

## The Apparent Death In Electrocution

Thamer Mohammad Kadhim\*

\* Msc. Forensic Pathology Assistant Lecturer, AlQadisiya Medical College

Email: Thamer\_Mohammad@yahoo.com

(Received 9/6/2013 , Accepted 1 / 7 / 2013 )

### الخلاصة:

بالرغم من أن أضرار التيار الكهربائي قليلة الحدوث ومن الممكن تجنبها، إلا أن عواقبها خطيرة جدا قد تصل إلى الموت .

أجريت دراسة راجعة على (33) مصاب متعرض لأضرار التيار الكهربائي في محافظة بابل ولمدة (15) شهرا، للفترة (كانون الثاني 2006- آذار 2007)، معتمدين على سجلات ردهة الحروق لمستشفى الحلة التعليمي والتقارير التشريحية للطبابة العدلية في بابل، آخذين بنظر الاعتبار : نوع الضرر، مقدار الفولتية ، الإصابات الرضية المصاحبة، مدى تعلق الإصابة بالمهنة، العمر، الجنس، موضع مدخل ومخرج التيار، والجهد الاسعافي والإنعاشي المقدم في ردهات الطوارئ.

معدل الوفيات في محافظة بابل من جراء أضرار التيار كان مرتفعا جدا (93'93%)، مقارنة بالدراسات الدولية (3-15%).

من الضروري أن يألف الطبيب المعالج أعراض الموت الظاهري عند المتعرضين لأضرار الكهرباء والذي بالإمكان معالجته باستخدام وسائل الإنعاش المتوفرة (القلبي والرئوي) حتى ولو كان وصول الضحية متأخرا.

### Abstract:

Background: Electrical injuries, though uncommon and largely preventable ,they usually have serious consequences including death .

Objectives: To study the pattern of electric injuries, and recognize the factors that increase their mortality so that we can reduce it

Materials & Methods :A retrospective study of sever electrically injured cases in Babil Governorate during a period of 15 months, from January 2006 to March 2007 (included) was carried out. From the records of the burn wards of Hilla Teaching General Hospital and the autopsy records of Forensic Pathology Department of Babil Health Directorate, sever electrically injured victims were retrospectively studied according to the type of electric injury, the voltage, associated secondary traumatic injury and whether it is work related or not. .The age ,sex , location of entry and/or exit of the electric current and the emergency resuscitative measures applied in the Emergency Departments (EDs)were considered.

Results:. The total number of electrically injured victims ( both hospitalized and non hospitalized ) were 33, 30(90.9%) cases due to contact with low voltage, 2(6.7%) due to high voltage and 1 (3.3%) due to lightning strike. Out of 28 cases for whom cardiopulmonary resuscitation was indicated, only in 14(50%) cases ,its application was recorded in the cards of Emergency Departments

Conclusions: The mortality rate following electrocution ,in Babil, was 93.93% which is too high in comparison with the international studies rate of 3-15%

Key words :Burns, ,Electric injuries ,Apparent death. Cardiopulmonary resuscitation .

**Introduction:** Patients with electric injury present a significant challenge . Possible mechanisms of injury include electrical disruption of cardiac rhythm and breathing , burns of several types, and inhalation of gases from fires. Mechanical trauma may come from electric arc blast, explosion of

gases, falls, and strong muscle contractions

<sup>1</sup>

Contact with alternating current at 60 cycles per second (the frequency used in most US household and commercial sources of electricity) may cause tetanic skeletal muscle contractions, preventing self-release from the source of the

electricity and thereby leading to prolonged characteristics regarding age, sex, place of exposure<sup>2</sup>. The extent of tissue damage in injury and whether work related or not, the electric burns is not indicated by the extent mechanism of electric injury, voltage, entry of cutaneous injury; extensive internal and exit wounds of electric current, any damage can cause intravascular fluid loss secondary traumatic injury, the description of and hypotension<sup>3,4</sup>. The heart is sensitive to the applied resuscitative measures, if any, also to electrical injury<sup>5</sup>, while the nervous system was considered. For those who died, the cause system is highly sensitive<sup>6</sup>. Central of death from the autopsy records was nervous system involvement can present considered.

with amnesia, loss of consciousness, confusion, anxiety, coma or injury to the respiratory center with resulting respiratory arrest<sup>7,8</sup>.

Obstetric consultation should probably be obtained in all pregnant patients reporting electrical injury, regardless of any symptomatology at the time of presentation<sup>9</sup>.

