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Using of normal saline in treatment of infected wounds at Al-Yarmouk teaching hospital

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Abstract
Background: Normal saline can be used to cleanse, irrigate, or moisturize wounds. It is also used in IV fluids for dehydration and in other uses.
Objective: is to evaluate the effectiveness of normal saline wash in treatment of infected wound by decreasing the time needed for complete healing and duration of antibiotic use
Patients & Methods: Randomized prospective studies of two hundreds twenty patients done by 5th unite of surgical department in AL-Yarmouk teaching hospital from January 2010 to February 2012. Patients with infected surgical wounds who underwent emergency operations to identify the effect of cleansing by normal saline on time required for healing and duration of antibiotic use. Hundred cases were washed with normal saline (group A); 120cases were not washed with normal saline (group B). Wound swab was taken from all patients for culture and sensitivity and made a comparison between the two groups.
Results: Regarding (A) group N/S wash had accelerated healing rate in 28 patients (28%) those include 8 cases of perforated viscous (perforated duodenal ulcer) (8%), and 20 patients were soft tissue infection (20%), while N/S was moderately accelerating the wound healing process in 63 patients (63%) in whom 2 patients (2%) were perforated viscous(perforated duodenal ulcer) and 40 patients (40%) were perforated appendicitis and 21 patients (21%) were penetrating injuries (small and large bowel injuries).N/S was less effective in 9 patients (9%) in whom 5 patients (5%)were penetrating injuries (multiple large bowel injuries),3 patients (3%) were perforated appendicitis and 1 patient (1%) was abdominal wall TB of soft tissue(chronic sinuses).
In group B 9 patients (7.5%) had a good response five of them were soft tissue infection (4%) and four were perforated duodenal ulcer (3.3%), 100 patients (83.33%) were moderately respond in whom 6 patients (5%) were perforated duodenal ulcer,20 patients (16.6%) were soft tissue infection, 52 patients (43.3%) were perforated appendicitis and 22 patients (18.3%) were penetrating injuries (small and large bowel injuries) and 11 patients of group B (9.16%) were poor response in whom 8 patients (6.6%) were perforated appendicitis and 3 patients (2.5%) were penetrating injuries (small and large bowel injuries).
Conclusions: Normal saline wash affect wound healing by acceleration of granulation tissue appearance, decrease antibiotic duration and cost effect.

Keywords: normal saline, infected wound and healing

Introduction

Normal saline solution composed of 9gm of sodium chloride in one liter of sterile water. Years of research provided the optimal concentration of 0.9 percent. Sodium chloride is containing 154 mEq of sodium that is balanced by 154 mEq of chloride [1] British doctors in 1831 were the first whom use normal saline for treatment of dehydration via IV rout [1]. Saline solution performs two separate functions. The most important thing that it does is wash debris and dried blood out of a newly formed wound. This helps removing things that can irritate the underlying tissue as well as help washing out any bacteria. The other thing that saline solution moisturizes the wound. If a cut or other type of wound is too dry, it won't heal properly [1]. For this reason, saline solution is often applied to a covering, such as gauze, to help keep a wound from drying out. Cleaning wounds prevents infection. While dirt and grit will irritate the wound, they also carry a much greater risk of infection from the bacteria that they contain. For any newly formed wound, it is important to clean it out to remove the dirt and bacteria. It is also important to keep the wound clean as it is healing [2]. Bacteria that gets into the wounds will cause inflammation and swelling. This will slow the healing process and will also lead to development of scar tissue, which will make the wound heal more poorly [2]. One of the best things about saline solution is that it is cheap and readily available. It is commonly found in many products, including contact lens solution and, if necessary, can be made easily. Another advantage that saline solution has over soap and water and other types of cleaning compounds is that it won't irritate the wound or cause any burning pain. On the other hand, saline solution won't actively disinfect like hydrogen peroxide will, and it won't be good at removing oily substances in the same way that soap will [3].
The purpose of wound irrigation is to remove rather than kill bacteria. This is primarily a mechanical function [4].

