

RELATED DEATHS DUE TO ELECTROCUTION – A COMPARATIVE STUDY

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ABSTRACT

Deaths caused by Electrocution should be thoroughly documented and investigated for safety, prevention and compensatory reason. In the present study fatalities from electrocution and the related deaths are investigated. Preventive measures are suggested to bring down the fatal incidence in both Men and Women. The mechanism of Electrocution, Circumstances of Electrocution and investigation of electrocution deaths are described and mentioned in the present study.

Keywords: Electrocution, Deaths

INTRODUCTION

Fatteh (1978) reported the death of a man who was found death beside his bed with electric wire round his penis. He had been in direct contact with the domestic supply of 220V. The pathological aspects are discussed. Bernad (1985) investigated the cases of electrocution by light in different persons. A detail study has been made and the results are analyzed. Nayak (1967) reported the deaths in Men and Women due to electric burns. Prevention and safety measures are mentioned. Thomas (1989) mentioned the extensive injury cause due to high tension. Persons of different age groups are taken up for the study and the Results are compared and analyzed. Wiecking (1983) reported the deaths due to electrocution occur accidentally. Circumstances of electrocution are discussed and a comparative study has been made.

MATERIALS AND METHODS

In Secunderabad city and the Ranga Reddy District which come to the Jurisdiction of Department of Forensic Medicine, Gandhi Medical College, Hyderabad, for Medicolegal cases, 5,756 Medicolegal autopsies are conducted during the period of 2001 and 2002. Amongst them are 77 deaths due to electrocution (Table 1). The records maintained for each case in the Department of Forensic Medicine include a copy of (i) Inquest Report (ii) Post-mortem examination report (iii) Extract from hospital in – patient ticket (if the deceased was treated in a hospital) (iv) Histopathological examination report (in a few cases). In addition the autopsy Pathologists' notes on the history obtained by him and the notes of criminal proceedings if any were also maintained. All these documents perused in relation to the cases of the death due to electrocution for the year 2001 and 2002. The cause of the death as given by the autopsy Pathologist has been taken as the criterion to consider that in autopsied case as a "electrocution fatality". The possibility of electrocution is always considered whenever the pathologist is investigating any sudden or suspicious death, taking into consideration the circumstances leading to his death. Many a time death due to electrocution may be totally unsuspected at the scene of death. Hence, an attempt has been made to ascertain the manner of death, taking into consideration the history as given in the Inquest Report, the age of the deceased, the nature of his occupation, circumstances related to his death and other available information, by a thorough investigation of electrocution death not only by autopsy but also a visit to the scene of occurrence along with an electrical expert.

RESULTS AND DISCUSSION

Perusal of table 1 shows the incidences of fatalities from electrocution constitutes 1.25% and 1.45% of the total number of cases subjected to post-mortem at Gandhi Medical College & Hospital for the years 2001 – 2002 respectively. Even though they constitute a miniscule percentage between 1 to 1.5% compare to

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wide spectrum of causative factors of medico-legal deaths. It is still on higher note and requires rapt attention as it is the field where almost all the fatalities are accidental in nature and mostly of human error.

Table 1: Showing the number if cases of death due to Electrocution from 2001-2002

Name of Year	Total No of Autopsies	No of cases of	Percentage of Autopsies
2001	2722	34	1.28%
2002	3034	43	1.45%

Perusal of table 1 shows the incidences of fatalities from electrocution constitutes 1.25% and 1.45% of the total number of cases subjected to post-mortem at Gandhi Medical College & Hospital for the years 2001-2002 respectively. Even though they constitute a minuscule percentage between 1 to 1.5% compare to wide spectrum of causative factors of medico-legal deaths. It is still on higher note and requires rapt attention as it is the field where almost all the fatalities are accidental in nature and mostly of human error.

Table 2: Showing the percentage of cases of deaths on arrival (D.O.A.CASES) and deaths after admission (D.A..A CASES)

Name of Year	Total No of Deaths from Electrocution	No of D.O.A Cases	%	No. of D.A.A. Cases	%
2001	34	19	56%	15	44%
2002	43	21	49%	22	51%

D.O.A. – Death on Arrival

D.A.A. – Death after Admission

Table 2 shown percentages of cases of deaths on arrival (D.O.A. Cases) and deaths after admission (D.A.A.Cases) reported to Gandhi Hospital during the year 2001-2002. The D.O.A. to D.A.A.Cases constitutes 56 & 44 % for the year 2001 and 49 and 51% for the year 2002.

Even though there is a drop of 7% of D.O.A.Cases with a rise of 7% in D.A.A.Cases from 2001-2002. Still approximately 50% of cases are reported in category of spot deaths or deaths during transportation. It clearly shows the old alternative left to lessen the mortality, the better management of admitted cases.