Both lightning and electrical trauma often cause multiple trauma, including injury to the spine<sup>10</sup>. They should be treated as trauma patients, with special attention given to cervical spine immobilization<sup>11</sup>. Deaths caused by electrical injury are usually VF (low voltage), a systole (high voltage), or respiratory arrest from interruption of the central respiratory center<sup>5</sup>.

**Material and Methods:** The severely electrically injured patients who reached any hospital within Babil Health Directorate during a period of 15 months from Jan. 2006 to March 2007 were retrospectively studied. The severe electric injured cases involved the cases that required hospitalization or those who died following electric injuries. The data were obtained from the case files of burn wards, and the autopsy records which also keep the ED cards of the referring health center or hospital. Data were analyzed by descriptive statistics. The patient

**Results:** The total number of severely electrically injured victims in our study was 33, male to female ratio was 1.75 : 1. The hospitalized patients were 3 (9.09%), 2 improved after surgical management (skin grafting in one, the other required upper limb amputation; in addition to skin grafting), 1 died; the cause of death was septicemia. The dead victims from the non-hospitalized group were 30 (90.91%) and represented those who reached the hospital or primary health center dead or apparently dead. Among dead victims following electric injuries – as shown in the table, children within 12 years of age were 10 (32.258%), the remaining victims were adolescents and adults. None of the victims was 50 years or above. All the electrical injuries occurred at home; none happened at a working place. In 18 (58.06%) cases, the site of entry and/or exit wound(s) of the electric current were through the upper limbs. Viewing the ED cards indicated that 14 (50%) only obtained resuscitative measures on arrival, the time period of resuscitation was not pointed to in the records. 29 (93.54%) of the electrically injured died due to contact with low voltage while one victim died following both lightning strike and high-voltage exposure (3.22%) for each. According to

autopsy records, cardiopulmonary arrest was the primary cause of death in 90% of the dead victims and no secondary trauma contributed to the mortality of any victim was found.

Serial no.	Age in years	Sex	Hospital Admission or ED resuscitation	Voltage: High(H) Low(L)	Site of current Entrance or Exit wound	Medical Saving Measures
1	4	F	ED resuscitation-	Low-voltage	Rt. hand	Nil
2	22	M	=	=	Rt .upper limb	I.V.F, D C
3	28	M	No	=	Right hand	Nil
4	3	M	=	=	abdomen	Nil
5	5	M	=	=	Lt. hand	Nil
6	17	M	=	=	Lt. hand	Nil
7	17	M	ED resuscitation	=	Rt. hand	D C
8	24	M	No	=	Rt. hand	Nil
9	12	M	No	=	Rt. hand	Nil
10	18	M	ED resuscitation	=	unknown	D C
11	4	F	No	=	Lt. hand	Nil
12	28	M	=	=	Rt. hand	Nil
13	33	M	ED resuscitation	=	Lt. chest	I.V.F
14	3	F	ED resuscitation	=	Rt. hand	I.V.F, D C
15	30	M	No	=	abdomen	Nil
16	31	F	ED resuscitation	=	Rt. hand	I.V.F, D C
17	17	F	No	=	Lt. hand	Nil
18	42	M	=	=	Lt. shoulder	Nil
19	26	F	=	=	Lt. hand	Nil
20	29	M	ED resuscitation	=	Upp. limb	I.V.F, D C
21	6	F	No	=	Rt. hand	Nil
22	38	M	ED resuscitation	=	unknown	I.V.F, D C
23	29	F	=	=	Lt. foot	I.V.F, D C
24	1	M	=	=	Head	I.V.F
25	20	M	=	=	unknown	I.V.F, D C
26	3	F	=	=	unknown	I.V.F
27	47	F	=	=	Rt. Upp. limb	I.V.F, D C
28	26	F	=	=	Abdominal wall	I.V.F, D C
29	3	F	No	=	unknown	Nil
30	25	M	Hospitalized	High-voltage	Upper & lower extremities	I.V.F and analgesia (on presentation, no cardiopulmonary arrest )
31	17	M	Autopsy	Lightning	Unknown	The victim was charred & dead .

**A table shows the dead victims ,their ages, gender , whether hospitalized or just ED primary survey ,type of voltage, entry or exit of the current wound ,description of resuscitative measures .**

**Discussion:** Brain death is the absence of clinical brain function when the proximate cause is known and demonstrably irreversible<sup>12</sup> . Prior to diagnose brain death, conditions; like electric shock injury , and drugs that simulate brain death have to be excluded and drug levels measured to ensure that there is no reversible cause for coma .Moreover; metabolic and endocrine disturbances must have been excluded as the cause for the continuation of

unconsciousness . The assessment of brain stem functioning should be performed by 2 physicians of not less than 5 years registration and at least one of them should be a consultant <sup>13</sup>.

