

REVIEW ARTICLE

Usage of Chlorhexidine Gluconate in Skin Preparation Protocols for Surgical Preparation to Reduce the Rate of Surgical Site Infection: A Literature Review

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ABSTRACT

Skin preparation with chlorhexidine gluconate is one of the actions to reduce the incidence of surgical site infection. This literature review aims to examine the effect of chlorhexidine gluconate in skin preparations on the incidence of surgical site infection. This review uses a scoping review approach. The keywords used are in several accessible databases online at Unpad library (Pubmed, Science Direct, SAGE, and Wiley). The inclusion criteria are the articles that were published from 2010 to 2020; articles in English; articles are available in full text. From 10 articles, the results have shown that the use of chlorhexidine gluconate significantly reduced the incidence of surgical site infection which is around 0% -2.15% to the group of chlorhexidine and 2.2%-6.3% to the group of non chlorhexidine. The use of chlorhexidine gluconate significantly decreases incidence rate of surgical site infection.

Keywords: Chlorhexidine gluconate, Skin preparation, Surgical site infection

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INTRODUCTION

Infection is still a problem in health services particularly in developing countries such as Indonesia. The infection concerned with health services is general complication which occur in health service facilitation that causes treatment time longer, cost is high and non-material risk from patient party (1). High infection rate will influence the quality of facilitation service based on KEPMENKES Number 129/Menkes/SK/II/2008 about Minimum Service Standards for Hospital (2).

Surgical site infection is an infection that occurs after surgery on the part of the body that underwent surgery which can sometimes be a superficial infection involving only skin or more serious and can involve the tissue under the skin, organs or implants (3). Surgical site infection is one of type from HAIs according to National Healthcare Safety Network (NHSN) 2014 as third ranking from Health Care Associated Infections (HAIs). While according to Magill et.al surgical site infection occupy the first order from total infection (Health Care Associated Infections) HAIs at hospital, namely 21.8% based on the research (4). For coverage in the Southeast Asia region by National Healthcare Safety Network (NHSN) 2014 incidence rate of surgical site infection as

much as 7.8% (4).

In surgical procedure, preparation skin is action taken to decrease germ colony on non-sterilized skin surfaces, but can be decreased with asepsis action. An antiseptic that can decrease germ colony is chlorhexidine gluconate. Chlorhexidine gluconate according to various literatures give benefits in preventing surgical site infection which the procedure can be done before operation (5). Therefore, evidence-based use of chlorhexidine gluconate in the prevention of would help in encouraging the use of chlorhexidine in the preparation of surgical patients. This literature review aims to examine the effect of chlorhexidine gluconate in skin preparations on the incidence of surgical site infection (SSI) based on published research literature.

METHOD

Study design uses literature review with scoping review approach. Keywords entered into the database includes “(((surgical procedure) AND (preoperative)) OR (preoperative procedure[MeSH Terms])) OR (chlorhexidine bathing) AND (surgical site infection)” on various accessed database online in Unpad library (Pubmed, Science Direct, SAGE and Wiley). The inclusion criteria used in this research as follow as : 1) used article is the article with issued year start year 2010 until year 2020; 2) Used language in this article is English language; 3) available article is full text form; 4) Article theme is chlorhexidine using in preparation

skin protocol in surgical preparation with rate decrease of surgical site infection.

Identified article as much as 1230 articles which then carried out the issuance of articles as many as 500 articles. Article selection processes used PRISMA (Figure 1). A lot of studies used this approach to guide the process of article selection (6) (7) (8) (9) (10-12). Furthermore the research made the article screening based on the title reading and abstract as much as 65 articles which then titled article and abstract it is not in accordance with will be issued. Furthermore the researcher makes the screening through the selection based on inclusion criteria so that predicted total articles is relevant as much as 25 articles. Furthermore selected article based on inclusion criteria will be examined such as appropriateness namely text reading wholly, and finally total relevant article will be analyzed namely as much as 10 articles.

