

# Comparing The Effectiveness of Normal Saline, Chlorhexidine-Setrimid and Propylbetaine Polihexanide as Wound Washing Solution On *Pseudomonas Aeruginosa* Contaminated Wound

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## Abstract

**Background:** The wound healing process is closely related to wound care techniques which consist of cleansing, debridement and dressings. In infected wounds, washing with a wound washing solution is expected to reduce the colony of germs and to eradicate the infection. One of the important pathogens in wound is *Pseudomonas aeruginosa*. In this study we will compare the use of normal saline, *chlorhexidine-cetrimide*, and *propylbetaine-polyhexanide* as wound washing solutions for wounds contaminated with *Pseudomonas aeruginosa*.

**Methods:** Twenty-seven mice were divided into 3 groups: normal saline, *chlorhexidine-cetrimide*, and *propylbetaine-polyhexanide* group. The wound was made on the mice's back then the *Pseudomonas aeruginosa* germ was inoculated on the wound. Four hours later, the wound was irrigated with the wound washing solution according to its group. Tissue culture will be taken 18 hours after washing.

**Result :** *Propylbetaine-Polihexanide* is the most effective wound washing solution on *Pseudomonas aeruginosa* contaminated wound compare to Normal Saline and *Chlorhexidine-Cetrimide*. Although, there is no significant difference in the number of *Pseudomonas aeruginosa* bacteria on the wound bed after washing with Normal Saline, *Chlorhexidine-Cetrimide*, and *Propylbetaine-Polihexanide*.

**Keyword :** Wound Solution; normal saline; chlorhexidine-setrimid; propylbetaine-polyhexanide; *Pseudomonas aeruginosa*; white mice

## 1. Introduction

Wound healing process is closely related to wound management or techniques which consist of cleansing, debridement and dressings. The wound care components above support each other in the wound healing process, however, cleansing is a measure of the success of wound care and is a standard wound care practice that is always practiced by professional health practitioners both in Indonesia and abroad (Baranoski & Ayello, 2012).

In the United States, *Pseudomonas aeruginosa* is the most common pathogen in hospitals and the second most common bacterial pathogen in patients with ventilator acquired pneumonia (Gellatly & Hancock, 2013). Research conducted by Asadullah (2015) on patients with nosocomial pneumonia at Dr. Soetomo Hospital Surabaya for the period January 1, 2011 - March 30, 2012, showed that the most pathogenic bacteria causing nosocomial pneumonia were *Pseudomonas aeruginosa* (Asadullah, Isbandiyah, & Sri Ardila, 2012).

In Dr. Soetomo Hospital, the standard antiseptic for wound management is *chlorhexidine-cetrimide*, more commonly known as Savlon®. While in several other hospitals using wound washing solution like normal saline (NaCl 0,9%) and *propylbetaine - polyhexanide* (Prontosan®)

## 2. Methods

Twenty-seven mice were divided into 3 groups: normal saline, *chlorhexidine-cetrimide*, and *prophylbetaine-polyhexanide* group. A full-thickness wound size of 1x1 cm was made on the back's mouse using a knife and scissors. *Pseudomonas aeruginosa* for contaminated wound in mice was obtained from positive culture isolates results of Dr. Soetomo Hospital's patients. Bacteria were incubated and cultured on standard media, then placed on the wound and covered with transparent dressing.

Four hours after application of *Pseudomonas aeruginosa*, each wound was irrigated using NaCl 0.9%, Savlon® 1:30, and Prontosan® according to the treatment group, using a 20cc syringe within 30 seconds, to the entire surface of the wound. Wound cleansing was implemented with irrigation alone, without any deep wiping of the wound, to prove the efficacy of the washing fluid. Tissue culture were performed on all parts of the wound 18 hours after washing the wound (Picture 1).

In calculating the number of colonies, score 1 is given if there is no germ growth, score 2 if the growth of germs is less than  $10^5$  colonies, and score 3 is given if it grows more than  $10^5$  colonies. Calculation of the number of colonies using colony forming units per  $\text{cm}^2$  (CFU /  $\text{cm}^2$ ).

