A rare survival case of electrocution with multi-organ damage due to Electric Blanket- Case Report

Original Research Article

ISSN : 2456-1045 (Online)
(ICV-MDS/Impact Value): 63.78
(GIF) Impact Factor: 4.126
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Journal Code: ARJMD/MDS/V-24.0/I-1/C-10/APL-2018
Category : MEDICAL SCIENCE
Volume : 24.0 / **Chapter**- X / **Issue** -1 (APL-2018)
Journal Website: www.journalresearchijf.com
Paper Received: 10.05.2018
Paper Accepted: 16.05.2018
Date of Publication: 20-05-2018
Page: 64-68

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Citation of the Article

Banaga Y.; Mohmmed K.; Mustafa H.; Awad H.; Elnour M.; Abuzaid I. ' Elmahi T. ; Awadalkareem H.; Khalil K.F.A. (2018) *A rare survival case of electrocution with multi-organ damage due to Electric Blanket- Case Report;. Advance Research Journal of Multidisciplinary Discoveries. 24(10) pp.64- 68*

ABSTRACT

Introduction: Electrocution caused by an electric blanket is a rare and challenging clinical condition. Limited numbers of Cases were reported; unfortunately, most of them were post-mortem and as a result of overheating. Our patient is an example of rare survival cases presented with electrocution and was due to forgetting the electric blanket turn on. Our case is unique as severe multi-organ damage was caused due to both excessive heating of the body and exposure to an electric shock. The damage was involved the heart, lungs, kidneys, bone marrow, musculoskeletal system and skin.

Case presentation: Our patient is the female of 74 years old she ives alone at home with limited mobility because of severe osteoarthritis in the back and knees as well as history of old fracture in the right shaft of the femur. She is long standing diabetes with neuropathic complications. She is Post Trans-catheter Aortic valve implantation [TAVI] for severe aortic stenosis. She was presented to the hospital due to generally unwell status following the events of electrocution due to electric blanket. She was very unwell, lethargic and hemodynamically unstable. The diagnosis was confused initially as pulmonary embolism and/or acute ischemic heart events due to her acute presentation with hypoxia, elevated d dimer and troponin in addition to the acute ECG changes. Further evaluation revealed the presence of multiples burn marks with an entrance wound in the right back and exit wound in the left heal. The diagnosis of multi-organ damage due electric blanket was established. The damage was extend to involve the bone marrow causing transient pause resulted in significant symptomatic anemia required blood transfusion. The patient treated conservatively and finally discharged home in good condition.

Conclusion: Overheating by Electric blanket can be highly risky and it can result in multi-organ failure extend to the bone marrow and result in significant anaemia.Diabetic patients are effected more due to neuropathic complications. Taking a proper thorough history and performing an early comprehensive systematic examination on the patients is essential for diagnosis.

Keywords: Electric blanket; overheating; multi-organ damage; prosthetic valve; electrocution; bone marrow; blood transfusion.

I. INTRODUCTION

Electric blankets are widely used warming tools that allow for more comfortable sleep on cool winter nights. Electric blankets typically save money compared to turning up the Heat when the temperatures drop. However they also present some dangers, in most cases costing an individual their life.

Each year, there are reports of fires and electric shocks caused by electric blankets. Mainly because safety guidelines and warnings were not observed properly .Death caused by electric blankets could be due to Burns, Smoke inhalation, Heart arrhythmias or severe dehydration that leads to hypovolemic shock and acute kidney injury. In addition, electric blankets cause severe tissue damage and necrosis to various areas along the electrical pathway. [7]

Overheating of the body via an electric blanket can be very dangerous particularly for those with diabetes and other medical conditions. A person with diabetes may not notice that a blanket is too hot until it's too late due to nerve damage, as in the case of our patient.

It is very important to consider prosthetic heart valves in such patients as their presence may increase the risk of cardiac damage further due to the high affinity of the metallic valve to be crushed by overheating. Fortunately, our case has a Trans-catheter aortic valve implantation (TAVI) which is a non-heat affected valve type.

Using an electric blanket according to the manufacturer's instructions helps decrease the risk for injury and other dangers of electric blankets. The Department of Fire and Emergency Services advises only using electric blankets to warm the bed and switching them off before getting in, not placing heavy products on the bed when the blanket is switched on and to replace the blanket after 10 years or sooner if excessively worn. The electrical cords connected to an electric blanket can present a fire or shock hazard if it becomes damaged as it did in this case.

