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Hydrotherapy in burn care: A survey of hydrotherapy practices in the UK and Ireland and literature review

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ABSTRACT

Introduction: Hydrotherapy is widely used in burns management however there are risks associated with its use, in particular cross-infection. Data regarding indications and techniques in common use is deficient. This study aimed to investigate hydrotherapy practices in the UK and Ireland.

Methods: A survey of the hydrotherapy practice of major burn care providers was performed by e mail and where necessary, follow up telephone contact.

Results: The survey included 28 burn care providers. 27 reported using hydrotherapy. Only 11 (41%) had defined indication criteria with 4 (15%) implementing a specific protocol. Variations in hydrotherapy practice were seen.

Conclusion: Hydrotherapy is used nationwide, however considerable variation in practice exists. One area worthy of further consideration is the need for appropriate standards of infection control.

1. Introduction

Loss of the skin's protective barrier and depressed immune function secondary to thermal injury make burn patients uniquely vulnerable to infection [1], and the burn wound an ample environment for bacterial colonisation with both endogenous and exogenous organisms [2]. Following better airway management [3] and effective resuscitation, sepsis has become the leading cause of death in major burns [4,5]. The prevalent organisms in burn wounds differ between countries and even hospitals within the same country, depending on local protocols and infection control policies [6–9]. Gram-negative bacteria, specifically *Pseudomonas aeruginosa*, are widely implicated as the pathogens associated with hospital-acquired infection in burns, causing increased morbidity and mortality [10,11]. In a survey of directors of burns centres in the United States, *Pseudomonas aeruginosa* (*P. aeruginosa*) was subjectively identified as the commonest pathogen nosocomially acquired with hydrotherapy, followed by Methicillin

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Resistant *Staphylococcus aureus* (MRSA) [12]. In England, since MRSA has become a mandatory surveillance reportable target for all acute care hospitals, with severe financial penalties [13], MRSA incidence has declined. This shift is echoed by reports from other centres [4,5,14].

Hydrotherapy is defined as ''The medical use of water in the treatment of certain diseases'' [15] and its use in the treatment of burn wounds can be traced back to its origins in the mid-seventeenth century [16]. Hydrotherapy in burns typically involves the washing of patients in a tank, shower or agitating bath, the techniques of which have evolved over the centuries. The earliest recorded techniques saw the permanent immersion of patients in wooden baths with twice daily water changes. The late 1880s saw the move towards gentle cleansing of the burn using a brush and a mercury cleansing solution [17]. Current practice has seen a move away from traditional bath hydrotherapy towards 'shower cart-hydrotherapy' [18].

Despite the widespread use of hydrotherapy in the United Kingdom, there is a lack of published data on the indications and efficacy of its use in the management of acute burn wounds. Benefits of hydrotherapy include: reduction of the wound bacterial load, providing an opportunity to clean the burn surface, debriding wounds, facilitating the separation of eschar, removing exudates and residual topical agents, facilitating physiotherapy and improving patient comfort [10,18,19]. However, studies have also reported negative outcomes associated with the use of hydrotherapy in burn care including the development of pyrexia and fatigue [18]. Electrolyte disturbances have also been reported associated with the use of hydrotherapy [17,18,20]. Cross-infection is of particular concern with several studies attributing outbreaks in burn centres to contaminated hydrotherapy equipment [10,21–24]. A study by Reuter et al. [25] on surgical patients (not including burns) suggested that 36–42% of healthcare associated cases of *P. aeruginosa* are due to contaminated water from the tap. Hospital acquired *P. aeruginosa* is associated with delayed wound healing, graft loss, sepsis, increased morbidity and even death [11,26,27].

Despite the conflicting evidence regarding the advantages and disadvantages of using hydrotherapy in burns management it has been estimated that 92% of burns units in the USA are using the technique with 74% of them incorporating it into their daily practice [18].