Table 3: Showing sex-wise distribution

Name of Year	Total No of Deaths from Electrocution	No of Male Cases	%	No. of Female Cases	%
2001	34	30	88%	4	12%
2002	43	38	88%	5	12%

Perusal of table 3 shows that 88% of fatalities or of male sex. The female fatalities of the study or young children who got electrocuted accidentally while playing near the unprotected transforms and in case of adults maneuvering faulty appliances with defective earthing. There is no meddling with live wires by female sex as they are vary of dangers from electricity and try to keep away from it as far as possible.

This is evidence from the absence of single fatal incidence of female skilled or professional worker dealing with electricity which has become an absolute male prerogative in the past, present and the scenario will be the same in future also.

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Table 4: Showing age wise distribution of 77 cases of deaths due to Electrocution

Name of Year	1 – 10 Years	11 – 20 Years	21 – 30 Years	31 – 40 Years	41 – 50 Years	51 – 60 Years
2001	2	6	15	7	2	2
2002	5	5	16	12	4	1
Total	7	11	31	19	6	3
Percentage	9%	14%	40%	25%	8%	4%

Study of table 4 shows that about 65% fatalities belong to 3rd and 4th decades of life where occupational exposure is the main factor. The fatalities seen and children are due to accidental contact with live wire out of ignorance, over enthusiasm like playing with unprotected transformers, removal of kites entangled in power lines. Stepping over snapped wires etc.

The incidence of fatalities in the 4th and 5th decade of life are minimal and mostly non-skilled personal, engaged in some other professions and accidentally become play to electricity. This group includes masons, plumbers, carpenters, industrial labor that come in contact with live wires, machinery or appliances with faulty earthing during the execution of their profession.

The major incidences of fatalities are seen in the prime period of life effecting not only the victim in fatal cases but also indirectly reflects the extent of disability of non-fatal cases and the fall out, not only on the victim but also their families causing disarray of their future life and needs professional attention to lessen the risks.

Table 5: Showing the season variations of 77 cases of Electrocution deaths

Months	Season	Cases	Percentage
March	Summer	15	20%
April			
May			
June			
July	Monsoon	35	43%
August			
September			
October			
November	Winter	27	37%
December			
January			
February			

Table 5 shown the seasonal incidence of mortality form electrocution. The seasonal variation comprises of 20%, 43%, and 37% respectively for summer, monsoon and winter.

As expected dampness and humidity of atmosphere in monsoon season lessens the resistance of the skin for conduction of electricity thereby increasing the vulnerability. Apart from it the frequent breakdown of power lines from short circuits, winds, power line snaps during monsoon, requires repairs and re-setting of power lines thereby decreasing exposure and subsequent risks.

Since hot humid weather induces sweating moisturized skin lessened resistance to the current and results in an ideal condition for passage of current to grounded body resulting in death.

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Hence on can expect a higher incidence in summer months. This is true as far as the western countries are concern and the reverse is true here with lower incidence in summer seasons. The main factor being the frequent power cuts, low voltage for most of the time year after year.

Table 6: Showing the percentage of skilled and unskilled victims (as per inquest)

Name of Year	Skilled Victims	%	Unskilled Victims	%	Unknown	%
2001	9	26%	22	65%	3	9%
2002	17	40%	24	56%	2	4%

Table 6 shows the percentage of fatalities of skilled and unskilled personal from electrocution the percentage of skilled category ranges from 26% to 40% considering this percentage of skilled personal who have knowledge and formal training with regard to electricity and when compared to the percentage of unskilled personal known no bound category who have no knowledge or formal training with regard to electricity, this much percentage in skilled category is surely on higher side.

The negligent attitude, lack of proper training, over confidence of withstanding an electrical shock is the main factors for fatalities in the skilled categories. Interestingly more fatal of the skill category are of contract labor, engaged the electrical department for repair and maintenance of power lines where the present motto is the privatization of the services.

Accidental electrocution among these persons would have because of inattention, carelessness, ignorance and haste. In some cases, malfunctioning of appliances or equipments such as ineffective insulation, lack of protective earthing, faulty grounding and short circuits.

Table 7: Showing the distribution of deaths due to high tension and low tension electricity (as per inquest)

Name of Year	Total No. Cases	Low Tension Electricity	%	High Tension Electricity	%
2001	34	28	82%	6	18%
2002	43	32	74%	11	26%

Perusal of table 7 showed the percentage of low voltage and high voltage current. The figures are 82% and 18% for the year 2001 and 74% and 26% for the year 2002. Electrocution is normally the results of direct contact with the 240-volt a.c. supply and the closer the contact the greater the danger, especially when it results in 'hold on'. A glancing contact or a fall against the conductor, on the other hand, is followed by a break in the circuit; in the case of high-tension supplies the victim is usually repelled violently and, if on a pylon or ladder, thrown to the ground. The fatal injuries may then be due to his fall. Indirect contact with high-tension current not only results in arcing but there may be direct flow of current in an indirect fashion.

