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Demographic Profile of Electrical Burns in a Tertiary Burn Care Centre

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ABSTRACT

Electrical burn injuries are challenging burns that require multi disciplinary approach. It is a major cause of morbidity among burn victims and requires more number of interventions and hospital stay. Certain unique features that are to be kept in mind while treating electrical burn patients are the differences in fluid requirement, assessment of cardiac involvement, other associated injuries like head spine or bony injuries and renal damage. Aim of treatment of these victims is to prevent infection, to achieve skin cover to allow early mobilization, to optimize function and to minimize long term scarring. Special effective authentic care and proper rehabilitation can make the electrical burn victim a useful productive member of the family/society.

INTRODUCTION

Electrical burn injuries are a challenge to the reconstructive surgeons. Providing a stable skin cover and functioning limb is a great challenge to the burn surgeon. Electrical burns are the most devastating of all thermal injuries, usually involving skin and deeper tissues. They have multiple acute and chronic manifestations. They primarily affect young working males and are the most frequent cause of amputations in burns unit.

AIM

In this retrospective study we have analyzed the incidence of electrical burns, age and sex preponderance, percentage of burns, time delay in admission, areas of involvement, dominant hand involvement, type of electrical burns, type of procedures done, hospital stay and outcome in our centre.

PATHOPHYSIOLOGY

Electrical burn severity is determined by voltage, current (amperage), type of current(Ac/Dc),path of flow of current, duration of contact, resistance at the point of contact and individual susceptibility. Tissue resistance offered in increasing intensity are blood vessels, muscle, skin, tendon, fat and bone. Current flow would be distributed in proportion to resistance of tissues. Tissues having the highest resistance generating the most heat.

Electrical burns are classified as low voltage (< 1000 volts) and high voltage injuries (>1000 volts). The burn injury has three different components, the true electrical injury caused by current flow, an arc injury resulting from the electrical arc generated as the current passes from the source to an object and a flame injury caused by ignition of clothing and or surroundings.

MANAGEMENT

ACUTE CARE

As soon as the patient is seen in the casualty the respiratory and cardiac status are assessed thoroughly. After initial assessment and fluid resuscitation, cardiac and renal monitoring should be restored to normalcy as early as possible. Urine output is the single clinical guide for adequate fluid replacement. It should be maintained at 1.5ml to 2ml per kilogram body weight per hour. Assessment should be done to rule out intracranial, intra thoracic, intra abdominal injuries and long bone fractures due to forceful contraction of muscles or a forceful fall. Tissue damage due to rhabdomyolysis and myoglobinuria leading to acute renal failure is to be kept in mind while treating electrical burn victims.

COMPARTMENT SYNDROME

Patients with high voltage electrical injuries of the extremities are at risk of developing compartment syndromes during the first 48 hours following injury. Damaged muscle, swelling within the investing fascia of the extremity may increase pressure to the point where blood flow to muscle is compromised. A high index of suspicion is of paramount importance for the early diagnosis (either by good clinical examination of the affected extremities or repeated measurement of compartment pressures) and prompt treatment of the increased compartment pressures is essential to salvage a limb. When compartment pressure exceeds 30mmHg, surgical decompression by open faciotomy becomes necessary to prevent ischemic muscle injury.

Figure 1: Fasciotomy for electrical burns of right hand

Compartment fasciotomies of the lower leg and anterior/posterior fasciotomies of the upper extremity (Figure 1) are performed in the operating room under anesthesia. Rarely medial and lateral fasciotomies of the thigh and upper arm are required to completely release all damaged areas. The initial operation is followed by a second look operation within 24 to 48 hours for debridement/amputation and the earliest possible closure.

WOUND CARE

Local wound care is performed by using silver sulfadiazine for microbial control of the deep flash or flame burns and on more superficial areas. Surgical excision is begun two to three days post burn either as a second look operation following fasciotomy or as the first procedure in patient not requiring fasciotomies. All obviously necrotic tissues are removed, while tissues of questionable viability are retained and reevaluated every two to three days until wound closure can be achieved.

SURGICAL DEBRIDEMENT

The concept of progressive tissue necrosis has led to the treatment strategy of early debridement and fasciotomy, followed by serial debridement and delayed wound closure. Now we perform an early but selective debridement in order to prevent discontinuity of functionally important structures. Available options for wound closure encompass the total range of reconstructive procedures from local tissue rearrangement after excising deeply burnt areas, skin grafts, local flaps, distant flaps and free tissue transfer. Limb salvage with functional preservation of vital structures should be attempted. This may require revascularization using segmental vein grafts or segmental cable grafting of nerves. Pedicle flaps should be considered in case of suspected arterial compromise.

