

Original article:

Histopathological Changes In Heart Due To Electrocutation Injury- A Autopsy Study

Dr Poonam Nanwani¹, Dr. Ashok Panchonia², Dr Anoop Jain³, Dr. Manisha Agarwal⁴

Dr.Rashi Gupta⁵, Dr Vandana Pahadiya⁵, Dr Rajlaxmi Bahadauriya⁷, Dr Rashmi Panthi⁸

1-Assistant Professor, 2-Professor, 3, 4, 5, 6, 7, 8-PG Resident

Department of Pathology, MGM Medical College, Indore

Corresponding Author: Dr. Sunil Jaiswal

Abstract

Introduction- In Forensic histopathology electrocutation injury is an challenging condition as in various cases there is no gross finding seen and surrounding evidence is are not very much supportive.

Aim- To study histopathological changes in heart due to electrocutation injury.

Methods and materials: In the present study, a total of 16 heart specimens due to electrocutation deaths and 16 normal heart specimens are considered during the study period of 4 year from 2017 to 2020. Case details are obtained from the records and analyzed. The histopathological findings are recorded by us.

Results: Myofibre break-up, separation of sarcomeres and extravasation of RBCs are found in all the 15 cases of electrocutation (100%). The other findings are disarray of the myofibres (87%), hyper contracted myocyte with squaring of nuclei (73%), myocellular segmentation (33%) and myocyte vacuolization (20%).

Conclusion- Most of the histopathological changes in heart are found consistently in electrocutation cases compared to that of the normal hearts for better understanding of electrocutation effect.

Keywords: Electrocutation injury , heart disorders , electric current

Introduction:

When electric current inter in the body then death caused by its passage in the body is called Electrocutation injury.¹ Although death due to electrocutation is not un common but in various cases there is no gross finding seen and surrounding evidence is are not very much supportive so histo pathological finding of internal organs are important for conclusion of death due to electrocutation injury. we studied the effect of electric shock injury over heart in the form of histo pathological changes and this study can help to reduce negative autopsy in future. Although ventricular fibrillation is most important cause of death in electrocutation injury² but in present study our aim is to find out changes in heart histopathologically.

Materials and Methods :

Place of study: Department Of Pathology, MGM Medical College, Indore

Duration of study: 2 years (2018-2019)

Type of study: Prospective study

Sampling method: Stratified random sampling

Collection Of Sample specimen: The material for the study was heart specimen brought by police in a sealed container which was received by him from Forensic department of MGM Medical college with all relevant documents and Post mortum reports. We select only those 16 cases for our study in which clearly entry wound was mentioned in P.M. reports and 16 normal heart specimens with no history of cardiac disease which were sent for the histopathological examination for comparison.

Inclusion criteria: Cases with a definite electric contact mark (entry or exit mark) on the skin of any part of body mentioned in PM reports and cases with circumstantial evidence favoring electrocution death.

Exclusion criteria: Cases with a any known cardiac disease and autolytic specimen condition as obtained from the detailed history. Ethical committee clearance was obtained for the histopathological study of heart.

A detailed history of the cases was obtained from the medical records. The details were recorded on a proforma. gross examination done inflow and outflow method is used for Grossing of heart and for microscopic examination H&E staining method was used. The heart was dissected following standard autopsy protocol at autopsy. we used inflow and outflow method for dissection of heart. All the sections of heart and coronary arteries from were fixed in 10 % formalin, marked for identification and sent for histopathological analysis. Paraffin sections were made and the sections stained using Hematoxylin and Eosin (H & E) dyes. All sections taken from each heart underwent histopathological examination. Microscopic examination was carried out to look for the various histopathological changes in the heart sections. These changes were recorded on a proforma and were compared with the findings of the normal heart.

Cardiac tissue injury

Gross and microscopic examination of the heart tissue of all victims at autopsy was of great value in detecting the multisystemic effect of current passage through the body even in the absence of any visible electrothermal skin lesion .The heart tissue damage had been seen grossly and detected 8.

Heart tissue injuries that had been detected include heart tissue burn (16.7%),petechial hemorrhage or congestion and/or edema and microscopic focal coagulative necrosis (in addition to myofibers separation, loss of myocytes striations, and square configuration of myocytes nuclei in almost all cases.

