
The use of Hydrogel Based Burn Dressings in Pre-Hospital First aid: Evidence based practice?

- A systematic review of the literature and non-traditional data forms exploring the efficacy of HBD practice in the pre-hospital setting.

Summary

This systematic review examines the evidence base used to underpin common treatment recommendations and practice guidelines for the use of Hydrogel Burn Dressings (HBD) in pre-hospital First aid in a sampled cross-section of burns advisory agencies and Emergency Medical Service providers.

The review also highlights apparent widespread divergences between recommended approaches to burn 1st aid practice using HBD, and their application in the field by Emergency Medical Services and First Aid agencies.

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Abstract

Introduction

While traditional use of water based cooling methods and conventional dressing have been the cornerstone of pre-hospital burn first aid, alternative therapies such as hydrogel-based dressings (HBD) have seeped into clinical practice principally because of ease of use in the field. It has also been proposed the technology is a suitable substitute for traditional approaches, being equally effective in the role of cooling the burn, mitigating burn progression, reducing pain and providing an effective covering for the wound.

The aim of this systematic review was therefore to determine the base level of evidence underpinning HBD for use in the pre-hospital setting and current burn first recommendations and practices.

Methods

Three electronic databases (Medline, Embase and Cochrane Database of Systematic Reviews) were searched independently using key terms such as 'pre-hospital setting' 'burn injury' and 'hydrogel', to identify systematic reviews, randomized and non-randomized controlled trials, well designed observational studies and superiority or non-inferiority comparative studies involving humans through to September 2014. We also screened individual journals and conference proceedings (e.g. hand searching), reviewed reference lists of relevant trials, and examined reference sources of clinical practice, first aid and paramedic websites. The search was limited to English language studies. Trials screening and identification was undertaken by two authors (NG and JW) using a pre-defined selection criteria.

Results

Of the 115 studies identified via medical databases and through additional hand searching of internet based data from burn associations, peak resuscitation bodies and paramedic organizations, we found 36 potential studies for inclusion. All were excluded because they were in the wrong clinical setting, explored the wrong patient population, did not examine the intervention or were animal or experimental studies. The examination was therefore considered an empty systematic review.

Conclusions

The current use of HBD in burn first aid appears to be driven by studies and other sources of information that do not reflect the pre-hospital clinical environment. Examination of recommendations from burns advisory bodies, peak resuscitation councils, hospital based burns units and pre-hospital first aid provider guidelines detail variations in their recommendations of use, which suggest not only a re-examination of current evidence, but also the urgent need to improve the intervention and its evidence-base.

Introduction

Advances in burn care have seen a dramatic improvement in patient survival, a reduction in complications and important improvements to cosmetic outcome. While much of this care has been driven by hospital-based practices such as surgery, antibiotics and intensive care, the contribution of pre-hospital burn first aid to improved patient outcome remains largely unknown.

Pre-hospital burn first aid has traditionally consisted of cooling the burn with water and covering the wound with an appropriate dressing. Experimental and animal studies have shown water-cooling may provide beneficial effects on wound oedema^[1], pain^[2], reducing cell injury^[3] and the inflammatory response^[4] as well as impacts on healing, recovery, cosmetic outcome and mortality^[5,6]. More recently, alternative approaches using hydrogel based burn first aid dressings derived from materials first developed in 1955^[7] have seeped into pre-hospital clinical practice.

This rapid gain in popularity was seen in a number of studies detailing its use as a burns dressing by emergency services in the United Kingdom. Allison (2002)^[8] showed 39% of UK EMS employed HBD in first aid, whilst in nearly 80% of fire departments, HBD was used as both a dressing and/or cooling agent (Walker 2005)^[9]. Cuttle (2009)^[10] also showed 13% of paediatric patients receiving first aid with HBD by local EMS, whilst Hyland (2013)^[11] found that over 50% of patients in a sample group of 455 were treated by lay first-aiders using hydrogel products.

