International Journal of Multiphysics
Volume 18, No. 3, 2024
ISSN: 1750-9548

Role of Saline Irrigation in Cesarean Sections

Shahenda Saleh, Gehad Abdallah*, Mohamed Abdel-moniem

Obstetrics and Gynecology Department, Faculty of Medicine, Zagazig University, Egypt

***Corresponding author:** Gehad Abdallah Ibrahim Gad

Email: gehadabdallah2@gmail.com ,

Abstract:

Saline irrigation using isotonic 0.9% sodium chloride solution is widely practiced in surgical wound management due to its safety, availability, and physiological compatibility with body tissues. Its primary role is mechanical cleansing through removal of debris, necrotic tissue, and reduction of microbial burden while maintaining a moist environment that supports wound healing. Despite its routine use across surgical specialties, including obstetrics and gynecology, the clinical effectiveness of saline irrigation—particularly in reducing surgical site infections—remains controversial. Evidence from randomized controlled trials and systematic reviews has yielded inconsistent results, especially in cesarean sections, where benefits appear limited to reduction of seroma and hematoma rather than definitive infection prevention. This review summarizes the physiological rationale, mechanisms of action, surgical applications, and current evidence regarding the use of saline irrigation, with a special focus on obstetric and gynecologic practice.

Keywords: Saline irrigation; Wound irrigation; Surgical site infection; Cesarean section; Obstetrics and gynecology; Normal saline

Introduction:

Normal saline (0.9% sodium chloride) is the most used solution for wound irrigations due to its safety (**1**).
Irrigation's aim is to clean wounds whereas minimizing trauma to wound bed and risk of introducing bacteria into wound bed (**2**).
Saline irrigation refers to the controlled flushing of wounds or body cavities with a sterile 0.9% sodium chloride solution. It is a cornerstone of wound management, serving three primary purposes: Removal of debris, foreign particles, and necrotic tissue. Reduction of microbial load and biofilm disruption. Moist Environment Maintenance to Facilitation of cellular migration and tissue repair (**3**).
The primary physiological rationale for using saline solution in wound irrigation is that it is the most suitable and preferred solution due to its isotonic and non-toxic properties (**3**).
Saline solution (0.9% sodium chloride) is isotonic, meaning it has the same osmotic pressure as the body's fluids. This is important because it does not cause damage to the wound tissue by drawing water in or out of the cells (**3**).
Saline solution is non-toxic to wound tissues, unlike some other potential cleansing agents. It does not interfere with the normal wound healing process (**3**).
The composition of saline solution is like the body's own fluids, making it well-tolerated and less likely to disrupt the delicate wound environment (**3**).
Saline solutions are readily available, inexpensive, and easy to use, making it a practical choice for wound irrigation. In contrast, using other solutions such as sterile water, which is hypotonic, can potentially damage wound tissues by causing cell lysis (**3**).

Physiological Rationale for Use in Wound Care

Isotonic Compatibility

The use of isotonic saline solution is considered the most appropriate and preferred choice for wound irrigation due to its physiological compatibility and safety for the wound healing process (**3**).

Mechanical Cleansing Action

Multiple methods of irrigation delivery have been described using a variety of equipment. A 35 to 50mL piston syringe with an eye irrigation cup attached to the end may be used to irrigate and reduce splashing back of irrigation fluid. A 35mL syringe with a 19G catheter placed on its end generates the pressure necessary to remove debris and reduce bacterial burden in the wound (**3**).

Other tricks of the trade include placing a liter of isotonic fluid in a pressure bag on an IV pole and attaching an 18-gauge catheter to the end which can provide a continuous stream of irrigation fluid under similar pressure (**3**).

You may also use an 18-gauge needle, puncture 3 or 4 holes in the cap of a bottle of irrigation, and this will create the pressure needed by squeezing the bottle for short increments. Manufacturers have now created devices that replace the cap of the irrigation bottle that acts similarly (**3**).

The periphery of the wound should be cleansed beginning at the wound and then moving out in concentric circles. Absorbent pads should be placed under the patient to minimize fluid run-off to the floor and exam bed. The operator should make use of personal protective equipment including eye/face shields, gowns, and gloves to minimize exposure risk to bloodborne pathogens (**3**).

The upper limit of pressure where injury to tissues may occur is 70 PSI. Studies have used 250mL of irrigation fluid per 5cm of wound length or approximately 50mL per centimeter of wound length (**4**).

