Emergency Nursing Resource: Wound Preparation

What method of wound preparation is most effective for promoting wound healing and reducing rates of infection for patients in the emergency department with acute lacerations?

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Background/Significance

Each year millions of patients with acute lacerations present to emergency departments for treatment. Management of these wounds will vary by practitioner, emergency department, and geographic location but the goal is the same: proper preparation of the wound to reduce the risk of infection and promote wound healing in order to achieve optimal results for the patient (Nicks, 2010; Dulecki, 2005).

Wound cleansing and irrigation for acute lacerations is one of the most frequent procedures performed to remove loose devitalized tissue, bacteria, and foreign bodies (Nicks, 2010). The standard of care for wound cleaning and irrigation of acute wounds in reducing the risk of infection and promoting optimum healing has been the subject of evolving research over the past several decades. Chatterjee (2005) reviewed several studies looking at the benefits of different irrigation techniques and concluded that there was a lack of substantial evidence to support one technique over another. There are multiple considerations in wound management including type, location, age, and size of the wound, as well as patient factors such as age and co-morbidities (Hollander et al. 2001). Hollander et al. identified that wound infection rates increased with patient age, diabetes, and jagged edge wounds.

This Emergency Nursing Resource (ENR) evaluates the scientific evidence for laceration preparation in regards to type of cleansing fluid, irrigating pressures optimal for cleaning a wound without damaging tissue, and patient satisfaction and comfort with cleansing technique.

Methodology

This ENR was created based on a thorough review and critical analysis of the literature following ENA's Guidelines for the Development of the Emergency Nursing Resources. Via a comprehensive literature search, all articles relevant to the topic were identified. The following databases were searched: PubMed, Google Scholar, CINAHL, Cochrane Library, Agency for Healthcare Research and Quality (AHRQ; www.ahrq.gov), and the National Guideline Clearinghouse (www.guidelines.gov). Searches were conducted using various combinations of the key words including wound cleansing, wound irrigation, acute wound care, and traumatic wound care. Initial searches were limited to English language articles from January 2005 – October 2011. This six-year search limit was found to be inadequate due to the limited number of relevant articles found and, therefore, the time frame was removed. In addition, the reference lists in the selected articles were scanned for pertinent research articles. Research articles from emergency department settings, non-emergency department settings, position statements and guidelines from other sources were also reviewed.

Articles that met the following criteria were chosen to formulate the ENR: research studies, meta-analyses, systematic reviews, and existing guidelines relevant to the topic of wound cleansing. Other types of reference articles and textbooks were also reviewed and used to provide additional information. The ENR authors used standardized worksheets, including the Reference Table, Evidence-Appraisal Table, Critique Worksheet and AGREE Work Sheet, to prepare tables of evidence ranking each article in terms of the level of evidence, quality of evidence, and relevance and applicability to practice. Clinical findings and levels of recommendations regarding patient management were then made by the Emergency Nursing Resource Development Committee according to the ENA's classification of levels of recommendation for practice, which include: Level A High, Level B. Moderate, Level C. Weak or Not recommended for practice (Table 1).

Table 1. Levels of Recommendation for Practice

Level A recommendations: High • Reflects a high degree of clinical certainty • Based on availability of high quality level I, II and/or III evidence available using Melnyk & Fineout-Overholt grading system (Melnyk & Fineout-Overholt, 2005) • Based on consistent and good quality evidence; has relevance and applicability to emergency nursing practice • Is beneficial
Level B recommendations: Moderate • Reflects moderate clinical certainty • Based on availability of Level III and/or Level IV and V evidence using Melnyk & Fineout-Overholt grading system (Melnyk & Fineout-Overholt, 2005) • There are some minor or inconsistencies in quality evidence; has relevance and applicability to emergency nursing practice • Is likely to be beneficial
Level C recommendations: Weak • Level V, VI and/or VII evidence available using Melnyk & Fineout-Overholt grading system (Melnyk & Fineout-Overholt, 2005) - Based on consensus, usual practice, evidence, case series for studies of treatment or screening, anecdotal evidence and/or opinion • There is limited or low quality patient-oriented evidence; has relevance and applicability to emergency nursing practice • Has limited or unknown effectiveness

Not recommended for practice
• No objective evidence or only anecdotal evidence available; or the supportive evidence is from poorly controlled or uncontrolled studies
• Other indications for not recommending evidence for practice may include:
  ○ Conflicting evidence
  ○ Harmfulness has been demonstrated
  ○ Cost or burden necessary for intervention exceeds anticipated benefit
  ○ Does not have relevance or applicability to emergency nursing practice
• There are certain circumstances in which the recommendations stemming from a body of evidence should not be rated as highly as the individual studies on which they are based. For example:
  ○ Heterogeneity of results
  ○ Uncertainty about effect magnitude and consequences,
  ○ Strength of prior beliefs
  ○ Publication bias

Evidence Table and Other Resources

The articles reviewed to formulate the ENR are described in the Evidence Table. Other articles relevant to wound cleansing were reviewed and identified as additional resources (Other Resources Table).