In our study ,we divided the victims into 3 groups according to the voltage of the power source or lightning bolt to which the victims were exposed. This division is important because treatment by emergency team differs for each group <sup>3,14</sup>. The 1<sup>st</sup> group ; exposed to low voltage ,were 30, the 2<sup>nd</sup> group ;exposed to high voltage was 1, the 3<sup>rd</sup> group ; lightning strike ,also one victim .In our study ,non of the injuries was work related while the literature stated that electrical injuries are the 4<sup>th</sup> leading cause of traumatic work related deaths<sup>7</sup>.Also the male to female ratio(1.75 :1) is less compared to other studies such as Nigerian burn center study <sup>15</sup> (4.8:1)while in Canadian burn care the ratio was 23.39: 1 <sup>16</sup>;the increased females rate of electric injuries in Babil was attributed to the shortage of the main electric power which, in turn , obliged their involvement in changing the source of electric power frequently at home particularly when the males are outdoors during the day time. Hanumadass ML and colleagues, in reviewing 113 cases of electrical burns during 10 years ,they found low-voltage electrical burns in 73 per cent. All 113 patients survived. They attributed this to early transfer of patients to the Burn Unit, aggressive fluid resuscitation, continuous haemodynamic and metabolic support, and early surgical intervention <sup>17</sup> . Children constituted 10( 32.25%) among the victims which is comparable with other studies <sup>3</sup>. The primary cause of death in 28 cases was

cardiopulmonary arrest which is comparable to literature findings in the immediate death in persons who have sustained an electrical injury <sup>18</sup>. The mortality in our study was too high (93:93%) if compared to that of Nigerian's which was 12.5 % <sup>15</sup>. In the E.D ,the managing doctor should realize that electric injury may be a cause of coma ,apnea and fixed pupils <sup>13</sup> . Following electric or lightning injury ,irritation of the anterior chamber can cause miosis, Horner's syndrome or mydriasis can be mistaken as a fixed – pupil which also may result from transient autonomic instability leading to early termination of resuscitation efforts <sup>19</sup> .

A few cases in our study were conveyed to the hospital late because some people believe that death following electrocution is irremediable .In spite of late arrival of the victim and the interval before the resuscitation attempt is prolonged, resuscitative efforts should be attempted for extended periods of time as it may be effective in reviving the victim <sup>20</sup>. Finding a normal pulsation in an electrically or lightning injured victim following a period of CPA(cardiopulmonary arrest) , even without application of resuscitative attempt, should not make us to believe that resuscitation is no longer required .The literature assures that in many cases intrinsic cardiac automaticity may spontaneously restore organized cardiac activity <sup>21</sup> . Aggressive persistent resuscitative efforts are indicated for all victims, especially those with spontaneous cardiac rhythms & prolonged apnea or coma <sup>19</sup> . Ventilatory support may be required for several hours, but even in

these cases, there is potential for full recovery<sup>22</sup>. Full support should be continued until cerebral function can be assessed<sup>23</sup>.

A mortality of 93.9% resulting from low voltage injuries was found in our study while the literature states that 'in general, therapy for low-voltage and lightning injury is supportive and involves cardiac resuscitation for the more seriously injured and supportive care for the less severely injured'<sup>24</sup>. An average of 2 cases loss monthly due to electric injury in Hilla

**Conclusions:** A mortality rate of 93.93% following electrocution, in Babil, was too high compared to the range reported by the international studies.

To prevent electrical accidents, the society should practice a conscious use of electricity and change the building codes that require a ground plug for all home outlets. If someone faces an electrically injured victim, he must transfer him to the near-by hospital early, even if the victim appears dead.

The clinicians should be familiarized with the tendency of electrocution victims to apparent death presentation which may be

## References :

- 1-Fish RMJ Electric injury, part I: treatment priorities, subtle diagnostic factors, and burns. *Emerg Med.* 1999; 17(6):977-83
- 2-Geddes LA, Bourland JD, Ford G. The mechanism underlying sudden death from electric shock. *Med Instrum.* 1986; 20: 303-315
- 3-Fahmy SF, Brinsden MD, Smith J, et al. Lightning: the multisystem group injuries. *J Trauma* 1999;46:937-940.
- 4-Fish R. Electric Shock, part III: deliberately applied electric shocks and the treatment of electrical injuries. *J Emerg Med* 1993;11:599-603.
- 5-Carleton SC. Cardiac problems associated with electrical injury. *Cardiol Clin* 1995;13:263 -266.