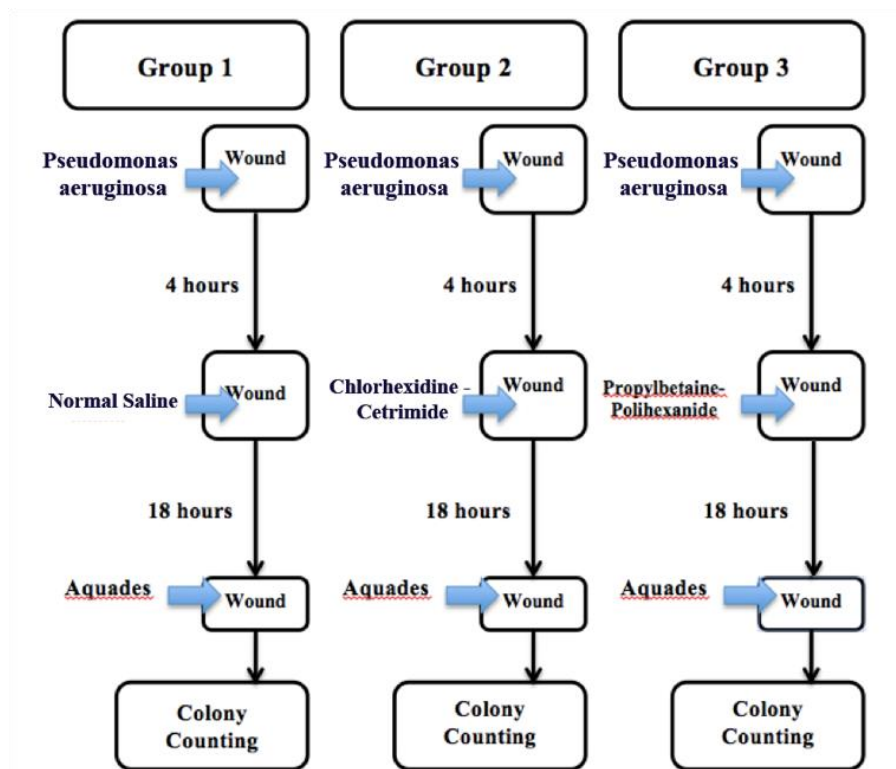


Fig .1. Research Framework

### 3. Result

Table 1. Score of colonies number calculation

| Treatment                                   | Score |       |   |       |   |       |
|---------------------------------------------|-------|-------|---|-------|---|-------|
|                                             | 1     |       | 2 |       | 3 |       |
| Washing with Normal Saline (0,9% NaCl)      | 0     | 0%    | 0 | 0%    | 9 | 100%  |
| Washing with Chlorhexidine - Cetrimide 1:30 | 0     | 0%    | 2 | 22,2% | 7 | 77,8% |
| Washing with Propylbetaine-Polihexanide     | 2     | 22,2% | 2 | 22,2% | 5 | 55,6% |

On the table 1, washing treatment group with normal saline shows point 3 has a percentage of 100%. The washing treatment group with chlorhexidine - cetrimide 1:30 showed that point 2 had a percentage of 22.2% and point 3 had a percentage of 77.8%. From the propylbetaine-polihexanide washing treatment group showed that point 1 showed a presentation of 22.2%, point 2 showed a presentation of 22.2%, and point 3 showed a presentation of 55.6%.

The results obtained were then analyzed statistically using a nonparametric test, namely the Kruskal Wallis.

Table 2. The Kruskal Wallis

| <i>Kruskal Wallis H</i> | <i>df</i> | <i>Asymp. Sig.</i> |
|-------------------------|-----------|--------------------|
| 5,272                   | 2         | 0,072              |

On table 2, it informs the difference in the number of *Pseudomonas aeruginosa* bacteria in wound beds after washing with normal saline, *chlorhexidine-cetrimide*, and *propylbetaine-polihexanide* resulted in an H test statistic of 5.272 with a significance value of 0.072. It can be seen that the significance value > significant alpha (5% or 0.05), means there is no significant difference in the number of *Pseudomonas aeruginosa* bacteria on the wound bed after washing with Normal Saline, Chlorhexidine-Cetrimide, and Propylbetaine-Polihexanide.

### 4. Discussion

#### 4.1 Colonization

Wounds which were made in the operating room and prepared by asepsis procedures were sterile wounds. Meanwhile wound that were not obtained that way such as by accident, the wound is called a contaminated wound. Contaminated wounds if left and have passed the contamination time will become an infected wound. Infected wounds are called dirty wounds. Contamination wounds, no matter how contaminated with external dirt, can still be cleaned during treatment and are not called dirty wounds, they are still contaminated wounds (Djohansjah, 2018).