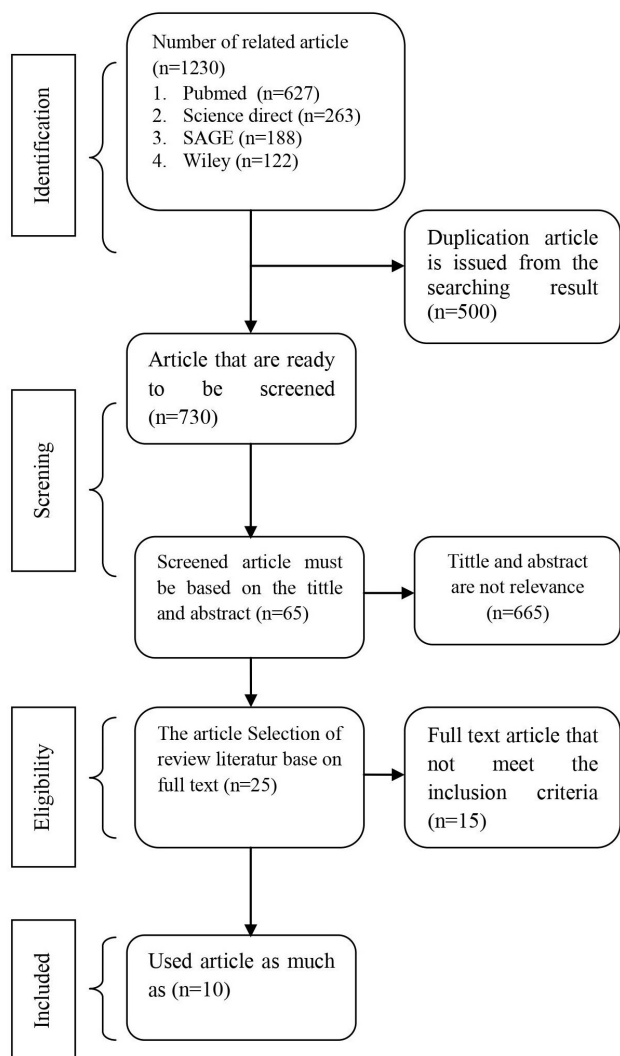


Figure 1: PRISMA flow diagram

RESULTS

This literature review with a scoping review approach

will present the data in the form of a narrative which explains the subject and setting, as well as the purpose of the research. Then, the results of the study related to the use of chlorhexidine gluconate to reduce the incidence of surgical site infections will be presented. The research related to the procedure for using chlorhexidine gluconate conducted by Edmiston et.al conducted in the USA to develop and evaluate the effectiveness of baths using chlorhexidine gluconate on the skin surface. The research design was randomized study groups divided into two groups, which are the 4% chlorhexidine group with 2 showers and 3 showers and comparing the bathing process using chlorhexidine without pause and with a pause of 1-2 minutes with a total sample of 120 patients. The subjects in this study were adult patients who would undergo elective surgery (scheduled surgery). The results show that chlorhexidine gluconat concentration with average value significantly higher on bathing group with pause the shower 1-2 minutes than bathing group without the pause ($p < 0.001$). As for chlorhexidine concentration what is used 970 ug/ml above the minimum concentration of 90% to inhibit the growth of gram-negative bacteria. Chlorhexidine using effectively to decrease total microbe on operative incision area, but for certain regions such as crotch, axial, perineum and popliteal can improve the infection risk because of minimum hygiene (13).

Regarding the concentration of chlorhexidine used, according to research conducted by Edmiston et.al which was conducted in England to analyze the benefits of using an electronic warning system to improve compliance in the usage of 2% chlorhexidine use. The research design was randomized study groups and the number of samples was 100 health worker volunteers who were randomized into 5 groups. The results show that chlorhexidine concentration average on skin surface of volunteer who use electronic alerts are from 5 groups as much as 1.040,5; 1.334,4; 1.278,2 1.643,9; 1.803,1 ug/ml and on non-electronic alerts groups from 5 groups as much as 931,8; 1.240,0; 1.249,8; 1.194,4; 1.364,2 ug/ml each ANOVA ($p < 0.001$). And using of electronic alert system results in chlorhexidine concentration improvement on significant skin with coefficient rate that uses electronic alert ($p < 0.04$) and non-electronic alert ($p < 0.007$) (14).

The incidence of surgical site infections in patients undergoing surgery is also influenced by personal hygiene factors, one of which is using the chlorhexidine skin preparation protocol. The research were conducted by Johnson et.al conducted in the USA to evaluate the incidence of surgical site infection in patients who underwent a protocol using chlorhexidine gluconate in total hip arthroplasty surgery. The research design is a randomized control trial cohort study with 1056 adult patients undergoing hip arthroplasty surgery, 159 were included in the intervention group consisting of 79 men and 80 women with an average age of 58 years and

the 897 control group consisting of 472 men and 425 women with an average age of 58 years. The results show that comparison between the group that complied with the protocol of use chlorhexidine with the group that did not comply with the protocol which showed that the group that adhered to the protocol was lower with a total 157 patients which underwent, while 897 patients group that not underwent as much as 14 (1.6%) with ($p=0.231$). When grouped into surgery risk there is increase on the group which not obey as much as 0.4% until 5.2% and not infection to obey groups (15).

