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ORIGINAL PAPER

The management and clinical outcomes of electrothermal burn injury patients over a ten-year period

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ABSTRACT

Introduction and aim. This study investigates electrothermal burns in children, including their incidence, causes, associated systemic changes, and treatments. Electrothermal burns are unique and can be caused by factors such as moisture, leading to heat conduction from the contact site. The study aims to determine the frequency of these burns in children, identify their causes, and evaluate various treatment methods. The outcomes of interest include wound healing, scarring, and long-term complications. The results of this study will help develop better treatment strategies and reduce the incidence of such injuries.

Material and methods. The Grodno Regional Children's Clinical Hospital, Belarus treated 666 children for burn injuries between 2014 and 2023, 35 of them diagnosed with electrothermal skin burns.

Results. According to our analysis, electrothermal burns make up approximately 5.3% of all burn injuries. Upon reviewing hospitalization records, it was observed that the number of hospital visits related to this type of injury ranged from 3 to 5 annually, except for 2022, when there were nine recorded cases.

Conclusion. Our study shows that electrothermal burns are usually caused by household appliances. There is a gender imbalance in those affected. Early detection and appropriate medical intervention are crucial in the management of these burns.

Keywords. biochemical blood test, dermoplasty, electrocardiography, electrothermal burn, treatment

Introduction

Electrothermal burns occur as a result of heat generated outside the skin due to electrical activity. Burns resulting from contact with high tension current, due to the leaping of an electric arc from the conductor to the skin, are the most commonly observed.[1] Direct and indirect mechanisms come into play, with direct damages being caused by contact with electrical energy and the electric arc, and indirect injuries being secondary mechanical trauma that can be linked to falls or burns caused by electrical arcs or flames that ignite combustible materials.[2] The harmful effects of electric energy include thermal action at the body level and electrolytic action at the cell level, which can lead to serious injuries such as electrothermal burns resulting in tissue damage and life-threatening complications.[3] Extensive full-thickness burns and soft tissue injuries are seldom observed after accidents with electricity used for home appliances (<1000 V); however, in high-voltage (>1000 V) accidents, there is a well-recognized relationship between extensive burns and necrosis of soft tissue coagulation necrosis.[4] The characteristics of electrothermal injuries

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to display an alveolar soot arrangement and skin metallization.[5]

Cardiac changes from electrical injuries often show up as rhythm or conduction problems like sinus tachycardia, ventricular and atrial ectopy, bundle branch block, heart block, atrial fibrillation, supraventricular tachycardia, and ventricular fibrillation.[6] The myocardium can be damaged by high- and low-voltage current, direct electrothermal conversion, electroporation, or contusion from a lightning strike.[7]

Respiratory complications can result from inhibition of respiratory drive of the CNS, paralysis, and tetany of respiratory muscles, leading to acidosis due to poor tissue perfusion and lactic acid production.[8,9] The literature often underreports neurological symptoms in patients with electrical injury, such as seizures, motor weakness, decreased sensation, left hemiparesis, and loss of consciousness.[10,11]

Electric current can cause significant damage to blood vessels, leading to heat generation, coagulation necrosis, and occlusion of small vessels, especially those supplying muscles.[12] It is important to take into account that electrothermal heating leads to muscle damage and is typically observed only when exposed to high voltage with long contact and current flow.[13] On arteriography, this can be visualized as arterial pruning proximal to occlusion, indicating an area of irreversible muscle injury. This may mimic the appearance of progressive muscle necrosis.[14] In severe cases of high-voltage injuries, muscle necrosis can spread to sites far away from the observed skin injury, causing compartment syndromes due to vascular ischemia and muscle edema.

Furthermore, the damaged muscle releases a massive amount of myoglobin which may result in myoglobinuric renal failure.[12] The risk of myoglobinuria, which is caused by muscle damage, is acute renal failure. This requires prompt treatment with crystalloid loading to a target urine output of 2 $mLkg^{-1}h^{-1}$.

