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Nasal Antisepsis Methods: Povidone-Iodine vs Alcohol Based Solutions

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Abstract

Surgical site infections (SSIs) are unforeseen complications of surgeries as a result of antibiotic-resistant bacteria. Often these SSIs are caused by bacteria that are naturally found on a person's body, specifically their own personal flora found in the nares. A method of eliminating this colonization is critical in decreasing rates of SSIs. Therefore, the purpose of this research was to determine the best solution of nasal antisepsis to use in my nursing capstone preoperative unit in order to eliminate the colonies of nasal bacteria in patients undergoing surgeries involving implants. Two solutions were identified as most commonly used antiseptics: povidone-iodine and alcohol. Currently, povidone-iodine is being used per hospital policy at my capstone facility but for the purpose of bettering infection control, the facility is open to looking at both solutions. Bacterial death percentage, ease of use, length of effectiveness, cost to the facility, and patient compliance were elements considered for this research. The outcome of this research will be to provide the preoperative unit and the facility with the needed information in order to identify and implement the best nasal antiseptic in regards to decreasing the rate of infections following surgeries involving implants.

Introduction

Every year thousands of people receive surgical operations requiring an implant. A few examples of these surgeries include shoulder arthroscopies, total joint replacements, pacemaker placements, spinal cord stimulators, and spinal fusions. Whenever something is put into a person's body that does not naturally belong there, a potential for infection is present. Often surgical site infections (SSIs) arise in the form of antibiotic resistant bacteria. Methicillin resistant *Staphylococcus aureus* (MRSA) is recognized as one of the most common organisms causing SSIs (Anderson et al., 2015, p. 3). One report states that "80% of *S. aureus* infections are caused by the patient's own clonal nasal flora" (Clorox Healthcare™Nasal Antiseptic Swabs, n.d.). Therefore it is necessary for hospitals to attempt

to eliminate the presence of *S. aureus* to prevent SSIs. The best prevention method is to target a person's own colonized sites of flora as a majority of SSIs arise from a person's own reservoir of bacteria (Darouiche et al., 2010, p. 18).

The purpose for this research was to determine what method of nasal decolonization was most beneficial in reducing rates of SSIs in patients undergoing surgeries requiring an implant at Mountain View Regional Hospital (MVRH). Two methods were researched: povidone-iodine and alcohol-based nasal antisepsis. Currently, at MVRH the povidone-iodine swabs are used prior to implant surgeries. In order to determine which method would be most appropriate for use several elements were evaluated: bacterial death percentage, ease of use, length of effectiveness, cost to the facility, and patient compliance.

Search Process

Several different search engines were used to find research articles about nasal decolonization. The four engines that provided results were Cumulative Index to Nursing & Allied Health Literature (CINAHL Complete), PubMed, ProQuest: Nursing and Allied Health Database, and Google Scholar. Each database would produce a few unique results and several duplicate research articles. Google Scholar was ultimately the best database with the most complete selection of articles.

Key terms that were input to each search engine "alcohol-based," "control," "infection," "infection control," "nasal antisepsis," "nasal swab," "povidone-iodine," "preoperative," "orthopedic patients," and "surgical infection." A variation of each term was used due to limited amounts of results that would occur on each search attempt.

Limitations placed on the search process were for full text articles and articles had to be published since 2010. When it was getting difficult to find additional relevant articles for this project, the time frame of publication was removed, thus resulting in the Reimer et al. (2002) article. Additional limitations included removing articles that did not pertain to nasal

antisepsis methods. Several articles discussed preoperative preparation of antimicrobial wipes for use on the body but not targeting the nose itself. However, Darouiche et al. (2010) was kept despite this limitation because it was the only article found that directly compared povidone-iodine antisepsis versus alcohol-based antisepsis despite it being about skin preparation and not nasal decolonization.

Throughout the search process, fifteen articles were reviewed for this project but five were identified as most pertinent to the overall research question. The articles were narrowed down based on credibility, significance, and applicability. The five articles found to be the most suitable all involved quantitative studies. Either laboratory experiments on tissues or randomly controlled trials were designed to test the efficacy of either povidone-iodine or alcohol-based antiseptics on bacterial decolonization.

Mehta, Hadley, Hutzler, Slover, Philips, & Bosco (2013)

The purpose of this article by Mehta et al. (2013) for this research project was to serve as background information regarding the importance of nasal decolonization prior to surgery. In this study, a five day application course of mupirocin nasal antisepsis was implemented and reviewed (p. 2368). Although this is neither the povidone-iodine nor the alcohol-based antisepsis, it is important to include because of its efficacy on decolonization as well as the fact that povidone-iodine and alcohol-based antiseptics are beginning to replace this source of application.