II. CASE PRESENTATION

74 year old female who lives alone at home with limited mobility because of severe osteoarthritis in the back and knees as well as history of old fracture in the right shaft of the femur. She is type 2 diabetes mellitus for than 10 years and using oral hypoglycemic agents. She is Post Trans-catheter Aortic valve implantation [TAVI] for severe aortic stenosis.

She was admitted in the hospital under medical care due to her acute unwell status. She was left last night by her son who left her in a fairly well and healthy condition while having no complaints of any problem. However, the following day early morning the son found her very sick, extremely weak and unable to move out the bed. He called the ambulance and brought her to the hospital.

She was very unwell, lethargic, tachycardic and breathing fast. However, She was conscious, able to talk and moving her limbs. She denied having any history of fever, cough, chest pain, and shortness of breathing. There were no urinary symptoms, no abdominal symptoms and no neurological deficit. The Pulse rate was 106, Respiratory rate was 28, Blood Pressure was 84/48 and Saturation was 88% on 3L oxygen .She was not febrile, her temperature was 36.6 .The Chest examination revealed bilateral crepitation in both sides but more in the right side. The examination of the heart, abdomen and neuro systems were unremarkable. Multiple horizontal burn marks and penetrating wounds were noted on the back of the right chest [figure1]. There is also a deep hole shaped wound noted in the left heel [figure1].

Figure - 1(A): Electric blanket Burn marks in the right back with an entrance wound in the right chest

Figure -1(B): Typical exit wound in the left heel where the electric current path away down to the ground [Opposite the entrance site.

The ECG demonstrated the presence of a sinus rhythm with new generalised T wave inversion and prolonged QT [figure2].The Bedside Echocardiograph revealed an inferior wall hypokinesia with EF 40% and showed the prosthetic aortic valve is well seated. HRCT reported as Patchy ground glass consolidations scattered in the right lung with right peribronchial cuffing, this is likely to be necrotic changes [figure3].

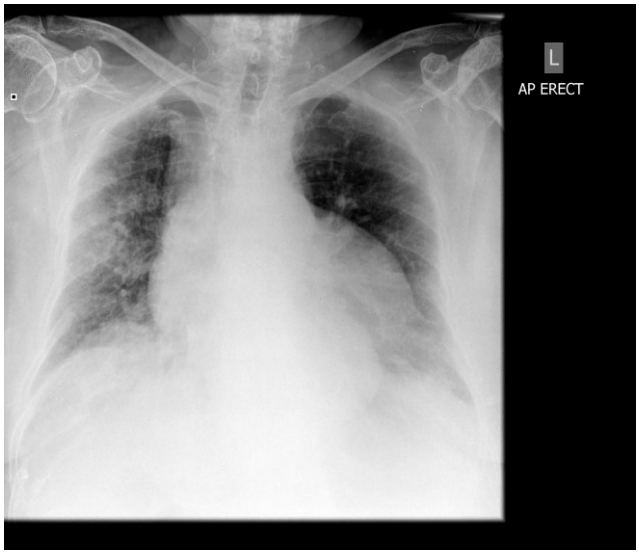

Figure – 3 (A): chest x ray showed bilateral consolidation more in the right lung at the entry site of electric current .

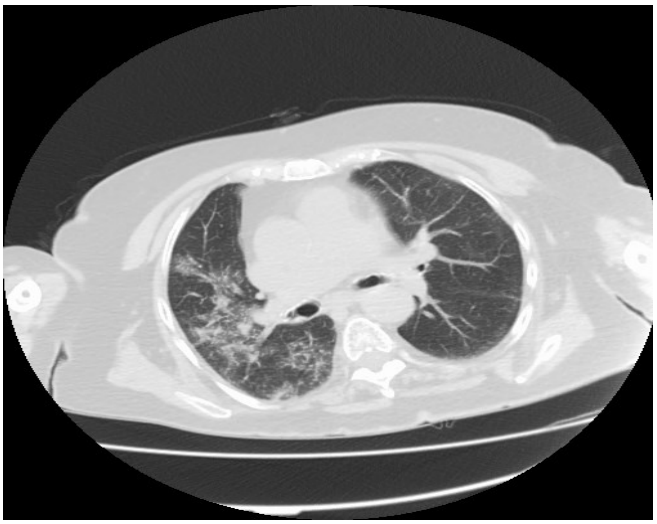

Figure 3(B): Multiples patches of consolidation in the right lung at entrance site of electric current in the CT thorax .

Coronary angiography which was done later after stabilization of the patient reported a normal result.

