

Original Research Article

Retrospective and prospective study of amputation in burn patients in Kashmir

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ABSTRACT

Background: Burn is the coagulation necrosis of tissue caused as a result of application of heat which is categorized depending upon its depth. Amputation in burn patient is widely reported especially in severe burn to enhance survival. Though the number of amputations is low in civilian population but it represents a significantly large economic loss. Objective was to do a retrospective and prospective study of amputation in burn patients in Kashmir.

Methods: This study was conducted retrospectively from July 2007 to June 2017 and prospectively from July 2017 to June 2019 in department of plastic and reconstructive surgery, SKIMS, Srinagar. For prospective group the patients were admitted and resuscitated as per the protocol and then shifted to the burn unit. The patients were closely monitored and the procedures like early and delayed amputation were done as needed.

Results: We had finally a total of 35 patients with 24 in retrospective and 11 in prospective group. In retrospective group, 9 patients had minor while as 15 had major amputation. Majority of the patients were in the age group of 20-40 years (58.3%). In prospective group, 6 patients had major while as 5 patients had minor amputation. Majority of the patients belonged to the age group of 20-40 years (45.5%).

Conclusions: The amputation rate in burn patients is not reassuring in Kashmir with minor or major amputation needed in almost all patients and the most effected age group is the “productive age group” representing a significant economic loss.

Keywords: Amputation, Burn, Prospective, Resuscitation, Retrospective

INTRODUCTION

Burn is the coagulation necrosis of tissue caused as a result of application of heat.¹ Depending up on the depth of burn, it has been categorized into four degrees, first degree, second degree, third degree and fourth degree.² Fourth degree burn involving deep tissue like muscles, bones and joints of the limb resulting in non-functional limb and thus need to be amputated. Each type of burn causes skin burning, however the extent and severity of tissue damage varies according to burn etiology. Thermal burn injuries usually cause skin and subcutaneous tissue damage. However high voltage electrical burn (>1000

volts) causes damage to deeper structures such as muscles, nerves, vessels and even bones.^{3,4} Serious burn injuries can cause mortal complications such as acute renal failure, acute tubular necrosis, multiorgan failure and sepsis or septic shock.⁵ With recent advances in burn treatment these complications less frequently cause death and burn mortality rate has decreased over last several decades.^{5,6}

Amputation in burn patient is widely reported. In severe burn injury, to make decision of amputation it is important to reduce morbidity and enhance survival.^{6,7} Although amputation is 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.⁷ These burned amputees are mostly men in working age and affected frequently in upper limbs so rehabilitation programs make essential importance to restore function of daily life, labour activity and social joining.⁸

High rate of amputation has been seen in electrical burns.⁹ Although electrical burn is less prevalent in comparison to other type of burn injuries, this type of injury is considered one of the most devastating injuries due to its high morbidity and mortality and is also associated with high cost, long term hospitalisation as well as need for multiple surgical procedures. Therefore, specific management considerations are required for this type of injury.^{10,11} High rate of amputation also has been seen in burn in epileptics.¹²

The burden of electrical burn is different among developed and developing countries. According to various reports it is more prevalent in developing countries and statistics show that its prevalence rate is higher among men.¹³ Though the number of amputations is low in civilian population but it represents a significantly large economic loss.¹⁴ Burn injuries can affect individuals from all socioeconomic groups and resulting in varying complications depending on various factors like the degree of burn and total body surface area burnt. These determine short- and long-term results of treatment.¹⁵ Major as well as minor amputations are also prevalent in the burn patients. Both electrical and flame burns have high incidence in our region. We encounter a lot of amputations in these patients. This prompted us to undertake this study.

Aims and objectives

To do a retrospective and prospective study of amputation in burn patients in Kashmir.

METHODS

Inclusion and exclusion criteria

All burn patients who required an amputation of an extremity were included and all those who were managed conservatively were excluded.

This study was conducted retrospectively from July 2007 to June 2017 and prospective study was done from July 2017 to June 2019 in department of plastic and reconstructive surgery of Sher-i-Kashmir Institute of Medical Sciences, Srinagar, Kashmir. In retrospective group, the medical record of patients was retrieved from the medical record department (MRD) of SKIMS Soura Hospital. Detailed analysis of these records was done as

per our proforma and these patients were called telephonically for follow up.