The practice of hydrotherapy in burn care varies considerably between different centres and units. A survey carried out by Thomson et al. demonstrated that variation exists with regard to whether the patient is immersed, showered or sprayed, the frequency and duration of ''tubbing'' which member of the team carries out the hydrotherapy; the type of tub used and the solution used [17]. Other documented variations include the use of disposable liners and whether equipment decontamination is undertaken [19,26–28].

To date, there has not been a published study regarding hydrotherapy practices in the UK and Ireland. Our group identified this as a worthwhile subject to investigate.

The aim of this project was to conduct a nationwide survey to investigate current hydrotherapy practices at the major burn care providers in the United Kingdom and Ireland.

2. Materials and methods

2.1. *Survey of burn providers in the United Kingdom and Ireland*

A survey addressing various aspects of hydrotherapy practice including; indication, protocol, method, frequency, additives, sedation, infection control measures, environmental surveillance and perceived benefits was sent via e-mail to all 28 burn providers. The burn providers contacted were those listed by the British Burn Association and the European Burn Association. Those who did not respond initially were followed up by telephone. Respondents were specialist burn nurses or members of staff knowledgeable in local hydrotherapy practice.

3. Results

The survey achieved 100% response rate with all 28 burn centres and units responding, 27 of them reporting the use of hydrotherapy. Only 41% (11/27) had specific indication criteria for the use of hydrotherapy, with 15% (4/27) implementing a hydrotherapy protocol.

Notable variations were reported in hydrotherapy practices (Table 1). Four providers exclusively showered patients, none exclusively performed immersion ''bathing'' hydrotherapy and only one provider reported not using showering. Bedside irrigation of wounds (as an alternative to hydrotherapy) was performed by all but one provider. Treatment sessions were very variable in duration (10 min to 4 h) and dependent upon individual patients needs.

Table 1 – Hydrotherapy practices.

	N (%)[a]
Method of cleaning wound	
Immersion in tub	21 (78)
Immersion with spraying/showering	21 (78)
Shower	26 (93)
Shower trolley	18 (67)
Frequency of wound cleaning	
Daily	8 (30)
Routinely every 3–5 days	18 (93)
Whenever dressing change is needed	14 (52)
Main cleansing agent(s) used	
Tap water	26 (96)
Regular soap	14 (52)
Povidone iodine	4 (15)
Chlorhexidine	11 (41)
None	1 (4)
Number of staff involved	
One to two	13 (48)
One to three	11 (41)
One to five	1 (4)
Five + not specified	1 (4)

[a] Percentages do not add up to 100% because more than one answer was given by many institutions.

Table 2 – Microbiological surveillance and infection control.

	N = 27 (%)[a]
Wound swabbing	
During treatment	8 (30)
Routinely weekly/biweekly	8 (30)
If clinically indicated	17 (63)
Water testing	
Yes routinely	17 (63)
No	10 (37)
Environmental cultures	
Yes routinely	2 (7)
No	25 (93)

[a] Percentages do not add up to 100% because more than one answer was given by many institutions.

With regard to facilities, the number of showers available in the burns units and centres ranged from 0 to 17 (mean 5.6). The number of showers in each unit or centre that were shared between patients varied from none, up to a maximum of 4. The majority of wards (70%, 19/27) had one or 2 shared showers, with the others being for the exclusive use of individual patients. As may have been anticipated, those wards with fewer total numbers of showers had greater sharing between patients.

Overall, fewer bathtubs were available than showers. Six providers reported not having any baths in the ward area, the others ranged from having 1 to 3 baths (mean 1.6). One adult unit with 2 bathtubs did not share these between patients. All other providers who had baths, reported that all their baths were shared between different patients.

Variations in microbiological surveillance (Table 2), infection control measures and the use of personal protective equipment (PPE) were also identified. Several burns services commented that these could vary depending on the perceived level of risk.

All of the 27 burn centres that use hydrotherapy reported that staff wear gloves during the cleaning of wounds and in 8/27 sterile gloves are worn. The majority wore either sterile gowns (4/27), aprons (16/27), or a combination of both (5/27) during hydrotherapy, with only 2 respondents saying that neither were worn.

