Cleansing diabetic foot wounds: Tap water or saline?

Lynne Watret, Alan McClean

Article points

1. There is some evidence to suggest that common tap water is a safe an effective agent for cleansing wounds.
2. Few studies specifically address the safety of using tap water as a cleansing solution in diabetic foot wounds.
3. The cleansing technique that is used makes a material difference in the safety of the process.
4. Further evidence is needed to justify the use of common tap water to cleanse diabetic foot ulcers due to the complex nature of these wounds.

Key words

- Diabetic foot wound
- Cleansing
- Saline
- Tap water

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There is an ongoing debate in the healthcare profession regarding wound cleansing with common tap water: is it safe for use, or should sterile saline be the only option? The impact of poor cleansing choices by healthcare professionals can have serious consequences for those with chronic and vulnerable diabetic foot wounds. The authors review the evidence for the use of tap water to cleanse diabetic foot wounds, discuss the risks that must be assessed, and evaluate how the method of cleansing – as well as the solution that is used – plays a role in managing risk.

Healthcare professionals are indoctrinated during their training to believe that sterile is best and anything less does not have a place in wound care. Yet, a recent Cochrane review stated: "There is no evidence that using tap water to cleanse acute wounds in adults increases infection, and some evidence that it reduces it" (Fernandez and Griffiths, 2008).

Here, the authors investigate this debate as it relates to the management of diabetic foot wounds. The arguments for and against the use of tap water, rather than sterile saline, are evaluated. The use of topical antiseptics and surfactants are outside the scope of this article. To further develop this debate, water and saline are looked at in the context of how wound cleansing is delivered and the cleansing techniques used.

Background

Cleansing involves the application of fluid to aid removal of loosely attached cellular debris and surface pathogens contained in wound exudate or residue from topically applied wound care products (e.g. hydrogels) from the wound bed (*Figure 1*; Towler, 2001; Williams, 1999). It is distinct from debriding, which is the removal of dead, adherent material from the wound (Stotts, 2004; Dow, 2008) by use of mechanical, sharp debridement by scalpel or hydrosurgery using a pressurised stream of fluid (e.g. Versajet, Smith & Nephew, Hull).

When a wound is in the acute, proliferating stage, cleansing may not be required. Acute wound fluid differs from that of chronic wound fluid (Schultz et al, 2003). In the acute, inflammatory phase of healing, exudate is normally viewed as beneficial as it provides "essential nutrients as an energy source for actively metabolising cells, and to achieve moisture-regulation function" (Thomas, 1997). This acts as "a carrier of the cells and biochemical mediators required for tissue regeneration" (Vowden and Vowden, 2004). Thus, the removal of a nutrient rich exudate through irrigation in the acute healing cascade may be detrimental to the natural wound healing process. Furthermore, for certain therapeutic agents that promote granulation and cell proliferation (e.g. Xelma, Mölnlycke Health Care, Dunstable; Promogran, Systagenix, Gargrave), the manufactures' instructions prohibit irrigation so that the potential of the agent can be optimised.

However, approximately 15% of all people with diabetes under good control would still not demonstrate normal healing rates (Sihl et al, 1998). It is out with the scope of this review to determine whether a recently surgically debrided diabetic lesion should be considered an "acute wound" and cleansing at dressing change may still be considered essential to remove barriers to healing present in chronic wound exudate (Schultz et al, 2003). A fuller discussion of when wound cleansing is appropriate is beyond the scope of this article.

Cleansing with tap water

If the rationale for wound cleansing is to remove loose slough, debris and the components of chronic wound fluid (e.g. senescent cells, proteases, bacteria), then the choice of a solution with which the irrigation will be carried out should be one that will do no harm and prevent infection while achieving this objective. The traditional position is put best by Fernandez et al (2004): "Various solutions have been recommended for cleansing wounds, however normal saline is favoured as it is an isotonic solution and does not interfere with the normal healing process". The debate over whether tap water can fulfill the above criteria has a long history among healthcare professionals, often with opinion dividing along professional boundaries.

Riyat and Quinton (1997) found that tap water was as effective as saline in the management of acute wounds in an emergency department. However, information on the comorbidities of their study population was not provided (e.g. outcomes for those with diabetes), which makes applying these findings to specific wound types (e.g. diabetic foot wounds) difficult.

