Journal of Pharmaceutical Research International

33(46B): 266-272, 2021; Article no.JPRI.75306
ISSN: 2456-9119
(Past name: British Journal of Pharmaceutical Research, Past ISSN: 2231-2919, NLM ID: 101631759)

Emergent Management of Thermal Burns in Emergency Rooms Saudi Arabia - A Review

Hisham Mohammed Sonbul[1*], Mohammed Ali Mohammed Alqahtani[2], Abdullah Mohammed Bajebair[2], Ali Abdallah A. Aljameely[2], Saud Ali Aloudah[2], Mohammed Ali M. Alshamrani[2] and Fayez Abdulaziz A Alharthi[2]

[1]King Abdulaziz University Hospital, KAUH, Saudi Arabia.
[2]King Saud Bin Abdulaziz University for Health Sciences, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i46B32940
Editor(s):
(1) Dr. Paola Angelini, University of Perugia, Italy.
Reviewers:
(1) Athina Myrou, Ahepa University Hospital, Greece.
(2) Wafaa Menawi, An-Najah National University, Palestine.
Complete Peer review History: https://www.sdiarticle4.com/review-history/75306

Review Article

Received 02 August 2021
Accepted 09 October 2021
Published 21 October 2021

ABSTRACT

According to WHO statistics, over 300,000 people die each year by burns, and more dying from electric burns, scalds or other causes of burns. Burn injuries and wounds are typically fatal. And they can cause serious long-term implications for victims. The most important aspect in reducing the morbidity and mortality associated with burns is to prevent them. Exposure of tissue to an external high temperature source causes thermal burns. Burns that occur at greater temperatures or over longer periods of time cause deeper and more serious injuries. Because burn patients are the most common trauma patients, the initial step in treating them should be to assess and stabilize their airway, breathing, and circulation according to ATLS standards. Supportive care should include crystalloid resuscitation, blood composition, and potentially endotracheal intubation. In this review we will be looking at thermal burns epidemiology, etiology, pathophysiology and most importantly management.

Keywords: Burns; epidemiology; etiology; pathophysiology.

**Corresponding author: E-mail: drhishamsonbul@gmail.com;*

1. INTRODUCTION

Burn injuries and wounds are typically fatal. They can have serious long-term implications for victims, and they remain a huge problem that affects communities all over the world. The care of these people is frequently lengthy, and huge sums of money are frequently required to achieve the medical and psychological healing that is required. The most important aspect in reducing the morbidity and mortality associated with burns is to prevent them. Education and training are critical stages in empowering communities to protect themselves, and children are among the most vulnerable burn victims. Studies regarding epidemiological characteristics linked to burn injuries have resulted in the implementation of training agendas, public awareness and social advance. By improving data collection, research collaborations, and preventative strategy development, international organisations such as the World Health Organization's Department of Violence and Injury Prevention and Disability (VIP) and the International Society for Burns Injuries (ISBI) hope to eventually reduce this significant threat. [1-12].

Thermal burns are skin injuries produced by exposure to high temperatures, such as hot surfaces, hot liquids, steam, or flame. The majority of burns are small and can be treated on an outpatient basis or at a local hospital. In specialised burn hospitals, about 6.5 percent of all burned patients are treated. The extent of body surface area damaged, the depth of the burns, and individual patient characteristics such as age, prior injuries, or other medical conditions all factor into the choice to transfer and treat at burn centres. Burns that happen at home account for 25% of all major burns [13].

1.1 Etiology

Tissue exposure to an external heat source causes thermal burns. Burns that occur at greater temperatures or over longer periods of time cause deeper and more serious injuries. Thermodynamic burn mechanisms are divided into three categories. Direct or indirect exposure of a patient to a flame source causes flash and flame burns. An ignition source, an oxidising agent, and a fuel supply combine to create these flames. If patients are exposed to open flames in a closed environment, they may suffer from inhalation injuries. The patient is exposed to high-temperature liquids, resulting in scald burns. Grease and hot-oil burns are frequently more deeper than the initial examination shows [14].

Thermal burns are the most frequent type of burn injury, accounting for around 86 percent of burn patients who need to be admitted to a burn centre. Hot liquids, steam, flame or flash, and electrical harm are all common causes of burns. The following are some of the risk factors for thermal burns: [13].