Types of solutions used to cleanse wounds

Potable tap water is safe to use to clean a wound if the means for the sterilization of water is not available to the person administering on-site care [4].
-A solution of Betadine mixed with saline or sterile water is especially good for cleansing wounds that become infected.
-Dakin's Solution (Hypochlorite) is another antibacterial agent that is used in the presence of infection.
-Chlorhexidene (Hibiscrub) skin preparation, surgical scrub and wounds cleansing if diluted.
-Soap.
-Hydrogen peroxide.

-Hexachlorophane (skin preparation and hand washing)
-Cetrimide (savlon) hand washing and surface cleaning.
-Alcohol for skin preparation.

Infection is defined by identification of microorganisms in host tissue, plus an inflammatory response to their presence. At the site of infection, the classic findings of rubor, calor, and dolor in areas such as the skin or subcutaneous tissue are common [8]. Most infections in normal individuals with intact host defenses are associated with local manifestations, plus systemic manifestations such as elevated temperature, elevated white blood cell (WBC) count, tachycardia, or tachypnea. The systemic manifestations noted above comprise the systemic inflammatory response syndrome (SIRS).

Surgical Site Infections (SSIs) are infections of the tissues, organs, or spaces exposed by surgeons during performance of an invasive procedure. SSIs are classified into incisional and organ/space infections, and the former are further sub classified into superficial (limited to skin and subcutaneous tissue) and deep incisional categories. The development of SSIs is related to three factors: (a) the degree of microbial contamination of the wound during surgery, (b) the duration of the procedure, and (c) host factors such as diabetes, malnutrition, obesity, immune suppression [5].

Surgical wounds are classified based on the presumed magnitude of the bacterial load at the time of surgery. Clean wounds (class I) Infection rate 1-2%, include those in which no infection is present; only skin microflora potentially contaminate the wound, and no hollow viscus that contains microbes is entered. Clean/contaminated wounds (class II) Infection rate < 10%, include those in which a hollow viscus such as the respiratory, alimentary, or genitourinary tracts with indigenous bacterial flora is opened under controlled circumstances without significant spillage of contents. Contaminated wounds (class III) Infection rate 15–20%, include open accidental wounds encountered early after injury, those with extensive introduction of bacteria into a normally sterile area of the body due to major breaks in sterile technique (e.g., open cardiac massage), gross spillage of viscous contents such as from the intestine, or incision through inflamed, albeit no purulent, tissue. Dirty wounds (class IV) Infection rate < 40%, include traumatic wounds in which a significant delay in treatment has occurred and in which necrotic tissue is present, those created in the presence of overt infection as evidenced by the presence of purulent material, and those created to access a perforated viscus accompanied by a high degree of contamination [6, 7].

The aim of Study

is to evaluate the effectiveness of normal saline wash in treatment of infected wound by decreasing the time needed for complete healing and duration of antibiotic use.

Patients & Methods

Over a 2 years period from January 2010 to February 2012, randomized prospective study of different age groups were underwent emergency surgery in the 5th surgical unit of AL-Yarmouk Teaching Hospital. Total no. 220 patients, group A and B. Group A (100 patients) were infected surgical wounds washed with normal saline by doctors, nursing staff and patients relative at home after taking instructions from doctors, three times daily of N/S under +ve pressure at room temperature with antibiotic. Group B (120 patients) were infected surgical wounds kept dry as apart of treatment with antibiotic and change dressing three times daily.158 patients were males (71.8%) and 62 patients were females (28.1%) of an age ranging from (15-60) years old with mean age of (41) year.

Diabetic, uremic, jaundiced and immunosuppressed patients or patients with anaemia were excluded from the study in order not to interfere with healing process so during follow up period full investigations and history was taken in order to include or exclude patients suffering from such diseases from the study. Using of normal saline in treatment of infected wounds, identify & compare time required for healing, and duration of antibiotic use. Both groups (A and B) underwent wound debridement when needed to get rid of dead, adherent and unhealthy tissue.

