Colloids in Acute Burn Resuscitation

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KEYWORDS

• Burn • Fluid • Resuscitation • Colloids • Shock

KEY POINTS

- Crystalloid excess leading to harm ("fluid creep") has stimulated interest in colloid provision as a volume-sparing strategy.
- Colloids limit edema formation in unburned soft tissues and contribute to reduced resuscitation volumes and faster restoration of cardiac output experimentally.
- Nonprotein colloids are effective volume expanders, but current safety concerns prevent use or recommendation of these colloids in burn resuscitation.
- Fresh frozen plasma is an effective volume-sparing colloid but its benefits must be weighed against its cost and risks of virus transmission and lung injury.
- Albumin has demonstrated volume-sparing effects when used immediately or later in burn resuscitation, possibly leading to improved outcome. It is not known if albumin increases lung extravascular water.

INTRODUCTION

A curious paradox in the acute resuscitation of the burn patient is that debate still continues in 2015 on the use of colloid solutions in burn resuscitation despite the fact that colloids have been recommended components of virtually every burn resuscitation formula since the 1940s (**Table 1**). Uncertainty surrounding the role for colloids and the composition of resuscitation fluids during acute resuscitation has been a repeated theme at Consensus Conferences,[1] at Burn State of the Science Meetings,[2] and in Burn Practice Guidelines of the American Burn Association.[3] A 2010 international survey conducted by the International Society of Burn Injuries and the ABA found that half of respondents initiate colloids in the first 24 hours, with nearly equal preference for fresh frozen plasma (FFP) or albumin as the chosen colloid.[4]

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Table 1
Use of colloids in burn resuscitation formulas 1940 to present

Formula	First 24 h	24–48 h
Harkins Formula[5]	YES (plasma)	Not described
Body Weight Burn Budget[6,7]	YES (stored bank plasma, "plasmanate" [plasma protein fraction], reconstituted 5% albumin)	YES (stored bank plasma, "plasmanate" [plasma protein fraction], reconstituted 5% albumin)
Evans Formula[8]	YES (plasma, plasma substitute [dextran or gelatin], whole blood)	YES (plasma, plasma substitute [dextran or gelatin], whole blood)
Brooke Formula[11]	YES (plasma,[a] dextran, polyvinyl-pyrrolidone, gelatin)	YES (plasma,[a] dextran, polyvinyl-pyrrolidone, gelatin)
Parkland Formula[14]	NO	YES (plasma)
Modified Brooke Formula[16,17]	NO	YES (plasma or "plasma equivalent")
Muir and Barclay Formula[23]	YES (reconstituted dried plasma or dextran)	Not described
Slater Formula[25]	YES (FFP)	Not described
Haifa Formula[24,77]	YES (plasma, "regular plasma")	YES (plasma, "regular plasma")

[a] Discontinued due to concerns surrounding viral hepatitis transmission.

Arguably, equipoise exists as to whether to initiate colloids during acute fluid resuscitation, and if used, the optimal colloid composition, dose, and timing of initiation remain uncertain. The purpose of this article is to review the historical background, physiologic basis, and clinical use of colloids in acute burn resuscitation. This study will not address use of albumin or other colloids after the phase of acute resuscitation to correct hypoalbuminemia.

HISTORICAL PERSPECTIVE

Over the past 7 decades of formula-based burn resuscitation, the use of colloids is best characterized by regular cycles of waxing and waning enthusiasm. Notably, Dr Henry Harkins recommended 1000 cc of plasma for each 10% of the body surface area burned for patients with burns to greater than 10% of their body, in what was probably the earliest burn size–based fluid resuscitation formula (described by Dr I.S. Ravdin and members of the National Research Council in 1942).[5] Following the Coconut Grove disaster in 1942, Cope and Moore[6] proposed a "body weight burn budget" formula that recommended 75 cc of plasma for each 1% of the body surface burned in the first 24 hours and half that amount during the second 24 hours.[6] Later, Moore[7] stated that the total volume of colloid should equal 7.5% of the body weight in the first 24 hours and 2.5% of the body weight in the second 24 hours. Colloid could be provided as stored bank plasma, plasmanate (plasma protein fraction), 5% reconstituted albumin, or smaller quantities of dextran.[7]

This immediate and liberal provision of colloid was based on the observation of hemoconcentration after a major burn, and the deduction that this must have resulted from a loss of plasma volume. Hence, the primary objective was to restore plasma volume with similar fluids. Indeed, the Evans Formula published nearly a decade after the body weight burn budget recommended 1 mL/kg/% total body surface area (TBSA) burn of plasma, plasma substitute, or even whole blood in the first 24 hours after injury