Barclay (2008) found that, for open fractures, no statistically significant differences in the incidence of infection could be seen between those wounds that were cleansed using saline, distilled water and water that had been boiled and cooled. However, distilled water and water that has been boiled and cooled cannot strictly be called potable tap water and are essentially sterile solutions.

Griffiths et al (2001) presented results in favour of the use of tap water to cleanse wounds in a randomised controlled trial, which included both acute and chronic wounds. However, the sample size was small.

Moscati et al (2007) carried out a multicenter trial in which tap water and saline for cleansing were compared in an emergency department setting. The authors found that the tap water and saline groups did not differ in terms of their incidence of infection. However, exclusion criteria in this study were people with diabetes, those who were immunocompromised, and those with wounds that extended to bone or tendon.

Small sample sizes and studies involving mainly acute wounds are major limitations of the available data. Care must be taken not to apply evidence from acute wounds to complex diabetic lesions, especially those with exposed tendon or bone (Lindholme et al, 1999). Given the paucity of data specific to diabetic wounds, it is difficult to construct an evidence-based argument for the use of tap water to cleanse this type of complex wound. However, the very positive results for wounds in general suggest that under certain circumstances water could be a safe and effective cleansing agent, and more evidence in this population is needed.

Cleansing technique and delivery

The process of wound cleansing involves two parts: the selection of a wound cleansing solution, and the selection of a mechanical means for delivering that solution to the wound (Bergstrom et al, 1994). Both elements should be considered when risk is being assessed. Where tap water is used in wound cleansing, a risk assessment must be made to ensure that the water, through its method of storage or delivery, does not increase the risk of infection. Thus, a discussion about cleansing will always be one that questions not

Figure 1. Irrigation of a diabetic foot ulcer with saline. Image courtesy of Duncan Stang.

Page points

1. The choice of a solution with which the irrigation will be carried out should be one that will do no harm and prevent infection while achieving this objective.
2. One solution suggested as an alternative to saline is common tap water, because of the ease with which it can be accessed, and because the expense is negligible.
3. Distilled water and water that had been boiled and cooled cannot strictly be called potable tap water and are essentially sterile solutions and not tap water.
4. Moscati et al (2007) found that the tap water and saline groups did not differ in terms of their incidence of infection, but people with diabetes were excluded.

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1. District and community nurses involved in wound care report using basins or buckets, lined with polythene bags, and filled with tap water to cleanse venous leg ulcers, with no apparent adverse consequences.
2. Doubts have been raised about the hygiene of basin cleansing, with one study reporting that patients' basins used for this purpose had some form of bacteria in 98% of the samples.
3. In many multi-dwelling residences, health centres and hospitals, water both hot and cold is stored for a period of time in water tanks and may lie idle for a period of time before use.

only the choice of solution, but also the method by which it is delivered.

Cleansing may imply a passive action compared with irrigation, which would suggest a more dynamic process. "Wound irrigation has been shown to accelerate the rate of healing of chronic wounds and probably does so by removing bacteria and adherent proteinaceous tissue exudates which can act as a foreign body" (Dow, 2009). Compared with swabbing or bathing "wound irrigation has emerged as the most useful and reproducible technique for wound cleansing" (Ennis et al, 2004). The method of delivery should be expected to be effective in achieving wound cleansing while preventing trauma to the wound bed and minimising risk of driving bacteria into the wound bed.

Experience with tap water in buckets and basins

District and community nurses involved in wound care report using basins or buckets, lined with polythene bags, and filled with tap water to cleanse venous leg ulcers. The main reason for this method is social cleansing of the peri-wound margin and the foot (Morison and Moffat, 1994; Lawrence, 1997; Watret and Armitage, 2002). Patients are usually asked to purchase their own basin for this purpose.

This method is a generally accepted custom and practice, although doubts have been raised as to its hygiene, with the cleaning and storage of the basins being usually unmonitored. Johnson et al (2009) found that patients' basins used for this purpose had some form of bacteria in 98% of the samples, including *Enterococcus*, vancomycin-resistant *Enterococcus* and meticillin-resistant *Staphylococcus aureus*. For the complex and high-risk diabetic foot wound, safer practice may be to avoid the use of basins for cleansing.