Three hospitals were used for this study, one that implemented the decolonization and plan and two that did not (p. 2368). At the experimental hospital, patients were expected to apply the mupirocin ointment twice daily for five days prior to their surgeries along with other prevention measurements, i.e. chlorhexidine showers and wipes. Compliance was self-reported on the day of surgery and 96% reported adherence (p.2368). The results were a decrease rate of infections from 1.23 per 1000 patients to 0.83 per 1000 patients at the

experimental hospital (p. 2369). The control hospitals reported an initial rate of 1.27 per 1000 and end of 1.24 per 1000. Overall Mehta et al. (2013) recognizes that proactive MRSA screening and nasal decolonization protocols are necessary and effective in decreasing the rates of SSIs.

The first limitation to this study, as reported by the researchers, was that they were unable to clearly define the cause-and-effect relationship between decolonization and MRSA infections (p. 2370). During the same time period as this study, the experimental hospital was undergoing additional changes that could have contributed to the decline in MRSA infections alongside the decolonization plan. The second limitation was that the MRSA infection rate was measured against the overall hospital census rather than just surgical patients, therefore potentially skewing the results. The final limitation was the inability of the researchers to determine the effectiveness of each decolonization method. Because nasal antisepsis, showers, and wipes were all implemented at the same time, the researchers failed to recognize which one, if any, contributed the most to prevent and which contributed the least.

Anderson, David, Scholz, Bull, Morse, Hulse-Stevens, & Peterson (2015)

The second article reviewed was by Anderson et al. (2015) and involved extensive research on povidone-iodine (PVP-I) based nasal preparation compared to mupirocin nasal antisepsis. Mupirocin is a nasal antisepsis technique that requires five days of preparation and is beginning to demonstrate increased bacterial resistance (p.16, 19). Therefore, the ultimate goal of this study was to understand how effective PVP-I is on decolonizing the nares prior to surgery in order to potentially replace the mupirocin application. Human skin and porcine mucosal tissue were treated proactively with PVP-I to determine how it impacted the presence of MRSA. For the purpose of this research project, the section focusing on nasal flora reduction was reviewed and evaluated.

Baseline sample swabs from human nares were obtained prior to treatment with PVP-I or the saline control (p.9) for an initial colony measurement. Next individuals were randomly assigned either the nasal antiseptic or the saline control. Each nostril was given a 30 second application of the iodine swab and then repeated for a second time. Nasal swabs were again collected immediately after application and then at 1 hour, 6 hours, and 12 hours post application (p. 2010). The swabs were then diffused in solutions and spread on plates to measure growth of bacteria. The samples were inoculated for 20 to 28 hours prior to evaluation of organism growth. The researchers used the Quebec Colony Counter measurement tool. When the growth plates were finally evaluated at all three time intervals, the human subjects who were given the PVP-I nasal antiseptic had significantly less growth than the individuals with the saline control (p. 14).

In addition to the short application time, the iodine application targets many cellular components, "including fatty acids, nucleotides, and the free-sulfur amino acids cysteine and methionine in proteins" (p. 18). Because multiple components are being targeted, less resistance is likely to develop, which is a concern with mupirocin usage. For both the ease of use and lack of resistance, Anderson et al. (2015) recommends the pursuit of PVP-I nasal antisepsis in reducing the presence of bacteria prior to surgery.

The main limitation with this article was the lack of discussion on trials. It is unknown if multiple trials were completed with the various tissues and products to see if results remained consistent. However, one benefit for this article is that multiple studies were cited within it for comparison and reference when discussing the results of Anderson et al. (2015).

Reimer, Wichelhaus, Schafer, Rudolph, Kramer, Wutzler,…Fleischer (2002)

Due to the ability of many organisms being able to develop resistance to drugs, there is a need to pursue an option that does not result in resistance. Reimer et al. (2002), like

Anderson et al. (2015), chosen to study povidone-iodine (PVP-I) because organisms are not able to establish a resistance to it (Reimer et al. 2002, p. 114), specifically, the ability of *S. aureus* to develop resistance. This article reviewed multiple applications of PVP-I studies regarding bactericidal effectiveness, tolerance on nares, synovial membranes and articular cartilage, veridical effectiveness, and potential as an anti-infective. For the purpose of this project only the nasal tolerance was evaluated. However, it is important to note that PVP-I demonstrated a broad spectrum bactericide action within 30 seconds of application (p. 115) and was highly effective in killing skin and respiratory viral infections.

To evaluate the effectiveness of PVP-I, 10 healthy individuals voluntarily provided ciliated cells from inside the nose to be inoculated (p. 117). The ciliary frequency was measured for its ability to tolerate the PVP-I at different formulations of the Betaisodona solutions. The solutions with inhibitory effects on the cilia but no damage resulted were 25%, and 50%. Therefore, the review by Reimer et al. (2002) indicated that not only is PVP-I beneficial for the lack of resistance developed but also for its ability to be well tolerated by the nasal epithelium.