The rationale for this widespread adoption of HBD into first aid, however, remains unclear. It may have been due to poor clinical understanding, the use of non-evidence based treatment strategies, the absence of defined burn protocols or the emergence of a growing HBD manufacturing base keen to develop market opportunities.

HBD were nonetheless, considered simple to adapt to practice and appeared to solve the dual problems of improvising water cooling in transit (using bottled saline or water) whilst providing a dressing option (from a myriad of choices) at the same time; features aiding the zeal of paramedics to exit the emergency scene with alacrity to definitive management in the ED – a long held (though often clinically misguided) mantra of prehospital care.

HBD are applicable to all areas of the body, come in many sizes and dissipate heat from the wound via convection and evaporation with several products also incorporating additives with anaesthetic, anti-inflammatory or nutrient properties.

Given the widespread use of HBD, there was an urgent need to use a systematic review methodology to determine the base level of clinical evidence supporting the efficacy of HBD in the pre-hospital burn first aid role. The authors also investigated the extent and type of alternative supporting literature and approaches to practice seen in published first aid recommendations and practice guidelines of 37 sampled agencies.

Materials and Methods

Literature search strategy

A structured literature search was last performed in Ovid MEDLINE, EMBASE and The Cochrane Library in June 2014 using a series of keywords such as 'burns', 'thermal injury' 'hydrogel', with 'first aid' and 'pre-hospital setting'. A predefined search strategy was designed for maximal retrieval using medical subject headings and free text search terms. Search terms were also adapted using the thesaurus vocabulary of each database. In addition to the automated search strategies, the internet search engine, Google, was searched for additional relevant studies, along with company/manufacturing websites, expert commentaries on burn first aid in journal articles and burn care agencies. Two authors (JW and NG) conducted the literature search. All searches were limited to articles in English.

Study selection criteria and procedures

Study designs: Systematic reviews, randomized and non-randomized controlled trials, well designed observational studies and superiority or non-inferiority comparative studies were considered for inclusion.

Clinical outcomes of interest: Effect on - burn wound temperature, burn progression, analgesic benefit, infection rate, healing and cosmetic outcome, recovery time, mortality.

Setting: HBD when used as part of immediate first aid burn care management in the pre-hospital setting.

Exclusions: In-vitro experiments or animal studies, non-English language, non-peer reviewed, case series or reports, unpublished manuscripts, narrative reviews, expert testimonials, commentaries and other descriptive articles were excluded.

Procedure: Two review authors (N.G, J.W.) excluded irrelevant materials following retrieval in the initial search then independently screened remaining titles, abstracts and full text articles using inclusion criteria. Authors resolved differences of opinion by discussion.

Assessment of burns advisory agencies and first aid provider organisation guidelines

Authors (NG,JW) identified recommendations and guidelines for practice of burns advisory agencies, Emergency Medical Services and other First aid organisations from institution websites or via electronic (PDF) documents on request from the document holder. References cited in recommendations and guidelines were analyzed using review inclusion criteria and graded based upon Australian National Health and Medical Research Council (NHMRC) hierarchies of evidence [¹²] and recorded in comparative tables.

Data extraction

Authors (NG,JW) applied a standardised data extraction form extracting detail on study design demographic and clinical variables as described.

Results

Database and Internet Search results

The search strategy identified 115 studies of which 25 potentially relevant articles were retrieved after independent scrutiny of the titles and abstracts. All were excluded because:

- i. They were undertaken in settings other than pre-hospital. (Burd 2007^[13]; Guilbaud 1992^[14] Guilbaud 1993^[15]; Grippaudo 2010^[16], Patel 2007^[17]; Vogt 2006^[18]; Zhang 2009^[19]; Edwards 2010^[20]; Gong 2009^[21]; Warren 1980^[22]; Nangia 1988^[23]; Osti 2006^[24]; Coats 2002^[25].
- ii. They were laboratory designs (Bullock 2010^[26]; Chen 2007^[27]; Martineu 2007^[28]; Ribeiro 2009^[29]).
- iii. They were animal studies (Homann 2007^[30]; Dressler 1980^[31]; Jandera 2000^[32]; Pei 2008^[33]; Kiyozumi 2007^[34]).
- iv. or non-English language articles ((Hauser 2007 (German)^[35]; Kassain 1991 (Russian)^[36]; Misterka 1991^[37] (Russian)).

