Adult Burns Fluid Resuscitation

Full Title of Guideline and ID Number:	**GUIDELINES ON FLUID RESUSCITATION IN ADULT BURN INJURIES - NUH Burn Resuscitation Regimen (3013)**
Author ***(include email and role):***	Mr C. O' Boyle Consultant Burns Surgeon Dr A Fletcher Consultant Anaesthetist Mary Kennedy Lead Nurse
Guideline ID:	3013
Division & Speciality:	Cancer and Associated Specialities Adult Burns Service
Scope ***(Target audience, state if Trust wide):***	All staff working in the adult burns service, emergency department and critical care.
Review date ***(when this version goes out of date):***	30th September 2024
Explicit definition of patient group to which it applies ***(e.g. inclusion and exclusion criteria, diagnosis):***	Adult Burn Injured patients with a burn injury requiring fluid resuscitation.
Changes from previous version ***(not applicable if this is a new guideline, enter below if extensive):***	Audit section added
Summary of evidence base from which this guideline has been created:	• Published peer-reviewed journal articles • Recommended best practise based on the clinical experience of the guideline developer
This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after the review date or outside of the Trust.	

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Background

Burn injury causes a marked systemic inflammatory response, with changes in blood vessel permeability and resulting fluid shifts. This may give rise to substantial fluid losses from the intravascular to extravascular tissue spaces, producing a relative hypovolaemia (so-called "burn shock"), which was a major cause of acute burn-related deaths in the past. Adequate fluid replacement (sodium, chloride & water) and resuscitation improves survival from burn injuries[1, 2]. Most centres in the developed world now advocate fluid resuscitation in adults, for burns of 15% total body surface area (%TBSA), or greater[3]. Infusion volumes are calculated using a formula. Care must be taken to ensure that burn size estimates are as accurate as possible and correctly recorded, as this will affect resuscitation fluid volumes administered.

Peripheral Hospital Referrals

Of paramount importance in cases referred to the Burns Service, is an estimation of the burn size. In acute referrals, initial burn size estimation is difficult and may be inaccurate. Re-evaluation will be required, upon admission. This should not delay commencement of fluid resuscitation.

The patient should be reviewed by the senior clinician at the referring Emergency Department (ED). The receiving Burns Service must ensure that, in making the initial burn size estimate, the referring ED clinician has:

- Used a Lund and Browder Chart[4] or accepted general rules for burn size estimation[3] and has *not* counted areas of simple erythema (i.e.: areas of red skin, with no blistering) in the burn size estimate.

If there is doubt about the actual burn size in a patient with multiple co-morbidities (EDs tend to over-estimate, rather than under-estimate burn size), it is safer to commence fluid resuscitation on a presumed burn size and await further review at the referring hospital, by the Emergency Department consultant, or ITU consultant and a more definitive burn size assessment. Then appropriate alteration of IV infusion rate, before transferring to the Burns Unit.

In young, generally well patients and in patients who are referred from nearby Emergency Departments, commence fluid resuscitation and transfer, then accurately re-assess and record burn size in the Burns Unit and alter infusion rates as required.

Worldwide, considerable differences are apparent in the choice of burns resuscitation fluids [5-8]. The most widely used fluid regime is the crystalloid-based Parkland Memorial Hospital formula[1]. However, many burn care services use colloid-based regimens, or mixtures of crystalloid and colloid (as used at NUH[9]).

Most UK EDs are familiar with the Parkland crystalloid resuscitation formula and will have the appropriate fluid (Compound Ringer's Lactate, Hartmann's solution, or Plasmalyte) readily available.

NUH burn service recommends the use of crystalloid resuscitation (Parkland formula) in the first 8 hours following injury. After 8 hours, with the patient admitted to the Burns Unit, the fluid will be changed to the colloid component of the NUH Adult Burns Resuscitation[10] formula.

Starting the Infusion

An intravenous cannula is sited in unburnt skin, in a reliable position. This site is protected from movement that could damage the cannula, or impair the infusion. All patients receiving fluid resuscitation require placement of a urinary catheter with an hourly urometer. It is not acceptable for patients receiving intravenous fluid resuscitation to be without a means of accurately measuring urine output. Alternative methods of urine output monitoring are less accurate than hourly urometry measurements[3].

