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Impact and Challenges in Psychology Management of Burn Injury for Adults and Children at Emergency Department

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Abstract

Burns are devastating and debilitating injuries leading to high morbidity and mortality, psychology and emotional stress and add to the financial burden. Severely burned patients should preferably be managed in a burn center with a dedicated intensive care unit (ICU). Severity of burns are classified according to the degree of burns and total body surface area (TBSA) with burns. Rule of nine is used for calculation of TBSA with burn. However, management of burn in adults and children at the emergency department are different. The management of paediatric burns can be a major challenge for the treating unit. One has to keep in mind that “children are not merely small adults”; there are certain features in this age group that warrant special attention. The peculiarities in the physiology of fluid and electrolyte handling, the uniqueness of the energy requirement and the differences in the various body proportions in children dictate that the paediatric burn management should be taken with a different perspective than for adults. This paper will present 5 case series about patient burn in adult and children and will review how challenging hospitals manage these patients.

Keywords: burn; psychology and management; emergency department

Introduction

Burn wounds and injuries are often devastating. The injuries can be caused by friction, cold, heat, radiation, chemical or electric sources, but the majority of burn injuries are caused by heat from hot liquids, solids or fire. They can have severe long-term consequences for the victims and they continue to be a major problem affecting communities worldwide. Education and training are vital steps to empower communities to help them protect themselves, and also

the most vulnerable of burn victims are children. Children and the elderly remain the most vulnerable groups with the highest mortality. The particular cause of a burn injury determines the treatment approach. Although all burn injuries involve tissue destruction due to energy transfer, different causes can be associated with different physiological and pathophysiological responses. For example, a flame or hot grease can cause an immediate deep burn, whereas scald injuries (that is, from hot liquids or steam) tend to appear more superficial initially, due to rapid dilution of the source and energy (Stander & Wallis, 2011).

The basic principles of resuscitation are the same in adults and children; however, children are not simply "little adults". They have unique physiologic needs that must be adequately addressed to successfully care for burn-injured children (Romanowski & Palmieri, 2017).

Psychological traumatic events such as accidental injuries are commonly happened among children during their childhood (Alisic et al., 2008). The presence and behaviors of the parents during and after the psychological traumatic event may improve the resilience of the children to recover themselves (Bakar et al., 2021). Based on a qualitative study conducted in the Netherlands, a qualitative study conducted in the Netherlands shows that parents can act proactively in responding to post-traumatic stress experienced by their children and this step is taken to ensure that they aware of their child's needs and support them accordingly (Alisic et al., 2012). However, parents too are reportedly affected by such cases and experience negative psychological effects including symptoms of post -traumatic stress (Ljungman et al., 2015).

Burn injuries that happen among children and adults can lead to the widespread skin damage and also the formation of burn scars. Several abnormal types of scarring include hypertrophic scars, keloids and contractures. These scars resulted from the injury of deep dermal or reticular, layers of the skin tissue, which is the most common in burn injuries (Brewin et al., 2018). Serious burn injuries suffered by the victims can cause significant psychological impact upon them (Taal et al., 1997).

Depression anxiety and post-traumatic stress disorder (PTSD) among the survivors is considered as the most common psychological problems seen after burn injuries (Lodha et al., 2020). In China, Zheng et al. (2021) conducted a research to determine the prevalence of PTSD and explore the socio-demographic and burn-specific associated factors of PTSD among Chinese burn survivors and their family members. The recruited respondents are 131 adult patients with unintentional burns and 194 family members of burn patients. Fifty-five (42.0%) burn victims and ninety-nine (51.0%) family members of burn victims met the criteria for having PTSD. Meanwhile in Pakistan, Bano et al. (2020) carried out a research to investigate the relationship of post-traumatic stress disorder, cognitive function and adjustment problems among 200 women burn survivors as respondents. The finding of the study showed that post-traumatic stress disorder (PTSD) significantly affected cognitive issues and adjustment problems of women burn survivors.