As for the incidence of surgical site infections in operations performed on children, such research were conducted by Berrondo et.al conducted in the USA to know the incidence of infection in pediatric patients who went through hernia/hydrocele or orchiopexy surgery. The research design was a retrospective cohort study and the research subjects were children from 0 to 18 years with an average age of 61 months old. The details of the respondents' numbers were 535 male and 6 female respondents. The results show that from 543 samples consist of 2 groups namely 203 non chlorhexidine group and 340 chlorhexidine groups. No relationship about chlorhexidine using with incidence of surgical site infection on child patient with infection rate as much as 0.92%. Generally, surgical rate infection not occur on child patient that underwent hernia operative/hydrocele or orkiopexi (16).

Another study related to the eradication of bacteria in the surgical incision site undergoing a chlorhexidine skin preparation protocol as carried out by Kline et.al conducted in the USA to figure out the colonies of staphylococcus aureus bacteria in the body parts that have been disinfected with chlorhexidine such as the nose, armpits, throat, and anus. The research design was a randomized control trial with a total sample of 110 samples. It consisted of 57 intervention groups and control groups with 53 females. In the control group, the average age was 52.5 years with a body mass index of 31 while in the intervention group the average age was 58.8 years with a body mass index of 30.7. The results show that from 127 study samples there is carrier of staphylococcus bacteria. Which then from 127 respondents there are 110 respondents eligibility meet the criteria (57 decolonization group and 53 control group). Staphylococcus aureus eradication from 57 decolonization group there are 41 (71.9%) and 13 from 53 (24.5%) from control group there are 47.4% with coefficient rate as much as 95% ($p<0.0001$). There is significant different between bathing group with using the chlorhexidine with the group uses the normal soap in number of germ colonialization (17).

The use of chlorhexidine in skin preparation protocols is also carried out in orthopedic surgery, a study conducted by Kapadia et.al conducted in the USA to know the effectiveness of 2% chlorhexidine on the incidence of

surgical site infections. The number of samples was 2545 people who underwent total hip arthroplasty surgery. A total of 557 patients underwent chlorhexidine skin preparation protocol with an average age of 56 years with details of the number of male respondents as many as 235 and 322 women. Shows the result that incidence of surgical site infection significantly lower on the group that uses chlorhexidine protocol 2% than the group not use chlorhexidine ($p=0.0428$) (18). There are 3 infections that occurs on chlorhexidine group (0.5%) than with 32 infections on the group that not use chlorhexidine protocol (1.7%). When grouped based on the age, sex and body mass index there is not significant different on both groups with ($p=0.4691-0.8140$) (18). In carrying out the skin preparation protocol which went through several stages, there were natural obstacles such as shown in the research by Qvistgaard et.al conducted in Sweden which aims to describe the patients' experience with a home-based chlorhexidine skin preparation protocol for elective hip replacement surgery. The design of this study was a qualitative study with a total of 14 respondents with inclusion criteria: patients who had recently undergone elective hip replacement surgery disinfected skin at home with chlorhexidine baths were given preoperative information, those people were able to speak and read Swedish. Shows the result that a patient preparing for surgery by bathing chlorhexidine is constrained and requires a supportive lordship. The patient's strengths are also important and help from caregivers is very helpful. Skin disinfection involves an important step to reduce microbes on the skin surface, because there are many steps that make it difficult for the patient, it is necessary to have a preoperative dialogue to identify the patient's needs. Conducting skin disinfection before the surgery is the patient's responsibility. However, due to numbers of difficulties, it is nurse's role to guide, educate, support and identify the needs of every patient (19).

And still related to the procedure for implementing the skin preparation protocol, there are several things related to patient knowledge, as stated/proven in the research Markstrum & Bjerse conducted in Sweden which aims to identify knowledge and practice of skin preparation in pre-surgery preparation in orthopedic surgery. The design of this study was descriptive research with a cross-sectional study with several samples of 106 respondents with an average age of 57.6 years old. There were 96 female and 11 male respondents with the details of 68 nurses and 38 nursing assistant respondents. Shows the result that there are 2 respondents from 106 respondents that uses the normal soap in preparation skin procedure. And 104 respondents use chlorhexidine in preparation skin on orthopedic preparation. Respondents from almost half of surgical treatment departments used different methods even though they worked in the same unit. One respondent stated that they carried out the procedure based on the manufacturer's recommendations, as many as (59/104) were familiar

with the manufacturer's recommendations and as many as (21/104) perform procedures according to their understanding. In this research shows that preparation skin practice on operative preparation not based on the fact and lack of knowledge in clinical practice (20).

The use of chlorhexidine also affects the incidence of surgical site infections in orthopedic surgery. The research conducted by Johnson conducted in the USA which aims to assess the incidence of surgical site infection in patients with total knee arthroplasty surgery who previously underwent a chlorhexidine skin preparation protocol. The design of this study was a cohort study with a total sample of 488 respondents with an average age of 63 years. There were 214 male and 274 female respondents with an average body mass index of 34. Shows the result that the incidence of surgical site infection was significantly lower in patients who had overall skin preparation protocols with chlorhexidine 2% than non-chlorhexidine group ($p= 0.021$). There are 3 infections that occurs on chlorhexidine group (0.6%) than 38 infections on the group not use chlorhexidine protocol (2.2%) with ($p= 0.0212$). When grouped by Health Care Safety Network infection risk category lower incidence of surgical site infection in the chlorhexidine than non-chlorhexidine (21).