RECONSTRUCTIVE CHALLENGES

HEAD

Head is a common site of injury in electrical burns with a central full thickness damage of the scalp involving galea, periosteum and sometimes bone (Figure 2). Treatment options depend on the extent of the injury to the bone. In case of partial necrosis of the bone the outer table of the skull can be tangentially removed with a high speed bone drill. The subsequent wound is covered with skin graft or local flap

depending upon the bed of the wound. Full thickness injury of the skull requires complete excision of the necrotic bone to prevent complications due to infections and the coverage of the excised area by a local flap or even a free flap.

Figure 2: Electrical burns involving the face and eyes; and scalp

EXTREMITIES

Electrical injuries to the extremities (Figure 3) are common among the young adults of the work force. Early debridement and decompression of neurovascular structures reduces the likelihood of amputations. Even though amputation is avoided the resulting limbs maybe a nonfunctioning extremity due to loss of muscles and nerves. In our view the early debridement of nonviable tissue prevents fatal complications. Suspected compartment syndrome always needs open fasciotomy to prevent further vascular compromise to the involved extremity. Hand and wrist involvement needs the release of the Guyon's canal and the carpal tunnel in addition to the fasciotomy to the forearm. Debridement over elbow and axillary areas leads to large tissue defects which may be covered by local flaps from anterior or posterior chest wall. For extensive defects on hand and forearm pedicle groin flaps or abdominal flaps provide good coverage with independent blood supply.

Figure 3: Common contact wounds of the extremities.

AMPUTATIONS:

With irreversible destruction of tissues, the decision for amputation is justified and should be made early. The main objective is to achieve a stump (Figure 4) which will allow early fitting of prosthetic devices. The optimum level of amputation is determined by the extent of the remaining viable tissues.

Figure 4: Level of gangrene and amputation

COMPLICATIONS:

Early complications of electrical injury involve cardiac, renal, septic, neurological and ocular manifestations. Renal failures and sepsis are preventable by adequate resuscitation and rapid removal of necrotic tissue. Cardiac damage is recognized and treated on admission. Neurological deficit may be present on admission or may develop days or months after injury. Cataract formation is the most frequent ocular manifestation.

PHYSIOTHERAPY AND REHABILITATION:

To minimize the development of contractures and joint deformities early mobilization, proper positioning and splinting is advocated. Availability of sophisticated modern myoelectric prosthesis may restore limb function and help in reintegration into daily life easily and early.

MATERIALS AND METHODS

A retrospective analysis of electrical burns of patients admitted in the Department of Burns, Plastic and Reconstructive surgery of Government Kilpauk Medical College Hospital, Chennai, India between January 2015 to December 2015 was done.

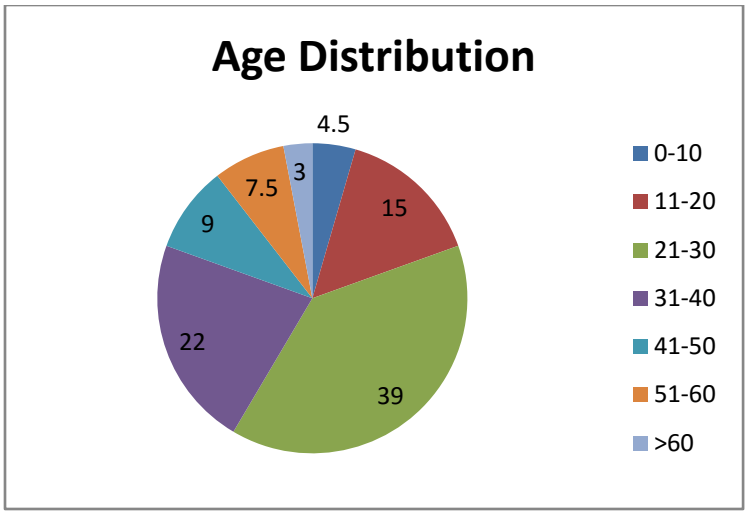
INCIDENCE OF ELECTRICAL BURNS

Total number of admissions in our burns unit from January 2015 to December 2015 were 1742 out of which 106 where electrical burns. Hence electrical burns constituted 6.1% of total admissions.