Manual searching of non-medical database internet sources including company/manufacturing websites identified a further 11 studies. Of these, all were excluded because:

- i. They were in the wrong setting. (Castner 2000^[38]; Castner 2001^[39])
- ii. The intervention was not assessed. (Allison 2002^[40]; Ashworth 2001^[41]; Hudspith 2004^[42]; Lonnecker 2001^[43]; McCormick 2004^[44])
- iii. They were in-vitro experimental studies (Carson^[45]; Faogoli 1997^[46]; Torsova 1995^[47]; Wang 2011^[48]).

Review of recommendations and guidelines (non-traditional data forms)

Of 14 peak resuscitation bodies and major burns advisory agencies 4 provided recommendations on HBD as an (alternative) cooling medium whilst 1 advised against its use on paediatric burns patients. None of the 14 bodies advocated for the use of HBD in the primary first aid dressing role. Only 4 agencies provided companion supporting literature for published recommendations. All reference studies were excluded from the review.

Of 23 sampled EMS agencies, none provided supporting HBD literature with published guidelines. (Many EMS agencies utilise in-house consensus medical evaluation or consultative models with local expert institutions to endorse clinical practice guideline development, thus evidence summaries are rarely published in the public domain^[49]).

Cooling and dressing practices of the sampled agencies appears to be based on studies done in the wrong clinical setting or had no recognized methodological assessment of study quality chosen when including these studies to endorse the practice currently in use. Examination showed no consistent or standardised approach to the use of HBD in burn first aid across regional, national or international boundaries. Due to variations in study design and setting, which precluded these studies from being part of the SR, we could not make any proper inferences.

Discussion

Overview of the evidence

Despite major advances in hospital burn care over the past few decades, minimizing burn wound progression with targeted cooling whilst avoiding hypothermia, effectively managing pain without resorting to excessive use of opioid medication and determining the best approach to wound covering to both protect the injured integument whilst impacting infection rates, remain complex and difficult areas of pre-hospital care. In the absence of a clear evidence based strategy, there has been a gradual shift in clinician behavior with the use of alternative therapies such as HBD.

Following an exhaustive search of medical databases, non-medical websites and first aid agencies using burn and pre-hospital search terms, this systematic review did not identify any studies describing an equivalent or superior effect from HBD in respect of addressing these critical areas in comparison with current recommended therapies. Moreover, we did not find any evidence supporting HBD application strategies for specified durations, at various temperatures or as a delayed treatment comparable or superior to current first aid guidelines.

The safety and effectiveness of HBD and indeed, of all burn first aid in the patient with a large TBSA or deep burn remains an area of both concern and controversy in the absence of adequate research. Nonetheless, HBD remain a widely used alternative burn first aid option in the United States, Asia, Europe, the United Kingdom, Australia, Canada and many other regions where they may be used to treat all sizes and depths of thermal burn injury.

Considering the alarming absence of evidence, a number of sampled agencies involved in providing first aid recommendations and guidelines for practice used a variety of animal, laboratory and observational studies, unpublished materials or manufacturer commissioned reports or testimonials, in various clinical settings other than pre-hospital, to piece together a series of clinically-led, consensus based statements almost exclusively on the water-cooling component of burn first aid.

For example, Singer (2010) compiled an evidence summary for The 2010 American heart Association “International Consensus on First aid Science with Treatment Recommendations”^[50] providing evidence to demonstrate the benefits of water cooling on healing and reducing pain but included studies in other health care settings and amongst

animal populations (Singer 2010, INFAA – citations listed below). However, the summary describes the HBD burn First aid situation as a “knowledge gap” (1) reflecting the dearth of trial based evidence and the AHA like many recommending bodies, does not provide a recommendation on HBD use in pre-hospital.