Anemia is the most frequent complication observed in electrothermal burn cases, which can be diagnosed through a complete blood count (CBC).[15] Additional diagnosis can be aided through urine myoglobin and creatinine kinase (CK) testing.[16] Elevations in lactate dehydrogenase (LDH), aspartate aminotransferase (AST), and alanine aminotransferase (ALT) are significant in terms of low-to-high voltage difference.[17] To detect the possibility of life-threatening arrhythmias, it is recommended to monitor electrocardiography (ECG) during transport.[6]

Additionally, treatment with sodium bicarbonate, mannitol, and furosemide facilitates myoglobin excretion and protects against renal tubular injury.[18] Electrothermal injury treatment is complex and difficult and should be customized based on the patient's particularities. Traditional treatment of electrothermal trauma included infusion therapy and the use of drugs to improve blood rheology, glucocorticoids, protease inhibitors, drugs to improve cardiac and respiratory activity, analgesics, neuroleptics, hepato-protectors, antioxidants, and antibacterial therapy. If necessary, patients also received transfusions of blood, plasma, and albumin.

The treatment of wounds is a crucial aspect of medical care that requires a careful and methodical approach. Local wound treatment involves the use of wet-drying and ointment dressings, which are chosen based on the specific phase of the wound process. For instance, gauze wet-drying dressings with antiseptic solutions such as iodopovidone, iodopyrine, and betadine are used for drying necrotic tissues, while multicomponent ointments with water-soluble bases may be applied in other situations. There is conclusive evidence supporting the effectiveness of early decompression incisions, neurectomies, and surgical debridement in promoting wound healing. These interventions facilitate the removal of necrotic tissue, relieve skin tension, improve blood flow, and eliminate edema. Additionally, the use of early fasciotomy on the first day after injury and early necrectomy has been shown to significantly reduce the frequency of crippling operations such as amputation and exarticulation of limbs. This approach also enables auto-dermoplasty to be conducted one week earlier, compared to traditional tactics. Furthermore, it enhances the engraving ability of autografts and reduces the duration of inpatient treatment. According to radiographic densitometric studies, the process of osteonecrosis after electrothermal trauma is completed within two weeks after the injury. As a result, osteo-necrectomy can be initiated one to three weeks earlier, including simultaneous radical osteo-necrectomy over the entire surface of osteonecrosis. These findings have significant implications on electrothermal trauma and its management and represent a valuable addition to the existing body of knowledge.[19,20]

Aim

The research aims to bridge the existing gap in literature concerning electrothermal burn trauma. It intends to delve into the innovative treatment approaches and the analysis of post-treatment care.

Material and methods

We conducted a thorough retrospective review of the pediatric population with electrothermal injuries who received inpatient treatment at the Grodno Regional Children's Clinical Hospital, Belarus. During the period spanning from 2014 to 2023, a total of 666 pediatric burn patients were admitted to the hospital for treatment, of which 35 presented with electrothermal skin burns. Of these 35 patients, 23 were male and 12 were female.

The statistical analysis has been conducted. The authors generated quantitative data on various subjects, which they then presented visually using curve charts,

bar charts, and pie charts. These visual representations served to illustrate the data clearly and concisely.

The present study has specific criteria for inclusion and exclusion of patients. The inclusion criteria consist of patients who have been subjected to electrothermal burns and are within the pediatric age group, residing in the Grodno region. Conversely, the exclusion criteria involve patients who have been subjected to burns that occurred by factors other than electrothermal burns, those who are above 18 years of age, and those who belong to regions other than Grodno. These criteria have established the certainty that the study is focused and to maintain the integrity of the study's findings. The study was approved by the institutional ethics and misconduct wing (approval number 2410).

Results

During our retrospective analysis of patient cases, we identified that out of the 666 patients who underwent inpatient treatment, a total of 35 patients were reported to have experienced electrothermal skin burns. We have included a few examples of such instances in Figure 1.