AGE AND SEX PREPONDERANCE

AGE GROUP ANALYSIS

Years	No of Cases	Percent(%)
0-10	5	4.5
11-20	16	15
21-30	41	39
31-40	23	22
41-50	10	9
51-60	8	7.5
>60	3	3

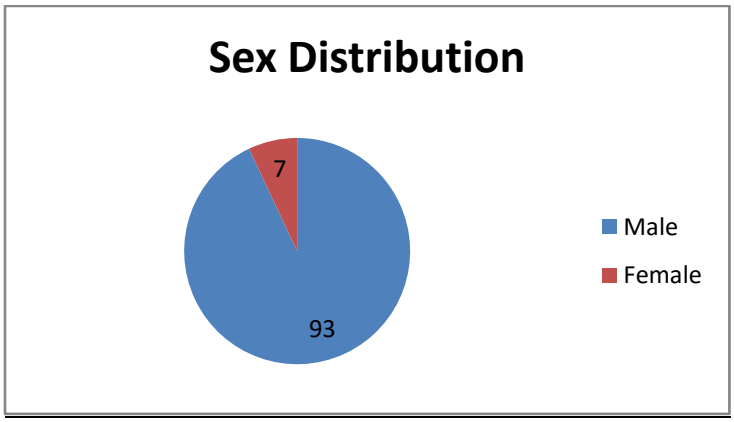


Majority of admissions were between 21 to 30 years.

SEX DISTRIBUTION

Out of 106 electrical burns admissions 99(93.4%) were male patients and 7(6.6%) were female patients indicating very strong male preponderance.

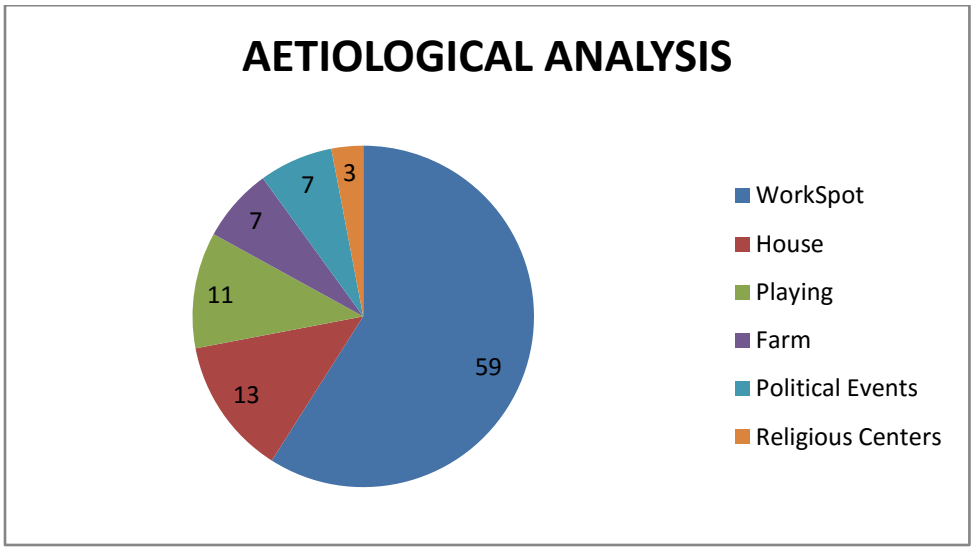
Gender	No of Cases	Percentage
Male	99	93.4
Female	7	6.6



AETIOLOGICAL ANALYSIS

In our study all our cases were accidental burns. Most of the burns were work spot burns 57(53.7%) (occurred while handling high tension wires or doing some work near high tension wires). Electrical burns which occurred in house 14(13.2%), while playing 12(11.3%) while working in farm 7(6.6%) during political events 7(6.6%) and in religious centers 3(2.8).

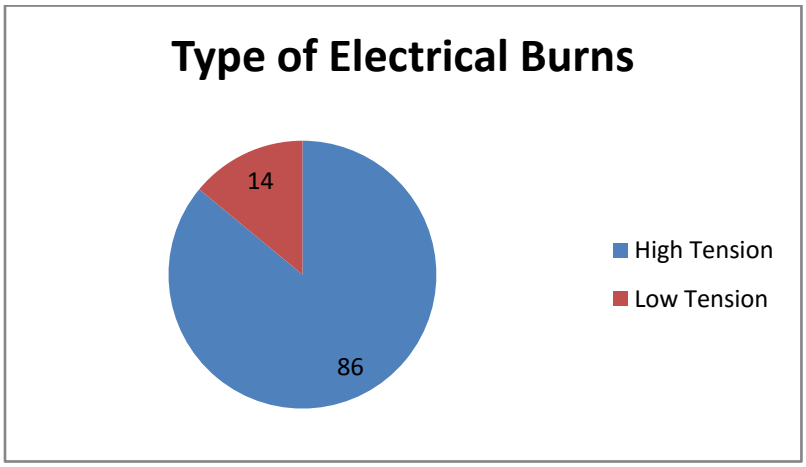
Place of Accident	No of Cases	Percentage
Works Spot	57	59
House	14	13
Playing	12	11
Farm	7	7
Political Events	7	7
Religious Centers	3	3



TYPE OF ELECTRICAL BURNS

Out of 106 electrical burn injuries high tension burns were 91(85.8%)and only 15(14.2%) were low tension electrical burns.