All patients were discharged from hospital after 2 days to 7 days postoperatively. All wound dressing were inspected before discharge, and all patients informed to come to hospital twice weekly after discharged.

Patients were instructed to attend for examination if any sign of infection appears in the wound. Wound swabs were taken from those patients and sent for culture and sensitivity to identify the causative microorganism and appropriate antibiotic required.

Results

The study included objective and subjective measures of wound infection or healing (objective measures of infection such as wound culture and biopsy, and objective measures of healing such as change in surface area and wound depth, while only subjective measures of wound infection were redness, purulent discharge, pain, smell and swelling around the affected area). The study classified the patients into 5 groups according the age in years as shown in table 2.

According to their pathology, patients are divided into four categories as shown in table 3(A, B):

*) .*Perforated acute appendicitis was 103 patients (46.8%.1

2.Penetrating injuries, as bullets and stab wound who were 51 patients (23.1%)

3.Soft tissues infection was 46 patients (infected sebaceous cyst and gluteal abscess) (20.9%)*(*

*) .*Perforated duodenal ulcer was 20 patients (9% *.*4

According to time of complete healing, patients can be divided in to three groups:

1. Good response, in which the wound complete healing in 10-15 days.
2. Moderate response, in which the wound complete healing in 30-45 days.
3. Poor response, in which the wound complete healing in more than 45 days.

According to antibiotic duration in group A, patients can be divided in to three groups as shown in table 4A:

*) .*From day 1-7 who were 33 patients (33%*.(*1

*).*From 8 days -15days who were 58 patients (58%*.(*2

3.More than 16 days, who were 9 patients (9%). According to antibiotic duration in group B, patients can be divided into three groups as shown in table 4 B:

*).*From day 1-7 who were 9 patients (7.5%*.(*1

*) .*From 8 days -15days who were 83 patients (69.1%*.(*2

*).*More than 16 days, who were 28 patients (23.3%*.(*3

According to wound closure patients are divided to three groups as shown in table 5:

*).*Primary closure which were done for 164 patients (74.5%*(*1*.*

Healing by secondary intensions which were 46 patients. (20.9%).2.including all soft tissue infection .3.Delayed primary suture which were 10 cases (4.5%) of perforated acute appendicitis. Culture of pus was performed in all cases and microorganisms' results were

1. staphylo coccus aureus in 145 patients (66.90%).
2. E. coli and proteus in 31 patients (14.09%)
3. mixed growth of both aerobic and anaerobes in 42 patients (19.09%).
4. A.F.B. in one patient only (0.45%).

The study showed that normal saline using as irrigating solution of infected wounds of 100 cases (group A) in surgical ward of AL-Yarmouk Teaching Hospital by doctors, nursing staff and patients relative at home after taking instructions from doctors, three times daily of about 35-50 ml of N/S least under +ve pressure had accelerated healing rate in 28 patients (28%), this included 8 cases of perforated viscous(perforated peptic ulcer) (8%), and 20 patients were soft tissue infection(20%),while N/S moderately accelerated the wound healing process in 63 patients (63%) in whom 40 patients (40%) were perforated appendicitis and 21 patients (21%) were penetrating injuries (small and large bowel injuries) and 2 patients (2%) were perforated viscous(perforated duodenal ulcer). N/S was less effective in 9 patients (9%) in whom 5 patients (5%) were penetrating injuries (multiple large bowel injuries), 3 patients (3%) were perforated appendicitis and 1 patient (1%) was TB of soft tissue (trusted with anti-TB).In group B nine patients (7.5%) had good response five of them were soft tissue infection (4%) and four were perforated duodenal ulcer (3.3%), 100 patients (83.33%) were moderately respond in whom 6 patients (5%) were perforated duodenal ulcer, 20 patients (16.6%) were soft tissue infection, 52 patients (43.3%) were perforated appendicitis and 22 patients (18.3%) were penetrating injuries (small and large bowel injuries) and 11 patients of group B (9.16%) were poor response in whom 8 patients (6.6%) were perforated appendicitis and 3 patients (2.5%) were penetrating injuries (small and large bowel injuries).