Fig. 1. A and C: III-degree burn, B: diagnostic sensitivity test (needle test) on III -degree burn

The tabulated data presenting the demographic information for the study is in Table 1.

Table 1. The demographic data of the study

Characteristics	n
Patients	35
Mean age (years)	9
Gender	
Male	23
Female	12

In our research, we included a parameter of hospitalizing a patient with electrothermal skin burns, which is shown in Figure 2. Our findings indicate that in the year 2014, no patient experienced electrothermal skin burns. However, among the 35 patients who experienced electrothermal skin burns, the highest number of patients, 9 (25.7%), was recorded in 2022, followed by 5 (14.3%) patients in 2018 and 2020, 4 (11.4%) patients in 2023, and 3 (8.6%) patients in 2016, 2017, and 2021. 2 patients in 2019 and one patient (2.8%) in 2015 experienced electrothermal skin burns.

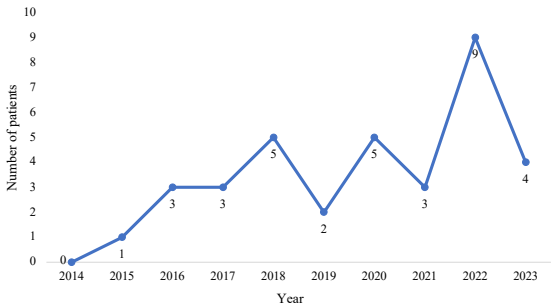

Fig. 2. Hospitalization of patients with electrothermal skin burns over nine years

The incidence of electrothermal burns varies depending on the age and gender of the affected individuals. According to our findings, children between the ages of one and three years are the most susceptible to electrothermal burns, and the incidence rate of electrothermal burns is higher in males as compared to females. The second most common age group affected by electrothermal burns is children between the ages of four and eight years, as evidenced by statistical data presented in Table 2.

Table 2. The distribution of children with electrothermal burns by age and gender

Age	Boys (n)	Girls (n)	Total (n)
Before 1	5	0	5
1–3	6	6	12
4–8	7	2	9
9–14	3	2	5
14–18	2	2	4
Total	23	12	35

According to Figure 3, electrothermal burns exhibit a gender-based distribution, with males experiencing such burns at about 65.7%, which is twice as frequent as females, who experience them at about 34.3%.

When examining the geographic distribution of children seeking inpatient care, it was observed that the regional pediatrics hospital in Grodno was chosen by 30 patients who were residents of the city itself. Conversely, the district hospital of the Grodno region was sought out by 5 patients residing on the outskirts of Grodno, as in Figure 4.

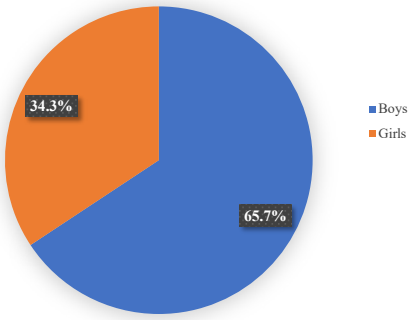

Fig. 3. Electrothermal burn according to gender distribution

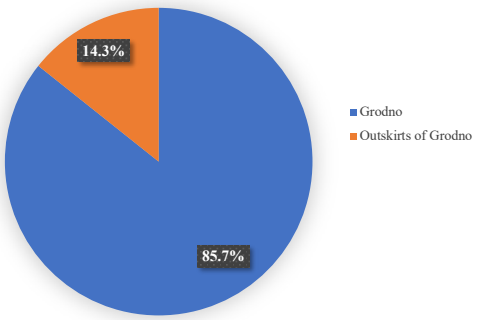

Fig. 4. The distribution based on the region of residence

The study sought to investigate the duration between electrothermal burns and the time patients sought medical attention. In Figure 5, a majority of the patients (65.7%) opted to seek medical assistance within an hour of the incident. Approximately 25.7% of the patients sought medical assistance within 1–3 hours, while only 5.7% sought help after a day. The remaining 2.9% of patients waited for up to 7 days before seeking medical attention. The results indicate that the majority of patients were proactive in seeking medical attention shortly after the incident, which is encouraging as prompt medical attention is critical in managing the associated complications of electrothermal burns.

