Wound Preparation—Myths and Controversies

a report by
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The goals of traumatic wound care include reducing the risk of infection, improving cosmetic appearance through repair, and providing pain control to the patient. The techniques to accomplish these tasks are passed down from physician to physician, sometimes without a full understanding of where they originated or what scientific data support their use. In this article, we will review 10 of the top myths and controversies in wound preparation and discuss the original research that lies behind them.

Myth—Lacerations Must Be Repaired within Six Hours of the Injury

This commonly held belief that a wound must be repaired within a 'golden period' of six hours originated following a study in guinea pigs in 1898. It is true that after three to six hours the bacterial counts within a wound increase, but several studies have looked at whether lacerations sutured after this period had a higher rate of infection. Of 108 hand wounds sutured within six hours or from six to 24 hours, the infection rate was no different (17 versus 15%).[1] In another study at the public hospital in Kingston, Jamaica, 372 patients had repairs performed long after the six-hour golden period.[2] In these patients, the rate of healing was similar for all wounds repaired within the first 19 hours after injury. In a more recent study of 5,521 patients, time to repair was not associated with an increased rate of infection (infected 3.0±5.6 hours versus non-infected 2.1±3.5 hours).[3]

Time from injury to repair is important in reducing wound infections after traumatic lacerations, but there are several other factors that are probably more important. These include location of injury, mechanism, contamination, and patient characteristics. Facial lacerations have an expected infection rate of approximately 1–2% compared with 4% for wounds to the upper extremity and 7–8% for lower extremity wounds. Lacerations to the face and scalp are unlikely to be infected even when they are repaired 24–48 hours after injury, owing to the excellent blood supply to the area. A crushing mechanism is 100-fold more likely to be infected. Patient characteristics such as diabetes mellitus are known to increase the likelihood of infection. The clinician must weigh all of these factors when deciding to repair a traumatic laceration. In heavily contaminated wounds, debridement, irrigation, and delayed repair of three to four days (i.e. tertiary intention) should be considered.

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Myth—Using Sterile Gloves Reduces Infection

A recent study randomized 816 patients to receive repair of their non-contaminated lacerations with either sterile or clean gloves.[4] The authors found that the rate of infection was not statistically significant (sterile 6.1 versus clean 4.4%). Similar findings have been reported with dental extraction, wisdom tooth surgery, dermatological procedures, routine wound care, and burn patients.[5–9]

The advantage of using clean gloves is basically one of cost. These gloves cost approximately 5 cents/pair compared with 50 cents/pair for sterile gloves. This modest saving must be weighed against the major disadvantage of clean gloves—a poorer fit.

Myth—Irrigation with Sterile Saline Reduces Infection Rates

Wound irrigation is one of the most important elements to good wound preparation. When performed properly, it reduces the bacterial count within a wound and removes soil contaminants that increase the likelihood of infection. Sterile saline is the classic wound irrigation fluid, but several studies have compared sterile saline with tap water to determine whether there is any advantage in infection reduction.[10–14] A recent meta-analysis of these papers showed benefit for tap water in the form of decreased odds of infection by 0.72.[15] While all of the studies were performed slightly differently, the benefit may be related to the greater volume of fluid when tap water is used. The difference is quite significant given similar irrigation times: liters of tap water versus 200–300ml of sterile saline.

The cost savings are again modest. A liter bottle of sterile saline can be purchased for approximately $2. Other factors that may be a deterrent to using tap water include patient perceptions and the difficulty of putting some wounds (e.g. to lower extremities) under the faucet.

Myth—Irrigation with a Saline Bottle Pierced with a Needle Is Sufficient to Provide Enough Pressure to Remove Bacteria and Decrease Infection

In addition to volume, another factor important to irrigation is pressure, measured in pounds per square inch (PSI). In an animal laceration model inoculated with bacteria, the effectiveness of irrigation with a syringe

and intravenous (IV) catheter (7–20psi) was compared with a bulb syringe (0.05psi).[16] The infection rate was significantly lower when the higher-pressured syringe/catheter was used (20 versus 95%). In a study of 335 emergency department patients, a syringe and catheter again outperformed a bulb syringe (infection rates 1.3 versus 6.9%).[17] Pressures above 10psi were shown to increase the amount of soil removed from the wounds.[18]

Based on these studies, the traditional method of irrigating a wound has been a syringe and catheter. More recently, irrigation shields that fit directly onto the end of the syringe and reduce splatter have been favored (see *Figure 1*). A syringe and shield produce approximately 20psi.[19]