- Children at a young age frequently come into contact with hot liquids.
- Male gender - guys are also at a higher risk of burn injuries, primarily as a result of work-related accidents. In addition, because many people use gasoline products for amusement or farming, flame burns are widespread during the summer. When it comes to burn injuries in adults, alcohol intake is a common risk factor.
- There are no smoke detectors in the house.

1.2 Epidemiology

According to WHO statistics, over 300,000 people die each year from flames alone, with many more dying from scalds, electrical burns, and other causes, although there is currently no accurate global data to back up these claims. Low- and middle-income nations account for more than 95 percent of fatal fire-related burns. Multitudes more patients have survived their injuries but are often left disfigured and destitute. Children and the elderly remain the most vulnerable groups with the highest mortality. Intensive and specialised burn centres are in existence all over the world but are very often situated in high-income countries.These novel and costly treatment approaches are crucial, but how a burn patient is initially managed is just as important. Simple attention to the basics, such as appropriate resuscitation and precise wound care, can help to improve outcomes and potentially influence fatality rates [1].

According to the 2014 World Fire Statistics, fire-related burn injuries have a considerable economic impact, with direct losses accounting for 0.02-0.22 percent of average GDP and indirect losses accounting for 0.002-0.95 percent. Males were responsible for around two-thirds of fire-related costs. Deaths per 100 thousand ranged from 0.02 in Singapore to 2.03 in Finland, with 1.11 in the United States. The majority of adult burn admissions were due to flash and flame burns, while the majority of paediatric burns were due to scald burns [14].

Annually, over 450,000 individuals need burn care, with about 30,000 requiring admission to burn centres. Thermal burns account for about 86 percent of all burns (43 percent from fire/flame, 34 percent from scalds, and 9 percent from hot objects), 4 percent from electrical burns, 3 percent from chemical burns, and 7% from other causes. Burns or related problems such as smoke inhalation, carbon monoxide or cyanide poisoning, organ failure, or infection kill over 3400 people each year. Residential fires account for over 72 percent of these deaths. Burns are the fourth largest cause of trauma deaths in children aged one to four, and the second major cause of unintentional deaths.The good news is that all forms of burns have a survival rate of around 97 percent, and burn mortality have decreased by roughly 75 percent since the 1960s [13].

1.3 Pathophysiology

The pathophysiology of thermal burns can be divided into local and systemic responses. When too much heat is applied to the skin, it radiates outward from the point of contact, forming a three-zone local reaction in all directions. Cell death, denaturation of proteins in the extracellular matrix, and damage to the circulation all occur in the zone of coagulation, which is the core contact point of maximum harm. Damaged circulation near the coagulation zone causes a second stasis zone to form around it. Increased circulation as the body responds to damage causes hyperemia in the third peripheral zone.With careful resuscitation and wound care, the stasis zone can heal. Long periods of hypotension and poor wound care, on the other hand, can turn the zone of stasis, and even the zone of hyperemia, into larger and deeper tissue damage [14].

Similar to skin burns, thermal injuries to the airways damage epithelial cells, denature proteins, and trigger a cascade of inflammatory reactions that result in the release of reactive oxygen species (ROS) and reactive nitrogen species (RNS), causing widespread cell damage. Poly(ADP ribose) polymerase (PARP) is also activated, leading in the depletion of adenosine triphosphate in cells, which leads to further necrosis and apoptosis. All of these processes result in increased microvascular pressure and increased endothelial permeability for proteins, resulting in epiglottis edema and tongue swelling, obstructing the airways [15,16-21].

Following a burn, the systemic response can be tremendous. Two clinically significant processes occur in a major burn. Increased capillary permeability and wide-scale extravasation of fluid and proteins from the intravascular to the extravascular region arise from the release of systemic inflammatory mediators and cytokines. In a response comparable to severe sepsis and septic shock, this can result in life-threatening hypotension, pulmonary edoema, and reduced circulation to end organs and the already stressed integument.Physical skin loss is the cause of the second process. The skin plays a number of critical roles in homeostasis, including temperature regulation, fluid management, and serving as a physical barrier to infection as well as a point of contact for mediating environmental interpretation. This crucial organ's large surface area decrease disrupts these critical activities [14].

