

Cleansing of acute traumatic wounds: tap water or normal saline?

KEY WORDS

- ▶ Normal saline
- ▶ Tap water
- ▶ Wound cleansing
- ▶ Wound irrigation

Acute traumatic wounds are considered contaminated and therefore require cleansing to remove any foreign material, reduce the risk of infection and facilitate an optimum healing environment. Normal saline has traditionally been the solution of choice for wound cleansing, because it is isotonic, relatively inexpensive and readily available. Several recent trials report that tap water (TW) of drinkable quality is as safe and effective as normal saline for the cleansing of acute traumatic wounds, with two trials reporting lower infection rates in the TW groups versus the normal saline groups. These results support wound cleansing with TW, which could be initiated at an early stage in the patient journey, and allow consistent, safe and cost-effective wound cleansing in a busy emergency department.

Acute traumatic wounds occur when the body is subjected to a force that exceeds the strength of the skin or underlying tissue (Whiteside and Moorehead, 1993), and can be caused by a variety of mechanisms (Holt, 2000). Healing of acute wounds involves a complex, well-orchestrated series of events, resulting in a healed wound in a timely and orderly manner (Enoch and Leaper, 2005). All acute traumatic wounds are considered contaminated and therefore require cleansing to reduce the risk of infection and to promote an optimum environment for healing (Riyat and Quinton, 1997).

Wound cleansing has been described as often ritualistic, not evidence-based and inconsistent (Young, 1995; Towler, 1995; Lawrence J, 1997; Watret and Armitage, 2002; Magson-Roberts, 2006) with significant variability in the irrigation techniques and fluids employed (Dulecki and Pieper, 2005). Two commonly used irrigation fluids in wound cleansing are normal saline (NS) and tap water (TW) of drinkable quality.

NS is often used to irrigate wounds and is isotonic, safe and available in most emergency departments; however, it does have an associated cost per bag, comes with a shelf life and requires administration by a healthcare professional.

TW as an irrigation fluid is certainly cost-effective, can be patient-delivered and a feeling

of wellbeing has been reported by patients who were allowed to shower their own surgical wounds (Neues and Haas, 2000). TW of drinkable quality appears safe to irrigate wounds; studies of acute wounds either exposed to TW or kept dry, have found no significant difference in infection rates (Fernandez et al, 2001). Looking more closely at pathogen risk, Riyat and Quinton (1997) analysed the bacterial content of TW samples in a UK accident and emergency department, referred to here as emergency department (ED). They reported that no pathogens were isolated and that TW of drinking quality was safe for the irrigation of open traumatic wounds (Riyat and Quinton, 1997). Concern regarding the regular use of TW for wound cleansing has been raised by some research, proposing that diffusion could remove the dissolved substances that aid healing from the intracellular fluid, such as growth factors and chemokines (Young, 1995). However, no strong evidence exists to support these concerns, nor any to suggest that

Identifying the studies to review

Databases:	Cochrane Library; Embase; Google Scholar; Medline; PubMed; Scopus; Web of Science
Search terms	normal saline; normal saline versus tap water; tap water; wound cleansing; wound cleaning

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this is not the case with other irrigation fluids. Other researchers have proposed that because water is a hypotonic solution, it could harm wound beds via creation of cellular oedema and rupture with increased osmotic pressure (Goldberg, 1988) and even cause increased pain and tissue damage (Goldberg et al, 1981; Glide, 1992; Towler, 1995). Again, there is a paucity of well-constructed trials to support or refute these opinions.

Three main variables in wound cleansing include cleansing solution, solution volume and delivery method (Trevelyan, 1996) and significant variation in these key elements of wound cleansing in different trials result in difficulty comparing study findings to ascertain the most effective method. No evidence-based guidelines exist with regard to the optimum cleansing solution, volume and delivery method on which clinicians can base their practice (Barnes et al, 2014). As TW and NS are commonly used irrigation fluids in ED and surgical assessment units, a critical in-depth review of the higher level evidence regarding these two irrigation solutions has been performed.

NORMAL SALINE OR TAP WATER?

Angeras et al (1992) conducted a large (n=617) randomised controlled trial (RCT), comparing infection rates in adults with a soft tissue injury. Patients were randomised by alternation into either the TW group (n=297), or NS group (n=322). A nurse blinded to the two treatment groups assessed infection rates (defined as presence of pus and prolonged healing) one to two weeks later. Results reported a significantly ($p<0.05$) lower infection rate in wounds irrigated with TW (5.4%) compared with those irrigated with NS (10.3%). This trial's large numbers were diminished as 88 patients were lost to follow up, increasing risk of attrition bias and reducing internal and external validity (Crombie, 2011). Randomisation was by alternation, which increases risk of selection and performance bias (Petrie and Sabin, 2009; Crombie, 2011). As the temperature of the solutions used differed, this could affect results via alteration of blood flow, which can reduce epidermal migration and affect healing (McGuinness et al, 2004). Wound dressings differed between patients; some had hydrocolloid dressings and others were left

exposed, which could affect temperature, healing and infection rates and introduces further bias (Miller, 1994). No guidelines were given as to how the wounds should be irrigated, volume of solution to use, or time length of irrigation, therefore, it is difficult to determine if the solution or technique was responsible for any results reported. Whether the same nurse assessed all wounds was not stated, and the variation in time of review, lack of defined healing parameters or microbiological evidence could be criticised as subjective.