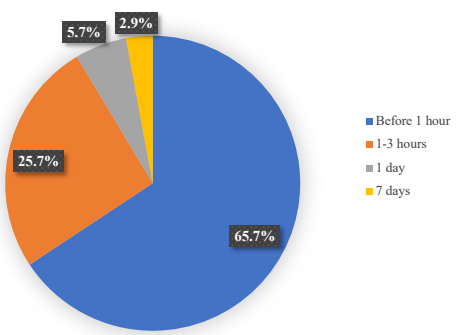

Fig. 5. The distribution depending on when a person seeks medical attention

Electrothermal injury caused by electrical appliances is a significant concern, particularly in children. Among young children, inserting metal objects, such as hairpins, metal nails, and metal rods, into a 220V socket was identified as the fundamental cause of low-voltage injury, accounting for 48.6% of cases. In contrast, 42.9% of children experienced injury due to bare electric wires, 5.7% due to contact with a light bulb base, and 2.8% due to exposure to a 380V transformer substation, as presented in Figure 6. These outcomes highlight the need for increased awareness particularly among young children, to reduce the incidence of electrothermal injury caused by electrical appliances.

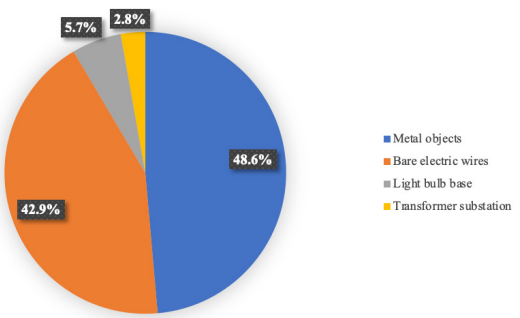

Fig. 6. The distribution depending on the etiology of the injury

The data presented in Figure 7 illustrates the seasonal distribution of electrothermal burns. A total of 35 children were injured during the study period, and the majority of the cases (34.3%) occurred during the summer. In contrast, 25.7% and 14.3% of the injuries were observed in winter, autumn, and spring, respectively. These findings suggest that the summer months pose a higher risk for electrothermal burn injuries among children. It is recommended that guardians take extra precautions during this season to minimize the risk of burns.

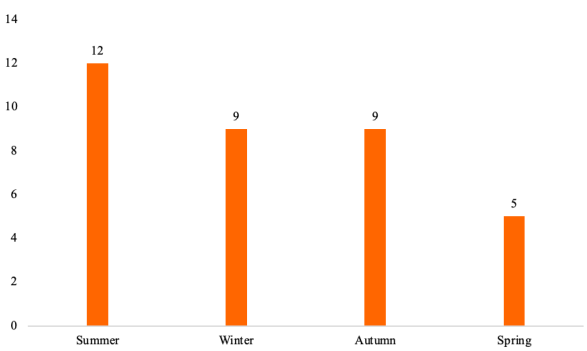

Fig. 7. The distribution of injuries by season

An analysis was conducted to evaluate the occurrence of injuries based on the day of the week. The findings indicate that the highest number of injuries were

reported on Sunday, with 9 children (25.7%) experiencing an injury. Friday followed with 6 children (17.2%), while Saturday recorded 5 cases (14.3%). Monday, Wednesday, and Thursday had 4 cases each (11.4%), while Tuesday had the lowest number of injuries with only 3 cases (8.6%). These results are in Figure 8.