Table 1: Distribution of patients according to the gender.

Gender	NO.	Percentage
Male	158	71.8%
Female	62	28.1%
Total number	220	100%

Table 2: Distribution of patients according to the age

Age group/year	15-25	26-35	36-45	46-55	56-60
No. of patients	79	56	33	39	13
Percentage	35.9%	25.4%	15%	17.7%	5.9%

Table 3A: Distribution of patients according to Pathology (group A) response to N/S wash.

Pathology	Total No.	Percentage	Good response	Moderate response	Poor response
Perforated A. A	43	43%	----------	40(40%)	3(3%)
Penetrating injuries	26	26%	----------	21(21%)	5(5%)
Soft tissue infection	21	21%	20%	----------	1(1%)
Perforated duodenal ulcer	10	10%	8(8%)	2(2%)	----------

Table 3B: Distribution of patients according to Pathology (group B)

Pathology	Total No.	Percentage	Good response	Moderate response	Poor response
Perforated A. A	60	50%	----------	52(43.3%)	8(6.6%)
Penetrating injuries	25	20.8%	----------	22(18.3)	3(2.5%)
Soft tissue infection	25	20.8%	5(4%)	20(16.6%)	----------
Perforated duodenal ulcer	10	8.3%	4(3.3%)	6(5%)	----------

Table 4A: Distribution of patients according to Antibiotic use (group A)

Duration of A. B	1-7 days	8-15 days	More than16days
Number of patients	33patients (8perf.DU.+ 20soft tissue inf.+5perf. A.A)	58(2perf.D.U.+35perf. A. A+21penetrating injuries)	9(1soft tissue infec. +5penetrating+3perf.A. A)
Percentage	33%	58%	9%

Table 4B: Distribution of patients according to Antibiotic use (group B)

Antibiotics duration	1-7 days	8-15 days	More than16days
Number of patients	9 patients (4perf.DU.+5soft tissue inf.	83(6perf.D.U.+42perf.A. A+15penetrating injuries+2Osoft tissue inf.)	28(10penetrating+18perf.A. A)
Percentage	7.5%	69.1%	23.3%

Table 5: distribution of patients according to types of wound closure

Types of wound closure	Number of patients	Percentage
Primary closure	164	74.5%
Healing by secondary intension	46	20.9%
Delayed primary suture	10	4.5%

Discussion

Microorganism are normally prevented from causing infection in tissue by intact epithelial surfaces, these are broken by trauma and surgery. The chance of developing an (SSI) after surgery is also determined by pathogenicity of organisms present and by the size of bacterial inoculums. Devitalized tissue, excessive dead space or hematoma, all the results of poor surgical technique would increase the chance of wound infection.

Proper cleansing to create a wound environment optimal for healing is perhaps the key component of acute and chronic wound management. Cleansing methods often differ among individual health care providers, institutions, and facilities

and many times are based on individual experiences and personal preferences [6]. A variety of cleansing solutions exist, and their selection should be based on cleansing effectiveness and lack of cytotoxicity [7]. Many cleansing solutions have demonstrated safe and effective results, whereas others may damage and destroy cells essential to the healing process [8, 9]. Normal sterile saline is regarded as the most appropriate and preferred cleansing solution because it is a nontoxic, isotonic solution that does not damage healing tissues [9]