Masks or protective eyewear were used less widely and only 5 of the 27 units recorded use of these forms of PPE. Other measures included the wearing of Wellington boots (2/27) and the use of plastic liners in the shower trolley (4/27).

4. Discussion and literature review

Hydrotherapy has a long history of use in the management of acute burn wounds although there have been notable changes in its method of practice. Prior to the 1980s surgical excision of burn wounds was delayed, allowing bacterial colonisation to assist in the breakdown of the eschar. Hydrotherapy was then used to assist in the gradual debridement of the burn wound until a healthy bed of granulation tissue was evident, at which point skin grafting was performed [23]. However, a greater understanding of burn pathophysiology has resulted in the modern practice of early surgical burn wound excision and skin grafting which is believed to minimise the systemic inflammatory response, decrease hypertrophic scarring, decrease wound infection and thereby decrease burn wound morbidity and mortality [29]. Despite changes in hydrotherapy practice over the past several decades the evidence supporting these changes is lacking. The best wound care strategy, with regard to method, solution, and frequency of wound cleansing is yet to be determined and it is argued by some that hydrotherapy practices are ritualistic and not based on scientific evidence [26].

Results from our study demonstrate that 96% (27/28) of respondents routinely use hydrotherapy, which is slightly higher than the 83.1% of respondent Canadian and American burn centres according to Davison et al.'s recent survey [19]. Only one unit reported not using hydrotherapy due to concerns about hospital acquired cross-infection. Davison et al. also reported the most common reasons given by burn directors for the discontinuation of hydrotherapy pertained to concerns of hospital acquired infection or outbreaks. In more contemporary hydrotherapy practice, showers have gained popularity over the immersion methods, the latter believed to play a greater role in infection transmission. In the North American survey 45.6% of centres immersed patients at some point [19], a reduction from 81.4% previously reported [22]. In our study 78% reported using immersion hydrotherapy however the majority reported that this was used infrequently and only in a selected group of patients. Immersion hydrotherapy therefore continues to be used routinely in the UK, despite the cross-infection risks it potentially poses and lack of scientific evidence on its benefit. It has been shown that immersion hydrotherapy does not reduce bacterial counts in the normal or burned skin of thermally injured patients without addition of sodium hypochlorite, the use of which is unfortunately limited due to its irritant nature [30].

Stringent infection control, including patient isolation, is central to decreasing transmission. This is particularly important with *P. aeruginosa* given its propensity for water systems and documented persistent colonisation of hydrotherapy equipment [10,12,31]. *P. aeruginosa* has evolved to thrive in aquatic environments using its polar pili that allow it to strongly adhere to surfaces and its protective mucopolysaccharide coat that limits the penetration of antimicrobial agents. It can furthermore undergo rapid chromosomal rearrangements resulting in the development of multi-resistant strains [10]. Sharing hydrotherapy equipment amongst patients breaches patient isolation. The high rates of this practice in our survey (94% of all bathtubs present in the burns wards and 28% of all showers were shared) are of concern. Similarly worrying is the low use of disposable shower trolley drapes. Only 4 out of 17 wards using shower trolleys reported using disposable shower trolley liners. This is in contrast to 80.4% of respondent burn centres using disposable tub or shower cart liners in the recent North American survey by Davison et al. [19]. The use of disposable bath liners was unfortunately not addressed in our survey. The use of disposable tub or shower cart liners gained popularity after research showed it to be effective in reducing wound contamination during shower hydrotherapy and it also shortens equipment decontamination time [24].

Table 3 – Summary of the literature.

