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Research Article

Burn Classifications with Its Treatment and Parkland Formula Fluid Resuscitation for Burn Management: Perspectives

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Abstract:

Burns can be caused by flames, ultraviolet radiation, hot liquids, electricity, lightning and certain chemicals. All burns require immediate first aid treatment. Partial and full thickness burns require urgent medical attention. Full thickness burns often require skin graft surgery. Simple analgesics (such as ibuprofen and acetaminophen) and opioids such as morphine didn't used in 3rd degree burn because the burnt place is painless. The "Wallace Rule of Nines" is the most common method of determining body surface area. The most commonly used resuscitation formula is the Parkland formula which calculates the amount of fluid required in the first 24 hours.

Keywords: Burn; Classifications; Fluid resuscitation; Management; Parkland formula; Treatment

Introduction

Burn is an injury to the skin and deeper tissues caused by hot liquids, flames, radiant heat, and direct contact with hot solids, caustic chemicals, electricity, or electromagnetic (nuclear) radiation. Most burns are due to heat from hot liquids (called scalding), solids, or fire [1].

Classifications of burn

Burn injury is classified to determine its severity depending on the extent or depth of the body affected. There are four primary types of burns: 1st, 2nd, and 3rd -degree. Each degree is based on the severity of damage to the skin, with first-degree being the most minor and third-degree/ 4th degree being the most severe. The higher the degree, the more severe the burn is [2].

A first-degree (Superficial) burn is superficial and causes local inflammation of the skin. Sunburns often are categorized as first-degree burns. The inflammation is characterized by pain, redness, and a mild amount of swelling. The skin may be very tender to touch. Long-term damage is rare. Since this burn affects the top layer of skin, the signs and symptoms disappear once the skin cells shed. First-degree burns usually heal within 7 to 10 days without scarring [3].

Figure1. Superficial burns

Treatment of 1st degree burns are; immediately immerse the burn in cool tap water or apply cold, wet compresses; **cover the burn with a nonstick, sterile bandage; apply petroleum jelly two to three times daily;** do not apply ointments, toothpaste or butter to the burn, as these may cause an infection; taking over-the-counter pain medication (acetaminophen or ibuprofen) to relieve the pain and reduce inflammation [4];

Second-degree (superficial partial thickness/ deep partial thickness) burns are deeper and, in addition to the pain, redness and inflammation, blistering of the skin also occurs. 2nd degree burn have a superficial second-degree burn, only part of your dermis is damaged and perhaps probably won't have scarring [5]. A deep partial thickness burn is more severe. It may leave a scar or cause a permanent change in the color of your skin. Superficial partial-thickness burns usually less than 3 weeks. Deep partial-thickness burns usually more than 3 weeks [6].

Figure2. Superficial partial thickness and deep partial thickness burns

Treatment of 2nd degree burns are; running the skin under cool water for 15 minutes or longer; simple analgesics (such

as ibuprofen and acetaminophen) and opioids such as morphine.; applying antibiotic cream aloe vera cream to blisters; daily cleaning of the wound to remove dead skin or ointment; if possible add systemic usage of antibiotics [7];

Third-degree (Full thickness) burns involve damage to both the first and second skin layers, plus the underlying tissue. The burn site generally appears black or charred with white exposed fatty tissue. Very deep burns may damage the underlying muscle or bone. The nerve endings are generally destroyed and so there is little or no pain at the site of the full-thickness burn. However, surrounding partial thickness burns will be very painful. Excluding fourth-degree burns, third-degree burns are the most severe. Without surgery, these wounds heal with severe scarring and contracture. There is no set timeline for complete spontaneous healing for third-degree burns/ heal only at the edges by scarring without skin grafts. A skin graft is a very thin layer of skin that is cut from an unburned area and put on a badly burned area [8].