The initial blood investigations as in the table below:

HB	12.6	**RBCS**	3.96	**D Dimer**	3.3 mg/L	**PH**	7.4
WBCS	15.7	**Neurophils**	13.4	**INR**	1.0 ratio	**Lactate**	2.0
MCV	91	**Lymphocytes**	0.96	**PT**	10 second	**Blood culture**	No growth
MCHC	35	**Monocytes**	1.3	**aPTT**	25 second	**Urine culture**	No growth
MCH	32	**CRP**	265 mg/L	**Urea**	15.5 mmol/L	**Urine myoglobin**	183 ng/mL
HCT	0.359	**CK**	605 IU/L	**Creatinine**	165 Umol/L	**Calcium**	2.24 mmol/L
Albumin	38 g/dL	**AST**	45 U/L	**Na**	136 mmol/L	**Phosphate**	0.86 mmol/L
GGT	51 U/L	**ALT**	20 U/L	**K**	3.5 mmol/L	**Magnesium**	0.79 mmol/L
Troponin	3817 ng/L	**ALP**	158 U/L	**eGFR**	28 ml/min		
BNP	1661 pg/mL	**Bilirubin**	10 Umol/L	**Glucose**	8 mmol/L		

Table 1: The initial blood investigations in our case [The abnormal results marked in red coloured]

The patient was admitted in CCU after resuscitation with IV fluids, improving blood pressure and oxygen saturation. No inotropes nor intubation were needed. The initial impression was either ACS [NSTEMI] or pulmonary embolism in view of her acute presentation, along with ECG changes and markedly elevated troponin. The possibility of a septic shock due to severe bronchopneumonia was borne in mind as the second differential diagnosis particularly in the presence of findings in the chest x ray and CT chest, plus leukocytosis and raised inflammatory markers**.** Further review of the patient clinically, the provisional diagnosis of multi-organ damage due to Electric blanket Electrocution was established. She remained in the CCU for a week and then shifted to the ward where she remained treated conservatively under medical care with a multidisciplinary team until she was discharged in a stable condition after another few weeks. [figure7]

Figure -7: Recovery of the burn marks in right side of the back and healing of the entrance wound in the lower right chest.

III. DISCUSSION

Our patient was fine until she slept on the electric blanket at night. The patient claims that the control unit of the blanket fell down on the ground and she forget to turn it off before sleeping as she does usually, as a result the electric blanket remained on the whole night.

The patient was Found to be unable to get up of bed by her son because she is feeling unwell and very weak, she didn't know what happened but she noticed that her clothes were stuck to her body and when she checked them she also discovered some blister on her right thigh that attached her clothes to her body.Furthermore,she noted damaged and broken areas in the electric blanket which she slept on. Then she understood that there was something wrong that happened while she was sleeping and it could be a burn because of the electric blanket which she was using for the last 5 years without any problem.

In spite of overheating that was enough to burn the skin and internal organs the patient's body failed to feel that, this most probably was due to loss of sensation as a result of microvascular complications due to long standing Diabetes. Also sleep tablets which she is using could have also contributed to her deep sleeping and decreased her awareness. The electric shock which she had and evident by the entrance and exit wound in her body could also be causing some sort of arrhythmia that led to loss of sensorium for some time. The acute ECG changes and prolonged QT supports this theory [figure2]. [8]

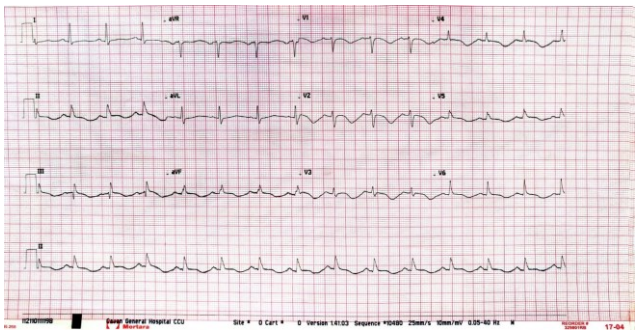

Figure -2: The ECG changes with significant T wave inversion and prolonged QT

Muscles Tetany that commonly occurs in these cases especially when the arc that carries the electric current, damages/ touches the body and then leads to the release of myoglobin [rhabdomyolysis] maybe another cause that contributed to her extreme fatigue and weakness, as well as her acute kidney injury.

The extensive burn marks on her back with an entrance wound of the electric current on the right chest shows clearly how the current behaves. It enters through the soft and moist part in the body [lungs, heart] and exits from below on the opposite side, to the ground [making a deep hole wound in the left heel].the presence of entrance and exit wounds in this patient is an indication of exposure to electric shock due to the damaged electric blanket, this in addition to the burn by overheating.

