Clinical question.
In patients with burns (P), does leaving the burn blister intact (I), compared with removing the blister (C), improve healing and pain control (O)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention
State if this is a proposed new topic or revision of existing worksheet: Revision

Conflict of interest specific to this question: Yes
Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? I have conducted a study on the effects of burn blister debridement on wound healing in swine.

Search strategy (including electronic databases searched).
PubMed “burns” or “thermal burns” as MESH (headings) AND “Blisters” AND/OR “First Aid) textword in abstract.
EMBASE search using text words (all fields) burns AND (blisters OR first aid)
AHA EndNote Master library, Cochrane database for systematic reviews, Central Register of Controlled Trials search using “burns” or “thermal burns” and “blisters” or “first aid”

Review of references from articles.

State inclusion and exclusion criteria
Both human and animal studies were included, regardless of study design.
The following studies were excluded: In-vitro or inanimate models (e.g., Cell and tissue cultures), reports of single cases, and studies that did not compare healing of burns in which one group had intact blisters and other had the blisters removed, aspirated or debrided.

Number of articles/sources meeting criteria for further review:
The search strategy identified 698 references whose titles and abstracts were reviewed.
26 studies met criteria for further review. Of these 1 was LOE 2 (quasi-experiment), 2 were LOE 4 (case series) and 23 were LOE 5 (not directly related volunteers [1] or animal studies [22]).
Summary of evidence

**Evidence Supporting Clinical Question**
In patients with thermal burns, leaving blisters intact improves healing.

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<tr>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<tr>
<td></td>
<td>Swain 1987 (E2, E3)</td>
<td>Cope 1943, Forage 1962 (E1, E3)</td>
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**Level of evidence**

A = return of spontaneous circulation  B = survival of event  C = survival to hospital discharge  
D = intact neurological survival  
E1 = healing  E2 = infection  E3 = pain relief  E4 = scarring  E5 = cosmesis

*Italics = Animal studies  Underline = In-vitro studies*
### Evidence Neutral to Clinical question

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<th>Deitch 1982, Reagan 1996</th>
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### Evidence Opposing Clinical Question

In patients with thermal burns, rupturing blisters improves healing.

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A = return of spontaneous circulation  
B = survival of event  
C = survival to hospital discharge  
D = intact neurological survival  
E1 = healing  
E2 = infection  
E3 = pain relief  
E4 = Scarring  
E5 = cosmesis

*Italics* = Animal studies  
*Underline* = In-vitro studies
**Discussion:** Burn blisters are caused by the accumulation of fluid between the epidermal and dermal layers of the skin and are a hallmark of superficial second degree burns. Some suggest that the fluid confined by the necrotic skin can lead to a closed space infection and that blisters should, therefore, be unroofed. Others have argued that the intact blister creates a moist wound environment that is beneficial to wound healing. The controversy regarding the optimal management of burn blisters has been fueled by conflicting in-vitro studies that have demonstrated both beneficial and detrimental effects of the burn blister fluid on a variety of cells and immune function.

There are no large prospective randomized clinical trials (LOE 1) evaluating the effects of burn blister debridement on wound healing and pain control. A quasi-experiment (LOE 2) comparing the rate of bacterial colonization in 202 patients with partial thickness burns whose blisters were left intact, aspirated, or removed, found that the incidence of bacterial contamination was lower in intact than in debrided burns (Swain 1987). Pain relief was greater when blisters were not deroofed. In a study of 40 experimental partial thickness burns created on 3 human volunteers (LOE 5), burns whose blisters were left intact healed 40% faster than those that were removed and exposed to air (Gimbel 1957). Cope described a series of 39 burn patients injured in the Cocoanut Grove night club fire in Boston (LOE 4). The burn blisters were left intact and covered with a bland ointment. Healing of burns was superior to previous methods that included debridement of blisters (Cope 1943). A single case report (LOE 4), comparing the healing of burn blisters that were removed or left intact also demonstrated faster healing and less pain when blisters remained intact (Forage 1962). Superior cosmetic outcome was also reported for the burn whose blister was left intact. In the same report, Forage studied evaporative water loss in 10 burn patients and found that it was reduced when the blister was left intact. Unfortunately, in some of the studies above the deroofed blisters were often left exposed, which has been show to result in wound desiccation and delayed healing when compared to a moist wound environment. Thus it is difficult to extrapolate these results to the use of occlusive dressings over deroofed blisters.

A porcine study of deep second degree burns (LOE 5) evaluating the effects of debridement of the necrotic epidermis demonstrated faster healing, less infections, and less scarring when the burn was left intact (Singer 2000a). In this study half of the debrided burns were covered with a cyanoacrylate based occlusive dressing while the other half were covered with dry gauze. A similar study in which the debrided and undebrided burns in a porcine model (LOE 5) were intentionally contaminated with *Staphylococcus aureus* (2/3 of which were then covered with octyl-cyanoacrylate or a polyurethane foam dressing) demonstrated increased infection rates and bacterial counts in debrided burns (Singer 2000b). A prior study in guinea pigs (LOE 5) also demonstrated faster healing of burns with intact blisters than those whose blisters were deroofed. However, all burns were then treated by exposure limiting the applicability to moist wound treatment (Wheeler 1976). Another study of burns in guinea pigs (LOE 5) demonstrated that removal of the blister eliminated any therapeutic effects of cooling or dipyridamol (Saranto 1983).

A series of in-vitro (LOE 5) studies have been conducted to determine the contents and biological activity of burn blister fluid obtained from patients with burns. Detrimental effects of burn blister fluid have included a reduction in the levels of the antimicrobial peptide human beta defensin-2 (Ortega 2000), reduced opsonic activity against *Pseudomonas aeruginosa* (Deitch 1983; Ono 1994), suppression of lymphocyte blastogenic activity (Deitch 1983), suppressed keratinocyte activity (Garner 1993), increased fibroblast contraction (Wilson 1997), and inhibition of fibrinolysis (Rockwell 1990). Burn blister fluid has also been found to be rich in vasoactive prostanoids that induce vasoconstriction and platelet aggregation (Heggers 1980) as well as in leukotrienes (Dobke 1987) that may be involved in immune alterations. Adenosine, which impairs the antimicrobial activity of macrophages, is also elevated in blister fluid (Shaked 2007) as is interleukin-1 (Kupper 1986) that may result in T cell sequestration around the wound. Others have found no effect of burn blister fluid on fibroblast growth (Uchinuma 1988) or keratinocyte proliferation (Reagan 1996). Still other studies have reported beneficial effects of the blister fluid including accelerated proliferation of keratinocytes (Ono 1995, Wilson 1994) and activation of neutrophils (Deitch 1990). The blister itself has also been shown to reduce evaporative fluid loss from wounds (Moserova 1983).
Citation List


(LOE 5, Fair, Opposes)

(LOE 5, Fair, Neutral)

(LOE 5, Fair, Opposes)

(LOE 5, Fair, Supports)

(LOE 5, Fair, Opposes)

(LOE 4, Poor, Supports)

(LOE 5, Fair, Opposes)

(LOE 5, Good, Supports)

(LOE 5, Fair, Opposes)

(LOE 5, Fair, Opposes)
(LOE 5, Fair, Supports)

(LOE 5, Fair, Opposes)

(LOE 5, Fair, Opposes)

(LOE 5, Fair, Opposes)

(LOE 5, Fair, Neutral)

(LOE 5, Fair, Opposes)

(LOE 5, Good, Supports)

(LOE 5, Fair, Opposes)

(LOE 5, Good, Supports)

(LOE 5, Good, Supports)