In the present study the victims of high-voltage are mostly of skilled category of electricity department with 1 or 2 cases of industrial origin.

Notwithstanding the wide distribution of high tension current in industry the majority of industrial accidents are due to contact with low or medium voltage supply. The agent commonly responsible for fatal accidents in industries was hand tools, over head lights, switch gears etc.,

Table 8: Showing the incidence of Industrial and Domestic cases of deaths due to electrocution

Name of Year	Total No. of Cases	Domestic	%	Industrial	%	Unknown	%
2001	34	22	65%	9	27%	2	8%
2002	43	29	67%	11	26%	3	7%

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In the present study as form table 8 roughly 25% of victims belong to industrial category even though majority of them died from low-voltage electricity during the course of their profession. The electricity that is generated artificially for human use has caused serious injuries and the large number of deaths. By far the group of people of such injuries and fatalities arise out of accidents along the transmission system which carry electric energy to the distant points where it is used. A much moral number of electrical accidents occur in homes and industries where low-tension currents are employed.

Table 9: Showing cases of deaths due to electrocution and electrocution associated with fatal injuries

Name of Year	Total No. of Cases	Electrocution	Electrocution with Burns	Electrocution with Fatal Injuries
2001	34	24	8	2
2002	43	29	13	1
Total	77	53	21	3

From perusal of table 9 it is evident that in 53% cases death has occurred from electrocution itself in 21% cases burns with electrocution and in 3% cases fatal injuries along with electrocution.

In most fatal electrical accidents, deaths is caused by the electric energy itself not uncommonly the electrotrauma becomes associated with mechanical injury; this is the case when the victim of the accidents falls from a height, and in this instance, it may be difficult to ascertain the immediate cause of death.

One of the most remarkable features of electrocution is the fact that death need not be instantaneous. Forensic Pathologists throughout the world have several documented cases where individuals came in contact with strong electrical current and were able to walk some distance and talk before the onset of collapse and death.

In our study in case of high-voltage victims sustained flash burns in 17 cases out of these in 2 cases victims died on the spot and the remaining 15 cases admitted into the hospital. In 10 cases victims died within the first 48 hours and in remaining 5 cases death occurred from septicaemia of burns at varying intervals.

Of low-voltage 40 victims died on the spot itself and in the remaining 20 cases death has occurred in first 48 hours. These instances do not prove that the onset of ventricular fibrillation was not instantaneous but only the number of seconds may follow before death occurs even though cardiac function is interrupted. The same phenomenon may occur with Ventricular fibrillation from any other cause.

Table 10: showing analysis of the 77 cases of electrocution deaths depending upon the type of electrical injuries

Name of year	Total no. of cases	No. of cases without signs of electrocution	No. of cases with entry and wound	No. of cases with entry wound only	No. of cases with exit wound only	No. of cases with burns	No. of cases with other fatal injuries
2001-02	77	5	39	18	4	21	3
Percentage		6%	51%	23%	5%	27%	4%

On perusal of table 10 in just due to electrocution direct contact with electricity is seen in 80% of cases. Of these 51% cases shows both entrance and exit injuries 23% shows entry wound only and 5% cases show exit wound only. In majority of the cases the entry wounds are seen over upper extremities particularly palm and fingers. The other areas are head and neck, where the contact is form slanging and dangling wires.

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In 4 cases the entry wounds are present over feet and sole due to accidental overstepping on snapped wires, fencing wires arranged by farmers to protect their crops from wild boars and hunters to catch wild animals in the forest.

The exit wound in most cases are present over feet, particularly over tip of toes, crease folds and seen as splits limited to skin only.

In a sizeable number of cases (18) the bodies revealed only entry wound with no evidence of exit wound, making it difficult, to assess the path of current in the body.

The greater the area of contact in the body lesser is the damage either at point of entry or exit. In 4 cases the dead bodies revealed only exit injuries with no evidence of entry wound. This may be due to greater area of body contact with electricity with lesser area of earthing with the ground. In 5 cases no evidence of electrocution is present. The reason is either the momentary contact or wider area of contact and earthing like stepping or falling into water where live wire is present.

The present study shows burns in case of electrocution in 27% of cases even though the fatalities from high-voltage constitute 21%. The presence of burns in low-voltage fatalities are due to flash cum short-circuits or flames from spark ignition.

In about 3 cases even though the fatalities received electric shock immediate cause of death is due to fatal head and other multiple injuries the victims sustained due to fall from height like electric pole. The role of electricity is debatable in these cases because of the unusually short duration that all the events take places.

The antemortem appearance of the injuries on the bodies cannot jeopardize the role of electrocution and had its own say in the cause of death.