Limitations to this study primarily focused on few trials of each study discussed and limited comparison of other research. The researchers reported ongoing studies in some areas of their work, such as the synovial membranes and articular cartilage research (p. 118), but they did not discuss having repeated trials with the nasal epithelium study to see if results were consecutive a second or third time. Additionally, while the findings were all consistent within each section of the article, there was not a lot of cross comparison to other outside research to further support the evidence found.

Steed, Costello, Lohia, Jones, Spannhake, Nguyen (2014)

The purpose of this study by Steed et al. (2014) was to determine the effectiveness of alcohol-based nasal antisepsis used on health care professionals (HCPs) (p. 841). The goal

was to see if alcohol-based nasal antiseptics could help to prevent cross contamination of *S. aureus* between the HCPs, patients, and communities (p. 842). Individual HCPs volunteered to be swabbed for colonization of *S. aureus* and then, if positive, were given either an alcohol-based antiseptic, Nozin application, or a placebo. The study had 39 participants in the active part of the experiment randomly receiving either the antiseptic or placebo. The HCPs were followed for a 10-hour shift day and had reapplications done at four hours and eight hours.

For collection of the original cultures and subsequent samples, sterile BD Eswab Collection Kits were used and then incubated (p. 842). After 48 hours of incubation, the agar plates used were measured for colony formations. The researchers used Medcalc 12.6.1.0, Sigma Stat 3.5 and SigmaPlot 11.2 for data analysis (p. 843).

When analyzing the findings from Steed et al. (2014), it was apparent that the nasal antisepsis application effectively eliminated bacterial colonies of participants while the placebo group saw growth of colonies (p.844). "Antiseptic treatment produced a uniform reduction in CFUs [colony forming units] at a level of 82% (mean) and 99% (median) for *S aureus* and 71% (mean) and 91% (median) for total bacteria" (p. 844). For this study, the results supported the overall purpose of finding an effective nasal antiseptic for nasal decolonization of *S. aureus* and other bacterial formations.

One limitation for this study was that the prevalence of S. aureus carriers in the HCPs was at the low end of the reported level from HCPs at 20.2%; the typical range for HCPs ranges from 20% to 40% (p.845). Therefore, a larger sample size could not be used for this study. A suggestion for the researchers would be to repeat the study with a larger available sample size for further results and analysis. An additional limitation was that this study occurred over a matter of a few days and no follow up of adverse reactions was completed (p. 845). If there had been a longer study there would have been record of adverse reactions, if

applicable, as well as a collection of long term effects of alcohol-based antiseptic use. An unusual discussion point that the researchers noted was that when the placebo was applied, there was a marked increase of bacterial colonies. It was unknown if that was as a result of the placebo itself or from a disruption of a dormant colony. Prolonging the study would prove to be beneficial in analyzing these results.

Darouiche, Wall, Itani, Otterson, Webb, Carrick,…Berger (2010)

The study by Darouiche et al. (2010) focused on comparing povidone-iodine skin preparation to alcohol-based skin preparation prior to surgery. The hypothesis of this study was that alcohol-based antisepsis would be more effective than the povidone-iodine (p.18). Six hospitals were part of the study and patients were randomly assigned to either test product (p. 19). Additionally, surgeons were unaware of which antisepsis was used until they entered the operating room. Thirty days after the surgery, the researchers followed up on occurrence of SSIs based on CDC criteria.

The researchers kept a consistent analysis of results across the six hospitals using the Breslow-Day test as well as long-rank tests on Kaplan-Meier for individuals who reported no SSIs (p. 20). By using the Breslow-Day tests, "no significant differences between hospitals with respect to the incidence of either any type of surgical site infection ($P = 0.31$) or individual types of infection ($P \geq 0.19$)" (p.23). The researchers also used Fisher's exact test to review the frequency of isolated organisms, categories of organisms, and adverse events.

To conduct this study, the researchers randomly assigned 897 individuals to either the chlorhexidine-alcohol group (431) or the povidone-iodine group (466) (p.21). Due to different circumstances, several individuals were removed from the study and left a total of 813 individuals: 391 in the chlorhexidine-alcohol group, and 422 in the povidone-iodine group. Each patient was prescribed an antibiotic prior to surgery but the researchers found no

significant difference with this factor. Additionally type of surgery and treatment were examined for causation but, as with the antibiotic, no significance was found (p.22).

