

### **G33 - Is there an optimal volume of irrigation solution in patients undergoing major orthopedic surgery?**

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#### **Response/Recommendation:**

Available evidence does not establish a precise optimal irrigation volume. We recommend the use of 3 to 9 liters of saline irrigation depending on the nature and complexity of surgery.

**Strength of recommendation:** Weak

#### **Delegate Vote:**

#### **Rationale:**

Determining an optimal irrigation volume in patients undergoing major orthopedic surgery remains challenging due to the heterogeneity of surgical procedures, wound types, and patient factors. While it is well established that irrigation is critical for reducing bacterial load and removing debris in open fractures, arthroplasty, and other orthopedic interventions, current evidence does not provide a definitive volume threshold. Instead, a general principle has emerged: increasing irrigation volume can improve wound cleansing up to a certain point, but the ideal amount remains unknown.

Studies on open fracture management have investigated various irrigation volumes and pressures without identifying a definitive combination that consistently reduces complications. For example, the Fluid Lavage in Open Fracture Wounds (FLOW) international survey, which included responses from 984 surgeons, standardized the minimum irrigation volumes based on the severity of open fractures using the Gustilo-Anderson Classification: 3 liters for Type I fractures and 6 liters for Types II and III [1]. Building on this standardization, the FLOW trial—a prospective, multicenter, randomized controlled study—evaluated the effects of irrigation solutions (soap vs. saline) and pressures (very low, low, high) on reoperation rates in 2,447 adult patients with open fractures. The trial found reoperation rates of 14.8% (182/1229) in the soap group versus 11.6% (141/1218) in the saline group (hazard ratio, 1.32;  $P = 0.01$ ). Regarding irrigation pressures, reoperation rates were similar across groups: 13.2% for high pressure, 12.7% for low pressure, and 13.7% for very low pressure ( $P = 0.53$ ,  $P = 0.89$ , and  $P = 0.62$ , respectively). These findings suggest that very low-pressure irrigation is a cost-effective, acceptable alternative, with saline outperforming soap in reducing reoperation rates [2]. Using the same dataset, Sprague et al [3], assessed the impact of irrigation solutions and pressures on health-related quality of life after open fractures. They concluded that neither solution type (soap vs. saline) nor pressure significantly influenced quality of life, indirectly suggesting that irrigation volume alone might not determine outcomes. Likewise, investigations into septic arthritis of the shoulder have shown that larger volumes can aid in more complete decontamination and potentially lower reoperation rates, though no single optimal volume was defined [4]. Studies on arthroscopic lavage in rheumatoid knees and postoperative pain/swelling in knee procedures suggest that using ample fluid may confer symptomatic benefits, but do not quantify a precise optimal volume [5, 6]. In spine surgery, increasing irrigation volume has been

shown to reduce post-operative drainage however, no significant improvements in short-term clinical outcome have been documented [7].

In arthroplasty, increasing irrigation volumes has been shown to enhance the removal of bone and cement debris, though the exact optimal volume remains uncertain. Niki et al [8], investigated this by collecting cement particles after different irrigation volumes in eight patients undergoing primary cemented total knee arthroplasty (TKA). Their findings suggest that 4 L of pulse lavage irrigation is sufficient to effectively remove cement and bone debris after cementing TKA components. This volume may also aid in clearing bacterial particles, highlighting its potential role in infection prevention.

Reviews and early research emphasize that while adequate irrigation is critical, more is not always better. Excessive pressure or excessively high volumes can risk tissue damage or promote deeper bacterial penetration [9, 10]. While pulse lavage has demonstrated improved bacterial clearance in certain scenarios, it may also cause tissue injury if both pressure and volume are not carefully managed [10]. Comparisons of irrigation techniques in spinal surgery indicate that some lavage methods can reduce infection rates; however, these benefits appear to be influenced more by technique than by a specific optimal volume [11].

### Conclusion:

Available evidence underscores the importance of irrigation in orthopedic surgery but does not define an exact optimal volume. Clinicians must strike a balance between ensuring adequate irrigation for effective cleansing and avoiding mechanical or soft-tissue damage. Further high-quality, procedure-specific randomized controlled trials are essential to establish clearer guidance on optimal irrigation volumes for various orthopedic conditions.

## References

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