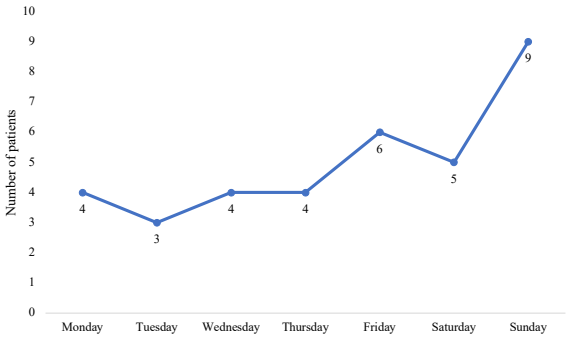

Fig. 8. The distribution varying depending on the day of the week

Upon admission, the medical care provided adhered to the clinical protocols. These protocols outlines the basic requirements for providing medical care to patients with burn injuries and their complications in both outpatient and inpatient settings. Among the admitted children, 22 (62.8%) were hospitalized in the emergency surgical department from the emergency room, while 10 (28.6%) received treatment in pediatric emergency medicine. Additionally, 3 (8.6%) children were admitted to the anesthesiology and resuscitation department, as in Figure 9.

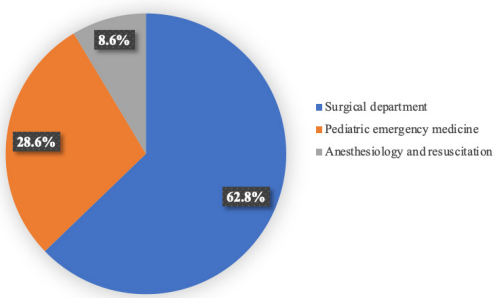

Fig. 9. The distribution of children by hospital department upon admission

A full blood count (FBC) was conducted on all patients on admission. Mild anemia was observed in 7 children (20%), leukocytosis in 11 children (31.4%), and an increase in erythrocyte sedimentation rate in 3 children (8.6%). These findings suggest the presence of an underlying inflammatory process, which may warrant further investigation.

Upon admission, a biochemical blood test was conducted on 18 patients to determine the level of aspartate aminotransferase (AST), alanine aminotransferase (ALT), creatine kinase (CK), and lactate dehydrogenase (LDH). The results indicated that AST levels were elevated in five of the children, while two children had elevated ALT levels. Four children had elevated CK levels, and one child had elevated LDH levels.

Eight patients underwent a coagulation profile test upon admission. The test results revealed that one child had an elevated level of fibrinogen, while another patient showed an increase in international normalized ratio (INR) to 1. These findings suggest the possibility of coagulation disorders. It is essential to monitor the patient's health status closely and take appropriate measures to manage their conditions.

Electrocardiography (ECG) was conducted on all patients. The analysis of the ECGs revealed certain changes in the cardiac parameters. Specifically, a decrease in voltage was noted in four children (11.4%), while three children (8.6%) exhibited a shortening of the PQ interval. Two children (5.7%) showed an atrioventricular block, while another two children (5.7%) showed a partial block in the right bundle branch. Further, one child (2.9%) had tachycardia, while another child (2.9%) showed bradycardia and atrial rhythm, as in Figure 10.

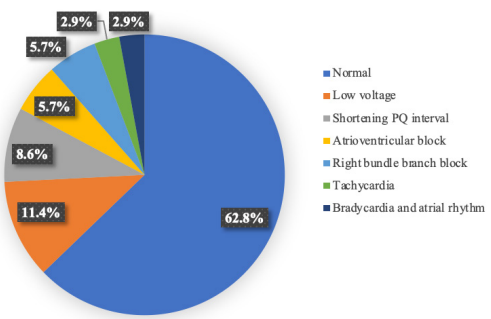

Fig. 10. The distribution of changes in ECG following electrothermal burn injury

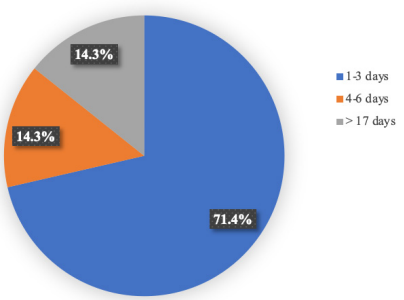

Fig. 11. The distribution according to length of stay after receiving an electrothermal burn injury