	Thomson et al. [17]	Shankowsky et al. [12]	Davison et al. [19]	2013 – UK and Ireland
Patient population	United States	United States and Canada	United States and Canada	United Kingdom and Ireland
Centres surveyed	100	202	142	28
Centres replied (%)	76 (76%)	153 (75.7%)	59 (42%)	28 (100%)
Survey method	Postal	Postal	Web-based	E mail + telephone
Number of beds replied (total)	1000 (1790)	1594 (1790)	827 (1900)	NS
Regularly used %	92%	95%	83%	96%
Immersion hydrotherapy (IH) only	46%	77%	10%	0%
Shower carts (SCH) only	6%	18%	54%	4%
IH and SC	3%	NS	35%	96%
Disposable liners	70%	46%	77%	NS
Antiseptic additives	67%	75%	49%	56%
Routine equipment cultures	14%	50%	44%	7%
Routine water culturing	NS	19%	NS	63%
Survey target staff	NS	BC supervisors	BC directors	Senior nurses

NS not specified.

Our survey reveals variability in frequency of showering and this is reported to be determined by several factors, including the amount of wound exudate, the half-life of the dressing's active ingredient and the presence of debris and necrotic tissues [26]. Evidence on the optimal duration and frequency of hydrotherapy sessions is lacking and warrants further investigation in light of concerns that routine cleansing and dressing changes may harmfully interfere with wound healing processes [32]. Variability in antimicrobial agents utilised was also reported. Concerns have been raised over the use of detergents and disinfectants in burn wound cleansing [26] on the grounds that their toxicity may outweigh the benefits of their antiseptic properties [33].

Tap water appears to be a significant route of transmission in hospitals however infections and colonisation can be significantly reduced by placement of filters on the water taps [34]. In our study all but one burn provider reportedly used tap water. The use of showerhead filters has not been addressed in this survey and warrants further investigation. One centre reported using sterile saline, however a recent Cochrane review found tap water to be statistically more effective than saline at reducing infection rates in acute wounds in adults but there was no statistical difference in children [35]. Table 3 summarises hydrotherapy surveys.

Monitoring of equipment is important in identifying sources of contamination to allow for interventions to prevent cross-infection and ensure adequate disinfection. Variability in environmental surveillance was observed in this study with only 2 of the 27 providers routinely swabbing the environment. Davison et al. reported that of the North American respondents only 43.5% routinely culture their equipment [19], a drop from the 49.7% previously reported [12]. Evidence on the efficacy of routine microbiological surveillance of environmental swabs and water testing to detect pathogens is lacking with Tredget et al. reporting a *P. aeruginosa* outbreak despite weekly surveillance cultures of hydrotherapy equipment [31]. The current UK department of health guidance advocates routine microbiological environmental surveillance as a mandatory activity for 'augmented patient care units' including all neonatal, paediatric, adult critical and burn care settings [36].

Local wound cleansing as an alternative to hydrotherapy has been shown to reduce *Pseudomonas*-associated morbidity and mortality [11], findings which have caused several burn centres to discontinue using hydrotherapy in their patients. In light of the growing body of evidence favouring the discontinuation of hydrotherapy further prospective trials with and without hydrotherapy may be needed to re-examine the role of hydrotherapy in modern acute burn care. In addition, a well-defined infection control policy, specific to hydrotherapy, is needed to suit different local practices.

5. Conclusion

Hydrotherapy continues to play an important role in the acute management of burn wounds, however notable variations in the practice of hydrotherapy exist. Despite its widespread use there are fundamental gaps in the evidence demonstrating the benefits of hydrotherapy and equally quantifying the associated risks. The need for evidence-based clinical guidelines and outcome and quality of care measurements for the usage of hydrotherapy is thus evident. Without these structured guidelines it is difficult, if not impossible, to establish evidence-based best practice that lends itself to being monitored, audited and improved.

The precise route by which patients become colonised remains unclear, however studies using modern molecular biology technologies have identified a role of contaminated hydrotherapy equipment in strain transmission. Such studies have been limited in their utility and future studies using whole-genome sequencing are needed to gain a more detailed understanding of strain transmission and evolution.

Conflicts of interest statement

There are no conflicts of interest. The first author was supported by a medical student grant from the Healing Foundation.

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