Antimicrobial and Anti-Biofilm Effects

NaCl dissociates into Na^+ and Cl^- ions; Cl^- disrupts bacterial cell membranes and inhibits pathogen proliferation (e.g., Staphylococcus aureus, Pseudomonas aeruginosa). Physical flushing reduces biofilm biomass, enhancing antibiotic penetration (**5**).

Promotion of Healing Mechanisms

Saline maintains a moist environment, enabling endogenous enzymes (e.g., collagenases) to break down necrotic tissue. Moisture supports endothelial cell migration and extracellular matrix formation (**6**).

Once the operator believes that the wound has been sufficiently irrigated and that no foreign material remains the clinician may proceed to either wound dressing or primary repair depending upon the situation **(3)**.

Wound irrigation should not be performed if the wound is actively bleeding, as irrigation may dislodge any clots that are forming.

Incomplete wound irrigation can lead to the persistence of debris or purulent discharge left inside the wound, especially in absences that may end up in sinus formation. When using povidone-iodine, care must be exercised not to pour it profusely inside the wound however, it should be used on the wound edges **(3)**.

Principles of Effective Saline Irrigation

Buffered Saline (e.g., Lactated Ringer's): Offers pH balance (6.5–7.5 vs. saline's 5.0–5.5) but is less commonly used. Bulb syringes, piston syringes, or pressurized systems (e.g., Pulse Lavage). Warmed saline (37°C) improves patient comfort and vasodilation, enhancing perfusion (**7**).

Use of Saline Irrigation in Surgical Practice

The available evidence suggests that the use of saline or other antiseptic irrigation solutions prior to wound closure is an effective strategy to lower the risk of surgical site infections in surgical practice. The optimal irrigation solution and technique may depend on the specific surgical procedure and patient factors (**8**).

Wound irrigation aims to reduce the microbial burden by removing tissue debris, metabolic waste, and tissue exudate from the surgical field before site closure (**9**).

A retrospective study of emergency laparotomies for abdominal infections found that high-volume saline irrigation (500–5,000 mL, depending on incision length) reduced SSI rates from 26.1% to 10.6%, particularly for superficial and deep infections. This was attributed to thorough mechanical cleansing of subcutaneous tissue and fascia (**10**).

In open appendectomy, layer-by-layer wound irrigation is shown to decrease the rates of incisional SSI compared to the no-irrigation group. However, adding gentamicin to saline solution did not further decrease SSI rates (**11**).

In a retrospective before-after clinical study, patients who underwent emergency laparotomy due to abdominal infections were included in the study to evaluate effectiveness of high-volume normal saline (NS) irrigation in preventing postoperative SSI for patients with abdominal infections (**10**)**.**

Results of this study have shown that irrigation patients had lower overall SSI rates, Irrigation patients also had lower rates of incision seroma (4.8% vs. 11.6%, $p = 0.012$), shorter duration of antibiotics use (5.2 ± 1.7 d vs. 7.2 ± 2.0 d, $p < 0.001$), and unplanned readmission (1.0% vs. 8.7%, $p < 0.001$), length of hospital stay showed a declining trend with irrigation intervention (**10**)**.**

However, a systematic review has shown that we could not identify an advantage for routine irrigation of abdominal wounds with normal saline over no irrigation prior to wound closure in preventing or reducing the rate of SSI (risk ratio 0.73, 95% CI: 0.37–1.43) (**12**).

Similarly, a 2024 network meta-analysis concluded that saline alone was ineffective for SSI prevention, while antiseptic solutions (e.g., chlorhexidine, povidone-iodine) showed clearer benefits (**13**).

Effective irrigation requires adequate pressure (5–15 psi) and volume (≥500 mL). Techniques such as pulsed lavage or syringe-based irrigation are recommended to optimize debris removal without damaging tissues (**3**)

However, Saline irrigation does not have antimicrobial properties; it cleans physically but does not kill bacteria (**14**).

Overuse or improper technique may irritate tissue or cause splash contamination, the optimal volume of irrigation varies but large amounts (50-100 mL/cm of wound length) are often used to ensure thorough cleansing (**3**).

Applications in Obstetrics and Gynecology

In obstetric and gynecologic surgeries, saline irrigation is commonly used but evidence for its benefit is limited and context-dependent: (**10**)

Cesarean Sections: A systematic review of abdominal surgeries (including gynecologic procedures) found no significant SSI reduction with saline irrigation. However, protocols often include irrigation to manage intraoperative contamination (e.g., amniotic fluid, blood) (**12**).