Based on the distribution of hospital stays, the majority of children, specifically 71.4%, remained hospitalized for 1–3 days. A smaller proportion of patients, comprising 14.3% of the total, were admitted for 4–6

days while the remaining 14.3% of patients were hospitalized for a duration exceeding 17 days, as shown in Figure 11.

On admission, an evaluation was conducted to determine the localization, burn area, and depth of the wound. The location of the electrothermal burns is presented in Table 3.

Table 3. Localization of electrothermal burns in children

One anatomical region			Many anatomical regions		
n=25 (71.4%)			n=10 (28.6%)		
Anatomical region	n	%	Anatomical region	n	%
Right hand	16	64	Both hands	9	90
Left hand	7	28	Left hand, leg	1	10
Left shin	1	4			
Head	1	4			

Among the 35 patients under review, it was observed that the majority of the lesions (71.4%) were localized in a single anatomical region, primarily among 25 children. The right hand was affected in 16 children (64%), while the left hand was affected in 7 children (28%). One child (4%) experienced the lesion on the left shin, while another child (4%) had it on the head. Additionally, there were 10 children (28.6%) who exhibited lesions involving multiple anatomical regions. Among these, both hands were affected in 9 children (90%), while the left hand and leg were affected in 1 child (10%).

Typically, electrothermal burn wounds do not exhibit significant damage over a wide area. However, it is common to observe skin lesions in the appearance of distinct marks, as summarized in Table 4.

Table 4. Distribution of electrothermal burns depending on the affected area

(%) of affected area	<0.05	0.1–0.2	0.3–0.8	1
Number of patients	20	9	5	1

Burns are classified into different degrees based on their severity, with superficial burns being classified as first-degree burns, partial-thickness burns as second and third-degree burns, and full-thickness burns as fourth-degree burns. All pediatric patients underwent primary surgical intervention for their wounds, and the depth and extent of their burns were thoroughly evaluated upon admission. The observed scars exhibited a mosaic pattern, affecting the superficial and deep layers of the skin. Three children were diagnosed with IV-degree electrothermal burns.

During the initial day of hospitalization, we implemented wet-to-dry dressings with antiseptics for local treatment. Subsequently, we utilized 1% silver sulfadiazine or 2% silver sulfathiazole cream, as well as ointment forms based on povidone-iodine and chloramphenicol for further treatment.

Two pediatric patients underwent surgical procedures, one of which involved one-stage plastic skin grafting, while the other received delayed dermoplasty involving Italian dermatoplasty and auto-dermoplasty utilizing a free split skin flap measuring 0.4 mm thick. In another case, a single child underwent partial resection of the distal phalanx, followed by stump plastic surgery using local tissues, as in Figure 12.

Fig. 12. Primary surgical intervention

Additionally, primary sutures on the wound were ligated to only one child, as outlined in Table 5.

Table 5. Methods of surgical treatment

Surgical treatment				
n=4 (100%)				
Anatomical region	Type of surgery	Day of surgical treatment	n	%
Right hand	Early necrectomy	6	2	50
	One-stage plastic surgery with skin flap	6	1	25
	Delayed Italian dermatoplasty and auto-dermoplasty with a free split skin flap	13	1	25
	Primary sutures on the wound	1	1	25
Left hand	Partial resection of the distal phalanx with stump plastic surgery using local tissues	25	1	25

As part of their treatment plan, nine children were prescribed a rigorous regimen of antibacterial therapy, with the addition of a comprehensive course of physiotherapy and physical therapy. This complex therapy approach was designed to address their specific needs and promote optimal healing and recovery.