Contamination time is the time when the bacteria in the wound are still in the wound room, not yet infecting the tissue so that it is easy to clean. Generally, it lasts around 6-8 hours. For areas of the face and neck that are rich in vascularization, this time can be longer than other parts, around 12-18 hours. (Djohansjah, 2018)

#### 4.2 *Pseudomonas aeruginosa*

*Pseudomonas aeruginosa* is a nosocomial pathogen most often responsible for infections in patients with cystic fibrosis, bronchiectasis, neutropenia, AIDS, and / or burns and patients with metabolic, hematological, or malignant diseases. This bacterium is mainly responsible for ventilator-related pneumonia, infections after surgery, and urinary tract infections, and sepsis in patients in intensive care units. Most strains are generally resistant to many antibiotics including imipenem and meropenem; therefore, pathogens are usually problematic in therapy (Yetkin, 2006).

The ability of *Pseudomonas aeruginosa* to form biofilms makes *Pseudomonas aeruginosa* a feared pathogen because of the combined effects of various intrinsic virulence factors, and its resistance to antimicrobial drugs, and due to *Pseudomonas* contamination can cause death (Hamijaya, 2014).

Physical characteristics of wounds infected with *Pseudomonas aeruginosa* are the presence of a lot of suppuration, turquoise in color and gives color to the bandage, pungent and disturbing smell; tend to infect other patients in the same ward; difficult to heal and very damaging to the wound; and can be followed by diarrhea due to septicemia, as well as weakness and anemia in patients (Turner & Richardson, 1917).

#### 4.3 Normal Saline (NaCl 0,9%)

Normal saline is a widely recommended wound washing fluid, because it is known to be compatible with human tissue. This fluid does not cause damage to new tissue and does not affect the function of fibroblasts and keratinocytes in wound healing. Its effectiveness in preventing infection has not been established (Moscati, 1998; Penn-Barwell, 2012).

Many cleaning solutions have shown safe and effective results, while others can damage and destroy cells that are important for the healing process. Normal saline is considered the most appropriate and preferred cleaning fluid because this solution is non-toxic, isotonic. fluid that does not damage healing tissue (Davis, 2017).

#### 4.4 Chlorhexidine - Cetrimide 1:30 (Savlon®)

One of the popular antiseptic ingredients is from the biguanide group, namely chlorhexidine. Chlorhexidine has extensive antimicrobial activity and is less irritating to the skin, but it kills organisms slower than alcohol, and decreases its activity if there is organic material and alkaline atmosphere in the wound. *Chlorhexidine* is the active ingredient most widely used not only in various antiseptic and disinfectant products but also in handwashing, preservative and mouthwash preparations. Cetrimide as a surfactant is added to chlorhexidine and has a non-specific destructive effect on bacterial membranes (McDonnell & Russell, 1999).

#### 4.5 Propylbetaine-polihexanide (Prontosan®)

Prontosan® wound solution, is a wound cleanser made of pure water and two main ingredients: polyhexamethylene, antimicrobial agent (0.1%) betaine, surfactant (0.1%) (Bradbury, 2011).

Although water can be used as a wound cleanser, and has not been seen to increase the risk of infection or delay healing, the use of specially designed wound cleaning agents may have the potential to improve clinical outcomes through their additional wound cleaning modalities. Evidence appears that the combination of polyhexamethylene with surfactants (betaine) has an increased ability to penetrate hard-to-remove layers, removing bacteria and biofilms from wounds (Bradbury, 2011).

The results of this study confirm previous studies that can prove the effectiveness of Propylbetaine-Polihexanide against *Pseudomonas aeruginosa*. A previous study by Minnich (2012) showed a reduction in the in vitro bacterial load in 12 of the 13 micro-organisms commonly found in wounds. As with all in vitro studies, the observed results may not translate into clinical benefit or represent the full range of situations seen in clinical practice. However, this study provides objective data on the antimicrobial activity of the product in vitro, adding that the affected patients gave the impression of clinical effectiveness of 0.1% polyhexanide / 0.1% betaine for wound cleansing (Davis, 2017).

In the case of irrigation for wound washing, the decrease in the rate of bacterial proliferation due to irrigation of wounds in the wound with Propylbetaine-Polihexanide solution, gave rise to evidence that the combination of polyhexamethylene with a surfactant (betaine) has an increased ability to penetrate difficult-to-remove layers, removing bacteria and biofilms from the surface. wounds (Bradbury, 2011).

## 5. Conclusion

Propylbetaine-Polihexanide is the most effective wound washing solution on *Pseudomonas aeruginosa* contaminated wound compare to Normal Saline and Chlorhexidine-Cetrimide, although there is no significant difference in statistic.

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