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Burn Calculations: Parkland Formula Fluid Resuscitation for Burn Management

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Abstract

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. Parkland Formula calculated as 4 millilitre/kilogram/% total body surface area (BSA) (2 millilitre/kilogram/% total body surface area in children) = total amount of crystalloid fluid during first 24 hours. The 24-hour formula is: fluids for 24 hours = 4 × kilogram × % burn (second & third added together) with first 50% of that total in the first 8 hours and the second 50% over the following 16 hours.

Keywords: Burn; Calculations; Fluid resuscitation; Parkland formula

Introduction

Burns are tissue damage that results from heat, overexposure to the sun or other radiation, or chemical or electrical contact. The Parkland formula for burns calculates fluid requirements for burn patients in a 24-hour period [1]. The formula is shown below in table 1.

Total fluid requirement in 24 hours = 4ml x Body surface area (%) x body weight (kg)	50% given in first 8 hours; 50% given in next 16 hours/4 mL/kg/% total body surface area (3mL / 2mL/kg/%TBSA in children) = total amount of crystalloid fluid during first 24 hours.

Table 1: Parkland Formula

The "Wallace Rule of Nines" is the most common method of determining body surface area [2]. Rules of nines of adults and pediatrics summarized beneath in the figures.

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 %

Figure 1: Estimation of body surface area for adults

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

Figure 2: Estimation of body surface area for paediatrics

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Flow rate signifies the volume of fluid per unit time flowing past a point through the area. Drip rates delineated as the rate of application of liquid medicines required to furnish a certain dosage per minute [3]. The formula is shown below:

Drip rate = volume of solution (mL) × drops/mL/time (seconds)

The volume of solution (mL) is the amount of solution to be administered. A drop per mL is the calibrated amount of the administration set usually indicated on the packaging. Time (seconds) is the amount of time that the fluids are to be administered [4].

Certain instances of parkland formula for burns resuscitation calculation are jot down beneath:

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

Step 1) Calculate total body surface area; anterior head and neck (4.5%), back of left leg (9%), anterior trunk (18%), total body surface area (TBSA)=4.5%+9%+18%=31.5%

Step 2) Convert pound to kilogram; 1 kg = 2.2 lbs; 165 Ibs/2.2 Ibs=75 kilogram (Kg)

Step 3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg);

2. But in the 1st degree (superficial) burn fluid resuscitation was not required because 1st degree burn is 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 colour and are not blistering are not included parkland burn resuscitation calculation.

3. A 50-year-old male victim 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 pounds. By using parkland burn resuscitation formula calculate the flow rate during the 1st 8 hours (ml/hour)?

Step 1) 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%

Step 2) Convert pound to kilogram; 1 kg = 2.2 lbs; 150 Ibs/2.2 Ibs=68 Kg

Step 3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg); total fluid requirements (TFR) 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.

4. A 25-year-old female causality 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 pounds. By using parkland burn resuscitation formula calculate the overall quantum of lactated ringers that will be bestowed over the next 24 hours?

Step 1) 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%

Step 2) Convert pound to kilogram; 1 kg = 2.2 lbs; 110 Ibs/2.2 Ibs=50 Kg

Step 3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg); TFQ in 24 hrs= 4ml*56%*50kg=11200ml.

5. A 61-year-old female causality 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 pounds. 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)?

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Step 1) 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%

Step 2) Convert pound to kilogram; 1 kg = 2.2 lbs; 90 Ibs/2.2 Ibs=41 Kg

Step 3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg); TFR 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.

6. 11 months old year male infants 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?

Step 1) 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%

Step 2) Convert pound to kilogram; 1 kg = 2.2 lbs; 35 Ibs/2.2 Ibs=16 Kg

Step 3) Calculate total fluid requirement in 24 hours; = 2ml x BSA (%) x body weight (kg); TFR= 2ml*56.5%*16kg=1808ml

7. 2 years 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 pounds. 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)?

Step 1) 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%

Step 2) Convert pound to kilogram; 1 kg = 2.2 lbs; 46 Ibs/2.2 Ibs=21 Kg

Step 3) Calculate total fluid requirement in 24 hours; = 2ml x BSA (%) x body weight (kg); TFR 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.

8. A 51-year-old female causality 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 1) 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%

Step 2) Convert pound to kilogram; 1 kg = 2.2 lbs; `190 Ibs/2.2 Ibs=83 Kg

Step 3) Calculate total fluid requirement in 24 hours; = 4ml x BSA (%) x body weight (kg); TFR 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.

Step 4) Calculate the drip rates in minutes; Drip rate = volume of solution (mL) × (drops/mL)/time (minutes);

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

9. 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?

Step 1) 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%

Step 2) Convert pound to kilogram; 1 kg = 2.2 lbs; 51 Ibs/2.2 Ibs=23 Kg

Step 3) Calculate total fluid requirement in 24 hours; = 2ml x BSA (%) x body weight (kg); TFR 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.

Step 4) 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

A burn is an injury to the skin resulting from direct contact or exposure from extreme heat or cold, friction, electricity, or chemicals. The "Wallace Rule of Nines" is the most common method of determining body surface area. The Parkland formula estimates the fluid requirements for critical burn patients in the first 24 hours after injury using the patient's body weight and the percent of total body surface area that is affected by thermal burns. 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 (% total body surface area) of crystalloid solution over the first 24 hours of care.

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Data Sources: Sources searched include Google Scholar, Research Gate, PubMed, NCBI, NDSS, PMID, PMCID, and Cochrane database. Search terms included: parkland burn fluid resuscitation calculations.

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