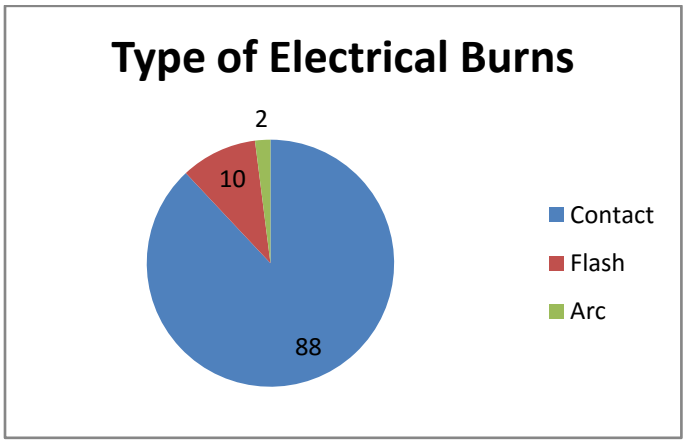
Type of Electrical Burns	No of Cases	Percentage
High Tension	91	86
Low Tension	15	14



In our study contact electrical burns (Figure 6) were 93(87.7%), flash burns 11(10.4%) and arc burns 2(1.9%)

Figure 6: Contact Burns and Flash burns

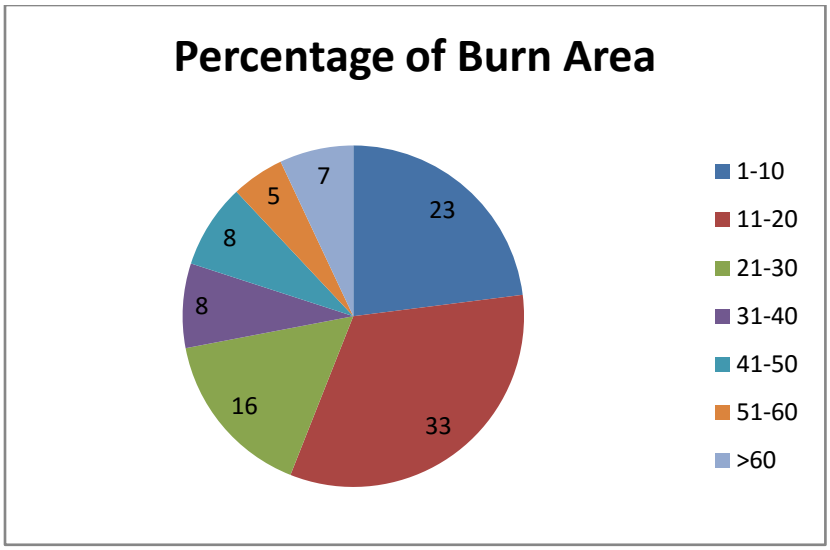
Type of Electrical Burns	No of Cases	Percentage
Contact Burns	93	88
Flash Burns	11	10
Arc Burns	2	2



BURN SURFACE AREA ANALYSIS

Most of the electrical burn injuries were less than 20%

Percentage of Burn Area	No of Cases	Percentage
1-10	24	23
11-20	35	33
21-30	17	16
31-40	9	8
41-50	9	8
51-60	5	5
>60	7	7



AREA DISTRIBUTION

In our study multiple regions (head, neck, trunk, both upper and lower limbs) involvement was 64(60.4%) and both upper and lower limbs involvement 33(31.1%). Isolated head, trunk and perineum involvement was noted in few cases only.

HAND INVOLVEMENT

Our study shows that most of the burn injuries occurred in work spot (Figure 7) which involved mostly the upper limb in which both upper limbs were involved in 21 cases, only right hand in 13(62%) cases and only left hand in 6cases (29%).

Figure 7: Electrical burns of the hand (common) and lips (rare).