We had around 2500 patients with 2000 in retrospective group and 500 in prospective one but only 35 patients with 24 in retrospective and 11 in prospective group met our criteria. In both groups majority of the patients were in the age group of 20-40 years (58.3% in retrospective group and 45.5% in prospective group). A written consent was taken from patients participating in the study whose confidentiality was maintained.

For prospective group, once the patient was admitted, detailed history, clinical examination and resuscitation was done as per the protocol. These patients were shifted to the burn unit on the same day after initial assessment and resuscitation in our accident and emergency department. In patients with compartment syndrome, fasciotomy was done urgently. All the patients were closely monitored and the procedures like debridement, early amputation (done in <48 hours) and delayed amputation were done as needed. Detailed analysis of the factors leading to amputations, site of amputation, whether major and minor amputation etc. were noted.

Statistical analysis

Statistical analysis of the data was done by using test statistics. The qualitative data was explained by using chi-square and quantitative data was expressed as mean±SD and t test for difference of means was used. Both these tests were two sided and were referred for p values for their significance. Any p value less than 0.05 was taken as statistically significant. The analysis of the data was done by using statistical package for social sciences version 20.

RESULTS

Retrospective group

Minor and major amputation

In our study 9 patients had minor amputation with mean total body surface area as 5.333 and mean hospital stay as 18 days while as 15 had major amputation with mean total body surface area as 21.200 and mean hospital stay as 40.80 days as depicted below in Table 1.

Age group (years) and amputation

In this study majority of patients with amputation were in age group of 20-40 years (n=14, 58.3%) followed by age group of below 20 years (n=5, 20.8%). Amputation was minimum in the age group of greater than 60 years (n=2, 8.3%) as depicted below in Table 2.

Table 1: mean total body surface area and hospital stay.

	Amputation	N	Mean	SD	Std. error mean	P value
TBSA	Minor	9	5.333	1.8708	0.6236	0.007
	Major	15	21.200	15.6351	4.0370	
Hospital stay	Minor	9	18.00	13.038	4.346	0.002
	Major	15	40.80	17.522	4.524	

TBSA=total body surface area.

Table 2: Age group and amputation.

Age group (years)	Amputation		Total
	Major	Minor	
20	4	1	5
	26.7%	11.1%	20.8%
20-40	8	6	14
	53.3%	66.7%	58.3%
40-60	2	1	3
	13.3%	11.1%	12.5%
>60	1	1	2
	6.7%	11.1%	8.3%
Total	15	9	24
	100.0%	100.0%	100.0%

Gender distribution

In retrospective study amputation is seen more in males (n=17, 70.8%) compared to females (n=7, 29.2%). Both major and minor amputation were seen in both genders as depicted in Table 3.

Table 3: Gender distribution.

Gender	Amputation		Total
	Major	Minor	
Female	4	3	7
	26.7%	33.3%	29.2%
Male	11	6	17
	73.3%	66.7%	70.8%
Total	15	9	24
	100.0%	100.0%	100.0%

Occupation and amputation

In this study majority of patients with amputation were labourers (n=11, 45.8%) followed by students (n=6, 25.0%) and housewives (n=4, 16.7%) as depicted in Table 4.

Burn type and amputation

In retrospective study the incidence of flame burn (n=13 i.e. 54.2%) were more than electrical burn (n=11 i.e. 45.8%). But major amputations were mostly seen in patients with electrical burn (45.8%, 9 major and 2 minor of the total 11 cases) compared to flame burns (54.2%, 6

major and 7 minor of the total 13 cases) as seen in Table 5 below.

Table 4: Occupation and amputation.

Occupation	Amputation		Total
	Major	Minor	
House wife	1	3	4
	6.7%	33.3%	16.7%
Nil	1	1	2
	6.7%	11.1%	8.3%
Skilled labourer	8	3	11
	53.3%	33.3%	45.8%
Student	4	2	6
	26.7%	22.2%	25.0%
Teacher	1	0	1
	6.7%	0.0%	4.2%
Total	15	9	24
	100.0%	100.0%	100.0%

Table 5: Burn type and amputation.