1.4 Management

Because burn patients are first and foremost trauma patients, the initial step in treating them should be to assess and stabilise their airway, breathing, and circulation according to ATLS standards. Supportive care should include crystalloid resuscitation, blood composition, and potentially endotracheal intubation. Following initial stabilization, an evaluation for transfer to an accredited burn centre must be considered.Indications for transfer are partial thickness TBSA or burns deeper than 10% or more, burns to the face, hands / feet, genitals / perineum, or large joints, chemical or electrical burns, large burns with accompanying trauma, inhalation injuries, large burns in the case of patients with special social or rehabilitation needs or major medical problems that affect mortality and when the investigating hospital does not have qualified personnel / equipment to handle pediatric burns. [14,15,22,23].

These are management steps [1].

1. Remove any Sources of Heat:

   - Take off any clothes that could be burned, has chemicals on it, or is restricting.
   - Apply cold tap water (18 degrees Celsius) to any burns that are less than 3

hours old for at least 30 minutes before drying the patient.
- To prevent hypothermia, cover the patient with a clean, dry sheet or blanket.
- Using Burnshield to cool and dress the damage for the first 24 hours is particularly useful.
- Constricting clothes and rings must be removed.

2. Assess Airway/Breathing:

- Where there are flame or scald burns on the face and neck, a careful airway examination is required. Intubation is usually only required for unconscious patients, hypoxic patients with severe smoke inhalation, or patients with face and neck flame or flash burns. Pharyngeal burning, air hunger, stridor, carbonaceous sputum, and hoarseness are all signs that your airway needs to be checked.
- For the next 24 hours, all patients with serious burns must be given high-flow oxygen.
- Carbon monoxide poisoning should always be considered in burn patients. Restlessness, headache, nausea, poor coordination, cognitive impairment, confusion, or coma are some of the symptoms they may experience. Using a non-rebreathing face mask, administer 100% oxygen; if possible, assess blood gases, particularly carboxyhaemoglobin levels.
- If respiration appears to be restricted as a result of tight circumferential trunk burns, see a burn center surgeon immediately to discuss the need for an escharotomy.

3. Circulation

- Put an end to any external bleeding.
- Determine the cause of any internal bleeding.
- In all compromised patients, use standard ATLS techniques to set up large-bore intravenous (IV) lines and deliver resuscitation bolus fluid as needed. The ability to perfuse possibly viable burn wounds is crucial.

4. Losses (Once the Patient Has Been Stabilised)

- Patients with TBSA burns of less than 10% can be resuscitated orally (unless the patient has an electrical injury or associated trauma). This will need to be monitored on a regular basis, and the patient may still require an IV line.
- Secure a large-bore IV line for patients with 10–40 percent TBSA burns; add a second line if transportation will take longer than 45 minutes.
- Burns over 40% TBSA need the use of two large-bore IV lines.
- Do not delay an IV line transfer if it will take fewer than 30 minutes from the time of call.

5. Incisions for decompression (Escharotomy)

- Examine the extremities or trunk for full-thickness circumferential burns. Elevate the burned extremities above the level of the heart with pillows. If transfer will be delayed, see a burn surgeon about the indications and methods for decompression incisions (escharotomies).

6. Burned tissue cooling: [24]

- Take off any burnt clothing.
- If transport is not possible right away, immerse the burn wound in cold (1-5°C) water for around 30 minutes.
- Do not use ice water or apply ice to the burn wound directly.
- To reduce discomfort, local cooling of burns containing less than 9% TBSA can be sustained for up to 30 minutes.
- After more life-threatening conditions have been treated, minor burns can be cooled with running tap water and bandaged.

7. Further Steps: [24]

- Minor burns should be cooled with cool sterile saline cloths.
- Any open blisters should be debrided.
- Individually wrap each finger and toe, with fluffed gauze separating the digits.
- Antibiotic ointment should be used to all partial-thickness wounds.
- Use a light soap and gentle scrubbing to clean any other places with small burns.
- Check all patients for tetanus and deliver tetanus vaccine as needed.

- Discharge the patient with specific wound care instructions and a follow-up appointment for wound assessment.