Social hygiene and cleansing

Many people, those with diabetic foot wounds included, like to shower daily, and this is important for a feeling of wellbeing and social hygiene. Stotts (2004) reminds us that many healthcare professionals recommend that patients remove wound dressings during showering so that the water flows directly on the wound. However, when cleansing wounds in this way, a number of considerations should be made, such as how clean is the tap and washing area in general.

In many multi-dwelling residences, health centres and hospitals, water (both hot and cold) is stored in tanks and may lie idle for a period of time before use. Questions should be raised as to the stability and sterility of such tanks and the water which they hold. In the hospital environment there are strict infection control guidelines on running showers for a period of time prior to use to reduce the incidence of bacterial contamination such as *Legionella*.

Ennis et al (2004) conclude that "widespread variations in water purity, as well as living conditions, make it difficult to support the universal use of tap water for irrigation". If we accept this position – that tap water should not be used for irrigation given concerns about wound infection – then showering with an exposed wound must also be considered a risky practice. However, people with wounds should not be excluded from showering for social hygiene purposes, particularly when a wound can be in existence for a prolonged period of time as is the case for many chronic diabetic foot wounds. The provision of seal tight boots should be considered to allow the patient to shower, while isolating the foot and wound from water exposure.

Aseptic technique versus clean technique

Aseptic technique can be provided in the theatre or treatment room environment, and only sterile equipment is used (Gilmour, 1999). In both hospital and community settings in the UK, there is access to sterile dressing packs that include gloves, drape, swabs, a bag and sterile saline in the form of pods or canisters. Use of this aseptic technique is common practice for the cleansing of a variety of complex wounds.

Alternatively, in wards, treatment rooms or at domiciliary visits a "clean" technique can be used. This involves wound cleansing with the aid of swabs, removed from a large multipack, and the use of non-sterile gloves. The wound is irrigated with sterile saline and the surrounding area dried with swabs. A non-touch technique, where swabs are used only to dry the area surrounding the wound to allow fixation of the dressing, should be practiced, to avoid trauma

to the wound bed, fresh inflammation and the deposition of fibers (Wood, 1976). There is a risk that the remaining swabs in the pack may be used on subsequent patients, or left in the patient's home for the next visit. Thus, do we lull ourselves into a false sense of security, thinking that the use of clean, but non-sterile, consumables will avert infection so long as the cleansing solution is sterile?

Pressure

The pressure used in irrigation is a key variable to achieve effective wound cleansing. Pressure of around the range of 8–15 pounds per square inch (PSI) is most frequently cited as an effective therapeutic range (Stewart et al, 1971; Rodeheaver et al, 1975; Fernandez et al, 2004; Dow, 2008). This is equated to the pressure achieved by the use of a 35 ml syringe with a 19 gauge angiocatheter, or commercially available canisters or pods for wound irrigation. Irrigation pressures <4 PSI are insufficient to remove surface pathogens, while those greater >15 PSI may cause wound trauma and drive bacteria deeper into wounds (Brown et al, 1978). When using commercially available wound irrigation canisters, the manufacturers' instructions must be followed to avoid spray back from aerosols applied <10 cm from the wound surface (Lawrence and Kidson, 1994).

Temperature of solution

Cleansing solutions should be used at body temperature as it can take 40 minutes for a wound to return to normal temperature following cold cleansing (Locke, 1979; Gannon, 2007), and around three hours for leukocyte activity to recover after irrigation with a cold solution (Miller and Dyson, 1996). The physiological effects of hypothermia (e.g. vasoconstriction, depressed neutrophil activity, reduced ability of the cells to use oxygen free-radicals to kill bacteria, and lower levels of collagen deposition) can result in impaired resistance to infection and delayed wound healing (Ikeda et al, 1998).

Thus, the temperature of the cleansing solution at the time of delivery can impact the risk of infection and progression to healing. This implies that it is not simply the type of solution used, but also the nature of its delivery that is important.