Burn type	Amputation		Total
	Major	Minor	
Electric burn	9	2	11
	60.0%	22.2%	45.8%
Flame burn	6	7	13
	40.0%	77.8%	54.2%
Total	15	9	24
	100.0%	100.0%	100.0%

In our study most of burn injuries occurred at home (n=15, 62.5%) followed by burns at a work place (n=9, 37.5%). All patients with amputation had fourth degree burn (n=24,100%) of whom 15 i.e. 62.5% were major and 9 i.e. 37.5% were minor. Early amputation was seen in 2 patients (n=2, 8.3%), both major in nature and delayed amputation was seen in all patients (n=24,100%) with 15 major (62.5%) and 9 minor (37.5%). Out of 24 patients with burn injury, 10 patients (41.7%) had compartment syndrome on admission and fasciotomy was done in all 10 patients (41.7%). Majority of patients who had amputation were not associated with any comorbidity (n=15 i.e. 62.5%) while 20.8% i.e. 5 had history of seizure, 1 had diabetes (4.2%), 1 had depression (4.2%) and 1 was alcoholic (4.2%). In our study majority of patients with burn injuries had digital amputation (n=9,

37.5%) followed by below elbow amputation (n=8, 33.3%), above elbow amputation (n=4, 16.7%) and below knee amputation (n=3, 12.5%). Death was reported in three patients all as result of electrical burn (n=3 i.e. 12.5%), hence the survival rate was 87.5%.

Prospective group

Minor and major amputation

In our study 6 patients had major amputation with mean total body surface area 29.0% and mean hospital stay was

36.5 days. 5 patients had minor amputation with mean total body surface area as 9.0% and mean hospital stay as 15.8 days as depicted below in Table 6.

Age group (years) and amputation

In our study majority of patients who had amputation were in age group of 20-40 years (n=5, 45.5%) followed by age group less than 20 years (n=3, 27.3%) and age group of 40-60 years (n=3, 27.3%). Both major and minor amputation were seen in all age groups as depicted in Table 7 below.

Table 6: Mean total body surface area and hospital stay in prospective group.

Amputation	N	Mean	SD	Std. error mean	P value
TBSA	Minor	5	9.000	6.5192	2.9155
	Major	6	29.000	7.5100	3.0659
Hospital stay	Minor	5	15.80	7.259	3.247
	Major	6	36.50	23.730	9.688

TBSA=total body surface area

Table 7: Age group and amputation in prospective group.

Age group (years)	Amputation		Total
	Major	Minor	
≤20	1 16.7%	2 40.0%	3 27.3%
20-40	4 66.7%	1 20.0%	5 45.5%
40-60	1 16.7%	2 40.0%	3 27.3%
Total	6 100.0%	5 100.0%	11 100.0%

Table 9: Occupation and amputation in prospective group.

Occupation	Amputation		Total
	Major	Minor	
House wife	0 0.0%	1 20.0%	1 9.1%
Skilled labourer	4 66.7%	1 20.0%	5 45.5%
Student	2 33.3%	3 60.0%	5 45.5%
Total	6 100.0%	5 100.0%	11 100.0%

Gender and amputation

Majority of patients with amputation were males (n=8, 72.7%) compared to females (n=3, 27.3%). Amputations were both major and minor in each gender as depicted in Table 8.

Table 8: Gender and amputation in the prospective group.

Gender	Amputation		Total
	Major	Minor	
Female	0 0.0%	3 60.0%	3 27.3%
Male	6 100.0%	2 40.0%	8 72.7%
Total	6 100.0%	5 100.0%	11 100.0%

Occupation and amputation

In our study majority of patients with amputation were skilled labourers (n=5, 45.5%) followed by students (n=5, 45.5%) and housewife (n=1, 9.1%) as depicted in Table 9.

Table 10: Burn type and amputation in the prospective group.