And the effectiveness of chlorhexidine on the incidence of surgical site infections has also been proven, based on research conducted by Graling & Vasaly conducted in the USA which aims to determine the effectiveness of 2% chlorhexidine on the incidence of surgical site infections. The design of this study was a randomized control trial cohort study with a total sample of 335 and a control group of 284. Of the 335 intervention groups with an average age of 57.1 years, there were 170 male and 165 females respondents. As for the control group, the average age was 53.1 years old with 142 male and 142 female respondents. Shows the result that respondents who underwent bath procedures and overall who experienced infection in the operating area were 7 respondents and the control group was 18 (6.3%) with ($p=0.01$). With details in the group, namely those who experienced surgical site infection as many as 7 respondents (2.1%) and control group as much as 18 (6.3%) with ($p=0.01$). While on control group namely experienced deep infection as much as 1 (0.35%). Superficial infection 8 (2.8%) and organ infection 4 (1.4%). Significantly decrease infection risk with $p = 0.01$ as for decrease of infection risk namely on the type of postoperative organ infection with $p = 0.04$ (22).

DISCUSSION

Preparation skin protocol uses chlorhexidine on the patient before operative significantly can decrease incidence of surgical site infection based on the research Edmiston et.al that chlorhexidine gluconat use with

bathing which its use is a pause of 1-2 minutes with a concentration of 970 above the minimum concentration of 90% to inhibit the growth of gram-positive and gram-negative bacteria (13). And compliance by officers in using concentrations will also support the success of establishing a skin preparation protocol before surgery based on the research Edmiston et.al (14). In addition to patient's knowledge about chlorhexidine procedure is also important such as study result from Markstrum & Bjerse that around 25% respondents underwent preparation skin protocol before operative as with their understanding, not based to manufacture's recommendations (20).

Regarding adherence to the preoperative skin preparation protocol, it was also revealed by Johnson et.al showing the results that the group that adhered to the preparation protocol using chlorhexidine had no incidence of surgical site infection, while the group that did not adhere to the skin preparation protocol using chlorhexidine showed an incidence of surgical site infection of 1.6% (15). This is in accordance with a study Kapadia et.al which revealed that the group that underwent a skin preparation protocol using chlorhexidine had a surgical site infection incidence of 0.5% compared to 1.7% in the group who did not follow the skin preparation protocol using chlorhexidine (18). And according to another study by Johnson et.al the incidence of infection in knee arthroplasty also showed that the group who underwent a skin preparation protocol using chlorhexidine had an incidence of 0.6% infection in the operating area compared to the group who did not undergo a skin preparation protocol. using chlorhexidine at 2.2% (21).

In further research on the benefits of chlorhexidine to reduce the incidence of surgical site infections, it was also revealed by Graling & Vasaly that the incidence of surgical site infections was 2.1% in the group who underwent a skin preparation protocol using chlorhexidine and 6.3% on the group not use preparation protocol uses chlorhexidine namely experience deep infection as many as 2 (0.6%), superficial infection as much as 4 (1.2%) and 0% that experience organ infection. While on control group namely that underwent deep infection as much as 1 (0.35%), superficial infection 8 (2.8%) and organ infection 4 (1.4%) (22). But there are obstacles in establishing a skin preparation protocol in surgical preparation proposed by Qvistgaard et.al namely supported environment, there needs to be someone who helps the implementation preparation skin protocol and because it involves important and many steps that make it difficult for the patient to dialogue (19). But there stated that benefit from chlorhexidine is useless on child patient that underwent hernia operative or orkiopeksi. No relation about chlorhexidine use with incidence of surgical site infection on child patient with infection rate as much as 0.92% (16).

CONCLUSION

Surgical site infection is caused by many factors, one of which is the personal hygiene of patients who will undergo surgery. These factors can be changed by maintaining personal hygiene from both patients who will undergo surgery and patients who have undergone surgery. Improving personal hygiene in preoperative patients can be done by undergoing preparation skin protocol using various disinfection fluids such as chlorhexidine gluconate. Based on various studies that have been done that surgical site infection is very beneficial for the personal hygiene of patients who will undergo surgery and has an impact on reducing the incidence of surgical site infection. Therefore, chlorhexidine use in preparation skin protocol before surgery must be recommended in pressing incidence rate of surgical site infection especially on adult patient. For future study, studies need to be related to the use of surgical site infection to reduce the incidence of surgical site infection in order to obtain various meaningful literature to serve as a procedure in health service area.

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