

# Possibility of Extension of Pre-operative Patient Preparation by Antiseptic Shower at the University Hospital Brno

Silvie Hodová<sup>1</sup>, Pavel Turčáni<sup>2</sup> and Markéta Hanslianová<sup>3</sup>

1. Department of Infection Control and Hospital Hygiene, University Hospital Brno, Jihlavská 20, 602 00 Brno, Czech Republic

2. Clinic of Pulmonary Diseases and Tuberculosis, University Hospital Brno, Jihlavská 20, 602 00 Brno, Czech Republic

3. Department of Clinical Microbiology, University Hospital Brno, Jihlavská 20, 602 00 Brno, Czech Republic

**Abstract:** Ensuring complex pre-operative patient preparation before planned surgery is an essential preventive measure of SSIs (surgical site infections). The aim of this study was to evaluate the difference in the effectiveness of the use of common soap and a tested product to reduce the occurrence of bacterial microorganisms on the skin surface in the area of the assumed surgical incision. Two hypotheses have been identified: H0: the tested product can be considered as beneficial for common pre-operative patient preparation in the incision area in order to significantly reduce the microbial load (decrease in CFU on a defined area of the blood agar by half of the original number and less). H1: the tested product exceeds common soap by at least 20% when reducing the microbial load in the incision area. There were 80 microbiological prints examined on filter paper using the cultivation method on culture medium. The statistical method of the classic hypothesis test on the binomial distribution parameter versus the one-sided alternative has been used to process the results for the occurrence of microorganisms. The statistical processing of the results obtained by microbiological examination of prints allows for the confirmation of H0 and rejection of the H1 hypothesis. The results have shown the importance of proper pre-operative hygiene of the patient's skin, regardless of the detergent base.

**Key words:** Skin decolonisation, pre-operative preparation, SSI.

## 1. Introduction

Surgery is a serious interference with the integrity of the patient's body and is associated with the risk of many complications including infection. SSIs (surgical site infections) are caused by microbial contamination of the operating field during the surgical procedure. The risk of SSI is dependent on the dose of microbial contamination, the virulence of microorganisms, and the host's immunity. SSIs that are associated with the use of artificial implants (biofilm infections) have specific pathogenesis.

In the group of the main healthcare-associated infections, SSIs are second to third (19.6%). For

surgical patients, their proportion is about 40% [1].

The spectrum of originators depends on the anatomical site of the surgical procedure. For pure treatments, the main originator of SSI is *Staphylococcus aureus* and *coagulase negative staphylococcus*. For abdominal surgical interventions, the aetiology of SSI is predominantly associated with enterobacteriaceae, enterococci, and anaerobes [2].

SSIs, which according to the surgical site affect various anatomical sites, are manifested differently. These may be minor infections, such as skin and subcutaneous skin inflammation, but also serious infections of organs and body areas.

SSIs occur during hospitalisation, but even after release. They may appear up to 30 days after surgery. For surgery where foreign material is implanted, SSIs occur within 1 year of surgery [3]. In general,

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**Corresponding author:** Silvie Hodová, Mgr., department of Infection Control and Hospital Hygiene, research fields: prevention of surgical site infection.

hospitalisation prolongs infectious complications—including SSIs on average by two weeks, with hospitalisation costs rising to about three times the amount [4].

An important preventive measure of SSI development is complex pre-operative patient preparation [5, 6]. One of the measures is proper pre-operative skin hygiene at the site of surgical intervention. An antiseptic shower may be used with antimicrobial whole-body cleaner or commonly available soap. For some antimicrobial emulsions, the possibility of non-rinse care is also advantageous.

## 2. Study Aim

The aim of the prospective study was to compare the reduction of microbial settlement at the site of the assumed surgical incision with and without the use of the tested antiseptic agent.

Hypotheses:

H0: the tested product can be considered as beneficial for common pre-operative patient preparation in the incision area in order to significantly reduce the microbial load (decrease in CFU on a defined area of the blood agar by half of the original number and less).

H1: the tested product exceeds common soap by at least 20% when reducing the microbial load in the incision area.