Governorate was concluded. The mortality in our study was too high (93.93%) if compared to that of USA and Nigeria which were 3-15% and 12.5% respectively<sup>25,15</sup>. The high mortality could be contributed to either improperly attempted, short-timed CPR or to non-resuscitating the victims with the belief that they were irremediable and dead; shortage of familiarity with apparent death presentation among such cases. The latter was assured through noticing autopsy reports and ED cards which indicated that 14(50%) of the dead cases received no CPR.

reversible if immediate and prolonged Cardiopulmonary resuscitation are started even if the victim reaches the hospital late or dead.

We recommend : 1 -Upgrading of ED of our hospitals through provision of advanced medical equipments required in performing CPR (Cardiopulmonary resuscitation), in addition to, improving the training of emergency teams.

2- International rules should be applied in signing death certificates by a medical committee after diagnosing brain death rather than clinical death only.

- 6-James TN, Riddick L, Embry JG. Cardiac abnormalities demonstrated post mortem in four cases of accidental electrocution and their potential significance relative to non fatal electrical injuries of the heart. *Am Heart J* 1990;120:143-157.
- 7-Koumbourlis AC. Electrical Injuries. *Crit Care Med* 2002;30(11 Suppl):S424-S430.
- 8-Sherer DM, Schenker JG., Accidental injury during pregnancy, *Obstet Gynecol Surv*; 1991 44-330-1
- 9-Leibovici D, Shemer J, Shapira SC. Electrical injuries: current concepts. *Injury* 1995;26:623-627.
- 10- Epperly TD, Stewart JR. The physical effects of lightning injury. *J Fam Pract* 1989;29:267.

- 11- Cooper MA. Lightning injuries: prognostic signs for death. *Ann Emerg Med* 1980;9:134.
- 12-Quality Standard Subcommittee of the American Academy of Neurology. Practice parameters for determining brain death in adults. *Neurology* 45;1012-14.
- 13- Nicholas E, Maartens. Elective Neurosurgery In" Bailey & Love 's Short Practice of Surgery " 24<sup>th</sup> ed. R .C G Russel , Norman S. Williams and Christopher J .K Bulstrode( eds) 2004 Hodder Arnold London C.S Kerr,p 606-632.
- 14-Lederer W, Kroesen G. Emergency treatment of injuries following lightning and electrical accidents Anaesthesist. 2005 Nov;54(11):1120-9
- 15-KO Opara, TOG Chukwuanukwu ,IS Ogbonnawa , CU Nwadinigwe .
- Pattern of severe electrical injuries in a Nigerian regional burn centre. *Niger J Clin Pract*. 2006 Dec;9(2):124-7.
- 16-Tredget EE, Shankowsky HA, Tilley WA . Electrical injuries in Canadian burn care. Identification of unsolved problems. Ann N Y Acad Sci. 1999 30;888:75-87.
- 17: Hanumadass ML, Voora SB, Kagan RJ, Matsuda T Acute electrical burns: a 10-year clinical experience. Burns Incl Therm Inj. 1986 Aug;12(6):427-31
- 18- Homma S, Giiam LD, Weyman AE. Echocardiographic observations in survivors of acute electric injury. *Chest*. 1990; 97 :103- 105.
- 19- Jain S, Bandi V. Electrical and lightning injuries. *Crit Care Clinics* 1999;319;15:
- 20-Milzman DP, Moskowitz L, Hardel M. Lightning strikes at a mass gathering. *South Med J*. 1999; 92: 708-710
- 21- Whitecomb D ,Martinez JA,Daberkow D. Lightning injuries. *South Med. J*. 2002; 95:1131-34 .
- 22-Fontanarosa PB. Electrical shock and lightning strike. *Ann Emerg Med* 1993;22:378-387.
- 23- Amy BW, McManus WF, Goodwin CW, et al. Lightning injury with survival of 5 patients. *JAMA* 1985;253:243.
- 24- Cooper MA. Emergent care of lightning and electrical injuries. Semin Neurol. 1995 Sep;15(3):268-78.
- 25- Edlich RF, Farinholt HM, Winters KL, Britt LD Modern concepts of treatment and prevention of electrical burns. \_\_\_\_\_2005;15(5):511-32