NUH Adult Burns Resuscitation Regimen

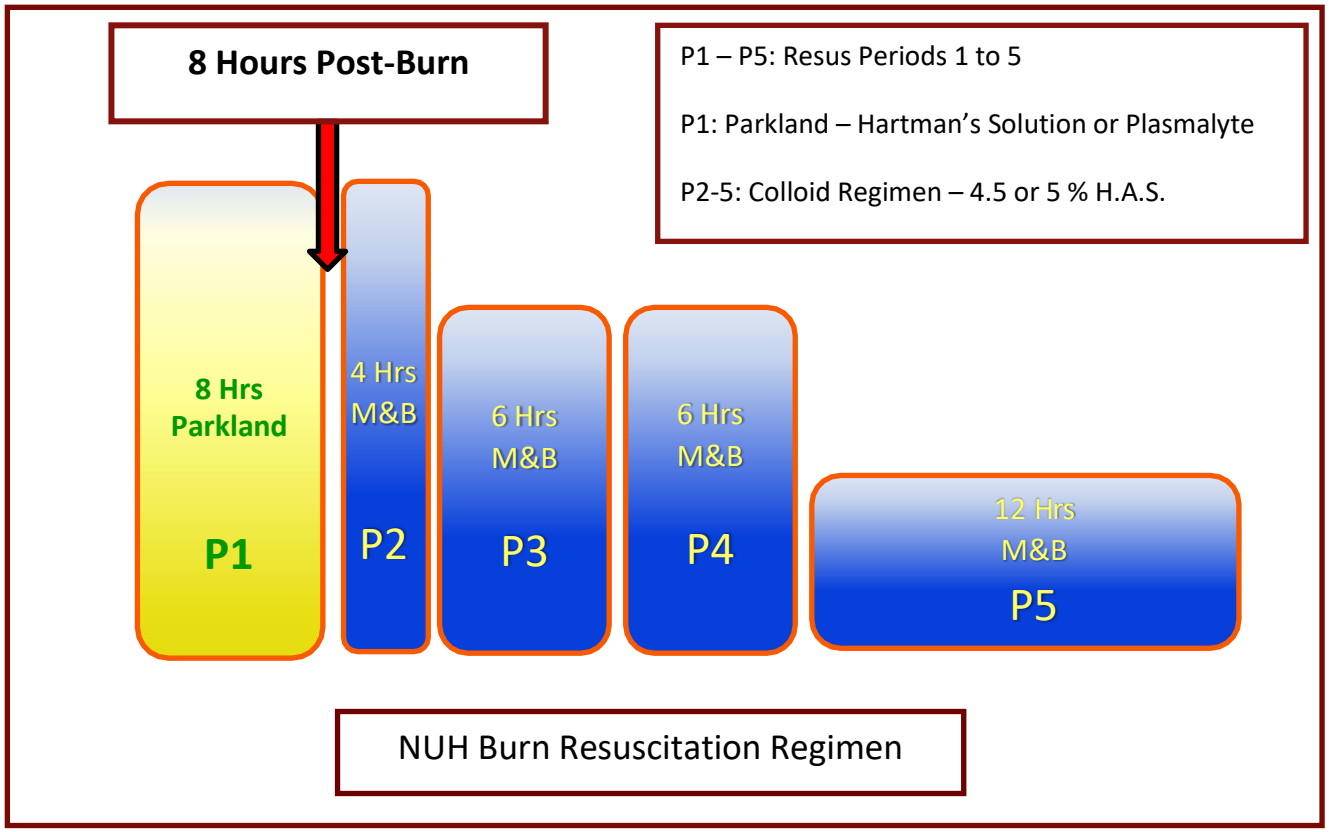
Initially following burn injury, use Compound Ringer's Lactate (Hartman's Solution), or Plasmalyte, until the end of Resuscitation Period 1, at eight hours post-burn. It is vital to recognise that **Resuscitation Period 1 commences at the time of the burn, *not* at the time of presentation in hospital**. Therefore, calculations of fluid volumes in the ED will nearly always involve delivery of the full Period 1 fluid volume in less than eight hours, as patients will present a certain amount of time after injury.

Achieving satisfactory Resuscitation despite differences in Fluid Regimes from Referring Hospitals

There is strong evidence that no particular fluid regime confers a survival benefit in burns or critical care [8-10]. Given the wide adoption of the Parkland formula, NUH Burns Service recognises that attempts to introduce a different formula, using different fluid, across the referral catchment would involve great difficulty and could introduce unnecessary risks to patients. There is substantial evidence demonstrating the safety of combined crystalloid and colloid formulae in burns resuscitation [6-13]. Consequently, NUH Burns Service advises the following:

- Adults requiring fluid resuscitation are accepted using resuscitation according to the Parkland formula, initially.
- At eight hours post-burn, patients are converted to the Colloid regimen formula[10], commencing the third of its four-hour periods, as if the patient had been on this formula from the time of their burn injury.