## 3. Set and Methodology

The study was conducted at the University Hospital Brno at the Clinic of Burns and Reconstructive Surgery. The study period was 10 months, from 1 April 2016 to 21 January 2017. The randomised study included a total of 40 patients undergoing planned abdominal-plastic surgery. The age range was set at 30-55 years. Sex and BMI were not limiting. Patients with diabetes mellitus type II were excluded, as well as people on immunosuppressive therapy, and those with allergies to povidone-iodine based preparations.

Half (twenty) of the patients underwent skin

decolonisation twice with the tested agent and the other half underwent decolonisation twice with soap without an antimicrobial component. The patients were explained the importance of the correct washing technique during the time period of the exposure to the tested product/soap on wet skin for at least one minute. After this cleansing, patients were always given clean pyjamas. Before the first skin decolonisation and after the second decolonisation, bacteriological prints were performed at the site of the surgical incision. The first decolonisation and collection of the bacteriological sample took place in the evening before the surgery, the second decolonisation in the morning of the surgery, including the bacteriological imprint. In total, 80 imprints were collected.

The tested product was a foam-based poly (hexamethylene) biguanide (*polyhexanide*). The soap without an antiseptic component was always the patient's own. Patients were instructed to perform thorough body cleansing.

Hair removal from the site of the surgical field was performed on the day of surgery before the second wash using a disposable razor using a wet path.

The imprints were taken aseptically onto 50 × 50 mm sterile filter paper and then placed into a Petri dish with blood agar (bowl diameter of 9 cm). Transport into a microbiological laboratory then followed, where they were incubated in a thermostat at 36 °C for 48 hours, with a first 24-hour evaluation [7]. After the prescribed period of cultivation, the growth of microorganisms was evaluated both qualitatively—genus and species allocation, and quantitatively—assessing the number of colonies on a defined area of blood agar. Bacterial identification was performed using a MALDI biotyper (mass spectrometry). At the same time, the susceptibility of the captured microorganisms to antibiotics was determined using a disk diffusion method with EUCAST (European Committee on Antimicrobial Susceptibility Testing) interpretation criteria.

The laboratory meets the requirements of the quality

management system ČSN EN ISO 9001:2008 and 15189:2013.

## 4. Results

In the group of 40 patients, there were 38 women and 2 men. The age range was from 32 to 54 years, BMI ranging from 18.6 to 43.9. No multi-resistant microorganism was detected. Only one case indicated colonisation by a single strain, in other cases a combination of two to four bacterial strains was observed.

### 4.1 Results Obtained by Microbiological Examination Using the Tested Product in Twenty Persons

The total occurrence of detected microorganisms decreased from 48 detected strains to 36 after the second decolonisation. This represents a 25% improved result.

There was a cultivation-wise improved result in CFU in 14 cases, in 5 cases the same result was observed and in 1 case the finding had worsened.

In four cases, pathogens, which are among the major SSI originators, were detected before the first skin decolonisation (20.0%) and their finding on the patient's skin is therefore considered very undesirable. After the second skin decolonisation, it was only in two cases (10.0%). This was the case of methicillin-sensitive gold staphylococcus (*Staphylococcus aureus*). Its quantity decreased in one case from  $10^3$  to  $10^1$ , in the latter case, it was a unique occurrence before and after skin decolonisation.

The detection of pathogenic microorganisms before and after the second skin decolonisation using the tested agent is shown in Table 1.

### 4.2 Results Obtained by Microbiological Examination Using Common Soap in Twenty Persons

There was a cultivation-wise improved result in CFU in 12 cases, in 2 cases the same result was observed and in 6 cases the finding had worsened.

In three cases, pathogens, which are among the major SSI originators, were detected before the first skin decolonisation (15.0%) and their finding on the patient's skin is therefore considered very undesirable. In two cases, this was due to the methicillin-sensitive gold staphylococcus (*Staphylococcus aureus*) in a quantity of  $10^2$  and  $10^1$ . In one case, *Streptococcus agalactiae* was massively detected. After the second skin decolonisation, only one case of *Staphylococcus aureus* (5.0%) was detected, and in an isolated amount.