With the emphasis on cooling the burn wound (the most widely studied element of first aid and whose efficacy is most widely supported by evidence), has seen investigation of the pre-hospital use of HBD specifically as a first aid dressing largely ignored.

The systematic review by Wasiak et al (2010)^[51] for example, failed to identify nor included any pre-hospital studies with the literature search limited to superficial and partial thickness thermal injury only. Hospital based HBD dressing studies did not explore the product in the first aid scenario or were unrelated product variants containing a hydrogel component not utilised in pre-hospital.

Furthermore, this review could not identify any studies analyzing the effectiveness of HBD to reduce burn wound pain whilst minimising reliance on pharmacological agents with potential adverse side effects. The studies by Osti (2006)^[24] and Coats (2002)^[25] whilst commenting on analgesic effect of HBD in two small patient cohorts (12 and 40) using different study design methodologies, did not quantify the effect with a data analysis from which generalisable conclusions can be drawn.

Current provider first aid guidelines do not advocate any preferred therapy. (HBD, water-cooling, opioid analgesics/other).

Recommendations and guidelines for practice

Despite the limited evidence base informed by clinical trials within this area of pre-hospital practice, with emphasis placed on various settings and animal or laboratory based study designs, there is some level of consensus amongst clinicians to consider “best available” evidence in the early first aid management of patients with burn injury.

Although consensus-based care may have expanded clinical knowledge, there are many areas that remain under-investigated but specific to HBD. These include its contribution to hypothermia complications^[52,53], its benefit or otherwise in mitigating burn wound progression and its relative or comparable efficacy to control burn wound temperature and pain and whether the technology inhibits infective complications in the burn wound more effectively than traditional dressing approaches.

Clinical hypothermia issues in particular have seen practice guidelines employing conservative risk mitigation strategies to HBD (and cooling generally) using caveats such as age and TBSA restrictions. However, there does not appear to be any standardisation in these practices. For example, some Australian EMS services employ HBD only where water is inaccessible^[78,54] or stipulate based upon patient age and/or TBSA^[75], whilst one suggests several alternatives all considered appropriate^[55]. Variations in Australian EMS practice are replicated in overseas jurisdiction. (Tables 3-4: Pages 15-16). Some EMS guidelines advocate

no cooling of the burn with any means (HBD or otherwise) irrespective of the TBSA. Only three of the sampled EMS agencies (Ontario, Florida, New York State) stipulated a burn depth caveat.

Recommendations from International and National first aid agencies^[56,57,58] reflect the general consensus on early water-cooling of burn injury seen in those from major burns advisory agencies but fail to demonstrate a consensus on other aspects of burn first aid where HBD is utilised. Non-traditional data sources also show similar variations in HBD use as noted in military First aid protocols^[59,60].

There remains no consensus amongst first aid providers sampled for this review on the preferred burn dressing in pre-hospital as seen in prior analysis. (Allison (2002)^[8] Walker et al (2005)^[9]. Amongst burns advisory agencies, polyvinyl Clingfilm is the most widely recommended choice principally for its practicality, simplicity and nominal sterility. One agency suggests HBD as an alternative dressing in major burns (RAHBU). Only one of three sampled peak bodies specifies a preferred pre-hospital burn dressing post wound cooling (ERCEFAG -"wet wound dressings"^[61]).

Conclusions

This systematic review did not identify pre-hospital burn first aid studies of any design and other data sources did not meet inclusion criteria as these were derived from other clinical settings, clinical observational and experimental animal studies or studies that did not assess the intervention (HBD) or clinical outcomes relevant to burn first aid. All thirty-six potential studies identified in the literature search and via non-traditional data forms were therefore excluded from the review.

Study data to establish the bona-fides of HBD as an effective burn First aid intervention thus appears lacking quantitatively and qualitatively making definitive conclusions on the efficacy of the technology in this role unclear.

Limitations of the Review

- Non-English language studies were excluded from the review.
- No studies met inclusion criteria

Conflicts of Interest

The Authors declare no financial, commercial, academic or affiliation conflicts of interest.