Consistent cleansing protocol

People with diabetic foot wounds encounter a variety of clinicians while undergoing treatment. Variations in practice within and between professions (nurses, podiatrists) and settings (hospital, community, home) exist, with practitioners having different views on best practice based on their own experiential learning. These variations in practice are heightened in clinical areas where the evidence base is not conclusive. In the case of wound cleansing, variation can result in the patient being the recipient of more than one method of cleansing, depending on who is carrying out the episode of care.

"The complex and multifaceted nature of wounds in an individual with diabetes requires a coordinated, interdisciplinary approach" (Regina Qu'Appelle Health Region's Diabetes Foot Care Working Group, 2009). Consensus and continuity of care reduces variations in practice and reassures the patient that, regardless of who is carrying out the care, the same procedure will take place. Decisions about wound cleansing, including the type of solution used and the way in which it is delivered, need to be made as part of a collaborative diabetic foot care team. Mutual respect between the professionals delivering care is essential.

Conclusion

The authors set out to consider whether there was sufficient evidence to support the use of potable tap water over sterile saline, for wound cleansing in the diabetic foot. With a Cochrane Review, and a number of other studies, reporting that the use of tap water during wound irrigation posed no more risk of infection than saline, the case for tap water as an easy, effective, inexpensive (or even free) solution for irrigation looked strong. However, the published data were based mostly on acute wounds, small sample sizes, and frequently diabetes was an exclusion criterion. This made the task of drawing a conclusion for the safe use of tap water specifically in diabetic foot wounds difficult.

Beyond the choice of cleansing solution, a discussion of the various wound cleansing procedures, and how they may impact on wound progression, was undertaken. The

Page points

1. The provision of seal tight boots should be considered to allow the patient to shower, while isolating the foot and wound from water exposure.
2. Aseptic technique can be provided in the theatre or treatment room environment, and only sterile equipment, while a clean technique can be carried out using swabs, removed from a large multipack, and non-sterile gloves in a number of settings.
3. The pressure used in irrigation is a key variable to achieve effective wound cleansing.
4. Cleansing solutions should be used at body temperature as it can take 40 minutes for a wound to return to normal temperature following cold cleansing because the physiological effects of hypothermia can result in impaired resistance to infection and delayed wound healing.

Page points

1. Variations in practice are heightened in clinical areas where the evidence base is not conclusive, and the patient can be the recipient of more than one method of cleansing, depending on who is carrying out the episode of care.
2. Decisions about wound cleansing, including the type of solution use and the way in which it is delivered, need to be made as part of a collaborative diabetic foot care team.
3. The published data on tap water irrigation is based mostly on acute wounds, small sample sizes, and frequently diabetes was an exclusion criteria.
4. Given the number of variables associated with tap water, the authors recommend that sterile saline solution is used to cleanse these complex and vulnerable wounds.

method of application of the cleansing solution to the wound should render it both effective in achieving the removal of unwanted debris from the wound site, while preventing trauma to the wound bed and minimising the risk of introducing infection. While tap water may be appropriate for cleansing wounds, such as venous leg ulcers, the method by which it is delivered may make the water a conduit for bacterial growth and potential cross contamination from the vessels in which the cleansing takes place. We not only require consensus on the cleansing solution, but on the procedure as well.

Wound cleansing should be viewed as part of wound bed preparation for healing, or it runs the risk of becoming "a separate, somewhat ritualistic activity performed for its own sake" (Gunnewicht and Dunford, 2004). Choices regarding the solution used, and the process of cleansing, should be evidence-based and subject to risk assessment. Choices about when, how and where to cleanse a diabetic foot wound should be agreed on by the interdisciplinary foot care team, in conjunction with the person receiving care (Lamond and Thomson, 2000). For protection of the wound, and continuity of care, all healthcare professional involved with a wound should be cleansing it according to an agreed protocol.

Despite Barclay (2008) stating that "the decision to use tap water to cleanse wounds should take into account the quality of water, nature of wounds and the patient's general condition, including the presence of comorbid conditions", best practice dictates that a risk assessment is carried out and rationale documented on a case-by-case basis with consideration to the complexity of the wound, the patient's immunological status, environmental factors and patient preference. Given the number of variables associated with tap water, and the absence of conclusive evidence specific to diabetic foot wounds, the authors recommend that sterile saline solution is used to cleanse these complex and vulnerable wounds. ■

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