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Surgical Irrigation of Open Fractures — A Change in Practice?

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The open fracture — in which the broken bone is exposed to the world outside the body — has long been a devastating injury. From the time of Hippocrates until after the American Civil War, the recommended treatment for an open fracture was amputation, with death from sepsis occurring in approximately 50% of patients. The adoption of antiseptic technique and formal surgical débridement in the late 19th century, and the introduction of antibiotic agents and improved surgical stabilization in the 20th century, all but eliminated death as an outcome. These advances, however, have not eliminated infection or non-union, which remain troublesome even today.

The preferred management of an open fracture includes thorough débridement, with removal of dead or devitalized tissue and copious irrigation with up to 12 liters of fluid. Although all agree on the primacy of débridement, the most effective technique for irrigation has been widely debated. Traditionally, irrigation was delivered by means of a bulb syringe, but the advent in the 1960s of what has been known as “jet lavage” or “pulsatile lavage” quickly displaced the bulb syringe in common use. The pressure of up to 70 psi and rapid fluid flow shortened the duration of irrigation, increased the volume of irrigation solution delivered, and provided what appeared, to the surgeon’s eye, to be a very clean operative field.

A number of published studies, however, called into question the safety and efficacy of high-pressure irrigation. Those studies, mostly performed in cadaveric specimens or animal models, seemed to indicate that high-pressure irrigation damaged soft tissues and cortical bone, impaired tissue resistance to infection, and delayed healing of fractures.¹⁻⁴ This body of work impelled many surgeons to revert to low-pressure methods in the irrigation of open fractures, but high-pressure methods still predominated.

In a related pathway, surgeons have for a century sought the most effective solution for the

irrigation of surgical wounds. Multiple studies were published in abdominal, orthopedic, and gynecologic procedures, most of which supported the addition of antimicrobial agents to the irrigation fluid. In the 1990s, published work in orthopedic surgery appeared to indicate that antibiotics in irrigating fluid did not add value over normal saline, that some agents could precipitate hypersensitivity reactions, that others could be toxic to tissues, and that castile soap might promise the best balance of effectiveness and low toxicity.^{5,6} A small trial of saline versus castile soap irrigation in open fractures suggested that soap was superior.⁷

Bhandari et al.⁸ now present in the *Journal* the results of an international, multicenter, blinded, randomized, controlled trial that has appropriately and definitively addressed both the irrigation pressure and irrigating solution in the care of open fractures. This well-conducted trial involving 2447 patients represents the most substantial contribution to medical knowledge in these areas to date. Standardizing treatment across 41 clinical centers in the complex care (involving multiple surgical procedures and 12 months of follow-up) of patients with open fractures, while achieving a protocol adherence rate of more than 96% and a patient follow-up rate of 90%, further emphasizes the strength of the trial and its findings.

The trial results indicate that there appears to be no difference in the rate of reoperation within 12 months after the index surgery among patients treated with high-pressure, low-pressure, or very-low-pressure irrigation (hazard ratios near unity for all comparisons). The trial also showed that normal saline was superior to 0.45% castile soap as an irrigating solution; patients in the soap group were 32% more likely than those in the saline group to undergo a reoperation. What is particularly instructive about this trial is its focus on an outcome of unequivocal importance to patients and health care providers (reopera-

tion), and the findings indicate that the differences noted in prior experimental studies do not translate into differences in important outcomes in clinical practice.

The implications of the findings in this trial are very broad. The topic of saline versus soap irrigation has interest for surgeons, proceduralists, and primary care physicians, and the findings have the potential to substantially change practice. The results of this trial should markedly decrease the use of soap in irrigating solutions, resulting in fewer adverse outcomes, fewer reoperations, and lower costs. The additional expense of a pulsatile lavage irrigation system in the care of a patient with an open fracture does not appear to add benefit. Finally, it is very important to know that, in contexts in which pulsatile lavage systems or additives to irrigation are not available, the care of patients with an open fracture is not compromised.

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Choosing Benefits while Balancing Risks

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Until the 20th century, home was where most births took place. By the second half of that century, hospital birth had become the norm in most Western countries. With this change came the “medicalization” of birth, as hospitals introduced interventions to reduce the risks inherent to childbirth that could not be performed in the home setting. Many of these interventions were beneficial, even lifesaving, for the mother or baby, but some, often judged in retrospect, seemed unnecessary. The occasional performance of a cesarean delivery for a fetus thought to have hypoxemia and acidosis followed by the delivery of an entirely healthy baby was an acceptable “mistake” and a tolerable price to pay to avoid the unacceptable mistake of an occasional fetal death or ischemic injury from hypoxemia resulting from a delayed delivery.

By the late 1970s, a woman arriving on the labor and delivery floor of a U.S. tertiary care

hospital with a nonmalformed, living, singleton fetus at term had a risk of intrapartum fetal death of 1 in 1000.¹ At that time the U.S. cesarean delivery rate was approaching 15%.² Since then, the rate of cesarean sections has more than doubled,³ but the intrapartum fetal death rate in major U.S. centers remains unchanged. Because fetal deaths are so rare, it is easy to forget that they still occur. Arguably, as the rate of obstetrical interventions — including cesarean delivery and the induction and augmentation of labor — has increased without obvious value added, it is easy to see them as unnecessary, meddlesome, and unacceptable. Thus, it is understandable that women seeking less obstetrical intervention in childbirth have sought safe alternatives to hospital births. The interpretation of studies conducted to assess the safety of out-of-hospital births has been limited by the fact that births intended to take place outside of a hospital frequently occur