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Preoperative Screening And Preparation Of Patients For Orthopedic Surgery

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Abstract

Introduction: Staphylococcus aureus is a major pathogen implicated in orthopedic infections worldwide. Preoperative decolonization has been promoted but different strategies present mixed results. Staphylococcus aureus (S. aureus) is an independent risk factor for orthopedic surgical site infection (SSI).We studied whether or not local treatment with bacteriophage could eliminate nasal colonization with S. aureus.

Materials and Methods: A total of 696 patients were screened for S. aureus nasal colonization between 2017– 2021 at a single institution. There were 23% (159 patients) initially S. aureus colonization preoperatively. They were decolonized with various medications: I group – with Mupirocin 35% (56), II group- with bacteriophage 65% - (103). In the II group Pyo bacteriophage were including 32% (33) and Staphylococcal bacteriophage 68% (70).After treatment, bacteriological control was done post- decolonization on the 5th -8 th days. MSSA persisted in 4% (7).Five patient who was persistently colonized for MSSA was not compliant with the decolonization protocol. There were 2 patients who had undergone decolonization and were persistently positive for MSSA at the time of surgery.

Results: Decolonization of orthopedic surgical patients using the bacteriophage intro nasal is a practical and effective regimen for reducing MSSA and MRSA surgical site infections, treatment processes was without any post-decolonization complications.

Conclusion: We hope the bacteriophage will be successfully used in the practice of decolonization S. aureus and this therapy will be reduce the resistant S. aureus to mupirocin.

Keywords – Staphylococcus aureus; MSSA/ MRSA orthopedic surgery; bacteriophage.

I. INTRODUCTION

The rate of *Staphylococcus aureus* colonization in the nares of the general population is reported to be as high as 30% (1). In addition, genotyping studies reveal that as high as 80% of *S. aureus* infections are caused by the patient's own nasal flora (2). Furthermore, there is an association between the presence of nasal *S. aureus* and an increased risk of surgical site infection (SSI), which has been extensively demonstrated in orthopedic surgery *Staphylococcus aureus* colonization in the nares of patients undergoing elective orthopedic surgery increases the potential risk of surgical site infections(3). Methicillin-resistant *S. aureus* (MRSA) has gained recognition as a pathogen that is no longer only just a hospital-acquired pathogen. Patients positive for MRSA are associated with higher rates of morbidity and mortality following infection. MRSA is commonly found in the nares, and

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methicillin-sensitive S. aureus (MSSA) is even more prevalent(4). A nasal mupirocin treatment is shown to significantly reduce the colonization of the pathogen. However, this treatment is expensive. Thus, in this study, we first sought to determine the prevalence of MSSA/MSRA in patients undergoing elective orthopedic surgery and then, we treated the positive patients with a nasal bacteriophage. Here, we demonstrate a successful reduction in the colonization of *S. aureus*. We propose that this treatment could serve as a cost-effective means of eradicating this pathogen in patients undergoing elective orthopedic surgery, which might reduce the rate of surgical site infections and also treatment with bacteriophages will be reduce the AMR of *S. aureus*.

Surgical site infection (SSI) is an infrequent but serious complication of total joint arthroplasty (TJA) (5), with rates ranging from 0.2% for primary total hip arthroplasty to 1.5% for total knee arthroplasty (6,7]. Orthopedic SSIs cause substantial morbidity, prolonging hospital stay by a median of 2 weeks, doubling re hospitalization rates, and more than tripling overall healthcare costs (8). Nasal decolonization of methicillin-susceptible *Staphylococcus aureus* (MSSA) and methicillin-resistant *S. aureus* (MRSA) is currently used in some countries for specific patient groups(9,10).

Aim of this study was determination of effectiveness broad spectrum lytic phage as a decolonizing agent for the nasal colonization.