Results: Table 1. HBD evidence summary – Peak Bodies; National Health and Medical Research Council, Australia Level Of Evidence Grading System – (NHMRC)

	Agency	HBD studies	Study Design	HBD Function	Participants
1	British Burns Association	i) Coats TJ, Edwards C, Newton R, Staun E. The effect of gel burns dressings on skin temperature. Emerg.Med J 2002;19:224-5. ii) Jandera V, Hudson DA, de Wet PM, Innes PM, Rode H. Cooling the burn wound: evaluation of different modalities. Burns 2000;26:265-70.	Controlled observational volunteer trial Comparative Porcine Laboratory Experiment	Cooling with HBD in different configurations, Analgesic effect Cooling Effect of HBD vs water compresses	12 Volunteers Porcine Animal Study
2	Australia New Zealand Burn Association	No published evidence brief for recommendations	Consensus statement on HBD	HBD 2 nd tier alternative for water cooling only if no water available	N/A
3	New Zealand Guideline Group	i) Castner T Monitoring of Temperature While Cooling Burn Injuries. Rettungsdiennst. 2001; No:1(23): 28-31 ii) Mertz PM, Davis SC, Cazzaniga AL, et al. To assess second-degree burn wound treatment with Water-jel. Carlstadt NJ: Trilling Medical Technologies Inc; 1990 iii) Torsova V, Chmelarova E. Evaluation of the effects of a new Water Jel System on Specific Bacterial and Yeast Strains in Laboratory Conditions 1995. Burns 21(1):pp47-56. iv) Dolocek R Torsova V. Water Jel in the treatment of Burns: A Bacteriological Study. Journal of Burn Care Rehabilitation. 1990. 11:pp135-141 v) Palmhert (1998) Controlled trial 23 patients. Non randomised study Unpublished abstract vi) Coats TJ, Edwards C, Newton R, Staun E. The effect of gel burns dressings on skin temperature. Emerg.Med J 2002;19:224-5. vii) Castner T Cooling out of the bag. Water Jel Burns Dressings. AGAN Product test.Rettungsdiennst.2002;5 (22):32-5 viii) Lonnecker S, Schroder V. Hypothermia after burn injury—influence of pre-hospital management. Der Chirurg2001;72:164–7.	Controlled observational volunteer trial Unpublished Porcine Laboratory Study 1.In-vitro Bacteriological Laboratory study 2. Case Series Case Series Unpublished Non-randomized controlled trial Controlled observational volunteer trial Cases Series Prospective Interventional Study	Does 1 st aid cooling cause hypothermia?: HBD vs water Cooling 1. HBD anti- bacterial and anti-mycotic effect 2. Signs of infection Preparation for grafting Cooling Cooling with HBD in different configurations, Analgesia Cooling Impact of pre-hospital cooling on incidence of hypothermia	No. not stated “Volunteers aged 27-33”. Porcine Animal Study N/A N/A N/A 23 patients 12 Volunteers No. Not stated. Volunteers N/A