Hysterectomy and Pelvic Surgery: Limited studies suggest irrigation may reduce seroma formation and superficial infections, though data is insufficient to recommend routine use (**9**).

Special Considerations: Obese Patients: Subcutaneous irrigation in cesarean sections with thick adipose tissue (>2 cm) is associated with lower wound dehiscence and infection rates. Povidone-iodine irrigation has been studied in cesarean deliveries but showed no significant advantage over saline. (**9**).

Studies on Saline Irrigation in Cesarean Sections

Multiple randomized controlled trials (RCTs) have been recently published, with conflicting results regarding subcutaneous saline irrigation post cesarean section (**15**).

Regarding cesarean delivery saline irrigation before wound closure did not reduce the overall infection rate in patients undergoing cesarean delivery (**16**).

According to Güngördük et al.; the incidence of wound infection was 7.3% for the control group and 6.5% for the saline group; however, the difference was not significant (relative risk: 0.88; 95% confidence interval: 0.45-1.74; p=0.86) and concluded as saline wound irrigation before wound closure did not reduce the infection rate in patients undergoing caesarean delivery (**16**).

However, saline irrigation of the subcutaneous tissue during cesarean section was found to decrease the rates of seroma, hematoma, and superficial surgical site infection (**17**).

Subcutaneous saline irrigation during the first cesarean delivery resulted in a decrease of 51% and 69% of hematoma and seroma, respectively. On the other hand, saline irrigation did not affect wound separation and superficial SSI rates (**17**).

In another randomized control clinical trial on obese female patients found that saline irrigation of obese pregnant female's subcutaneous tissue throughout caesarean section significantly reduced rates of seroma, hematoma, and superficial surgical place of infections. Even so, there were no variations in wound dehiscence among categories (18).

Another systemic review study found the relative risk of developing a surgical site infection was lower when wound irrigation with normal saline was performed prior to wound closure, although the difference was not statistically significant (**17**).

In summary, the evidence on the benefits of saline irrigation in wound closure for cesarean sections is inconclusive. Some studies have found it can reduce complications like seroma and hematoma, while others have not shown a clear benefit in reducing surgical site infections.

Guidelines and recommendations.

There are no established recommendations by major obstetrics and gynecology professional organizations, including the American College of Obstetricians and Gynecologists (ACOG), endorsing routine intra-abdominal saline irrigation during cesarean delivery (**19**).

Evidence from systematic reviews and randomized controlled trials does not support routine saline irrigation to reduce surgical site infections (SSI) or improve postoperative maternal outcomes in cesarean sections while some clinical guidelines highlight that while saline irrigation is simple, safe, and cost-effective, its benefits in cesarean surgery are inconclusive due to insufficient high-quality studies (**20**).

Recommendations emphasize surgeon preference and experience as current determinants for performing abdominal irrigation during the cesarean section, reflecting the lack of consensus (**20**).

References:

1. Aslan Çetin, B., Aydogan Mathyk, B., Barut, S., Koroglu, N., Zindar, Y., Konal, M., & Atis Aydin, A. (2018). The impact of subcutaneous irrigation on wound complications after cesarean sections: A prospective randomised study. European Journal of Obstetrics, Gynecology, and Reproductive Biology, 227, 67–70.
2. Mostafa, M., Hassan, S., & Abdelatef, M. (2023). How to handle hypotension following spinal anesthesia for a cesarean section. Journal of Current Medical Research and Practice, 8(2), 57.
3. Lewis, K., & Pay, J. L. (2025). Wound Irrigation. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/pubmed/30860757
4. Resende, M. M. C., Rocha, C. A., Corrêa, N. F. M., Veiga, R. R. G., Passos, S. J. F., Novo, N. F., Juliano, Y., & Damasceno, C. A. V. (2016). Tap water versus sterile saline solution in the colonisation of skin wounds. *International Wound Journal*, *13*(4), 526–530.
5. Deng, W., Lei, Y., Tang, X., Li, D., Liang, J., Luo, J., Liu, L., Zhang, W., Ye, L., Kong, J., Wang, K., & Chen, Z. (2022). DNase inhibits early biofilm formation in Pseudomonas aeruginosa- or Staphylococcus aureus-induced empyema models. *Frontiers in Cellular and Infection Microbiology*, *12*, 917038.
6. Olteanu, G., Neacșu, S. M., Joița, F. A., Musuc, A. M., Lupu, E. C., Ioniță-Mîndrican, C. B., Lupuliasa, D., & Mititelu, M. (2024). Advancements in Regenerative Hydrogels in Skin Wound Treatment: A Comprehensive