Cognitive functioning plays a significant role in performing daily life activities including learning, thinking, reasoning, remembering, problem solving, decision making, and attention in dealing with the social and physical environment (Kielhofner, 2009). Cognitive dysfunction is one of the psychological impacts that associated with burn injury among survivors (Sveen, 2011). In Pakistan, Bano et al. (2020) carried out a research to investigate the relationship of post-traumatic stress disorder, cognitive function and adjustment problems among 200 women burn survivors. The results showed that post-traumatic stress disorder (PTSD) significantly affected cognitive issues and adjustment problems of women burn survivors. However, limited evidence is available to conclude on cognitive functioning among

young burn survivors due to limited sample sizes, may be hampered by selection or non-response bias, and differed too much in outcomes studied (Bakker et al., 2013).

In this case series, we present 5 different cases of burn injury in adults and paediatrics that come with different clinical presentations and managed specifically.

2. Methodology

Retrospective study through case series.

2.1 Case report1

A 32 years old gentleman referred from Pelantar Minyak Bekok Charlie Kemaman presented with alleged burn injury secondary to gas explosion at offshore 5 hours prior to ED. He was working as a contractor at Petronas in an enclosed space with 3 other colleagues. They were not aware of gas leaking in the room then suddenly spark came from the equipment causing a flash fire and caught the PPE. Post trauma, he sustained burn injury over his face, back and bilateral upper and lower limb. First aid given at offshore was burn sheet. Otherwise he denied of loss of consciousness, shortness of breath, noisy breathing, eye pain, blurring of vision, stridor or hoarseness or voice.

On physical examination, he was alert and conscious. His airways was patent and breathing was normal. His vital sign shows mild systolic hypertension (145/85mmHg), slight tachycardia (99bpm), mild tachypneic (20bpm), afebrile and optimum oxygen saturation. The other systemic reviews were normal. His weight is 96kg and height is 172cm.

Further examination, on right upper limb examination, there were present of mixed superficial and deep dermal burn over the right arm, immediate and delayed blanching with TBSA of 2%. On left upper limb examination, there were present of mixed superficial and deep dermal burn over the left arm, immediate and delayed blanching with TBSA of 1%. On right lower limb examination, there were present of mixed superficial and deep dermal burn over anterior and posterior of right thigh and leg, immediate and delayed blanching with TBSA of 10%. On left lower limb examination, there were present of mixed superficial and deep dermal burn over anterior and posterior of left thigh and leg, immediate and delayed blanching with TBSA of 10%. On posterior trunk, there were present of mixed superficial and deep dermal burn, immediate and delayed blanching with TBSA of 10%. On bilateral buttock, there were present of mixed superficial and deep dermal burn, immediate and delayed blanching with TBSA of 4%. So the total body surface area was 37%. There were also bilateral eyebrow and nasal singing but oral examination was normal.

Initial management given during the transferred process was prepared IV access, start IV drip normal saline, monitor vital sign and dressing the burn area. At the emergency department, he was triaged to the red zone, vital signs monitoring was done and IV morphine 1g was given. IV drip normal saline was continued with 5040ml in the first 8 hours then continue another 5040ml for 16 hours (3ml/kg/hr) with strict monitoring of I/O chart.

2.2 Case report2

A 33 years old gentleman triaged to the red zone presented with alleged burn by flames while he was burning the trash sustained second degree burn. He was awake and alert with no loss of consciousness at the scene but sustained significant thermal injuries. It happened when he decided to pour some gasoline (petrol) into the burning pile, wanting to speed up the process and thus caught on fire. Immediately after that he removed his t-shirt and was put under cold

water for a bit, then covered the burned area with oyster sauce and soybean sauce. His family members brought him to the hospital themselves due to severe unresolved pain.

His airway was patent, normal breathing pattern, bilateral breath sounds and was given fluid resuscitation 2560ml in the first 8 hours and 320ml for the next 8 hours (4ml/kg/hr). He was also administered intravenous morphine for pain management.

Initial evaluation revealed that he was in hypertensive crisis (180/155), not tachypnea, not tachycardic, normal temperature, optimum oxygen saturation with readily apparent mixed partial injury over neck, chest, right flank and left upper limb and deep dermal to full thickness injury over right upper limb and minimal soot over the nose area. The total body surface area involved was 16%. Secondary survey and imaging revealed no further injuries.