The circumstances of death due to electrocution may be accidental, suicidal, homicidal, iatrogenic, auto-erotic electrocution and due to lightening. In our study all the cases were accidental in nature.

Polson sites 4 suicidal cases of electrocution described by Munck in 1934 Nippe (1921) were one of the first to report a case of suicidal electrocution.

Homicidal electrocution is rare. Why brow was convicted of attempted murder by electrocution in 1951 and sentenced to 10 years imprisonment. Carrier, 1957 cited by Polson reported a case of a man who murdered his wife by electrocution.

In industry the risk is greater than in domestic circumstances because the workers may be on concrete which is rarely quite dry, or on damp ground or flooring, they may be wearing steel-shod boots or worn boots. They are often near steel work. In the home the person is likely to be dry shod, stood on wood or carpeted floor. Here the greatest risk is in the bathroom and above all in the bath. In the home glancing contact with the electric current may result only in a sensation of tingling or at worst an unpleasant shock and temporary increase in heart and respiration as happened when a finger was put on a live floor socket. If, however, the conductor is grasped there is the likelihood of 'hold on' and fatal shock.

In our survey of 77 cases of electrocution deaths 51 were due to domestic supply of current and 20 deaths industrial supply of current. Cases of electrocution deaths are increasing year after year due to increased utility of electrical appliances without taking proper precautions the domestic front.

Some of the common examples of the electrocution deaths are seen at the repairing work of TV, Radio, Iron, Washing machine, domestic dryers, electric stoves and rice cookers. The commonest causes are due to defective insulations of the wire improper fitting, insufficient knowledge regarding the electrical fittings and carelessness while handling the electrical appliances. The common electrical accidents are seen in bath rooms and kitchens.

All electrocution deaths may become frequent some of them are litigant, Electrocution is an unexpected events in a society which have come to dependent upon reliable electric distribution and operation.

Those who became its victims are the survivors and usually looking for the someone to blame for the sudden and tragic death.

As with numerous other amenities of modern life the people have come to expect faultless operations of the electrical system and electrical appliances.

Unfortunately as the aphorism so appropriately states it Family breads contempt.

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The forensic pathologist must remember every electrocution death is very likely source of subsequent litigation, medical documentation of the cause of the death, the nature of the death and related factors should be very complete.

Death due to electrocution is a medico-legal case which demands close attention not only to document the true cause of death of the unfortunate victim, but also to detect defective condition which should be remedied in order to prevent future electrocution at the same site.

Electricity is ubiquitous in our modern civilization and is the source of much productivity and enjoyment. It is also a very dangerous instrumentality which should be respected by everyone. The occasional fatality due to electrocution must be thoroughly explained. Every one of these deaths is potentially preventable, since each is due to either equipment malfunction or victim error.

By the present study following conclusions are arrived at:

It is important that electrocution deaths be thoroughly documented and investigated for safety, prevention and compensatory reasons. A worker who suddenly drops dead while operating an electrically energized tool should be suspected to have died of electrocution. Electrocution deaths will almost invariably result in litigation. The exact circumstances in which the electrocution occurred and the relation for the deceased to the offending energized source must be clear and documented. Electricity is ubiquitous in our modern civilization and is the source of much productivity and enjoyment. It is also a very dangerous instrumentality which should be respected by everyone. The occasional fatality due to electrocution must be thoroughly explained.

Sex incidence was 88% male and 12% female.

The maximum age incidence was in the age group of 21 to 30 years (40%) followed by 31 to 40 years (25%) and 11 to 20 years (14%).

Lightening deaths are relatively rare. When they do occur, the cause of death is usually quite obvious from the circumstances. Lightning deaths can occur, however, where the circumstances are less obvious. The medical examiner should be aware of the unique pathological findings associated with lightning deaths and should always think of a lightning strike as potentially being the cause of death in anyone unexpectedly found dead during or shortly after a thunderstorm.

The following precautionary measures against electrocution are suggested.

- (a) Do not touch any electrical fittings with wet hands.
- (b) Do not change fuse wire before disconnecting the mains.
- (c) Do not keep water and electrical fittings close to each other to avoid earthing.
- (d) Damaged flexible or other electrical wires or fittings should at once be replaced and defective earthing should be properly attended.
- (e) Proper precautions should always be taken while handling any electrical fittings or gadgets. Water heaters, electric blankets should always be switched off before use.
- (f) Education of the public, especially children in respect of potential dangers is a worthwhile investment.
- (g) To limit the risk of fire and electrocution to the minimum in the houses the householder should not only have the wiring of the house approved by the Electricity Board but also any connection be made only by a professional.

Accidental electrocution is an infrequent but tragic form of sudden death in our modern civilization. Every one of these deaths is potentially preventable, since each is due to either equipment malfunction or victim error.

In all electrocution cases the circumstances of death must be thoroughly investigated in order to determine the nature of the occurrences.

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