Burn type	Amputation		Total
	Major	Minor	
Electric burn	6 100.0%	1 20.0%	7 63.6%
Flame burn	0 0.0%	4 80.0%	4 36.4%
Total	6 100.0%	5 100.0%	11 100.0%

Burn type and amputation

Majority of patients who had amputation were associated with electrical burn (n=7, 63.6%) followed by flame burn (n=4, 36.4%) as depicted above in Table 10.



Figure 1: Gangrene of right index and middle finger as a result of flame burn.



Figure 2: Amputation of right middle and index finger.

In our study majority of injuries occurred at home (n=6, 54.5%) followed by burns at a work place (n=5, 45.5%). 90.9% (n=10) of them were associated with fourth degree burn while only 9.1% had a third-degree burn (n=1). 18.2% (n=2) needed early amputation which were all minor in nature while delayed amputation was seen in all patients (n=11 i.e. 100%) with 54.55% (n=6) major in nature and 45.45% (n=5) minor in nature. 4 patients (36.4%) had compartment syndrome on admission and underwent fasciotomy as well as major amputation. Majority of patients didn't have any comorbidity (n=7, 63.6%). Those who had comorbidity, 2 had major (n=2, 18.2%) and 2 minor (n=2, 18.2%) amputation. Hypertension (n=2, 18.2%) was commonest comorbidity. In this study majority of patients with burn injury had digital amputation (n=5, 45.5%, all minor) followed by

below elbow amputation (n=3, 27.3%, all major), above elbow amputation (n=2, 18.2%, all major) and above knee amputation (n=1, 9.1%, all major). Only one patient died as a result of burn injury after major amputation (n=1, 9.1%) with survival rate of 90.9% (n=10).



Figure 3: Gangrene of all fingers of left hand following flame burn.



Figure 4: Insensate and non-viable little and ring finger of right hand following flame burn.



Figure 5: Amputation of little and index finger of right hand.

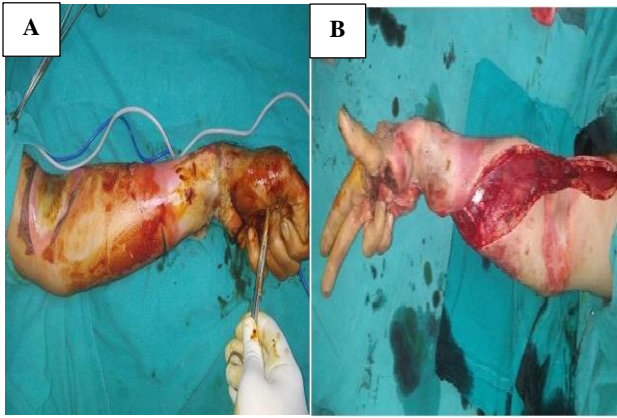


Figure 6: Compartment syndrome followed by fasciotomy of bilateral upper limbs as result of electrical burn; A) left upper limb, B) right upper limb.



Figure 9: Left upper limb amputation at shoulder joint.



Figure 7: Below elbow amputation of bilateral upper limbs.

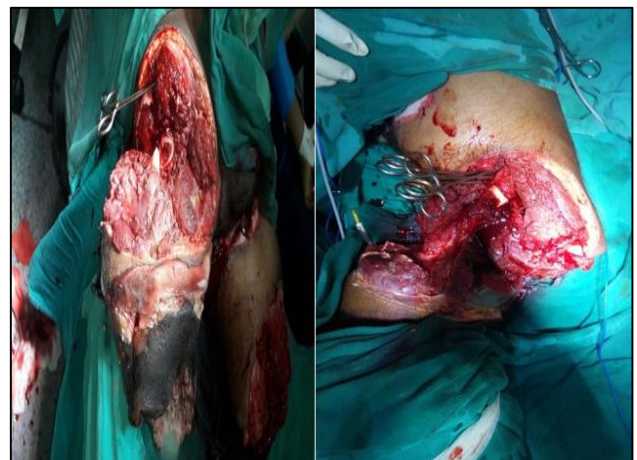


Figure 10: Bilateral transfemoral amputation of lower limbs due to fourth degree electrical burn (intra operative).