2.3 Case report3

A 8 years old boy triaged to red zone presented with alleged flame burn injury on left leg and ankle. It happened while playing with cousin at 6pm in front of his house. The patient was trying to ignite fire using petrol when fire suddenly caught his trousers. He used water to stop the fire. His father brought him to the hospital themselves due to severe unresolved pain.

Initial evaluation revealed that he was not tachypneic, not tachycardic, normal temperature, optimum oxygen saturation with apparent superficial partial thickness injury over left leg involving the ankle joint and partially involving posterior aspect of knee joint with circumferential burn over 2/3 aspect of lower leg. Otherwise, the compartment was soft, capillary refilling time immediate and pink. The total body surface area involved was 5%. Secondary survey and imaging revealed no further injuries,

The management for this patient start with wound cleaning with copious saline, blister area was removed and exposed on IVD maintenance 52 cc/hr (15cc/hr + 15cc/hr+22cc/hr) HSD 5% (Sodium Chloride and Dextrose) given at emergency. Ascorbic acid and Paracetamol syrup also was given. He was referred to the burn ward for monitoring.

2.4 Case report4

A 31 years old lady triaged to red zone with complaint of alleged steam and scald burn injury. The incident happened when the patient was cooking using pressure cooker. The food just cooked for about 5 minutes, later she tried to open the lid of the pressure cooker but she couldn't as the lid was very tight. The lid suddenly opened up and the steam with hot water splashed onto her. The patient sustained burn wound over abdomen and lower limbs. Immediately, the patient removed her cloth and took bath with cold water in less than 10 minutes. The patient also has severe pain at the area of burn wound with pain score of 9/10.Then the patient was brought to Emergency Department within 40 minutes.

Initial evaluation revealed that she was in tachypneic (120bpm), normal temperature, optimum oxygen saturation level. Her airway was patent, with normal breathing, bilateral breath sounds was heard. IV fluid therapy was given and crystalloid infusion was initiated. Urine output was monitored. The patient was bathed with running water and the blisters was aspirated using clean needle. The wounds are washed with mild antiseptic solution and the left to air. On examination, the patient sustained mixed partial injury over her abdomen and bilateral thighs, and superficial partial thickness inj8ury over bilateral leg with overall TBSA of 11.5 %.

The patient was given capsules of Tramadol 50mg, Paracetamol 1g, Maxolon 10mg and ascorbic acid 500mg for pain relief. The patient was started on Parkland regime with rate of

389.5 mls/hr. Then bactigrass gel dressing was provided. Tetanus immunization was given. Then the patient was referred to burn ward and to occupational therapy.

2.5 Case report5

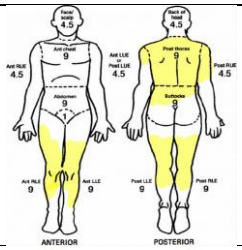
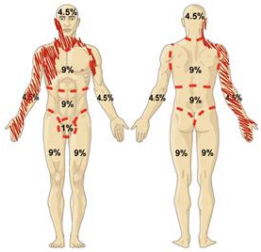
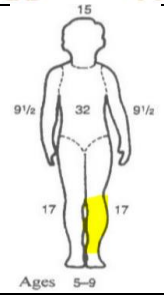
A 11 years old boy referred case from health clinics presented to yellow zone with burn injury over face area and left ear post alleged firecracker injury 2 hours prior to admission. He was playing by himself when he put the firecracker into a plastic bottle which contained remnant petrol. He burned the firecracker then suddenly it exploded in front of his face and he sustained burns involving his left face, left eyebrows, left ear and left hand. Post trauma, he washed his face with tap water for less than 5 minutes. Otherwise, he denied shortness of breath, noisy breathing, eye pain or redness, blurring of vision, stridor or hoarseness or voice.