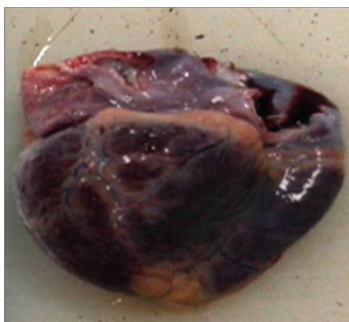


FIGURE 1. Congestion of cardiac muscle due to electrocution injury

Results

The microscopic examination of the heart sections in cases of electrocution deaths revealed the following spectrum of histopathological changes: separation of the myocardial fibres (In all electrocution injury heart), Break down of Myocardial fibres (In all electrocution injury heart), Haemorrhagic area with extravasation of RBCs (In all electrocution injury heart), disarray of the myofibres (In majority of cases), hyper contracted myocyte with squaring of nuclei (In majority of cases. These changes were found diffusely throughout the sections.

The normal heart sections showed few similar histopathological findings such as myofibre break-up (In nearly 25% cases) and separation of the myofibres (10%) which were not accompanied by haemorrhagic area and extra vasation of RBCs. There is no disarray of the myocardial fibres found in any normal heart taken for histo-pathological comparison.

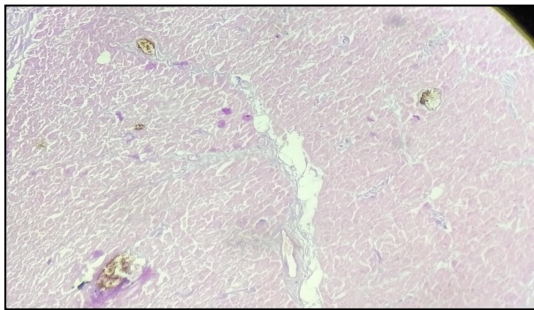


FIGURE 1.Square expression of the myocyte nuclei, H and E stain

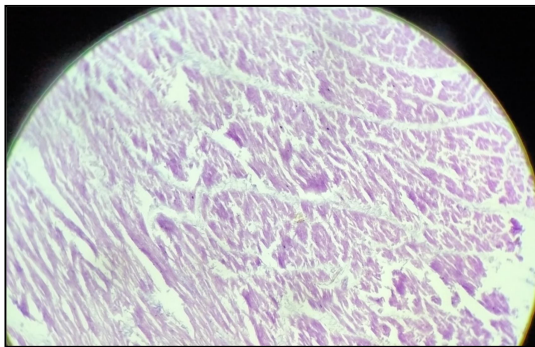


FIGURE 2.Myofibre break-up, H and E stain

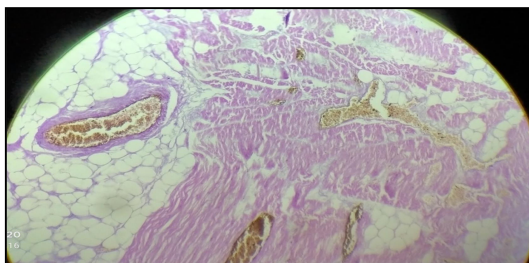


FIGURE 3.Extravasation of the RBCs

	Histopathological changes	No. of cases	Percentage
1.	Breakdown of myocardial fibers	16	100
2.	Extravasation of RBC with haemorrhage	16	100
3	Seperation of myocardial fibers	13	87
4.	Disarray of myocardial fibers	12	75
5.	Squaring of nucleus	11	68

Discussion

In electrocution death ventricular fibrillation is principal cause of death. Random asynchronous electric activity of ventricles occur in ventricular fibrillation.³ In fibrillation both electrophysiological and structural changes occurs . Ku et al. said that electrocution can cause direct injury to the myocardium which causes damage myocardium with resulting myocardial infarction [5].Electrical injury may cause necrosis of myocardium.⁶ or may cause patchy necrosis.^{5,6,7}

In electrocution death some time there is no definite cause of death find out after autopsy, histopathological and biochemical test, In such condition which are negative autopsy, histo pathological changes in heart are very beneficial and may provide help in framing final opinion electrocution as cause of death.