Resuscitation Summary



Resuscitation Formulae

First 8 hours (Period 1) Post Burn- from Referring ED to Burns Ward *Follow Parkland regimen*:

This formula uses Compound Ringers Lactate (Hartman's), or Plasmalyte Solution. The formula is:

2- 3mls x Patient weight (kg) x %TBSA = Volume (in ml) infused (24hours)

Half the calculated volume and first half given over 8 hours

First 8 hours (Period 1) Post Burn

Example:

A 75kg patient with 35% burns, no airway injury, in ED 2 hours post-burn.

35 x 75 x 3 = 7875; Divided by 2 = 3938, over 6 hours (as delayed 2 hours)

= 656ml/hr for 6hrs

Calculation of the fluid requirements commences at the **time of the burn,** not from time of presentation. If a patient has fluid resuscitation delayed for a period > 4hr, review fluid administration requirements / calculation with a senior colleague.

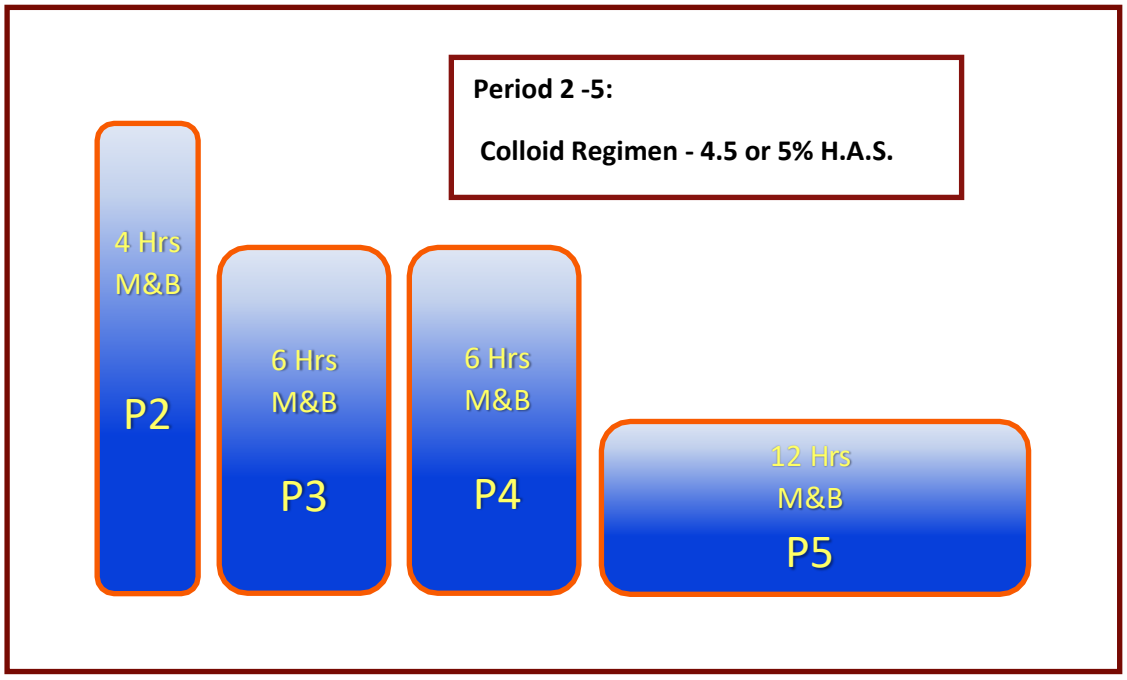
The elderly / frail and patients with cardiac / renal disease or comorbidities should be monitored closely as fluid overload is easily caused. Patients may be resuscitated at the lower end of the formula range. If any concerns each case should be discussed with the relevant burns consultant.

Hour 9 – 36 Post-Burn (P2 – P5) - In NUH Burns Unit or ITU: *Follow Colloid regimen*

Use 4.5 or 5 % Human Albumin Solution. Calculate the infusion volume for each period by:

$$\frac{\%TBSA \times Patient\ weight\ (kg)}{2} = Volume\ (in\ ml)\ given\ in\ each\ time\ period$$

Period 2 (8 – 12 hours *post* burn):	Volume infused over 4 hours
Period 3 & 4 (13–18 & 19–24 hours *post* burn):	Volume infused over 6 hours each
Period 5 (25-36 hours *post* burn):	Volume infused over 12 hours



Example:

The same 75kg patient: 35% burns, no airway injury, in Burns Unit, 8 hours post-burn. What is the fluid requirement for the next 28 hours?