In the emergency room, inhalation harm must be ruled out. If there is any question, intubation is recommended. Inhalation injury might cause upper airway edema within 12 to 24 hours. Fiberoptic bronchoscopy is an option since it provides a precise approach to detect inhalation harm. Following airway control, a vertical incision of the eschar on the chest should be made to minimize chest expansion limits. Sometimes additional lateral incisions may be required depending on the degree of eschar formation [13].

Stopping the burning process, washing, debridement, and applying topical ointments and/or dressings to encourage recovery are all common local burn treatments. Initial cooling of the burn site offers various benefits, including pain relief, stopping the advancement of tissue necrosis produced by high temperatures, and maybe assisting wound healing. The best cooling agent, as well as the optimal timing, duration, and temperature of the cooling agent, are all debatable. In animal experiments, 30 minutes of tap water (12°C–18°C) reduced necrosis and improved healing [15,25,26].

Fluid resuscitation is required for all patients with a major burn injury, which is influenced by the proportion of the TBSA covered by the burn as well as the occurrence of inhalation injury. A normal sensorium, stable vital signs, and a normal urine output indicate adequate resuscitation, as follows:

- Children younger than 2 years: 1 mL/lb/h
- Older children: 0.5 mL/lb/h
- Adults: ≥ 30-40 mL/h
- The Parkland formula for calculating fluid needs for burn victims in the first 24 hours is as follows:

Fluid requirement (mL) = (4 mL of crystalloid) × (% TBSA burned) × body weight (kg)

The Galveston formula, which determines the volume of lactated Ringer solution provided throughout the first 24 hours, is an alternate formula for determining fluid needs in children [24].

Fluid requirement = 5000 mL/m2 × % TBSA burned + 2000 mL/m2

Partially-thickened burns can be treated by applying topical antibiotic ointments as bacitracin or triple-antibiotic ointment, followed by a simple absorbent bandage. Spread the ointment over the dressing like peanut butter on bread, then apply it to the burn. Dressings are changed once or twice a day, and healing can take anywhere from one to two weeks. Silver sulfadiazine has long been a popular topical antibiotic cream, but it's losing favour due to the growing evidence that it slows recovery. Another option for burn wound care is to put a customized occlusive burn dressing on the burn and leave it on for about a week [13].

It might be difficult to effectively manage pain in severely burned sufferers. Potent opioids including morphine sulphate, hydromorphone, and fentanyl should be given intravenously and titrated based on the patient's response during the early emergent period. Oral oxycodone/acetaminophen mixtures can be used for moderate pain, whereas nonsteroidal anti-inflammatory medications and acetaminophen can be used for lesser pain. Antidepressants, anticonvulsants, and antianxiety medications have also been discovered to be effective adjuvants in the treatment of burn patients' pain. Ketamine can be given intravenously at sub-dissociative doses of 0.1–0.2 mg/kg, especially in individuals who are resistant to heavy doses of opioids [15,27-29].

2. CONCLUSION

There’s no doubt that burns are one the most critical cases that can be presented to the emergency department which have high chance of causing death, treatment of burns begins immediately after exposure before patient reach ED which can be by removing the source of burn, ensuring the breathing and circulation functions. Then restoring the liquieds for the body as large burns can lead to serious fluid losses. Furthermore,all circumferential full-thickness burn injuries need an escharotomy to prevent compartment syndrome.