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To save time, a commonly substituted method is to punch a hole in the top of a bottle of saline with an 18–19-gauge needle and use this to irrigate. Similar commercially available devices include a port or cap (see *Figure 2*). The port device is connected to an IV bag, while the cap is attached to the top of an irrigation bottle. Pressures of only 2–3psi are created via these methods.[19–22] Of the few studies evaluating these alternative methods, bacterial washout and infection rates seem to be similar to traditional techniques, possibly related to increased volumes of fluid delivered. More data are needed, however. For those that prefer to irrigate under the faucet, one study reported irrigation pressures of 45psi.[23]

Two other points are worth discussing briefly. There seems to be a limit to the amount of pressure that should be used to irrigate wounds. If the pressures become too high, fluid is displaced into the tissue, injuring it and increasing the rate of infection.[24] Finally, for non-contaminated face and scalp wounds, irrigation does not significantly influence the infection rate and therefore can be avoided altogether.[25]

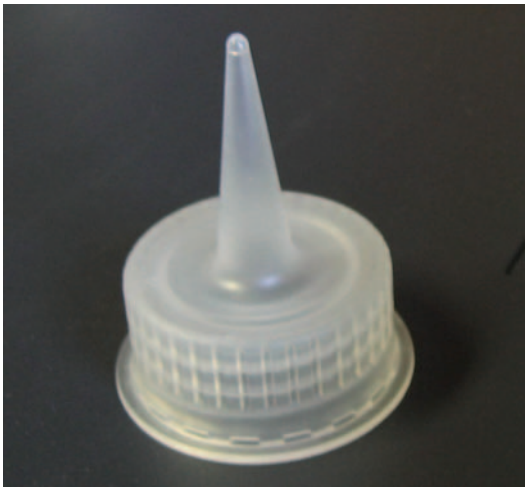
Myth—Injecting Local Anesthetic Around the Wound Is Less Painful Than Injecting Through the Wound Edges

Two small studies have addressed this issue and their results support injecting local anesthetic through the wound edges (see *Figure 3*).[26,27] This technique is significantly less painful than injecting through intact skin around the wound. The one caveat to applying this technique concerns contaminated wounds. In an animal model, puncturing a needle through the wound edges resulted in the dissemination of bacteria into the tissues.[28]

Buffering the anesthetic agent with bicarbonate has been shown to reduce the pain of injection, while warming the anesthetic agent to body temperature has produced variable results.[29–33] Other methods to reduce the pain of local anesthetic injection include subdermal, slower injections with a small needle.[34]

Figure 1: Syringe and Irrigation Shield Reduces Splatter Compared with the Traditional Syringe and Catheter

Figure 2: Irrigation Cap



This lower-pressure device provides 4.5psi of pressure when attached to a 250ml bottle of saline.

Myth—Local Anesthetics With Epinephrine Should Never Be Injected into a Digit

This commonly purported myth originated following cases of digital gangrene after injection with local anesthetic agents mixed with epinephrine prior to 1948. Since that time, local anesthetic agents mixed with epinephrine were commercially introduced, making the desired concentration (1:100,000 to 1:200,000) much more reliably found. Of the 21 pre-1948 cases, the concentration of epinephrine was unknown in 17.[35,36] Furthermore, many cases involved other techniques (e.g. tourniquets and a high volume of anesthetic injected) and other anesthetic agents (e.g. cocaine), which may have contributed.

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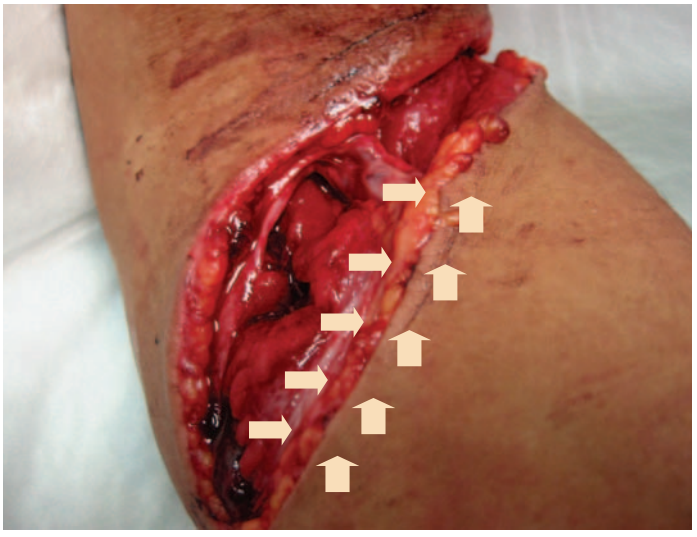
Figure 3: Injection Methods



Injection of lidocaine through the wound edges (rightward arrows) is less painful than through intact skin (upward arrows), but should be avoided in contaminated wounds because it may allow dissemination of bacteria into the tissues.