II. MATERIAL AND METHODS

A total of 696 (564 total hips, 132 total knees) patients were screened for S.aureus nasal colonization preoperatively between 2017– 2021 at a single institution. Patients were screened for S. aureus colonization, on average, 19 days (range: 2–3 weeks) prior to surgery. 22.8% (159) patients were colonized with MSSA, and no one with MRSA. Colonized patient demographics were as follows: 71 females, 88 males, Average age = 61 years, Average body mass index = 30.1

Samples were collected from both nares on a single swab. The inside circumference of each anterior nares was rubbed for 3 to 5 seconds to obtain adequate sampling. S. aureus strains were identified throughout conventional methods, based on phenotypic properties: morphology, Gram stain, coagulase (Pastorex™ Staph plus, Bio-Rad, France) and catalase test. Specimens were inoculated onto Blood agar plate and mannitol salt agar plate, which were incubated for 18 to 24 hours at 35°C to 37°C. Negative plates were incubated for an additional 24 hours. .The identification of the isolated S. aureus strains was made also throughout semiautomatic (Api Staph Bio Merieux) system. Yellow color on mannitol- salt media were reported as Staphylococcus aureus. All isolates were tested using conventional methods -the **Cefoxitin** disk diffusion. The antibiotic susceptibility testing was performed throughout the Kirby-Bauer disk diffusion method using antibiotic discs from Bio-Rad (France). The phages susceptibility testing was performed according to the SOP provided by the G. Eliava Institute of Bacteriophages, Microbiology and Virology (Georgia).

Colonized patients, depends on local susceptibility test results, were treated with bacteriophage (Pyo bacteriophage and Staphylococcal bacteriophage - Eliava Institute of Bacteriophages Georgia) according to manufacturer instructions. Among the 159 *Staphylococcus aureus* 154 (97 %) were Staphylococcal bacteriophage susceptible and 5 (3 %) resistant. With Pyo bacteriophage were susceptible 28% (45).

In case of resistance to the phage and other cases Mupirocin applied to the anterior nares twice daily for five days. In case of resistance to the Mupirocin, phage applied to the anterior nares twice or third daily for five days.

Among the 159 *Staphylococcus aureus* 153 (96 %) were mupirocin susceptible and 6 (4 %) resistant by 5µg disc diffusion method. After treatment, MSSA persisted in only 7 patients. Five patient who was persistently colonized for MSSA was not compliant with the decolonization protocol. There were 2 patients who had undergone decolonization and were persistently positive for MSSA at the time of surgery. Nasal colonization was eliminated in 96% of colonized patients. Bacteriophage was well tolerated with no side effects noted.

For a total of 159 strains, the antibiotic susceptibility testing was performed throughout the Kirby-Bauer disk diffusion method using antibiotic discs from Bio-Rad, for Antibiotics: β-lactams, Macrolides (Erythromycin, Clarithromycin), Glycopeptides (Vancomycin, Teicoplanin, Lincosamides (Clindamycin, L) Oxazolidones (Linezolid), Aminoglycosides: (Gentamicin, Amikacin, Tobramycin), Quinolones, Tetracyclines, Cotrimoxazole (Sulphamethoxazol & Thrimetoprim (SXT). Interpretation: European Committee on Antimicrobial Susceptibility Testing documents. The rate of methicillin-resistant S. aureus prevalence were determined by Cefoxitin (30µg) disk diffusion method. We interpreted Mupirocin susceptibility by Clinical and Laboratory Standards Institute (CLSI) susceptibility documents (10,11).

III. Results

The decolonization treatment was given for 5 days before the surgery. After treatment course, all patients (159 the patients that were positive for MSSA) were screened again to determine whether the MSSA was decolonized from the patients' nostrils. The result from showed that 7 patients were positive for MSSA colonization, showing a 96 % successful decolonization. However, 7 patients were positive for MSSA colonization.

Decolonization of orthopedic surgical patients using the bacteriophage intro nasal is a practical and effective regimen for reducing MSSA and MRSA surgical site infections, and also treatment with bacteriophages will be reduce the resistant S. aureus to mupirocin.

IV. Conclusion

1. Phage was able to significantly reduce MSSA strains on patients nasal epithelial cells
2. Phage, given along was able to effectively eradicate the colonizing MSSA population from the nares of patients by day 5.
3. Use of bacteriophage for decolonize the nose of MSSA will be beneficial, especially when bacterial resistance to mupirocin is rising, and so it will become less effective.
4. Staphylococcal bacteriophage may be useful in controlling nasal colonization with S. Aureus in the health care settings

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