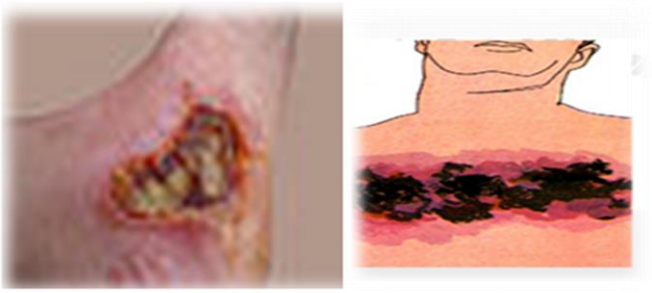

Figure3. Full thickness burns

Treatment of 3rd degree burns are; avoid further contact with smoke or heat, but do not remove the person's clothes and do not immerse the burn areas in cold water; conduct cardiopulmonary resuscitation if necessary; cover the affected area with a cool, moist cloth or bandage; simple analgesics (such as ibuprofen and acetaminophen) and opioids such as morphine didn't used in 3rd degree burn because the burnt place is painless [9].

Fourth-degree (Extension to deep tissues) burns. This is the deepest and most severe of burns. They're potentially life-threatening. These burns destroy all layers of your skin, as well as your bones, muscles, and tendons/ are deep and potentially life-threatening injuries that extend through the skin into underlying soft tissue and can involve muscle and/or bone [10].

Figure4 Extension to deep tissues burns

Treatment of 4th degree burns are; avoid further contact with smoke or heat, but do not remove the person's clothes and do not immerse the burn areas in cold water; conduct cardiopulmonary resuscitation if necessary; cover the affected area with a cool, moist cloth or bandage; simple analgesics (such as ibuprofen and acetaminophen) and opioids such as morphine didn't used in 3rd degree burn because the burnt place is painless [11].

A combination of the burn mechanism, burn depth, extent, and anatomic location determine the overall severity of the burn injury, which provides general guidance for the preferred disposition and care of these patients [12]. Minor or mild burn injury is those that can be treated in a physician's office or in an emergency department as an outpatient. Moderate burn injury would be those that require admission to a hospital but not to a burn center. These include superficial burns or deeper burns of limited extent. Severe burn injury can be defined as burns that should be referred to, and treated at, a designated burn center [13]. The treatment of burns depends on the depth, area and location of the burn [14].

Parkland formula fluid resuscitation burn management

Fluid losses from burn injury must be replaced to maintain homoeostasis. Burns covering more than 15% of TBSA in adults and more than 10% in children necessitate formal fluid resuscitation [15].

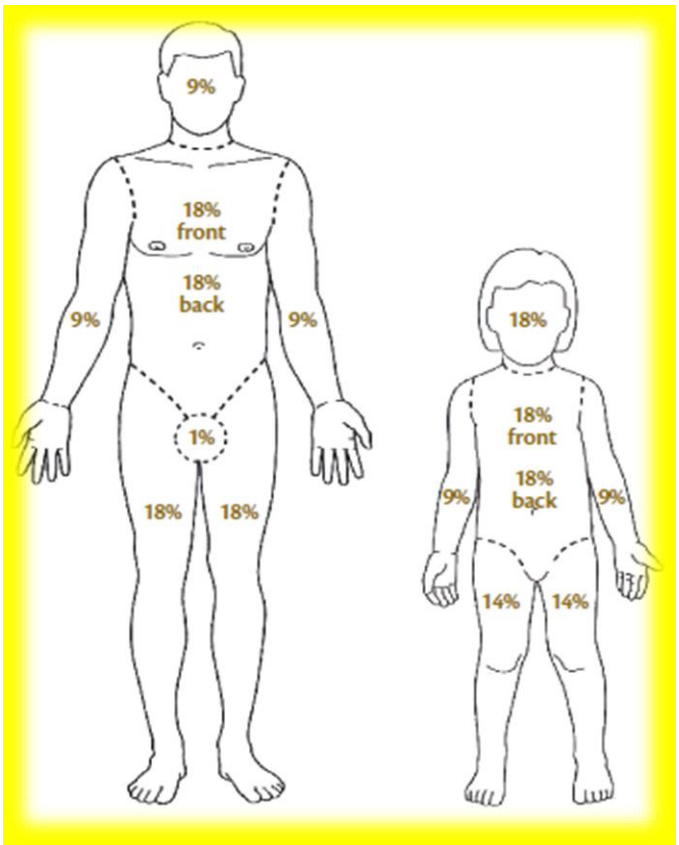

Figure5. Burn percentage in adults and pediatrics; rule of nines

Burns are measured as a percentage of total body area affected. The "rule of nines" is often used, adjusted for adults, infants and children [16]. The burn percentage in adults and perdiatrics ; rule of nines; which illustrated in figure 5 also estimated in table 1 and table 2 in turn below.