Preventive methods such as avoidance of burning accidents by well trained and educated populations and following the safety methods and tools can be the best way to reduce any injuries caused by burn incident.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Melanie Stander, Lee Alan Wallis. The emergency management and treatment of severe burns. Emergency Medicine International. 2011;Article ID 161375:5. Available:https://doi.org/10.1155/2011/161375
2. Mock C, Peck M, Krug E, Haberal M. Confronting the global burden of burns: a WHO plan and a challenge. Burns. 2009;35(5):615–617.
3. Parbhoo A, Louw QA, Grimmer-Somers K. Burn prevention programs for children in developing countries require urgent attention: a targeted literature review. Burns. 2010;36(2):164–175.
4. Atiyeh BS, Costagliola M, Hayek S. Burn prevention mechanisms and outcomes: Pitfalls, failures and successes. Burns. 2009;35(2):181–193.
5. Liao C, Rossignol A. Landmarks in burn prevention. Burns. 2000;26(5):422–434.
6. Ho WS, Ying SY, Chan HH, Chow CM. Assault by burning—a reappraisal. Burns. 2001;27(5):471–474.
7. Adamo C, Esposito G, Lissia M, Vonella M, Zagaria N, Scuderi N. Epidemiological data on burn injuries in Angola: A retrospective study of 7230 patients. Burns. 1995;21(7):536–538.
8. Van Niekerk A, Laubscher R, Laflamme L. Demographic and circumstantial accounts of burn mortality in Cape Town, South Africa, 2001–2004: An observational register based study. BMC Public Health. 2009;9:article 374.
9. Rao K, Ali SN, Moiemen NS. Aetiology and outcome of burns in the elderly. Burns. 2006;32(7):802–805.
10. Malic CC, Karoo ROS, Austin O, Phipps A. Burns inflicted by self or by others-an 11 year snapshot. Burns. 2007;33(1): 92–97.
11. Cahill TJ, Rode H, Millar AJW. Ashes to ashes: Thermal contact burns in children caused by recreational fires. Burns. 2008;34(8):1153–1157.
12. Mzezewa S, Jonsson K, Aberg M, Salemark L. A prospective study on the epidemiology of burns in patients admitted to the Harare burn units. Burns. 1999;25(6):499–504.
13. Schaefer TJ, Tannan SC. Thermal Burns. [Updated 2021 Aug 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021. Available:https://www.ncbi.nlm.nih.gov/books/NBK430773/
14. Walker NJ, King KC. Acute and chronic thermal burn evaluation and management. [Updated 2021 Jul 21]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021. Available:https://www.ncbi.nlm.nih.gov/books/NBK430730/
15. Toussaint J, Singer AJ. The evaluation and management of thermal injuries: 2014 update. Clin Exp Emerg Med. 2014;1(1):8-18. DOI: 10.15441/ceem.14.029 PMID: 27752547; PMCID: PMC5052819.
16. Rehberg S, Maybauer MO, Enkhbaatar P, Maybauer DM, Yamamoto Y, Traber DL. Pathophysiology, management and treatment of smoke inhalation injury. Expert Rev Respir Med. 2009;3:283–97.
17. Pacher P, Szabo C. Role of the peroxynitrite-poly(ADP-ribose) polymerase pathway in human disease. Am J Pathol. 2008;173:2–13.
18. Lobo SM, Orrico SR, Queiroz MM, et al. Pneumonia-induced sepsis and gut injury: effects of a poly-(ADP-ribose) polymerase inhibitor. J Surg Res. 2005;129:292–7.
19. Gero D, Szabo C. Poly(ADP-ribose) polymerase: A new therapeutic target? CurrOpinAnaesthesiol. 2008;21:111–21.
20. Szabo C, Ischiropoulos H, Radi R. Peroxynitrite: Biochemistry, pathophysiology and development of therapeutics. Nat Rev Drug Discov. 2007;6:662–80.
21. Toon MH, Maybauer MO, Greenwood JE, Maybauer DM, Fraser JF. Management of acute smoke inhalation injury. Crit Care Resusc. 2010;12:53–61.
22. Ramachandra T, Ries WR. Management of nasal and perinasal soft tissue injuries. Facial Plast Surg. 2015;31(3):194-200.
23. Wu C, Calvert CT, Cairns BA, Hultman CS. Lower extremity nerve decompression

in burn patients. Ann Plast Surg. 2013;70(5):563-7.
24. Erik D Schraga, Joe Alcock, MD, et al; Emergent management of thermal burns. Medscape. Updated; 2020. Available:https://emedicine.medscape.com/article/769193
25. Jandera V, Hudson DA, de Wet PM, Innes PM, Rode H. Cooling the burn wound: Evaluation of different modalites. Burns. 2000;26:265–70.
26. Venter TH, Karpelowsky JS, Rode H. Cooling of the burn wound: The ideal temperature of the coolant. Burns. 2007;33:917–22.
27. Summer GJ, Puntillo KA, Miaskowski C, Green PG, Levine JD. Burn injury pain: The continuing challenge. J Pain. 2007;8:533–48.
28. Norman AT, Judkins KC. Pain in the patient with burns. Contin Educ Anaesth Crit Care Pain. 2004;4:57–61.
29. Richardson P, Mustard L. The management of pain in the burns unit. Burns. 2009;35:921–36.

© 2021 Sonbul et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/75306