Raised troponin is due to myocardial tissue injury and necrosis as a result of overheating rather than due to acute vascular ischemic events particularly in the absence of cardiac symptoms in the history. This later was supported by normal coronary angiography. Although elevated troponin doesn't tell us how large the extension of myocardial damage is, as reviewed, elevated troponin is seen with minor myocardial injury. This is why misdiagnosis of electrocution to ACS or pulmonary embolism and the use of an anticoagulant is eventually highly risky and fatal as it may facilitate the perforation of injured myocardial tissue and cause severe bleeding and immediate death, this is in addition to massive bleeding in the lung or from the gut. [2]

Furthermore very high troponin here is reflected on how significantly the heart of this patient was affected by overheating, More so than the effect of the electric shock which usually alters myocardial electricity and causes fatal arrhythmia which usually does not cause a significant rise of troponin. This noted in many cases after cardioversion was reported not to cause elevation of troponin, [3, 4].borne in our minds electrical shock itself may cause severe tissue damage and necrosis as a result of overheating due to conversion of the electric energy to thermal energy.

Fortunately the material of the replaced valve is not affected by heating otherwise the cardiac complication would have been more dangerous and severe.

Overheating due to electrocution is also responsible from the right haziness seen in her chest x-ray and vividly clear in the CT chest, particularly in the right lung where the electric current entered causing extensive consolidation and tissue necrosis. This finding that initially was explained by an infection particularly in the presence of neutrophilic leukocytosis and raised inflammatory markers. In fact marked leukocytosis, reported also in many cases of electrocution with no evidence of infection (5), but as the result of stress, and hypoxia.

The damage of skeletal muscle and release of its breakdown products like myoglobin, Creatine phosphokinase (CK) and lactate dehydrogenase (LDH) into the circulation contributed to her acute kidney injury (AKI) [1, 5].This in addition to the direct damage to renal vessels and prerenal azotemia because of dehydration which was due to overheating.

In our case there was another significant effect on the bone marrow presumed to be also due to overheating as a result of electrocution, which occurred late, approximately 10 days after admission, the Hemoglobin dropped from 12g/dl on the admission to 8.2 g/dl which required urgent blood transfusion. Initially she received 2 units of blood but her Hemoglobin failed to pick up, then an urgent OGD and colonoscopy was done,OGD reported as mild gastritis and hiatus hernia but no active bleeding or ulceration while Colonoscopy reports were normal. [figure5]

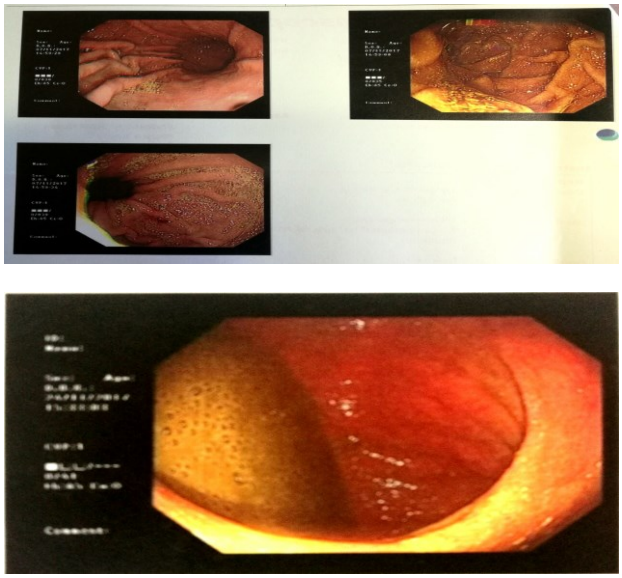

Figure 5: normal OGD and Colonoscopy which done as the part of anemic work-up after dropping of her hemoglobin.

Extensive anemic screening that was done before blood transfusion including workup for autoimmune diseases and myeloma showed there was nothing impressive apart from low red blood count [2,4] with almost normal other blood parameters. The CT thorax, abdomen and pelvis done as a part of anemic work-up does not show any underlying abnormalities.

The Patient received the 3rd unit after OGD but her Hemoglobin remained unchanged so she received the 4th and 5th unit, which finally elevated her hemoglobin to rise slowly up to 10g/dl [patient received total of 5 units]

Hematologists were involved in this case but could not find any convincing reasons to explain her anaemia, other than a transient pause of the red cell precursor in the bone marrow [pure red cell aplasia] as a result of electrocution and overheating. The delay in the dropping of her hemoglobin 10 days after the event of the electrocution period can be due to the prolonged life span of red cells [about 120 days]. Unfortunately there is no bone marrow study done to complete anemic workup and give us a clear explanation on what is happening.