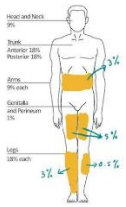
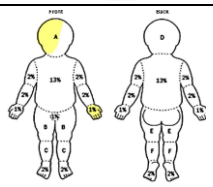
On physical examination, he was alert and conscious. His airway was patent with normal breathing. His vital sign was normal as he was not tachypneic, not tachycardia, afebrile with optimum oxygen under room air. There are presents of superficial burn with evidence of redness over 2/3 of his face more on the left side, left pinna and left palm but no blister. There were also present of singed nasal hair, left eyebrow and left frontal hair. Otherwise, other systemic review was normal.

The patient was managed by closed monitoring of vital sign and wound dressing. Tablet paracetamol 500mg was given. Further examination by otorhinolaryngologist shows no evidence of airway involvement. So he was retriaged to green zone due to no evidence of inhalation injury. Then was admitted to the ward for further management and monitor for respiratory distress.

3. Results and analysis

Table 1. *Results of Cases, Management and Challenges of Burn Injuries*

No.	Case	Total Body Surface Area (TBSA)	Fluid Resuscitation	Management Challenges	Overcome Challenges
1.	32-year-old gentleman presented to red zone with third degree burn (TBSA 37%).		IVD normal saline 5040ml in the first 8 hours then continue another 5040ml for 16 hours. (3ml/kg/hr)	Third degree burn Long transport time needed	Must give good initial treatment.
2.	33 y/o Male presented to red zone presented with second degree burn. (TBSA 16%)		Fluid resuscitation by started park regime was 2560ml in the first 8 hours and 320ml for the next 8 hours (4ml/kg/hr).	Use of home remedies (oyster sauce and soybean sauce)	Education on burn injury first aid among community.
3.	8 years old boy presented to red zone with second degree burn (TBSA 5%)		IVD maintenance 52 cc/hr HSD5%	Patient was not cooperative during management	Proper pain management

4.	31 years old lady presented to red zone with second degree burn (TBSA 11.5%)		Parkland regime with rate of 389.5 mls/hr.	Delayed first aid	Raise awareness about knowledge of first aid in burn injury among the public.
5.	11-year-old boy presented to yellow zone with second degree burn (TBSA 4%).		No fluid resuscitation	Possible inhalation injury	Referred to ENT

4. Discussion

In case report 1, the patient came with major burns 5 hour prior to admission, Multiple study conducted shows varies mean transfer time which result in delayed hospital admission and few factors contribute to it such as time-consuming pre-hospital treatment, long distances, and lack of an efficient transport method. A long transfer time increase the risk of renal dysfunction, wound sepsis, bacteraemia, longer duration of wound healing, pneumonia, increased presence of resistant organisms, and increase number of ventilation days. These can result in a longer length of stay and an increased mortality, compared to patients without delayed transfer (Schiefer et al., 2016).

By optimizing pre-hospital care significant differences can be made to the mortality and morbidity from burns injuries. Firstly, secure airway by endotracheal tube (ETT) in suspected inhalation injury as airway compromise will only be adequately treated by ETT placement. Secondly, oxygen therapy as an initial treatment are recommended to all patient with major trauma including burn associated with smoke inhalation symptom. Thirdly, secured the IV access for fluid resuscitation and drug administration. Forth, assessed the burn severity based on estimated TBSA as it can influence the next management based on minor burn (<20%) or major burn (>20%), with regard to the necessity of fluid resuscitation and the triage to a burns facility or center. Fifth, wound care which included burn cooling optimally for 20 minutes and wound dressing to aid with wound hygiene. Sixth, fluid resuscitation in pre-hospital settings by using a threshold method in which required an estimation of TBSA, age and weight only. Sixth, pain management must be given adequately based on patient's pain score (Battaloglu et al., 2019).