Following their discharge from the hospital, all children underwent a thorough examination conducted by a pediatric surgeon. This examination took place one month after the complete epithelialization of the wounds as shown in Figure 13, and was followed by a course of conservative treatment aimed at preventing the development of pathological scars. Subsequently, the

children were taken for follow-up, following established protocols.

Upon admission, all pediatric patients underwent culturing at sites of tissue damage exhibiting no microbial growth. Only one patient experienced infectious complications, while rapid marginal epithelization occurred in the others. For more extensive injuries, necrectomy followed by plastic surgery was performed, effectively preventing the development of infectious complications. After a year of treatment, it was observed that a significant majority of the children (97.1%) showed positive outcomes and were excluded from further observation. However, in the case of a single child who suffered an electrothermal burn caused by a transformer substation, the surgeon observed the formation of a flexion contracture. Additionally, the child exhibited psychiatric complications such as hyperkinetic behavior disorder.

Fig. 13. A and C: epithelialization of the transplanted skin flap after a month, B: epithelialization of the transplanted skin flap after 12 months

Discussion

Electrothermal burns are a serious concern as they can result from low-voltage sources that are capable of producing large currents. When a metal object comes into contact with a live terminal and a grounding, it can short-circuit the battery and rapidly heat the metal object.[21] Children have been reported to have had electrothermal burns from various objects such as metal objects, bare electric wires, light bulb bases, and transformer substations. Electrothermal injury can occur due to different reasons such as capacitive coupling, direct application, direct coupling, insulation failure, etc.[22] The severity of the injury depends on several factors such as voltage, amperage, type of current (alternating or direct), tissue resistance, tissue susceptibility, duration of contact, the path of electrical flow through the body, and extent of grounding.[23] It is worth noting that most patients with electrothermal injuries are young and healthy.[24] Gender and season distribution analysis shows that boys are at higher risk of electrothermal burns during the summer season compared to girls.

According to the results of an ECG, changes in low voltage were observed in 11.4% of children, while 8.6% of children showed a shortening of the PQ interval. Atrioventricular block and right bundle branch block were detected in 5.7% of children, and tachycardia, bradycardia, and atrial rhythm were observed in the remaining 2.9% of children. It has been found that electrothermal conversion and electroporation can cause damage to the myocardium, with the direct impact of electric current being a primary cause of such damage. Furthermore, elevated levels of myocardial damage parameters, such as CK-myocardial band isoenzyme and troponin levels, could indicate cardiac complications. However, an ECG remains a crucial diagnostic tool for identifying myocardial damage as a complication of electrothermal injury.[24] Cardiac events usually occur immediately after the accident, resulting in the proarrhythmic effect of electric shock. Electromechanical disturbances, such as sinus tachycardia, ventricular premature beats, atrial fibrillation, ventricular tachycardia, ventricular fibrillation, and conduction abnormalities, such as sinus bradycardia or bundle-branch blocks, or varying degrees of atrioventricular blocks, are all potential consequences of electrothermal injury.[25]

During the FBC analysis, the patients exhibited anemia, leukocytosis, and an elevation in ESR levels. Anemia and leukocytosis are the most frequent laboratory findings among these patients.[26] Furthermore, patients' coagulation profile tests revealed increased levels of fibrinogen and INR. A biochemical blood test revealed elevated levels of AST, ALT, CK, and LDH. The severity of the injury may be correlated with the LDH level.[27] Within an hour of the electrothermal burn incident, most children sought medical attention, while parents of 25.7% of children decided to seek medical attention within 1-3 hours, and the remaining children sought medical attention within 1–7 days.