Recent studies have further tested this myth by injecting digits with local anesthetic and epinephrine and, to this point, no complications have been reported.[37–39] The largest such study involved nine hand surgeons in six cities injecting a total of 3,110 consecutive hand and digital operative cases.[40] There were no instances of digital tissue loss or use of phentolamine reversal.

The obvious advantage to the use of anesthetic with epinephrine is increased duration of effect and decreased bleeding. The addition of epinephrine at a concentration of 1:100,000 increases the duration of anesthesia in the hand four-fold.[41] A word of caution applies to contaminated wounds. In an animal model, contaminated lacerations injected with 0.1ml of epinephrine at various concentrations caused an increase in bacterial counts and infection rate, presumably by decreasing the ability of the tissues to resist infection by reducing local blood flow.[28] For this reason, it is best to avoid anesthetics with epinephrine in highly contaminated wounds.

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Myth—Allergies to Local Anesthetics Are Common

An allergy to an amide anesthetic agent is considered exceedingly rare, if it exists at all. In a study of almost 200 patients sent to an allergist with a reported allergy to an amide anesthetic agent, skin testing revealed a reaction in only two and no patients produced immunoglobin E (IgE) suggesting an allergic reaction.[42] In five patients, however, a reaction was observed to the preservative agent (methylparaben) within the anesthetic.

The clinician treating a patient with a purported allergy to anesthetic agent has a couple of options. A 0.1ml test dose of 2% lidocaine used for cardiac arrhythmias can be given. This agent does not contain methylparaben. If no reaction is apparent within 30 minutes, it is safe to proceed with the procedure.[43] Another alternative is using diphenhydramine instead of local anesthetic. A 0.5% mixture can be obtained using a 1ml vial (50mg) of diphenhydramine with 9ml of sterile saline. Diphenhydramine has been shown to be as effective as lidocaine for all wounds except facial lacerations.[44]

Because the inability to detect foreign bodies in wounds is a leading cause of malpractice claims in the US, it is routine for many clinicians to obtain plain radiographs.

Myth—Soaking Wounds in Povidone–Iodine Reduces Bacterial Counts and the Infection Rate

Povidone–iodine solution has properties that have both positive and negative consequences for wounds in that it is both bactericidal and cytotoxic. An *in vitro* study found a dilute concentration (0.001%) that was bactericidal but did not kill fibroblasts.[45,46] A guinea pig study of inoculated lacerations found no difference between wounds soaked with 1% povidone–iodine and saline.[47] A human study of 33 contaminated wounds soaked for 10 minutes in 1% povidone–iodine, saline, or a control group (no soak) found no difference in the bacterial count between the control group and the povidone–iodine patients.[48] The bacterial counts of wounds soaked in saline were much higher than baseline.

The results of other human studies are mixed, leaving the question still somewhat controversial.[49,50] The author's recommendation is not to soak wounds. Povidone–iodine should be used around the wound edges prior to repair and, if used within the wound, only a very dilute solution should be applied.

Myth—Shaving the Hair Around a Wound Decreases the Infection Rate

Several studies in the surgical literature have addressed this issue.[51–53] All have found a higher infection rate in shaved wounds compared with unshaved or clipped wounds. The most likely explanation is microtrauma to the tissue caused by the razor. In the only study in the emergency medicine literature, no infections were found in 68 patients with scalp lacerations without hair removal.[54] In summary, do not remove hair: it is cosmetically less desirable and increases the rate of infection. If suturing is difficult due to surrounding hair, mat it down with an ointment and use a blue suture.

Myth—All Lacerations Caused by Glass Must Have Radiographs to Exclude Retained Glass Foreign Bodies

Glass foreign bodies are detected with plain radiography with a sensitivity of 98% for those as small as 2mm.[55] Risk factors for a retained glass foreign body in a wound are motor vehicle collisions, stepping on glass, head wounds, or puncture wounds.[56] In a study from 1992, it was reported that 7% of lacerations due to glass had the foreign material present despite the ability to visualize the depth of the wound.[57] Because the inability to detect foreign bodies in wounds is a leading cause of malpractice claims in the US, it is routine for many clinicians to obtain plain radiographs. A recent study of 264 wounds with glass foreign bodies present in 8.7% found that in superficial wounds (to subcutaneous fat only) a glass foreign body that was diagnosed on radiographs was missed on exam in only 1.5%.[58] For deeper wounds the rate was 7.7%. The study concluded that routine radiographs are not required in superficial wounds.

The author's recommendation is for the clinician to consider each wound separately. If thorough inspection and irrigation of a superficial wound in a patient without risk factors for a retained glass foreign body does not reveal a foreign body, a radiograph is not required. Use other modalities, such as ultrasound or computed tomography in addition to inspection and irrigation when a radiopaque substance (i.e. wood, rubber) is the suspected foreign body. ■

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