can also cause peripheral neuropathy. Most of them were injured by high voltage current of 22900 Voltage AC. The hand was the most frequent sites of neuropathy [21,25].

Although there have been greater progress in treatment of the acute burn, rehabilitation remains a challenge in burn injuries. These burn patients in labor accident are mainly at working age, so rehabilitation takes a necessity for their quality of life [3]. Early rehabilitation intervention would be critical to prevent complications and to improve physical function of burned amputee. So, the Labor Insurance should provide financial coverage for rehabilitation [20,26].

The limitation of this study is that the data described in this survey is center-based rather than population-based. This may represent selection bias. Even though, our survey that reflect a notable characteristics of burn patients in Korea as the largest unit and as the referral center from the entire country. Another limitation is that this database does not provide specific information on prosthetic prescription, rehabilitation protocols, and rehabilitation outcome of amputees, because periodic follow-up checks could not be carried out since many patients had been referred to local rehabilitation center at long distance.

Conclusion

A retrospective study of burn patients with amputation over a 10 year period using burn center-based rather than population-based survey reflected unique characteristics of burn patients in Korea

Age and sex appear to be the distinctive features. The two peak of age distribution represent different forming of burns for childhood and adulthood. Children below the age 15 constituted about one third of total burn injuries. The unique Korean food culture also has an effect on the type of burn injury. In adulthood, burn injuries were chiefly occurred in the fourth and fifth decades of males as labor injuries. The electrical burns associated with high-voltage electric shock associated to more serious burns and related to longer hospital admission. This suggests the need of safety education from electric shock.

The amputation rate was 1.9%, which slowly decreased in the last ten years. The amputation rate was highest in the electrical burn. The best way to keep from amputation will be to keep from electrical burns. Patients with electrical burns are generally due to labor accidents. The prevention from electrical burns, the more efforts is needed at the company level as well as at the national level.

This information thus obtained in this investigation would be expected to be helpful to support prevention program, management protocol, and rehabilitation program for burned amputees for their welfare. Further research is needed to provide specific information on prosthetic prescription, rehabilitation protocols, and rehabilitation outcome.

Conflict of Interest

All authors declare that they have no conflict of interest.

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