Table1. Estimation of body surface area for adults

Body region (Adults)	Percentage
Head and neck	9 %
Anterior trunk	18 %
Posterior trunk	18 %
Right and left arm	18 %
Front and back stomach	18%
Palm	1%
Upper/mid/low back and buttocks	18%
Right and left leg	36 %
Perineum	1 %

Table2. Estimation of body surface area for paediatrics

Body region (infants)	Percentage
Head and neck	18 %
Anterior trunk	18 %
Posterior trunk	18 %
Each arm	18 %
Palm + Fingers	1%
Each leg	28 %

Only second- and third-degree burn areas are added together to measure total body burn area. While first-degree burns are painful, the skin integrity is intact and it is able to do its job with fluid and temperature maintenance [17]. The most commonly used resuscitation formula is the Parkland formula which calculates the amount of fluid required in the first 24 hours. Colloids have no advantage over crystalloids in maintaining circulatory volume; IV fluids are given to patients in shock or with burns > 10% TBSA. A 14- to 16-gauge venous cannula is placed in 1 or 2 peripheral veins through unburned skin if possible. Venous cutdown, which has a high risk of infection, is avoided. Lactated Ringers is the preferred choice of crystalloid solution, as it effectively treats both hypovolemia and extracellular sodium deficits caused by burn injury, and it is isotonic, inexpensive, readily available, and easily stored. Also, large volumes of normal saline solution can lead to hyperchloremic acidosis [18]. The Parkland formula for burns calculates fluid requirements for burn patients in a 24-hour period. Total fluid requirement in 24 hours = 4ml x BSA(%) x body weight (kg), 50% given in first 8 hours; 50% given in next 16 hours/4 mL/kg/%TBSA (3mL / 2mL/kg/%TBSA in children) = total amount of crystalloid fluid during first 24 hours [19].

Certain instances of the Parkland formula for burn resuscitation calculation;

1. A 43 year old male victim admitted to the burn center has superficial burns on the anterior head and neck, back of left leg, and anterior trunk. The weight of the victim was 165 Ibs. By using parkland burn resuscitation formula calculate the overall quantum of lactated ringers that will be bestowed over the next 24 hours?

Step1) Calculate total body surface area; anterior head and neck (4.5%), back of left leg (9%), anterior trunk (18%), TBSA=4.5%+9%+18%=31.5%

Step2) Convert pound to kilogram; 1 kg = 2.2 lbs; 165 Ibs/2.2 Ibs=75 Kg

Step3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg);

But in the 1st degree (superficial) burn fluid resuscitation was not required because 1st degree burn are painful, the skin integrity is intact and it is able to do its job with fluid and temperature maintenance and the burns that are only red in color and are not blistering are not included parkland burn resuscitation calculation.

2. A 50 year old male victim admitted to the burn center has superficial partial thickness burns on the posterior trunk, back of left arm, front and back of right leg, front of left leg, and

perineum. The weight of victim was 150 pound. By using parkland burn resuscitation formula calculate the flow rate during the 1st 8 hours (ml/hour)?

Step) Calculate total body surface area; posterior trunk (18%), back of left arm (4.5%), front and back of right leg (18%), front of left leg (9%), perineum (1%), TBSA= 18%+4.5%+18%+9%+1%=50.5%

Step2) Convert pound to kilogram; 1 kg = 2.2 lbs; 150 Ibs/2.2 Ibs=68 Kg

Step3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg);TFQ in 24 hrs= 4ml*50.5%*68kg=13736ml. Note during the 1st 8 hours half of the solution is infused, which will be 13736ml/2=6868 ml; hourly rate during the 1st 8 hours flow rate=6868ml/8hours=859ml/hour.