our study showed that wound infection of upper GIT perforation (D.U) and causative micro-organism of soft tissue infection were more affected by N/S washing while poor response to N/S washing in infected wounds in lower GIT injuries, this difference in response was due to causative micro-organism which were mixed in lower GIT, and one case of soft tissue infection who take a time for healing (mycobacterium T.B) also moderate to poor response to N/Swash can be explained by time of presentation as in two cases of perforated D.U who took more than 24 hours until reaching hospital (self & paramedics medication).regarding perf. A.A. 40 cases was moderately respond to wash all of them operated upon in 4 days from first complain as grid iron incision while other 3 cases of perforated A.A. Poorly response to N/S wash were delayed in presentation (more than 4 days) operated upon as exploratory laparotomy. Regarding penetrating injuries 21 case were moderately response to wash presented less than 24 hours and all of them were not in shock state while other 5 cases of penetrating injuries in spite of early presentation, explorative laparotomy showed multiple small & large bowel injuries associated with other abdominal organs injuries and shock state, so washing with N/S of these 5 cases showed poor response. Our study shows significant difference regarding time need for complete healing between group A and B as P value was 0.016 (less than 0.05) In comparison with a study of Fernandez, Ussia, 2001 that reported several clinical trials regarding the use of normal saline as a wound cleanser. Their findings provide some support for the use of normal saline for routine cleansing of acute and chronic wounds. Using normal saline on surgical and sutured wounds decreased infection rates and accelerate wound healing which may bring into question the standard practice of avoiding showering and irrigation during this early postoperative period. These findings appear to support the cost-effectiveness and ease of use of normal saline, the single group that reported a 45% reduction in the relative risk of infection with normal saline used for irrigation of infected wound. The researchers cautioned that the temperature differences of the solutions could have affected tissue healing and microbial growth [10]. In comparison with study of Museru and colleagues, 1989 performed a randomized controlled trial comparing isotonic saline, distilled water and boiled water in irrigating open fracture wounds. The reported infection rates were 35% for the isotonic saline group, 17% for the distilled water group and 29% for the boiled water group leading the investigators to conclude that the irrigation solution type did not influence the infection rate [11, 12].

Studies that support our studies are

William A. Agger, of the 2823 procedures (soft tissue), 1043 were irrigated with an antibiotic solution and 1780 with N/S, Were 47 (4.5 percent) surgical wound infections (SWI) in the Group irrigated with an antibiotic solution and 83 (4.6 percent) SWIs in the group irrigated with normal saline. There was no Statistically significant difference between the groups [13, 14, 15] (chi square 0.04, p value = 0.85). with our studies

Studies that are not in agreement are

Angeras.1992 Participants 705 patients with infected wounds.

Interventions: 1) wounds irrigated with tap water group A (n= 295). 162patients were good response (55%)

2) Wounds irrigated with sterile normal saline group B (n= 332). 215 patients were good response (65%), so the P value was 0.08 (not significant).

Neues 2000 enrolled 817 patients (274 washed with tap water, 268 washed with N/S, 302 kept dry for 8 to 10days) study show no difference in infection rate among them (P value=0,08)

The study shows the mean time to heal is affected by (16)

- Using of N/S as irrigating solution decrease the time needed for complete healing& duration of A.B. use in infected wound mainly of soft tissue and perf. D.U.
- The infection delay healing process and need more time to complete, as the toxic products of bacterial infection disturbed normal healing process [16].
- The use of Antibiotic postoperative will decrease the infection rate & healing time in all infected wounds.
- Local wound care will accelerate healing process by wash out necrotic tissue.
- Infected wound by Mycobacterium and mixed infection showed little or no benefit with N/S washing.

Conclusion

Normal saline (0.9%) is the favored wound cleansing solution because it is an isotonic solution and does not interfere with the normal healing process, damage tissue, cause sensitization or allergies or alter normal bacterial flora of the skin leading to surgical infection particularly surgical site infection (SSI) which always been a major complication of surgery and trauma, normal saline accelerate wound healing of infected wound by cleansing microorganism and necrotic tissue, it used to cleanse deep wound by irrigation or flushing out debris and dried blood, especially in upper GIT perforation (perforated D.U) and we advise to irrigate such wound by normal saline, but it had less effectiveness on dirty wound as penetrating injury involving large bowel, where antibiotic was essential in their treatment.

Recommendations

Using of N/S for washing of infected wound in general is beneficial. High pressure wash is better than low pressure wash to remove most adherent necrotic tissue. Local wound debridement if needed is essential for wound healing side by side with N/S washing.

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