Summary of Literature Review

Wound Cleansing and Irrigation Methods

In order for wound irrigation to be effective, the force of the irrigation must be great enough to remove debris and organic material (bacteria, viruses) from the surface of the wound without causing harm to surrounding tissues (Luedtke-Hoffman & Schafer, 2000). Wound cleansing and irrigation may be accomplished using a variety of methods including bulb syringe, syringes with intravenous (IV) catheters or needles attached, or specialty irrigation devices.

Wound irrigation research has been carried out on various models including in vitro, live animal, and human. Stevenson, Thacker, Rodeheaver, Bacchetta, Edgerton, and Edlich (1976) conducted research on both fluid irrigation dynamics and the effectiveness of irrigation on experimental wounds. They found that irrigation fluid delivered through a 19-gauge needle produced higher pressure than fluid delivered through a 21, 23, or 25 gauge needle. When using a 19 gauge needle the researchers found pressures of 7 pounds per square inch when delivered through a 35 ml syringe and 20 pounds per square inch when delivered through a 12ml syringe. Fluid delivered through a bulb syringe produced an irrigation pressure of 0.05 pounds per square inch. Additionally, Stevenson and colleagues (1976) tested the syringe combination on contaminated wounds in a live rabbit model. High-pressure irrigation with both the 35ml syringe and 12ml syringe with a 19-gauge needle decreased bacterial contamination significantly and unequivocally. A bulb syringe was not effective in removing bacteria from wounds. High-pressure syringe irrigation significantly reduced the rates of infection in the wounds compared with the controls and the bulb syringe. The rates of inflammation did not significantly differ. Longmire and Broom (1987) completed a similar study using a human model comparing infection and inflammation rates in those who received bulb syringe irrigation and those who received high-pressure syringe irrigation. Those subjects who received high-pressure syringe irrigation had a significant decrease in infection and inflammation compared to those subjects who received bulb syringe irrigation. Of the subjects who received bulb syringe irrigation, 27.8% had evidence of wound inflammation and 6.9% had evidence of wound infection. Of those subjects who received high-pressure syringe irrigation, 16.8% had evidence of wound inflammation and 1.3% had evidence of wound infection at the time of wound assessment.

Compared to high-pressure syringe irrigation, high-pressure pulsatile lavage (HPPL) irrigation produces markedly increased pressures ranging from 50 to 80 pounds per square inch. The primary purpose of HPPL is for irrigation of wounds during surgical procedures; however, some emergency departments use HPPL for wound cleansing and irrigation. Draeger and Dahners (2006) conducted an in vitro study using flank steak contaminated with inorganic and organic debris to compare the efficacy of HPPL irrigation to bulb syringe irrigation combined with suction. Tissue samples irrigated with HPPL had more qualitative and quantitative degrees of tissue damage than suction irrigation or bulb irrigation. HPPL was also less efficacious at the removal of inorganic material. However, these data have yet to be extrapolated to in vivo or human models.

Saline versus Other Solutions

Saline has traditionally been utilized for wound cleansing and irrigation in the emergency department setting. Dire (1990) compared normal saline, 1% povodine iodine, and pluronic F-68 (Shur-Clens®) to determine which was the most efficacious in reducing the risk of wound infections in patients with soft tissue lacerations. Among the three solutions studied, the author found no significant differences in infection rates (p=0.571). Normal saline was found to be the most cost-effective. The authors noted that povodine-iodine has been found to be cytotoxic in non-human studies and that pluronic F-68 can be cost prohibitive.

Tap Water Versus Other Solutions

Tap water is commonly used in community settings for wound cleansing and has the advantages of being cost effective and readily available (Fernandez, Griffiths, & Ussia, 2010). Fernandez and colleagues (2010) completed a Cochrane Review to address the comparative effects of healing and infection in wounds cleansed with potable tap water compared to other solutions. Pooled data from three studies (Angeras, 1992; Godinez , 2002; Moscati, 2007) identified a 37% reduction in the rate of infection in wounds cleansed with tap water compared to wounds cleansed with normal saline.. Fernandez et al. (2010) point out that data from one study showed a significantly higher rate of infection in the group that received normal saline; however, this could have been attributed to difference in the temperature of the irrigation solution. Moscati (2007) concluded that with the use of tap water and the decrease in infection rates, supplies for irrigation and saline, an estimated $65 million would be saved annually in the United States if wounds were irrigated with tap water as opposed to normal saline. The review also included data from two studies that included infection rates in children (Bansal, 2002; Valente, 2003). Data from the studies including children showed no difference in the infection rate between tap water and saline.

Irrigation and Pain

Wound cleansing and irrigation is an often uncomfortable and sometimes painful procedure for patients. A review of the literature revealed a noticeable lack of research related to wound preparation and pain, and the efficacy of using local anesthesia before cleansing and irrigation. The researchers in one study compared the effect of warm versus room temperature normal saline on patient comfort during cleansing and irrigation. Ernst, Gershoff, Miller, Tilden, and Weiss (2003) conducted a randomized single blind crossover trial with 38 subjects using both warm (90-100°F; 32.2-37.8°C) and room temperature (70°F; 21.1°C) saline with a 10-minute rest period in between the two solutions. Sixty three percent of subjects preferred the warmed solutions and 47% found the warm solution soothing whereas, 29% preferred the room temperature and 16% found the room temperature solution soothing. Twenty four percent found the warmed solution caused more discomfort, 53% found the room temperature solutions caused more discomfort. Overall, warm solution was considered more comfortable by a greater number of subjects.