Finally all results returned to the norm. Troponin was repeated a few days later and came back to normal values [from 3817 to <5].BNP came down from 1661 to 24, repeated echocardiography reflected the improvement in EF from 40% to 55%.The CT chest shows resolution of the lung damage on the right lung [figure6].Furthermore, Kidneys function improved [creatinine from 165 to 85, urea from 15.4 to 8 and eGFR improved from 28 to 61].ECG changes and prolonged QT returned to normal [figure4].

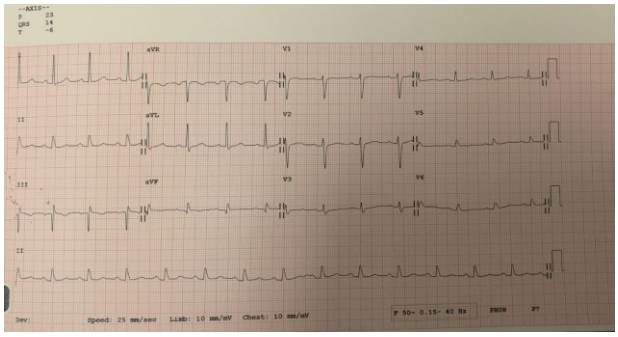

Figure 4: normalization of the ECG and correction of prolonged QT and T inversion just few days after the conservative treatment.

The burn wounds in the back and left heel recovered [figure7].The patient spent a few weeks in the hospital as a part of her recovery and rehabilitation care, until her discharge home healthy and in good condition.

IV. CONCLUSION

Overheating the body with an electric blanket can be highly risky and it can result in multi-organ failure including damage to the bone marrow and causing anaemia with a significant drop in haemoglobin. The mechanism by which electrocution affects the bone marrow and causing anaemia is still not well understood as in most cases there is no study done on the bone marrow. In our case it's assumed the cause is a transient pause in the bone marrow at the level of red cell precursor due to overheating causing transient pure red cell aplasia and resulting in anaemia.

Electrocution due electric blankets has more serious consequences on the Patients with diabetes ,people with disabilities, anyone who is immobile or cannot operate the control unit of the electric blanket properly and it's advisable to not be used by them. A person with diabetes may have insensitivity to heat that makes it difficult to tell that the blanket is too warm. This lack of sensation can result in burns in extreme cases and unfortunately only a few lucky patients may survive.

This case also aims to highlight the importance of taking a proper thorough history and performing an early comprehensive systematic examination on the patients which is the key way for correct diagnosis and early initiation of appropriate treatment that would improve the prognosis and avoid us using medications that may cause serious damage and complications [e.g. anticoagulants]

For those whose use of electric blankets is mandatory, we advise following the instructions for safe use. Fundamentally they should be aware that the wires that run through the blanket are tiny filaments prone to damage. These can easily overheat and cause sparks or a fire, which is why it's important to turn it off before bed and before leaving the house. Never leave an electric blanket turned on and unattended. [9]

V. DECLARATIONS

Acknowledgments:

I want to express my sincere gratitude to everyone who helped to make this such a resounding success.

Special thanks to Mr. Ayman Yasir Ahmed for his valuable advice and comments on the manuscript preparation and design. We also would like to thank all the staff members of Cavan general hospital whose contribution one way or the other aided in the management of the patient.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Ethics approval and consent to participate
Not applicable.

Competing interests
The authors declare that they have no competing interests regarding the publication of this paper.

Funding
We receive no funding support.

Availability of data and materials
Datasets used and/or analyzed for this study have been included in this published article.

Authors' contributions
Study concept and design: KM and YB. Acquisition of data: KM, HM, MA, ME, HA, KFAK, TE and EA. Analysis and interpretation of data: KM, YB, and HM. Drafting of the manuscript: KM, YB and HM. Critical revision of the manuscript for important intellectual content: All authors. All authors read and approved the final manuscript.

VI. ABBREVIATIONS

TAVI: Trans-catheter Aortic Valve Implantation
HRCT: High Resolution CT Thorax
ECG: ElectroCardioGraphy
EF: Ejection Fraction
CCU: Coronary Care Unit
ACS: Acute Coronary Syndrome
NSTEMI: Non ST Elevation Myocardial Infarction
OGD: Oesophago-Gastro Duodenoscopy
eGFR: Estimated Glomerular Filtration Rate

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