Agency	HBD studies	Study Design	HBD Function	Participants	
4	ACI New South Wales Statewide Burn Injury Service	i) Jandera V, Hudson DA, de Wet PM, Innes PM, Rode H. Cooling the burn wound: evaluation of different modalities. Burns 2000; 26:265-70.	Comparative Porcine Laboratory Study	Cooling Effect of HBD vs water soaks	Porcine Animal Study
5	Victorian Adult Burns Service	No HBD studies cited in references	Consensus recommendation on HBD only	HBD as alternative cooling agent Hypothermia risk in major burns Not suitable for paediatrics	N/A
6	Western Australian Burns Service	No published evidence brief for recommendations	No published directive on HBD in First aid recommendations Provider stipulated Guideline on HBD use by first responders	N/A (HBD used as Dressing alternative in EMS Protocol)	N/A
7	Australian Resuscitation Council	i) Jandera V, Hudson DA, de Wet PM, Innes PM, Rode H. Cooling the burn wound: evaluation of different modalities. Burns 2000;26:265-70. ii) Osti Enzo. Cutaneous Burns Treated With Hydrogel (Burnshield) and a Semipermeable Adhesive Film. Arch Surg. 2006;141:39-42	Comparative Porcine Laboratory Study Prospective controlled observational Study	Cooling Effect of HBD vs water soaks Effect on scar formation and time to re-epithelialization; Analgesic benefit and wound maceration	Porcine Animal Study 40
8	European Resuscitation Council European First aid Guidelines	No HBD studies cited in references	Evidence Summary: Three guidelines, one cross-sectional survey, two expert opinion scripts	Dressing (“wet wound dressings can protect the burn”)	N/A
9	American Heart Association (American Burn Association)	No HBD studies cited - no references detailed in published burn First aid recommendations	Evidence Summary	N/A	N/A
10	Royal Adelaide Hospital Burns Unit	No HBD studies cited - no references detailed in published guidelines	Consensus recommendation on HBD only	HBD as cooling and dressing agent when no water available	N/A
11	The Children’s Hospital West Mead	No HBD studies cited in references	No published directive on HBD in First aid recommendations Local Provider stipulated Guideline	N/A	N/A

	Agency	HBD studies	Study Design	HBD Function	Participants
12	Royal Children's Hospital Melbourne	No HBD studies cited - no references detailed in published burn First aid guidelines	No published directive on HBD in First aid recommendations Paediatric advisory to local EMS	N/A	N/A
13	Prince of Wales Hospital Hong Kong	No HBD studies cited in references	No published directive on HBD in First aid recommendations	N/A	N/A
14	Women And Children's Hospital Adelaide	No HBD studies cited in references	Consensus recommendation on HBD only	HBD as alternative cooling agent where no water available	N/A

Results: Table 2. Representative bodies (Refer Evidence Summary Table 1 and Website Links: Appendix 1)

Key: HBD=Hydrogel Burn dressing CRW=cool running water C=Clingfilm NS=Not specified in guideline DD=Dry Dressing WD=Wet Dressing (undefined) A=Adult P=Paediatric

	Burns Associations						Peak Bodies			Hospital Burns Units				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	BBA [62]	ANZBA [63]	NZGG [64]	NSWACISBIS [65]	VABS [66]	WABS [67]	ARC [68]	ERCEFAG [61]	AHA [69]	RAHBU [70]	CHWM [71]	RCH [72]	POWH [73]	WCHA [74]
Cooling method	"Cool the burn area" (Water)	CRW	"Running tap water" or HBD where water unavailable	CRW	CRW or HBD if no water available	Room temp water"	CRW	CRW	"Cold Water"	CRW or soaked towels for still water/ immersion or HBD if no water available	"Cold tap water"	CRW	"water"	CRW - HBD if no water available
Duration of cooling	20mins	20mins	20mins	20mins	20mins	20-30mins	20mins	15-20mins	"At least until pain is relieved"	20 mins or if no water available "Use HBD for 20mins (high risk) or 10mins (extreme risk) then remove" or 10-20 mins CRW (flame burn)	20-30 mins (Public fact sheet" 20 mins only)	20mins	"up to half an hour"	10-20 mins; 20 mins minor burn 10 to 20 mins major burn HBD removed after 20mins
Cooling Temp	NS	NS	8-15°C	8-25°C "Ideal temp=15°C"	8-20°C	10-15°C	NS	NS	10-25°C	NS	(5-25°C) NS in actual guidelines	NS	NS	NS
Preferred Dressing	C	"Clean dressing"	C	C	C	Clean non-adherent dressing	NS	NS	NS	"Non- adherent dressing" (minor burn)	"A simple non-stick dressing is suitable"	C "useful"	NS	C or "non-adherent dressing"
Alternate dressing	NS	C	"PVC film should not be used as a substitute for a dressing product"	"Wet packs and Soaks"	"Any clean, dry dressing"	NS	NS	NS	NS	C or Clean linen (major burn) or "wrap clean towel around hydrogel"	NS	No HBD on paed. burns. Advisory to local EMS	NS	NS