Based on case 2, burns are potentially devastating injuries with a substantial range of consequences, including physical, functional, and occupational harm, as well as cosmetic and psychosocial damage. Proper burn first aid knowledge reduces the overall impact of the injury. Preventive measures and burn first aid have been proven to reduce morbidity and mortality from burns (Parbhoo et al., 2010). Studies have shown that certain first aid measures have a beneficial impact on reducing morbidity-related healthcare costs, through limiting tissue damage, leading to a decrease in the need for surgical intervention (Skinner et al., 2004). Stopping the burn process, immediately applying cold tap water for 20 minutes, removing clothing and jewelry, and covering the wound with a clean bandage would all help to improve the outcome of burns. Cold water, which has been proven to aid healing and final cosmetic results, should be between 2 and 15 degrees Celsius and applied immediately for the same amount of time. Based on animal histological section studies, there will still be some positive benefit if water is applied somewhat later or for less than 20 minutes, but the analgesic

advantage of immediate administration will be lost (Cuttle et al., 2008).

However, serious complication may result from improper practice of burn first aid. A common mistake such as the use of eggs, toothpaste, mud, and other traditional remedies that are damaging, exacerbating the injury, and creating a more favorable environment for infection, and at best, these remedies are of no benefit (Cuttle et al., 2008) for example, ice is a common measure used by victims and first responders; ice increases the risk of hypothermia especially in larger surface area burns (Cuttle et al., 2009).

The use of different remedies in the fact that such wounds are painful if exposed and with the improper knowledge about correct and clear first aid measures such application provides a temporary relief. In which they do no harm but are of no benefit either. For other remedies, deleterious effects might occur. For example, an incident of an anaphylactic reaction after the application of eggs to a burn wound was reported in the USA in an immigrant African family that was luckily treated successfully (Hansen & Mecham, 2006).

According to a study in Saudi Arabia, honey was chosen as a remedy to treat burns by 69.9 %, toothpaste was chosen by 53.7 %, while myrrh (*Commiphora myrrha*) was chosen by 9.4 % of respondents. Most of these respondents were females, from younger age group (19–25 years), from central region, and university graduates (Kattan et al., 2016).

Suleiman (2014) conducted a cross-sectional study among the Saudi population to assess the level of awareness and safety of various herbal remedies and found that 91.1 percent of respondents did not seek expert (pharmacist, physician) advice before using them, while 66.2 percent relied on recommendations from friends or relatives. In addition, 81.2 % of respondents believed that the use of herbal remedies is harmless.

Based on case 3, a 8 years old Malay boy with underlying no known medical illness presented to ED for alleged flame burn injury sustained superficial partial thickness burn left leg with second degree burn and TBSA 5%. According to Nelson essentials of pediatrics, for severe burns care is best managed by a multidisciplinary team in a qualified burn center. The American Burn Association criteria for patients who should be transferred to a burn center are as follows: partial-thickness burns greater than 10% total body surface area (TBSA); partial and full-thickness burns involving the face, hands, feet, genitalia, perineum, or major joints; full-thickness burns in any age group; electrical burns (including lightning injury); chemical burns; inhalation injury; burn injury in patients with preexisting medical conditions that could complicate management, prolong recovery, or affect mortality; any burn with concomitant trauma in which the burn injury poses the greatest risk; burn injury in children admitted to hospitals without qualified personnel or equipment for pediatric care; burn injury in patients requiring special social, emotional, or rehabilitative support, including child abuse cases.

Initial treatment should follow the ABCs of resuscitation. Airway management should include assessment for the presence of airway or inhalation injury, with early intubation if such an injury is suspected. Smoke inhalation may be associated with carbon monoxide toxicity; 100% humidified oxygen should be given if hypoxia or inhalation is suspected.

The systemic capillary leak that occurs after a serious burn makes initial fluid and electrolyte support of a burned child crucial. The first priority is to support the circulating blood volume, which requires the administration of intravenous fluids to provide maintenance fluid and electrolyte requirements and to replace ongoing burn-related losses. Formulas exist to help guide fluid management; however, no formula accurately predicts the fluid needs of every burn

patient. Children with a significant burn should receive a rapid bolus of 20 mL/kg of lactated Ringer solution. Thereafter, the resuscitation formula for fluid therapy is determined by the percent of body surface burned. Total fluids are 2-4 mL/kg per percent burn per 24 hours, with half the estimated burn requirement administered during the first 8 hours. (If resuscitation is delayed, half of the fluid replacement should be completed by the end of the eighth hour post-injury.) Fluids should be titrated to achieve adequate perfusion, and one marker of which is urine output greater than 1 mL/kg per hour. Controversy exists over whether and when to administer colloid during fluid resuscitation, but colloid therapy may be needed for patients with extensive burns.