Review. *International Journal of Molecular Sciences*, *25*(7), 3849.
7. Hughes, M. S., Moghadamian, E. S., Yin, L. Y., Della Rocca, G. J., & Crist, B. D. (2012). Comparison of bulb syringe, pressurized pulsatile, and hydrosurgery debridement methods for removing bacteria from fracture implants. *Orthopedics*, *35*(7).
8. Groenen, H., Bontekoning, N., Jalalzadeh, H., Buis, D. R., Dreissen, Y. E. M., Goosen, J. H. M., Graveland, H., Griekspoor, M., Ijpma, F. F. A., Van Der Laan, M. J., Schaad, R. R., Segers, P., Van Der Zwet, W. C., Orsini, R. G., Eskes, A. M., Wolfhagen, N., De Jonge, S. W., & Boermeester, M. A. (2024). Incisional Wound Irrigation for the Prevention of Surgical Site Infection: A Systematic Review and Network Meta-Analysis. JAMA Surgery, 159(7), 792–800.
9. Papadakis, M. (2021). Wound irrigation for preventing surgical site infections. World Journal of Methodology, 11(4), 222–227.
10. Wang, J., Lv, W., Xu, S., Yang, C., Du, B., Zhong, Y., Shi, F., & Shan, A. (2022). Intraoperative incision irrigation with high-volume saline reduces surgical site infection for abdominal infections. *Frontiers in Surgery*, *9*, 927896.
11. Emile, S. H., Elfallal, A. H., Abdel-Razik, M. A., El-Said, M., & Elshobaky, A. (2020). A randomized controlled trial on irrigation of open appendectomy wound with gentamicin- saline solution versus saline solution for prevention of surgical site infection. *International Journal of Surgery*, *81*, 140–146.
12. Ambe, P. C., Rombey, T., Rembe, J.-D. D., Dörner, J., Zirngibl, H., & Pieper, D. (2020). The role of saline irrigation prior to wound closure in the reduction of surgical site infection: a systematic review and meta-analysis. Patient Safety in Surgery, 14(1), 47.
13. Cho, N. Y., Le, N. K., Kim, S., Ng, A., Mallick, S., Chervu, N., Lee, H., & Benharash, P. (2024). Trends in the adoption of diverting loop ileostomy for acute complicated diverticulitis in the United States. *Surgery (United States)*, *176*(1), 38–43.
14. Falagas, M. E., & Vergidis, P. I. (2005). Irrigation with antibiotic-containing solutions for the prevention and treatment of infections. *Clinical Microbiology and Infection*, *11*(11), 862–867.
15. Albzea, W., Almonayea, L., Alzayed, M. M., Alharran, A. M., Alrashidi, H. F., Alenezi, S., & Hadi, H. (2024). The Effect of Subcutaneous Saline Irrigation on Wound Complications After Cesarean Section: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Cureus*, *16*(6), e62152.
16. GÜngÖrdÜk, K., Asicioglu, O., Celikkol, O., Olgac, Y., & Ark, C. (2010). Use of additional oxytocin to reduce blood loss at elective caesarean section A randomised control trial. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, *50*(1), 36–39.
17. Gül, D. K., & Kanza Gül, D. (2021). The role of saline irrigation of subcutaneous tissue in preventing surgical site complications during cesarean section: A prospective randomized controlled trial. *Journal of Surgery and Medicine*, *5*(1), 8–11.
18. Albzea, W., Almonayea, L., Alzayed, M. M., Alharran, A. M., Alrashidi, H. F., Alenezi, S., ... & Alenezi II, S. (2024). The effect of subcutaneous saline irrigation on wound complications after cesarean section: a systematic review and meta-analysis of randomized controlled trials. Cureus, 16(6).
19. Eke, A. C., Shukr, G. H., Chaalan, T. T., Nashif, S. K., & Eleje, G. U. (2016). Intra-abdominal saline irrigation at cesarean section: a systematic review and meta-analysis. The Journal of Maternal-Fetal & Neonatal Medicine, 29(10), 1588–1594.
20. Satir Ozel, C., Gungordu, Z. R., Donmez, N. H., Demircivi, E., Yardimci, O. D., & Turgut, A. (2022). How Abdominal Irrigation During Cesarean Delivery Affects Gastrointestinal Functions and Short-term Maternal Morbidities: A Randomized Controlled Study. Medeniyet Medical Journal, 37(3), 264–269.