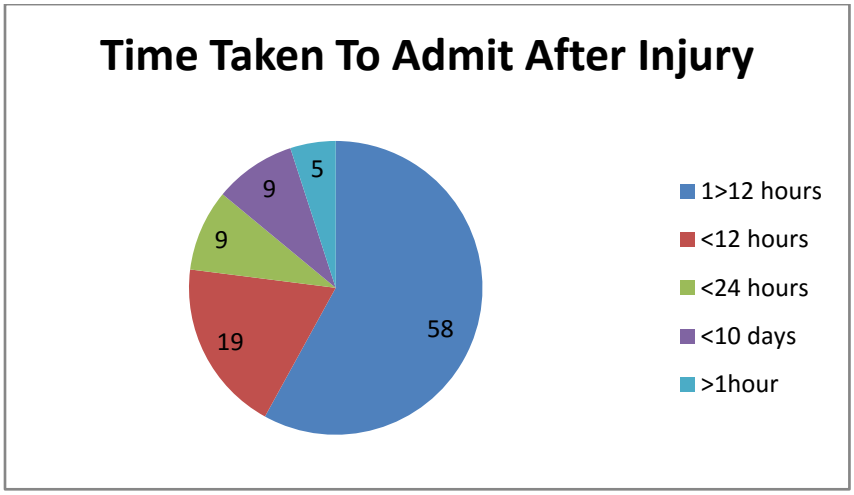
NO OF HOSPITAL DAYS

Our study showed hospital stay from minimum 4 days to maximum 75 days

OUTCOME ANALYSIS

In our study most of the electrical burns were admitted between one to twelve hours 61 cases (57.5%). More than 12 hours 20cases (18.9%) more than 24hours 10 cases (9.4%) more than 10 days 10cases (9.4%) and very few 5 (4.7%) were admitted within an hour of injury.

Time Taken To Admit	No of Cases	Percentage
1>12 hours	61	58
<12 hours	20	19
<24 hours	10	9
<10 days	10	9
>1hour	5	5



SURGICAL INTERVENTIONS

Our study showed that multiple procedures were done in electrical burn victims from day one to the last day in the hospital starting from fasciotomy to skin grafting or flap cover. In our study fasciotomy was done in 7 cases, amputation /disarticulation of fingers in 7 cases, disarticulation of shoulder in 1 ,debridement and skin grafting in 20 cases and flap cover in 8 cases which included local and distant flaps. Stump revision was done in 13 cases and orchidectomy was done in 1 case.

Out of 7 patients who underwent fasciotomy 2 patients went in for amputations and in other 5 cases limb survived. Our study showed guillotine amputations in 8 cases, in which below elbow was done in 7, above elbow in 1 and shoulder disarticulation in 1. Below elbow amputation involving right upper limb was done in 5 cases, left in 4 cases and both in 3 cases.

Our study showed distant flaps (abdominal flap) was done in 4 cases, local flaps in 4 cases (transposition flap 3, cross finger flap 1).

Stage I	Cases	Stage II	Cases	Stage III	Cases
Fasciotomy	7	Amputation	2	Stump revision	2
Amputation (Guillotine)	8	Stump Revision	11	SSG	13
Disarticulation of Fingers	7	Debridement	5	Flap	4

Disarticulation of Shoulder	1	SSG	7	Mobilization & Splinting	6
Debridement	7	Orchidectomy	1		
		Flap	4		

Figure 8: Skin grafting for a case of electrical burns on the finger

Figure 9: Flap cover for a case of electrical burns on the forearm

Figure 10: Flap cover for electrical burns scalp in a young boy.

PROGNOSIS ANALYSIS

Our study showed 63(60%) patients were discharged after multiple procedures and completing rehabilitation measures who had a long hospital stay. 23(21.7) patients died and discharged against

medical advice were 20(18%). Our study showed a mortality rate of 8% in electrical burn victims in overall burns admission.

DISCUSSION

Our study shows that 6.1% of electrical burns occurred in active young age group (21-30)39% with male preponderance 93% with contact burns in 88% due to high tension wires in 86%. However total burn surface area was less than 20% in majority of cases(56%). 64% involved multiple regions and only one limb involvement in 31% in which upper limb involvement was 20% with right hand preponderance of 62% and had 8% mortality rate.

CONCLUSION

Electrical burns are preventable as it happens in work spots due to carelessness. Victims are active young men who are the sole financial supporters of the family. Carelessness, risk taking attitude, absence of specific instructions regarding safety measures like helmets, gloves, the lack of properly insulated wires and lack of enforcement of strict rules are the causes for the rising incidence of electrical burns.

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