Bansal et al (2002) conducted a double-blind RCT comparing infection rates in simple lacerations in a paediatric ED. Forty-six children were randomised to NS (n=24) or TW (n=21) (excluding dog bites, hand lacerations and immunosuppressed patients) and received identical irrigation with a 35ml syringe and pressure of 25–40psi. Wounds were swabbed for culture pre- and post-irrigation with no significant ($p=0.2$) difference observed between post-irrigation positive cultures of the TW group (52%) and the NS group (29%). Clinically diagnosed infection rates (with well-defined criteria) were assessed at 48 hours and two were reported in each group, leading the authors to conclude that there was no increased risk of infection in using TW to irrigate traumatic lacerations. A significant strength of this trial was its design rigour, as all clinicians and patients were blinded to treatment group and irrigation methods were identical, increasing validity and reliability of the trial (Petrie and Sabin, 2009). However, the relatively small numbers, lack of information regarding randomisation or solution temperature and short follow-up assessment time limited this study. In other wound infection research, follow-up assessment times range from 7–10 days where 10.5% infection rates were detected (Ferraz et al, 1992); through to 6 weeks where 59% infection rates were detected (Law et al, 1990). This could suggest that a 48-hour follow-up time could miss later infections and impacts on the study findings.

Godinez et al (2002) conducted a RCT of 94 adult patients, comparing infection rates of simple extremity lacerations irrigated with TW (n=36) or NS (n=41). TW was used at a flow rate of 7l/min, whilst NS was aspirated using a syringe, and irrigation performed using a pulsatile motion.

Results concluded that infection rates were lower in the TW group (0%) versus NS (7%) though this failed to reach statistical significance ($p=0.15$). The authors provided no detail how, when or by whom infection was measured, thus it is difficult to compare findings and obviously hinders this research. The very different methods of irrigation could also have impacted on the findings, as different irrigation pressure and pulsatility has been reported to affect bacterial levels (Joanna Briggs Institute, 2006). Missing data for 17 patients and lack of baseline demographics compounded the methodological flaws of this study, however, reported results supported those of previous trials (Bansal C et al, 2002).

Valente et al (2003) performed a RCT of 530 children with simple lacerations irrigated with either TW or NS in a paediatric ED, excluding immunocompromised patients and those with (well defined) complicated lacerations. In terms of demographics, the TW group contained higher numbers of lacerations to the hands (21%) versus NS (9.2%), which have been reported to present an increased risk of infection (Trott, 2005). TW pressure and flow rates were standardised to a predetermined position, (3.53 to 4.22 kgf/cm² approximately 1.5l, 238ml/s) and wounds were irrigated for a minimum of 10 seconds. The NS group received irrigation with a minimum of 100ml of NS using a 30–60ml syringe, with an 18-gauge angiocatheter, with further irrigation was given at the discretion of the clinician. Follow-up was performed by a blinded clinician at 48–72 hours using rather wide clinical criteria (i.e. any tenderness, warmth or induration); two thirds of each group were assessed in person and a third over the telephone. Results reported no difference in infection rate between wounds irrigated with TW (2.9%) or NS (2.8%). Significant limitations of this study were the different methods of wound cleansing and in particular the additional cleansing at the physician's discretion, introducing a huge confounder. Telephone follow-up is known to be more subjective, risking bias to the results and the short follow-up could have missed infections as previously discussed. Allocation was by again alternation, odd days for the TW group ($n=259$) and even days for the NS group ($n=271$), which

risks selection bias (Crombie, 2011), which along with the wide criteria for infection reduces the impact of any findings.