Because burn injury produces a hypermetabolic response, children with significant burns require immediate nutritional support. Enteral feeds should be started early unless there is a specific contraindication. Children with critical burn injury may require parenteral nutrition if unable to tolerate full enteral feeds. Consider supplementation of vitamins and trace elements. Other factors that may improve the hypermetabolic state include pain control, blood glucose control, and the use of medications including anabolic steroids such as oxandrolone and β blockers such as propranolol.

Wound care starts with cleaning and debriding the wound. Effective pain control is important to allow for complete debridement. Topical agents and dressings are then applied to control bacterial colonization, decrease evaporative losses, and aid in pain control. Various grafts, such as cadaver allografts, porcine xenografts, or skin substitutes, have been used initially to cover wounds. For full-thickness burns, skin autografting and skin substitutes are required for eventual closure (Marcdante & Kliegman, 2018; Kate, 2022).

Based on case report 4, Public's understanding and overall knowledge of first aid for burns play a crucial role in raising awareness regarding this topic in their community. After a minor burn injury, immediate first aid plays an important role in determining the outcome and level of subsequent morbidity, as well as in limiting tissue damage, including the need for surgery. Furthermore, management of burn injuries has the most significant effect on morbidity and mortality is in the first hour since its occurrence. Applying water (10–15°C) for 20–30 min as first aid for burns is considered the most appropriate step. According to a study conducted in Saudi Arabia, most burn injuries occur in the pediatric age group and at home. Scald injuries are the most common type of burn injuries, whereas injuries caused by flames rank second. Therefore, public should have awareness and knowledge about first aid that need to be done after burn injury as primary prevention is the best method to reduce the burden of this health issue in the community, as providing first aid for burns remains an important part of the management of burns, especially as it reduces complications.

Additionally, a study with similar results conducted among Australian healthcare workers was published, as they showed burn first aid overall knowledge among healthcare workers was very poor.

Despite the efforts of healthcare professionals to instruct the general public about the positive effects of applying water (10-15°C) for 20–30 min as preliminary control for acute burns,33.2% of the participants in our study answered "washing the burned area with cool water is the first correct step in case of burn injuries" incorrectly. Recent studies conducted in Saudi Arabia, China, Australia, and Cambodia reflected a similar situation wherein only 5.8%, 13.7%, 9%, and 13% of the study participants, respectively, had knowledge on how to apply water to the burn area. The level of the knowledge score was significantly different across different age groups, gender groups, nationalities, marital status groups, and job positions (P <

0.001). Participants with higher-level job positions were considered more aware, and this association could potentially be explained by the experience and knowledge gained with time. To conclude, education of the masses via multimedia and conducting formal training courses, are both imperative in raising awareness and knowledge regarding first aid in burn injury among public (Mortada et al., 2020).

In case report 5, the patient came with no symptom of inhalation injury but there is evidence of inhalation injury, so close monitoring must be done because paediatric inhalation injury has high morbidity and mortality rate especially if associated with burn injury. Early diagnosis and initial treatment must be given. Diagnosis of inhalation injury can be obtained by asking the mechanism of injury and on physical examination. Paediatric patient may come with respiratory distress due to inhalation injury and physical signs such as singed nasal hairs, smoke soot on face and nose, soot in oropharynx may indicate inhalation injury (Sen, 2017). But for this patient, he was admitted monitoring if he suddenly develops respiratory distress as inhalation injury cannot be rule out even though he had no symptoms of inhalation injury.

5. Conclusion

Burn management at emergency department must be individualized based on the manifestation of the burn in term of severity. The severity of burn can be evaluated based on mechanism of injury, depth of burn and total body surface are involved. An early intervention given start from home or incident site can significantly improve mortality and morbidity rate. Hence, first aid burn management should be thoroughly explored by all health physician and awareness should be raised among public.

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