3. A 25 year old female causality admitted to the burn center has deep partial thickness burns on the front of left leg, posterior head and neck, back of left arm, anterior trunk, back and front of left leg, perineum and palm. The weight of victim was 110 pound. By using parkland burn resuscitation formula calculate the overall quantum of lactated ringers that will be bestowed over the next 24 hours?

Step) Calculate total body surface area; front of left leg (9%), posterior head and neck (4.5%), back of left arm (4.5%), anterior trunk (18%), back and front of left leg (18%), perineum (1%), and palm (1%). TBSA= (9%+4.5%+4.5%+18%+18%+1%+1%=56%

Step2) Convert pound to kilogram; 1 kg = 2.2 lbs; 110 Ibs/2.2 Ibs=50 Kg

Step3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg); TFQ in 24 hrs= 4ml*56%*50kg=11200ml.

4. A 61 year old female causality admitted to the burn center has full thickness burns on anterior and posterior trunk, front of head and neck, back of left arm, front and back of right arm, back of right leg. The weight of victim was 90 pound. By using parkland burn resuscitation formula; the nurse has already infused fluids during the 1st 8 hours. Recently what will nurse set the flow rate during the next 16 hours (ml/hr)?

Step) Calculate total body surface area; anterior and posterior trunk (36%), front of head and neck (9%), back of left arm (4.5%), front and back of right arm (18%), back of right leg (9%), TBSA= 36%+9%+4.5%+18%+9%=76.5%

Step2) Convert pound to kilogram; 1 kg = 2.2 lbs; 90 Ibs/2.2 Ibs=41 Kg

Step3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg);TFQ in 24 hrs= 4ml*76.5%*41kg=12546ml. Note nurse already infused fluids during the 1st 8 hours, which will be 12546ml/2=6273 ml; so solely 6273 is remain and it necessitated to be infused over 16 hours. hourly rate during the next 16 hours flow rate=6273ml/16hours=392ml/hour.

5. The 11 months old year male infant admitted to burn center with full thickness burns on posterior left leg, anterior right arm, posterior head and neck, front and back of the trunk. The weight of the causality was 35 Ibs. By using parkland burn resuscitation formula calculate the overall quantum of lactated ringers that will be bestowed over the next 24 hours?

Step1) Calculate total body surface area; posterior left leg (7%), anterior right arm (4.5%), posterior head and neck (9%), front and back of the trunk (36%), TBSA=7%+4.5%+9%+36%=56.5%

Step2) Convert pound to kilogram; 1 kg = 2.2 lbs; 35 Ibs/2.2 Ibs=16 Kg

Step3) Calculate total fluid requirement in 24 hours; = 2ml x BSA (%) x body weight (kg); TFR= 2ml*56.5%*16kg=1808ml

6. A 2 year old female toddlers admitted to burn center with deep partial thickness burns on anterior left leg, posterior right arm, anterior head and neck, posterior trunk, perineum, and palm. The weight of causality was 46 pound. By using parkland burn resuscitation formula; the nurse has already infused fluids during the 1st 8 hours. Currently what will nurse set the flow rate during the next 16 hours (ml/hr)?

Step1) Calculate total body surface area; anterior left leg (7%), posterior right arm (4.5%), anterior head and neck (9%), posterior trunk (18%), perineum (1%), and palm (1%), TBSA= 7%+4.5%+9%+18%+1%+1%=40.5%

Step2) Convert pound to kilogram; 1 kg = 2.2 lbs; 46 Ibs/2.2 Ibs=21 Kg

Step3) Calculate total fluid requirement in 24 hours; = 2ml x BSA (%) x body weight (kg); TFQ in 24 hrs= 2ml*40.5%*21kg=1701ml. Note nurse already infused fluids during the 1st 8 hours, which will be 1701ml/2=851 ml; so solely 851 is remain and it necessitated to be infused over 16 hours. hourly rate during the next 16 hours flow rate=851ml/16hours=53ml/hour.