The detection of pathogenic microorganisms before and after the second skin decolonisation using common soap is shown in Table 2.

### 4.3 Assessment of Hypotheses

H0: the tested product can be considered as beneficial for common pre-operative patient preparation in the incision area in order to significantly reduce the microbial load (decrease in CFU on a defined area of the blood agar by half of the original number and less).

Comment: The reduction of microbial load using the tested product was demonstrated in the genus of *Streptococcus* spp., *Bacillus* spp. and the Enterobacteriaceae group. Due to the significant reduction of the massive load within the genus *Staphylococcus* spp. as well as within the *S. aureus* genus, the tested product may be considered suitable.

**Table 1** Number of detections—tested agent.

Microorganisms	Before	After
<i>Streptococcus</i> spp.	2	1
Enterobacteriaceae	8	0
<i>Enterococcus</i> spp.	4	4
<i>Staphylococcus</i> spp. (coagulase negative)	23	24
<i>Staphylococcus aureus</i>	4	2
<i>Bacillus</i> spp.	6	2

**Table 2** Number of detections—ordinary soap.

Microorganisms	Before	After
<i>Micrococcus</i> spp.	2	0
<i>Streptococcus</i> spp.	2	1
Enterobacteriaceae	5	2
<i>Enterococcus</i> spp.	4	2
<i>Pseudomonas</i> spp.	1	0
<i>Staphylococcus</i> spp. (coagulase negative)	25	27
<i>Staphylococcus aureus</i>	2	1
<i>Streptococcus agalactiae</i>	1	0
<i>Bacillus</i> spp.	7	2

For this reason, we can confirm the hypothesis.

H1: The tested product exceeds common soap by at least 20% when reducing the microbial load at the incision site.

Comment: 14 patients (70%) achieved better results with the tested product, 12 patients (60%) when using common soap. The difference was two patients (10%). For this reason, we reject the hypothesis.

## 5. Discussion

Our study included an agent based on *polyhexanide biguanide* and soap that patients brought for hospitalisation themselves. When performing body cleansing in the shower, patients were not observed in this activity with respect to the privacy of the individual. As a result, results may be affected by individual patient techniques. However, the most realistic order at the department was sustained, which, after the simulated conditions, would then be performed again.

The above-mentioned chemical base is not included in the available studies in the guideline recommendations [8, 9] on the prevention of infections at the sites of surgical intervention. Due to its testing and comparison with common soap, we concluded that in both cases the microbial load was reduced. However, difficulties may lie in the relatively small number of samples taken, where the difference of one case greatly affects the overall result. The results of our study are not consistent with the results of the studies stated in the given guidelines:

Data from a study with more than 700 patients who

used an antiseptic shower using *chlorhexidine gluconate*, *povidone iodine*, and *triclocarban*-medicated soap has been published in the CDC guidelines [8] and the number of colonies of bacteria on the skin was reduced from 9-fold to 1.9-fold; However, a reduction in the incidence of SSIs was not demonstrated in connection with its simple mentation.

The new WHO guidelines—Prevention of Infections in sites of surgical interventions [9] refer to 9 studies that included a total of 17,087 adult patients who had undergone pre-operative bathing or showering with antimicrobial soap (using *chlorhexidine gluconate*) by comparing this with common soap. There is a moderate quality of evidence available that bathing with CHG soap did not significantly reduce the incidence of SSIs compared to bathing with common soap. Other chemical bases have not been included in the summary guidelines.

## 6. Conclusion

In our study, data obtained from a prospective audit at the Clinic of Burns and Reconstructive Surgery of UH Brno was processed. From the processed results, both pre-operative washing procedures significantly reduced or eliminated all significant SSI originators (*Staphylococcus aureus*, *Streptococcus agalactiae*).

The results were brought to the attention of members of the Commission for the Prevention and Control of Infections and the management of the clinic. These findings were used in the revision of the standard nursing procedure—patient preparation for surgery with a recommendation to perform body

cleansing both in the evening and on the day of surgery. The tested product was not introduced into pre-operative patient preparation at UH Brno.

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