Moscato et al (2007) performed a multi-centre, prospective RCT of 715 adult patients (excluding the immunocompromised) with uncomplicated skin lacerations requiring staple or suture repair in an ED. The TW group ($n=300$) irrigated their own wounds under an unmodified tap for a minimum of two minutes, whilst the NS group ($n=334$) were irrigated by clinicians, using a minimum of 200ml of saline and a 35ml syringe. Post-irrigation bacterial wounds swabs were compared and wounds assessed for infection (defined clinically as a change in treatment plan e.g. antibiotics or debridement) at 5–14 days by a blinded clinician, though 4% of each group received telephone follow-up. Results reported no significant difference in bacterial counts ($p=0.623$) and reported infections were equivalent for TW (4%) and NS (3.3%). Costs were also measured by comparing the price of the specific equipment required to perform wound cleansing for each group. This multi-centre study had large numbers, though 10% of patients were lost to follow-up; 35 in the NS and 36 in the TW groups. Computer randomisation reduced risk of allocation bias, and increased validity, and blinding of the assessing clinician increased reliability of the trial (Petrie and Sabin, 2009; Crombie, 2011). However, no maximum time or volume of solution used was stated for either group, which combined with the different methods used introduces bias and reduces reproducibility as does the use of telephone follow-up data (Crombie, 2011).

Weiss et al conducted a single-centre RCT of 631 patients over the age of 1-year, comparing wounds irrigated with TW ($n=318$) versus NS ($n=313$) (Weiss et al, 2013). All patients received irrigation using a 35ml syringe and 500mls of solution and wound infection was determined by broad clinical indicators (i.e. erythema or gross exudate), at direct review, telephone follow-up and self-reporting by subjects at one month. The authors concluded no significant difference in the infection rates of the NS group (6.4%) compared with the TW group (3.5%) though a clinical trend existed towards fewer wound infections in the TW group. Computer randomisation protocols increased validity of the

trial, as did the low numbers of patients lost to follow-up (NS=5, TW=1) however, the broad and varied methods of detecting infection could have impacted on the findings.

DISCUSSION

Cleansing of acute wounds is one of most consistently performed steps in the process of caring for acute traumatic wounds, however there remains a paucity of trials with good methodology comparing irrigation solutions and methods.

A recent Cochrane review compared water (tap, boiled, distilled or saline) with other solutions for wound cleansing (Fernandez and Griffiths, 2012) and reviewed five of the papers included in the literature presented in this review (Angeras et al, 1992; Bansal C et al, 2002; Godinez et al, 2002; Valente et al, 2003; Moscati et al, 2007). Similar to previous researchers, Fernandez and Griffiths concluded that cleansing with water was safe, but added that insufficient evidence existed to support cleansing of wounds at all to reduce infection or improve healing. However, the idea of wound cleansing is intuitive and though evidence for it is lacking, this could be a result of the number and design of the trials performed. It is accepted that acute wounds in ED are cleansed, and the most common solutions used are TW and NS.

The strength of the available evidence reviewed is diminished by inability to compare trial results due to huge variation in cleansing techniques and trial design, making meaningful data interpretation difficult (Polit et al, 2001).


Overall, available research supports the use of TW as a solution for acute wound cleansing and suggests that it is safe, with equivocal infection rates as those cleansed with NS (Bansal C et al, 2002; Godinez et al, 2002; Moscati et al, 2007; Weiss et al, 2013), if not less (Angeras et al, 1992; Valente et al, 2003). The natural next step in this research field would be a large multi-centre well-constructed RCT with standardised solution volume, technique and temperature, which could increase the available body of evidence. No available research investigated anxiety or patient opinion connected with the use of TW or irrigation with NS, which could perhaps help to understand the patient perspective.

When considering costs, Moscati et al (2007) found that individual patient costs were slightly reduced with TW, when comparing the value of the specific equipment necessary for each technique though if extrapolated across health care providers the savings could be substantial. When cleansing a wound with NS it is syringed or poured via a giving set over the patient's wound in the ED by a health care professional, whereas patient-directed TW wound cleansing involves sitting the patient by a sink with the wound under a running tap. It is perhaps not unreasonable to hypothesise that in a busy ED with waiting time targets, the duration and therefore amount of cleansing water could be increased in the TW scenario. The cost-benefit of freeing a busy ED clinician to attend to other tasks whilst a patient cleanses their own wound under a tap is difficult to calculate, but can be easily perceived.

Due to advances in medical knowledge, technology and medicines, increasing demands are being placed on the NHS, and there is a growing need for cost-containment, efficiency and value for money (Department of Health, 2010). The general public and media increasingly scrutinise Health Authorities' spending, and are quick to highlight areas where they believe money has not been spent wisely. An example of this was an article in the Daily Mail where it was reported that £750 was paid for 'salt water' (Waters, 2016).

Despite the lack of evidence to support wound cleansing per se, many clinicians hold with the saying "the solution to pollution is dilution" and thus a large volume of TW irrigation performed as early as possible can be beneficial. If we accept that cleaning with TW is safe then this could be performed after triage, directed by the ED nurse and performed by the patient whilst awaiting definitive wound closure, speciality referral or dressing.

CONCLUSION

Current evidence supports the use of TW as a safe method of acute wound irrigation, with reported rates of infection at least as low as those with NS. Patient-directed wound cleansing with TW in the ED may allow for early and effective wound cleansing, which could be beneficial for patients and cost-effective for health care providers. 

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