Irrigation versus No Irrigation

Wound cleansing and irrigation is the standard of care for acute soft tissue lacerations. Clean wounds to the face and scalp pose a lower infection risk than other areas of the body. Hollander, Richman,

Werblud, Miller, and Huggler (1998) compared the infection rates and cosmetic outcomes for facial and scalp lacerations for subjects who received irrigation and those who did not. The researchers included subjects who presented less than six hours after injury and had no history of diabetes mellitus, renal disease or immuno-compromised. The authors found no differences in the rates of infection between those subjects who did not receive irrigation and those who did receive irrigation ($p=0.28$). Additionally, the authors found no difference in cosmetic appearance at the time of suture removal. However, there was a trend towards worse cosmetic outcome in subjects who received irrigation (95% CI for the difference between groups).

Description of Decision Options/Interventions and the Level of Recommendation

1. Irrigation with a syringe and needle/catheter is more effective than bulb syringe irrigation for laceration cleansing and irrigation across the lifespan. Level A: High (Stevenson, et. al, 1976 ; Longmire & Broom, 1987)

2. Potable tap water is equivalent and may be superior to normal saline for laceration cleansing and irrigation in patients across the lifespan. Level A: High (Fernandez, et. al, 2010).

3. Cleansing or irrigation may not be required for low-risk patients* with clean facial/scalp lacerations of less than six hours in both adult and pediatric patients. Level B: Moderate (Hollander, et. al, 1998)

* Low-risk patients refers to patients with clean, non-contaminated lacerations and without significant co-morbidities (e.g., diabetes, renal disease, or immuno-compromised).

References

Angeras, M., Brandberg, A., Falk, A., & Seeman, T. (1992). Comparison between sterile saline and tap water for the cleaning of acute traumatic soft tissue wounds. European Journal of Surgery, 158, 347-350.

Chaterjee, J. (2005). A critical review of irrigation techniques in acute wounds. International Wound Journal, 2, 258-265.

Dire, D. (1990). A comparison of wound irrigation solutions used in the emergency department. Annals of Emergency Medicine, 19, 704-708.

Draeger, R., & Dahners., L. (2006). Traumatic wound debridement: a comparison of irrigation methods. Journal of Orthopaedic Trauma, 20, 83-88.

Dulecki, M., & Pieper, B. (2005). Irrigating simple acute traumatic wounds: a review of the current literature. Journal of Emergency Nursing, 31, 156-160.

Ernst., A. Gershoff, L., Miller, P., Tilden, E., & Weiss, S. (2003). Warmed versus room temperature saline for laceration irrigation: a randomized clinical trial. Southern Medical Journal, 96, 436-439.

Fernandez, R., Griffiths, R., & Ussia, C. (2010). Water for wound cleansing (review). Cochrane Database of Systematic Reviews, Issue 2. doi: 10.1002/14651858.CD003861.pub2

Gravett, A., Sterner, S., Clinton, J., & Ruiz. E. (1987). A trial of povidone–iodine in the prevention of infection in sutured lacerations. Annals of Emergency Medicine, 16, 167-171.

Godinez, F., Grant-Levy, T., McGuirk, T., Letterle, S., Eich, M., & O'Malley, G. (2002). Comparison of normal saline vs tap water for irrigation of minor lacerations in the emergency department. Academic Emergency Medicine, 19, 396-397.

Hollander, J., Richman, P., Werblud, M., Miller, T., Huggler, J., Singer, A. (1998). Irrigation in facial and scalp lacerations: does it alter outcome? Annals of Emergency Medicine, 31, 73-77.

Hollander, J., Singer, A., Valentine, S., & Shofer, F. (2001). Risk factors for infection in patients with traumatic lacerations. Academic Emergency Medicine, 8, 716-720.

Longmire, A., & Broom, L. (1987). Wound infection following high-pressure syringe and needle irrigation. American Journal of Emergency Medicine, 5, 179-181.

Luedtke-Hoffman, K., & Schafer, D. (2000). Pulsed lavage in wound cleansing. Physical Therapy, 80, 292-300.

Moscati, R., Mayrose, J., Reardon, R., Janicke, D., & Jehle, F. (2007). A multicentre comparison of tap water versus sterile saline for wound irrigation. Academic Emergency Medicine, 14, 404–410.

Nicks, B. A., Ayello, E. A., Woo, K., Nitzki-George, D., & Sibbald, R. G. (2010). Acute wound management: revisiting the approach to assessment, irrigation, and closure considerations. International Journal of Emergency Medicine, 3, 399-407.

Stevenson, T., Thacker, J., Rodeheaver, G., Bacchetta, C., Edgerton, M., & Edlich, R. (1976). Cleansing the traumatic wound by high pressure syringe irrigation. Journal of the American College of Emergency Physicians, 5, 17-21.

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