7. A 51 year old female causality admitted to the burn center has full thickness burns on posterior and anterior trunk, back of head and neck, front of left arm, front and back of right arm, front of right leg, and perineum. The weight of victim was 190 pound and the drops per mL are 20. By using parkland burn resuscitation formula; the nurse has already infused fluids during the 1st 8 hours. Recently what will nurse set the flow rate during the next 16 hours (ml/hr) and calculate the drip rates in minutes?

Step) Calculate total body surface area; posterior and anterior trunk (36%), back of head and neck (9%), front of left arm (4.5%), front and back of right arm (18%), front of right leg (9%), perineum (1%),TBSA= 36%+9%+4.5%+18%+9%+1%=77.5%

Step2) Convert pound to kilogram; 1 kg = 2.2 lbs; `190 Ibs/2.2 Ibs=83 Kg

Step3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg); TFQ in 24 hrs= 4ml*77.5%*83kg=25730ml. Note nurse already infused fluids during the 1st 8 hours, which will be 25730ml/2=12865 ml; so solely 12865 is remain and it necessitated to be infused over 16 hours. hourly rate during the next 16 hours flow rate=12865ml/16hours=804ml/hour.

Step4) Calculate the drip rates in minutes; Drip rate = volume of solution (mL) × (drops/mL)/time (minutes); Drip

rates=12865 ml*20 drops/ml/16 hours (960 minutes) =268 drops/minutes

8. A 6 years old male toddlers admitted to burn center with deep partial thickness burns on posterior left leg, anterior right arm, posterior head and neck, anterior trunk, and palm. The weight of causality was 51 pound and the drops per mL are 15. By using parkland burn resuscitation formula; the nurse has already infused fluids during the 1st 8 hours. Currently what will nurse set the flow rate during the next 16 hours (ml/hr) and calculate the drip rates in seconds?

Step1) Calculate total body surface area; posterior left leg (7%), anterior right arm (4.5%), posterior head and neck (9%), anterior trunk (18%), and palm (1%), TBSA= 7%+4.5%+9%+18%+1%=39.5%

Step2) Convert pound to kilogram; 1 kg = 2.2 lbs; 51 Ibs/2.2 Ibs=23 Kg

Step3) Calculate total fluid requirement in 24 hours; = 2ml x BSA (%) x body weight (kg); TFQ in 24 hrs= 2ml*39.5%*23kg=1817ml. Note nurse already infused fluids during the 1st 8 hours, which will be 1817ml/2=909 ml; so solely 909ml is remain and it necessitated to be infused over 16 hours. hourly rate during the next 16 hours flow rate=909ml/16hours=57ml/hour.

Step4) Calculate drip rates in seconds; Drip rate = volume of solution (mL) × (drops/mL)/time (seconds); Drip rates=909 ml*15 drops/ml/16 hours or (57600 seconds) =0.235 drops/seconds

Conclusion

Burns are injuries of skin or other tissue caused by thermal, radiation, chemical, or electrical contact. First-degree burns are superficial with red skin, pain, and no blistering. Second-degree burns involve destruction of the second layer of skin, causing blistering, swelling, and pain. Third-degree burns involve destruction of all layers of the skin, including fat, muscle. The "Wallace Rule of Nines" is the most common method of determining BSA. In the adult formulation, the head is 9%, each circumferential upper extremity is 9%, each circumferential lower extremity is 18%, the anterior trunk is 18%, the posterior trunk is 18%, and the perineum is 1%. The formula recommends 4 milliliters per kilogram of body weight in adults (3 or 2 milliliters per kilogram in children) per percentage burn of total body surface area (%TBSA) of crystalloid solution over the first 24 hours of care.

Abbreviations

Ibs: Pounds; KG: Kilogram; ml: Milliliter: NSAIDs: Non-steroidal anti-inflammatory drugs; TBSA: Total body surface area; TFQ: Total fluid requirement;

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