Results: Table 3 - Australian, United Kingdom and Canadian EMS (state based Guidelines for Practice. Refer Website Links: Appendix 1)

	15	16	17	18	19	20	21	22	23	24	25	26
	QAS [75]	ACTAS [76]	SJWA [77]	NSWAS [78]	SAAS [79]	PHECCI [80]	UK AS [81]	Alberta EMS [82]	Nova Scotia EMS [83]	Ontario EMS [84]	Manitoba EMS [85]	Saskatchewan EMS [86]
Cooling method	CRW	Cold water or NaCl	"Cooling with water"	CRW or if still water-wet towels or no water-NaCl or Hartmanns	CRW	"Commence local cooling of area"	Initial irrigation CRW	NS "Cool burn and limit further injury". "If time of injury >30mins do not cool burn"	"Cool the burn with water"	"wet (not soaked) dressings. If shivering or hypotension develops discontinue cooling efforts"	"Irrigation of a burn can cause hypothermia and introduce infection in compromised skin, and is not an appropriate method of pain control"	"Apply a clean dry non-adherent dressing to the burned area" "Cold compresses should not be used for a burn >20% burn surface area"
Duration of cooling	20mins	NS	At least 10mins	20mins	"Up to 20mins"	Min15mins cooling	"Rare to need more than 10MINS irrigation"	NS	"minimum 10mins"	NS	NS	NS
Cooling Temp	NS	NS	NS	"cool/tepid"	"cold water"	NS	NS	NS	NS	NS	NS	NS
Preferred Dressing	C	Gel burns dressings after cooling or DD	Any of C,H, WD wet sheet	C	C	Burns gel (caution for > 10% TBSA) Cling film Sterile dressing Clean sheet	C	<10% TBSA Cool moist dressings >10% TBSA clean dry sheets	"Sterile Dry dressings"	If burn 1 st deg or 2 nd deg <10-15% cover with wet sterile dressing "not soaked"	"cover burned area with sterile soaked saline dressing, then cover with dry dressings"	"Place patient between clean dry sheets"
Alternate Dressing	HBD A<20% TBSA P<10% TBSA	"Cover the burnt area with clean dressing/sheets"	Any of C,H,WD	If no water apply HBD (after NaCl/Hartmann's cooling)	HBD no >20mins	HBD no >20mins	HBD if burn <12.5% TBSA due to potential for hypothermia	NS	NS	NS	NS	NS

Results: Table 4 - US EMS (state based Guidelines for Practice - Refer Website Links: Appendix 1)