Figure 8: Full thickness circumferential electric burn left upper limb.

DISCUSSION

Our study was both retrospective and prospective study. Retrospective study was done from July 2007 to June 2017 and prospective study was done from July 2017 to June 2019 in the department of plastic and reconstructive surgery SKIMS. In retrospective study, a total of 2000 burn patients were admitted in department of plastic and reconstructive surgery from July 2007 to June 2017. Out of 2000 patients, 24 patients complied with inclusion criteria and were included in study representing an incidence of 1.2%. Similar results incidence (1.1%) was reported by Li et al in their study titled ‘amputation in burn unit: a retrospective analysis of 82 patients across 12 years’.¹⁶

In retrospective study the mean hospital stay for major amputation 40.8 days and for minor amputation was 18 days. Similar results like average hospital stay (28.8±0.9 days) was reported by Jang et al in their study titled ‘burn and amputations; a retrospective analysis of 379 amputations out of 19958 burns in 10 years’.¹⁷ The mean

total body surface area for major amputation was 15% and for minor amputation was 9%. Similar results like mean total body surface area (12.4±7.9%) were reported by Ozalp et al in their study titled 'amputation in burn patients'.¹⁸

Males showed predominance (n=17, 70.8%) over females (n=7, 29.2%) in view of percentage of amputation. Similar results like males (93%) predominate over females (7%) were reported by Handschin et al in their study titled 'surgical treatment of high voltage electrical injuries'.¹⁹ In this study the predominant age group with amputation was 20-40 years old (n=14, 58.3%). A young labour force that lacks operating experience led to high incidence of injury. Ghavami et al reported 38.6% and 20.8% incidence of amputation in age group of 20-30 years and 30-40 years respectively in their study titled 'electrical burn injury: a five year survey of 682 patients'.²⁰ Amputations were mostly seen in skilled labourers (n=11, 45.8%) followed by students (n=6, 25%) and housewives (n=4, 16.7%). Most of the injuries occurred at home (n=15, 62.5%) followed by workplace (n=9, 37.5%). Similar results like amputation in labourers (40.2%) were reported by Li et al in their study titled 'amputation in burn unit: a retrospective analysis of 82 patients across 12 years'.¹⁶

Majority of amputation occurred in patients with flame burn (n=13, 54.2%) followed by electrical burn (n=11, 45.8%). Similar results like amputation in flame burn (41.2%) and electrical burn (23.2%) reported by Bartely et al in their study as 'amputation following burn injury'.²¹

All patients with amputation had fourth degree burn. Most of amputation were delayed (n=22, 91.7%) and few amputations were early (n=2, 8.3%) with survival rate of (87.5%, n=12.5%). Similar results like early amputation (33.3%), delayed amputation (66.6%) with survival rate (89%) were reported by Kennedy et al in their study titled 'burns and amputation: a 24 year experience'.¹⁵

In our study 10 patients (41.7%) had compartment syndrome on admission and all required fasciotomy (41.7%). 6 patients had electrical burn (60%) and 4 patients had flame burn (40%). Similar results like fasciotomy (62.3%) which was done in majority of electrical burn injury compared to other burn injuries were reported by Li et al in their study titled 'amputation in burn unit: a retrospective analysis of 82 patients across 12 years'.¹⁶ For burn the escharotomy should be performed within 6 hours of injury if compartment syndrome is suspected. Clinical indication such as pain with passive motion, distal ischemia and compromised muscle compartments are adequate signs of need for compartment release.