Period requirement from Formula (above): 35 x 75 / 2 = 1312.5ml per period

P2: 1312.5ml per period = 328ml of 4.5 or 5 % Albumin per hour (1312.5 / 4)

P3: 1312.5ml per period = 219ml of 4.5 or 5% Albumin per hour (1312.5 / 6)

P4: 1312.5ml per period = 219ml of 4.5 or 5 % Albumin per hour (1312.5 / 6)

P5: 1312.5ml per period = 109ml of 4.5 or 5 % Albumin per hour (1312.5 / 12)

HAS fluid infusion rate needs to be changed at the ends of Resuscitation Periods.

At the end of a period, if the assessment shows that the patient's clinical condition is stable; the transfusion is continued according to the formula. If there is any clinical evidence of under- or over-transfusion then the plasma rations for the next and following periods are altered accordingly, following discussion with senior burns staff (consultant or registrar).

Patients who are unstable, despite Burns Resuscitation Fluids

Occasionally, a patient may be haemodynamically unstable, with tachycardia or reduced blood pressure, despite the use of correctly calculated resuscitation fluid volumes. Each case should be discussed with the relevant burns consultant. If there is a strong suspicion that the burn size may have been under-estimated, in these cases, it may be necessary to remove the dressing and re-assess the burn. Airway injuries and sepsis will increase fluid requirements above those suggested by the formula. Management initially will involve the use of colloid fluid boluses (human albumin 4.5 or 5 %) and possible introduction of additional maintenance fluids. If the patient does not respond or responds poorly to increased fluid infusion, then inform the Critical Care on-call or Outreach team of the patient's condition.

Monitoring during Burns Resuscitation

Formulae only estimate requirements and the individual patient must be closely and patients receiving fluid resuscitation require regular monitoring as follows:

- Urinary catheterisation and hourly urometery (aim for 0.5-1ml/kg/hour urine output or 1-2ml/kg/hour following electrical injury).
  Urine output consistently high for a number of hours may be an indication of over resuscitation, patient needs to be reassessed and resuscitation fluid reviewed with senior advice / supervision.
- Blood for urea, electrolytes and creatinine, full blood count initially on admission, then repeated at eight hours post-burn, 24 hours post-burn and 36 hours post-burn.
- Patients in whom an airway injury is suspected should have arterial blood gas measurement on admission.

Maintenance Fluids

The Adult Burns and Critical Care Units healthcare staff will ensure that adult patients on burns resuscitation protocols receive maintenance fluids orally, whenever possible. If oral intake is not possible, enteral routes for maintenance fluid administration are preferred (naso-gastric or naso-jejunal). Intravenous maintenance fluid administration should be reserved only for those cases in which oral or enteral administration is not possible.

Choice of maintenance fluid administered: For oral or enteral administration, water is an excellent choice of fluid. Supplemental feeding must deliver the required amounts of sodium, potassium, chloride and glucose. For intravenous maintenance fluids, commence with administration of 25–30 ml/kg/day of fluid volume, containing 1 mmol/kg/day of potassium; sodium; and chloride and 50–100 g/day of glucose. Intravenous fluids vary in electrolyte and glucose concentrations. This may give rise to electrolyte imbalance, due to changes in fluid type or failure to calculate accurately doses of electrolytes administered, because of fluid choice.

For obese patients, adjust IV fluid administration to the ideal body weight. Use lower range volumes per kg (patients rarely need more than 3 litres per day) and seek specialist help if the BMI is greater than 40 kg/m^2.

Always regard electrolyte intake in terms of both intravenous and enteral routes, in order to avoid over- or under-administration.

When intravenous fluids are no longer required, they must be stopped[14].

For patients on the Burns Unit, who are taking oral fluids, no volume intake needs to be prescribed. For ITU patients, commence maintenance fluids after 36 hours (when fluid resuscitation schedule has finished), as these patients will encounter as many problems from over-infusion as from under-infusion.

Audit

All patients requiring burns resuscitation fluids will have an Adult Burns Fluid Resuscitation audit form completed to review fluid resuscitation requirements. MDT will review results of each patient audit form and complete an annual review. Presentation of annual review will occur at relevant local / national burn meetings.

References

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