According to the clinical protocols of the Ministry of Health of the Republic of Belarus, children with burns were treated in different departments based on the extent and depth of the injury. 62.8% of children required treatment in the surgical department, 28.6% received treatment in pediatric emergency medicine, and 8.6% were treated in anesthesiology and resuscitation. It is imperative to consider varying monitoring and treatment concepts for patients, especially after sustaining an injury.[28] The condition can be managed through conservative treatment, primary intervention, and epithelialization.[29] In our study, all children underwent primary surgical treatment of wounds upon admission, which helped to determine the burn's depth

and area. Wet-to-dry dressings with antiseptics were performed on the first day, followed by a prescription of creams like 1% silver sulfadiazine or 2% silver sulfathiazole cream, and ointment forms based on povidone-iodine and chloramphenicol. Additionally, complex therapies such as physiotherapy, physical therapy, and antibacterial therapy were prescribed to a few children.

Some children had undergone early necrectomy using different surgical techniques, including one-stage skin grafting, delayed Italian dermatoplasty, and auto-dermoplasty with a free split skin flap measuring 0.4 mm thick. Primary suture ligated on the wound in one child. Furthermore, partial resection of the distal phalanx with stump plastic surgery using local tissue was performed in a single child. In the hospital, most children had a shorter stay, ranging from 1–3 days, while 14.3% had more extended stays of more than 17 days. Follow-up care after a month showed complete epithelization of the wound, and conservative treatment was prescribed to prevent the development of pathological scars. After a year, 34 children had fully recovered with no complications, except for one child, who had developed a flexion contracture and exhibited hyperkinetic behavior disorder. It is crucial to note that neurological complications, including loss of consciousness, memory problems, hypoxic encephalopathy, intracerebral hemorrhage, and stroke, were observed in previous studies.[9]

Conclusion

According to our research, electrothermal burns are observed in 5.3% of hospitalized children with burn injuries. It has been observed that patients under the age of three are the most commonly affected group, accounting for 48.6% of cases. Furthermore, boys are twice as likely as girls to suffer from such burns, with the majority of cases occurring during the summer season and on weekends. These findings highlight the need for enhanced awareness and preventive measures to mitigate the risk of electrothermal burn injuries among pediatric patients. Parents should exercise increased vigilance with children under the age of 4, as this age group is particularly vulnerable to sustaining electrothermal burns from common household appliances.

Injuries caused by electrical shock are primarily attributed to contact with household instruments, with the majority of cases (97.2%) involving incidents such as inserting metallic objects into a 220 V socket and contact with bare conductors. In the episode of an electrical injury, most children (65.7%) seek medical attention within an hour of the incident. The most common site of injury is the hands (91.4%), with a sizeable proportion of cases (11.4%) requiring surgical intervention.

Declarations

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This research received no funding.

Author contributions

Conceptualization, A.I.V.H. and G.R.P.; Methodology, G.R.P. and L.R.S.D.L.; Software, An.V.H. and Y.V.A.; Validation, A.I.V.H., G.R.P., L.R.S.D.L., An.V.H. and Y.V.A.; Formal Analysis, G.R.P., An.V.H. and Y.V.A.; Investigation, A.I.V.H., G.R.P., L.R.S.D.L., An.V.H. and Y.V.A.; Resources, A.I.V.H., An.V.H. and Y.V.A.; Data Curation, A.I.V.H., G.R.P. and L.R.S.D.L.; Writing – Original Draft Preparation, G.R.P. and L.R.S.D.L.; Writing – Review & Editing, A.I.V.H., An.V.H. and Y.V.A..; Visualization, A.I.V.H.; Supervision, A.I.V.H., An.V.H. and Y.V.A.; Project Administration, A.I.V.H., G.R.P., and L.R.S.D.L.; Funding Acquisition, A.I.V.H.

Conflicts of interest

None declared.

Data availability

All data generated or analyzed during this study are included in this manuscript.

Ethics approval

It was approved by institutional ethics and misconduct wing (approval number 2410).

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