In our study most common level of amputation was digital (n=9, 37.5%) followed by below elbow amputation. Similar results like digital amputation (35%)

were reported by Ghavami et al in their study titled 'electrical burn injury, a five year survey of 682 patients'.²⁰ Majority of patients had no comorbidity (n=15, 62.5%) and 5 had seizure disorder, similar results were reported by Adigun et al in their study titled amputation from burn following epileptic seizures.²²

Prospective study

In our prospective study which was done in department of plastic and reconstructive surgery from July 2017 to June 2019. A total of 500 patients with burn injury were admitted in this department. Out of total 500 patients, 11 patients complied with inclusion criteria and were included in study representing an incidence of 2.2%. Similar results like incidence 1.9% were reported by Jang et al in their study titled 'burns and amputations: a retrospective analysis of 379 amputations out of 19958 burns in 10 year'.¹⁷ Mean hospital stay for major amputation was 36.5 days and minor amputation was 5 days. Similar results like mean hospital stay 28.8±0.9 days were reported by Jang et al in their study titled 'burns and amputation: a retrospective analysis of 379 amputations out of 19958 burns in 10 year'.¹⁷

Mean total body surface area for minor amputation was 9% and for major amputation was 29%. Similar results like mean total body surface area of 12.4±7.9% (2-60%) were reported by Ozalp et al in their study titled 'amputation in burn patients'.¹⁸ Majority of amputation were seen in 20-40 years (n=5, 45.5%) followed by age group of less than 20 years (n=3, 27.3%) and 40-60 years (n=3, 27.35%). Similar results like amputation in 20-30 years (38.6%) and 30-40 years (20.8%) were reported by Ghavami et al in their study titled 'electrical burn injury: a five year survey of 682 patients'.²⁰

Most of amputations were seen in males (n=8, 72.7%) in comparison to females (n=3, 27.3%). Similar results like amputation in males (89%) and in females (11%) reported by Li et al in their study titled 'amputations in burn unit: a retrospective analysis of 82 patients across 12 years'.¹⁶ Majority of amputation occurred in skilled labourers (n=5, 45.5%) followed by students (n=5, 45.5%) and house wife (n=1, 9.1%) and most of these injuries occurred at home (54.5%) followed by workplace (45.5%). Similar results like injury occurred at work place (62.2%) and labourers (40.2%) being most affected were reported by Li et al in their study titled 'amputations in burn unit: a retrospective analysis of 82 patients across 12 years'.¹⁶

Most of amputations occurred in patients with electrical burn (n=7, 63.6%) followed by flame burn (n=4, 36.4%). Ozalp et al reported electrical burn being most common etiological agent (p<0.001) titled 'amputations in burn patients'.¹⁸ Majority of patients had 4th degree burn (n=10, 90.9%) and 1 had third degree burn (9.1%).

In our study 4 patients presented with compartment syndrome (36.4%) and all required fasciotomy. Majority patients who required fasciotomy were having electrical burn. Li et al reported 62.3% of fasciotomy with most patients having electrical injury in his study titled 'amputations in burn unit: a retrospective analysis of 82 patients across 12 years'.¹⁶ Majority had delayed amputation (n=9, 81.8%) with early amputation in 2 patients (18.2%). Similar results like early and delayed amputation as 34.1% and 56.1% respectively were reported by Li et al in his study titled 'amputations in burn unit: a retrospective analysis of 82 patients across 12 years'.¹⁶ Majority had no comorbidity (n=7,63.7%) followed by hypertension (n=12,18.2%). Survival rate in this study was 90.9% while as 1 patient died (9.1%). Similar results reported by Kennedy et al as survival rate 89% and 11% died.¹⁵

In our study majority had digital amputation (n=5, 45.5%) followed by above elbow amputation (n=2, 18.2%). Similar results like digital amputation (35%) were reported by Ghavami et al in their study titled 'electrical burn injury: a five year survey of 682 patients'.²⁰

The main limitation of the study was its sample size. We had a total of 35 patients with 24 in retrospective and 11 in prospective group. Had it been we got larger number of the patients, the results might have been more refined.

CONCLUSION

A retrospective study of burn patients with amputation over 10 year period and prospective study of burn patients with amputation over 2 year period using centre based rather than population based survey reflected unique characteristics of burn patients in Kashmir. The amputation rate was 1.1% in retrospective study which slowly increased in prospective study as 2.2%. Flame burn was found to be the main mechanism of injury in retrospective study and electrical burn in prospective study. Inexperienced young labour force represented the largest component among amputee patients in Kashmir. Education and compliance with safety measures as well as common sense and respect for the potential danger of electricity are still essential for avoiding these injuries.

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