	27	28	29	30	31	32	33	34	35	36	37
	Montana EMS [87]	Alabama EMS [88]	Nth Carolina EMS [89]	Massachusetts [90]	NY State EMS [91]	Pennsylvania [92]	Connecticut EMS [93]	Alaska EMS [94]	Florida EMS [95]	Nebraska EMS [96]	Maine EMS [97]
Cooling method	NS	“Cooling with adequate available sterile water”. “Do not induce hypothermia by applying cold or wet dressing to burned area”	“Burn patients are prone to hypothermia - never apply ice or cool the burn, must maintain normal body temperature”.	“Stop the burning process with water or saline.....”	“Stop the burning process”	“Stop the burning process with water or saline”	Thermal: apply dry sterile dressings “Cool water or saline is of value if applied within 15mins” to no >10% of body	“Cool with water immersion”	“Lavage the burned area with tepid water (sterile, if possible) to cool the skin”	NS “if <10%BSA may cool the burn” “Cool burning material adhering to pt”	<10% Dressing soaked in NaCl or other commercial wet dressing (H) If >10% dry dressing sterile sheet or commercial dry dressing
Duration of cooling	NS	N/A	NS	“.....for up to 10 minutes”	NS	NS	NS	“Little benefit after few minutes”	NS	NS	NS
Cooling Temp	N/A	N/A	NS	NS	NS	NS	NS	NS	NS	NS	NS
Preferred Dressing	Large burn: “place patient between clean dry sheets”, sterile dry dressing for small burns	“Dry Burn Sheet”	“Dry Clean Sheet or Dressings”	“Clean dry dressing”	Partial thickness < 10% TBSA area: moistened sterile dressings or moistened burn sheets	“Cover burned areas with dry sterile burn sheets/ dressings or sterile commercial burn sheets/ dressings.”	“ Dry Sterile burn dressing”	>10% dry sheet, burn sheet or sterile dressing <10% wet e.g. HBD	>= 20% 2 nd deg. or 5% 3 rd deg. burns, cover with dry sterile dressings or Water Gel™ wraps. < 20% 2 nd deg. burns or 5% 3 rd deg. apply wet sterile dressings to burns for 15 mins. to aid in pain control. Alternatively, Burn Free™ gel pads or Water Gel™ wraps may be applied continuously to aid in pain control.	“Cover burned area with Dry bandages or sheets”	“If <10% Dressing soaked in NaCl or other commercially prepped wet dressing If >10% dry dressing, sterile sheet or commercially prepped dry dressing”
Alternate dressing	NS	NS	NS	NS	Full thickness >10%: dry sterile dressings or burn sheets to the burned area(s).	NS	NS	NS	If <20% 2 nd deg or <5% 3 rd deg burns apply wet sterile dressings or H for 15mins	NS	NS

Appendix 1 First aid Guidelines and recommendations - Website Links

Peak Bodies, Burns Associations and Burns Hospital Units

1. British Burns Association: <http://www.nettas.com.tr/burnshield/Pre-hospital%20Approach%20to%20Burns%20Patient%20Management%20Cooling%20British%20Burn%20Association.pdf>
2. Australia New Zealand Burn Association: <http://anzba.org.au> [http://anzba.org.au/assets/Factsheet-First aid2.pdf](http://anzba.org.au/assets/Factsheet-First%20aid2.pdf)
3. New Zealand Guideline Group: <http://www.health.govt.nz/publication/management-burns-and-scalds-primary-care>
4. New South Wales Association for Clinical Innovation Statewide Burn Injury Service Clinical Practice Guidelines: burn Injury Management http://www.aci.health.nsw.gov.au/resources/clinician-resources/multidisciplinary_burn_education_program
5. Victorian Adult Burns Service: <http://www.alfred.org.au/Assets/Files/ManagementofMinorSuperficialBurns.pdf>
6. Western Australia Burns Service: http://www.healthnetworks.health.wa.gov.au/docs/burns_education_booklet.pdf
7. Australian Resuscitation Council: <http://www.resus.org.au/policy/guidelines/index.asp>
8. European Resuscitation Council European First aid Guidelines: http://www.researchgate.net/publication/6641654_European_first_aid_guidelines
9. American Heart Association http://circ.ahajournals.org/content/122/18_suppl_3/S934.full.pdf+html
10. Royal Adelaide Hospital: <http://www.rah.sa.gov.au/burns/downloads/2009-Practice-guidelines.pdf>
11. The Children's Hospital West Mead: http://www.schn.health.nsw.gov.au/_policies/pdf/2006-8142.pdf
http://www.chw.edu.au/prof/services/burns_unit/05_factsheets.htm
12. Royal Children's Hospital: http://www.rch.org.au/clinicalguide/guideline_index/Burns/
13. Prince of Wales Hospital (Hong Kong) <http://www.fmshk.org/database/articles/03mb6.pdf>
14. Women and Children's Hospital Adelaide: http://www.wch.sa.gov.au/services/az/divisions/psurg/burns/documents/burns_guidelines.pdf

Australian, UK and Canadian EMS Services

15. Queensland Ambulance Service: <https://ambulance.qld.gov.au/clinical.html>
16. ACT Ambulance Service: <http://esa.act.gov.au/actas/about-us/clinical-management-guidelines/>
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