Ultimately after the 30 day follow-up of SSI rates, chlorhexidine-alcohol was found to have "significantly fewer superficial incisional infections…and deep incisional infections" (p. 22). For abdominal surgeries, the rate of infections for the chlorhexidine-alcohol group was 12. 5% while the povidone-iodine group resulted in 20.5%. In non-abdominal surgeries, "the rate of infection was 1.8% in the chlorhexidine-alcohol group versus 6.1% in the povidone-iodine group" (pp. 22-23). An additional variable measured by the researchers was the causative organism in each infection. " Gram-positive aerobic bacteria (63 isolates) outnumbered gram-negative aerobic bacteria (25 isolatees) by a factor of 2.5…" (p. 23). No significant differences in organisms were found between the alcohol-based group and the povidone-iodine group, except that the alcohol-based group had fewer streptococci. Due to all of these findings, the researchers recommend the use of chlorhexidine-alcohol for its better efficacy in reducing superficial and deep incisional infections.

The biggest limitation from this study for the purpose of this research project was the fact that nasal antisepsis was not specifically tested. Regardless, the results are still relevant for effectiveness on prevention of infection.

Clorox: Povidone-Iodine Nasal Antisepsis

Currently at MVRH the Clorox: Povidone-Iodine Nasal Antisepsis swabs are used. Clorox reports that one application of this antiseptic "reduces 99.4% of S. aureus at 1 hour and maintains persistence through 12 hours" (Clorox Healthcare™Nasal Antiseptic Swabs, n.d.). The swabs are presaturated and only require application one hour before surgery, rather than a multiday regimen as seen with mupirocin nasal antisepsis. Additionally no studies have shown any bacterial resistance to povidone-iodine, which is highly beneficial in the fight against MRSA and other causative organisms.

A couple of benefits, besides lack of resistance, seen with the povidone-iodine application is that the nares tolerate the solution well and the cost is less than that of a MRSA screen (Clorox Healthcare™Nasal Antiseptic Swabs, n.d.). The cost estimated for an application of povidone-iodine nasal antisepsis at MVRH is $3.60. Patients reported no discomfort with the application, which requires rotating the swab in the nostril for 30 seconds on each side and then repeating the process.

Nozin: Alcohol-Based Nasal Antisepsis

The main competitor to the povidone-iodine swabs is the alcohol-based nasal antisepsis. Nozin is one company that promotes the alcohol-based antiseptic. According to Nozin (Nozin Nasal Sanitizer Antiseptic | Nozin Popswab®, n.d.), their applicator "kills 99.99% of germs" and has an 8 hour duration period. It is also moisturizing to the nares and has a citrus scent which helps with promoting adherence. For use, the applicator is removed from the sleeve, reinserted in the opposite direction and squeezed to move the liquid on to the cotton end. Then, the applicator is inserted into the front of the nose and rotated around six times. An alternative method is getting a cotton swab and a bottle of the Nozin solution and placing droplets of the solution on to the cotton swab before inserting into the nose and rotating it.

While this antiseptic is not currently being used at MVRH, samples were distributed to the nurses. A few volunteered to try it and reported it to be easy to use, less messy than the povidone-iodine swabs, and had a pleasant scent. An additional benefit to the Nozin product is that one application can cost as low as $1.31 when bought as a bulk product of 250 applicators. The Nozin alcohol-based appears to be a good competitor to the povidone-iodine swab.

Recommendation

Through the research conducted and personal experience of each product, the Nozin alcohol-based nasal antiseptic is recommended for use of nasal decolonization at MVRH. First, studies have shown that both povidone-iodine and alcohol-based antiseptics are good sources for nasal decolonization; however, the alcohol-based antiseptics appear to be more effective. Second, the cost of the Nozin product is almost three times less expensive than the Clorox povidone-iodine product, which is important for both the hospital's and patient's finances. Finally, the Nozin product is a cleaner technique and takes less time to apply to a patient's nares, therefore increasing patient willingness and compliance. One concern for the use of Nozin over the Clorox povidone-iodine swabs is the time discrepancy because the Nozin only covers eight hours and the Clorox is effective for 12 hours. However, most surgeries requiring nasal antisepsis at MVRH do not take over eight hours and thus the Nozin application would suffice.

One important factor for MVRH in considering the switch to the Nozin nasal application is that they currently have to use the Clorox antiseptics for six months. They began the nasal decolonization protocol in January 2017 and have to continue through June 2017. Therefore, while it is recommended that MVRH trial the Nozin application, at the time of this research project, it could not be evaluated first-hand and thus is only a suggestion.

Conclusion

The purpose of this research project was to determine the best nasal antiseptic for use in the preoperative unit at Mountain View Regional Hospital. After review of many articles, some helpful and others less informative, it was determined that the Nozin alcohol-based nasal antiseptic was a better fit than the Clorox povidone-iodine nasal antisepsis. While each served to be very effective in decolonizing a patient's nares, the Nozin product would be preferred for its ease of use, clean technique, timing of application, and cost per application.

One short fall in the research for this project was the limited studies on the nasal decolonization effect of alcohol-based antiseptics. The studies analyzed were informative but due to lack of research, validity and consistency were difficult to evaluate. However, of the research found, the alcohol-based products were preferred over the povidone-iodine products.

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