Breakage of myocardial fibres is an important histopathological changes in electrocution injury which was found in all 16 electrocution cases of our study. Same finding was seen by **Vittorio Fineschietal** In his study,where he found Breakage of myocardial fibres in 90% of electrocution cases. so it is a characterstic finding in electrocution death^{8,9,10} Stanca et al.also found same finding in his case.¹¹

Myocardial fibres breakage was not found in our 16 other heart which was taken for comparision. **Study done by** Luo BT et al. described other histopathological changes in heart due to electrocution injury like disarray of myocardial fibres, rupture of myocardial fibres and focal interstitial haemorrhage has been described.¹² In our study, haemorrhage was found in 100% of the cases separation of fibres in 87% cases and disarray of the myofibres in 75% of the cases. Other findings such as square expression of the myocyte nuclei were seen in 68% of our cases. This characteristic finding has been mentioned by Fineschi et al. and in a case report by Dabas et al.¹³. In another study conducted by Viswakanth et al., squaring of the myocyte nuclei were reported in all the cases. Tanaka N et al. also has describediffuse fragmentation of the myocardium with myocardial nuclei in hyper contracted cells showing a square appearance.¹⁴

Conclusion-

The histopathological changes in the heart definitely provide an additional clue in the diagnosis of death due to electrocution injury .Most of the histopathological changes described in our study were found consistently in the cases and their presence in the sections studied can be relied upon in the diagnosis of electrocution deaths especially in the absence of any external marks and ambiguity of external environment was present.

References

1. Taber CW, Venes D. Tabers cyclopedic medical dictionary, 20th ed. Philadelphia: F.A. Davis Co.; 2009.
2. Vishwakanth B, Shruthi P. Low voltage electrocution deaths and histo pathological findings: One-year prospective autopsy study. *J. Curr. Forensic Sci Res.* 2015; 1(2):1-5.
3. Zipes DP. Electrophysiological mechanisms involved in ventricular fibrillation. *Circulation* 1975 Dec; 52(6):120-30.
4. Ku CS, Lin SL, Hsu TL, Wang SP, Chang MS. Myocardial damage associated with electrical injury. *Am Heart J.* 1989;118(3): 621-4.
5. Koumbourlis AC. Electrical injuries. *Crit Care Med.* 2002; 30 (11): 24-30. DOI: <http://dx.doi.org/10.1097/00003246-200211001-00007>
6. Lewin RF, Arditti A, Sclarovsky S. Non-invasive evaluation of electrical cardiac injury. *Br Heart J.* 1983; 49:190-2. DOI: <http://dx.doi.org/10.1136/hrt.49.2.190>
7. James TN, Riddick L, Embry JH. Cardiac abnormalities demonstrated post-mortem in four cases of accidental electrocution and their potential significance relative to nonfatal electrical injuries of the heart. *Am Heart J.* 1990 Jul;120(1):143-57. DOI: [https://doi.org/10.1016/0002-8703\(90\)90171-S](https://doi.org/10.1016/0002-8703(90)90171-S)
8. Fineschi V, Karch SB, D'Errico S, Pomara C, Riezzo I, Turillazzi E. Cardiac pathology in death from electrocution. *Int J Legal Med.* 2006 Mar;120(2):79-82. DOI: <https://doi.org/10.1007/s00414-005-0011-8>
9. Uzun I, Akyildiz E. Histo pathological differentiation of skin lesions caused by electrocution, flame burns and abrasion. *Forensic Sci Int.* 2008; 178 (2-3): 157-61. DOI: <http://dx.doi.org/10.1016/j.forsciint.2008.03.012>
10. Fontanarosa PB. Electrical shock and lightning strikes. *Ann Emerg Med.* 1993;22(2):378-87. DOI: [http://dx.doi.org/10.1016/S0196-0644\(05\)80468-8](http://dx.doi.org/10.1016/S0196-0644(05)80468-8)
- 11.13. Stanca L, Zavoi R, Marinescu AM, Niculescu M, Stanculescu D. Cardiac morphological changes in electrocution. *Rom J Leg Med* 2007;15(2):100-5.
12. Luo BT, Zhao YH, Chen XY, Jiang HG. Pathology of accidental electrocution: an autopsy study of 16 cases. *Chinese J Pathol.* 2009 Jun;38(6):380-3. DOI: 10.3760/cma.j.issn.0529-5807.2009.06.006
13. Dabas N, Bakkannavar SM, Bhat S, Palimra V. Microscopic cardiac changes in an electrocution death. *J Punjab Acad Forensic Med Toxicol.* 2015;15 (2): 93-6.
14. Tanaka N, Kinoshita, Jamal M, Kumihashi M, Tsutsui K, Ameno K. Findings for current marks: histopathological examination and energy-dispersive Xray spectroscopy of three cases. *Leg Med.* 2013 Sep; 15 (5):283-7. DOI: <https://doi.org/10.1016/j.legalmed.2013.06004>