COMPARISON OF THE COLONIES NUMBER OF THE GERMS FORMED POST OPERATION BETWEEN THE UTILIZATION OF SINGLE, DOUBLE, AND ORTHOPEDIC GLOVES IN CLOSED FRACTURE OPERATIONS MORE THAN 2 HOURS

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Abstract: Post-operative infection is still one of the most common nosocomial diseases that can cause great losses because it will increase the length of stay, use of drugs, and reduce the quality of life of the patients. *The risk will increase if the number of colonies is> 105 bacteria per gram of tissue. Various ways have been done to reduce the number of bacteria in the operation area, including the use of surgical gloves. This study analyzed the comparison of the level of bacterial colonies that grew on the surface of single, double, and orthopedic surgical gloves in closed fracture management for more than 2 hours at Hasan Sadikin Hospital. The statistical analysis was done with p-value = 0.011 (<0.05), which means a significant difference in the number of germ colonies that grow between single, double, and orthopedic gloves. Double gloves and orthopedic gloves have a better ability to reduce bacterial colony growth. Meanwhile, there was no significant difference in the number of bacterial colonies formed between double gloves and orthopedics. Perforation is a factor affecting the number of germ colonies that formed. The use of double gloves and orthopedic gloves in closed fracture surgery for more than 2 hours shows the number of bacterial colonies formed is less than single gloves. There was a significant difference in the rate of perforation between standard surgical gloves and orthopedic gloves.*

Keywords: *Bacteria colony, Single glove, Double glove, Orthopaedic glove, Perforation*

INTRODUCTION

Surgical wound infection is an infection in the surgical area that occurs within 30 days or 1 year after surgery, an implant-placing surgery. This condition causes harm because it increases morbidity and mortality directly. This is related to the number of repeated operations, increased length of hospital stay, prolonged use of antibiotics and rehabilitation, and the loss or decline in a person's ability to return to work which further worsens patients' productivity and quality of life.[1,2]

In the U.S., surgical wound infections can reach 5% or 300,000 cases per year, with a longer hospital stay period of 9.7 days on average. It costs up to 3.5 to 10 billion dollars per year and becomes the greatest amount of expenditure among other nosocomial diseases.[3] According to reports of infection cases at Hasan Sadikin Hospital between January to December 2019, 20 cases of surgical wound infection (1.3%) out of 1533 surgical operations.[4]

The development of surgical wound infection depends on bacterial contamination that cannot be resisted by the patient's immune response. Microorganisms can enter through 2 ways, endogenously (microorganisms originating from within the patient's own body, for example, in hollow organs that are exposed or via hematogenous spread) and exogenously (infection occurs when microorganisms from instruments or the surgery area contaminate the surgical wound before or after surgery).[5]

The risk factor for surgical wound infection depends on two things: the patient and perioperative factors. The patient factors are related to age, smoking habits, alcohol consumption, and comorbidities such as diabetes; while perioperative factors were divided into preoperative, intraoperative, and postoperative. Preoperative factors are related to the optimization of the patient's condition. Intraoperative factors are related to the characteristics of the surgical procedure itself, such as duration of operation, type of surgery, instruments, consumables, operator, and blood loss. It often causes variations between health institutions. And finally, postoperative factors related to wound care and bacterial growth are often caused by antibiotic-resistant bacteria.[6]

In orthopedic surgery, the risk of perforation becomes greater. Dar, et al. in their study reported the incidence of perforation reached 65.3% in fracture treatment operations caused by needle sticks or tearing due to manipulation of bone fragments, instruments, and implants, which frequently occur in the non-dominant hand and are located around the thumb, forefinger, and palm. It indicates that currently available standard surgical gloves do not provide sufficient protection against perforation. Makama, et al. reported a significant difference in the use of single and multiple surgical gloves in reducing the incidence of perforation. And currently, there is one type of orthopedic surgical glove that has a greater thickness than standard surgical gloves, although there have not been many studies that have described its advantages over standard surgical gloves (table 1, table 2).[11-13]

Table 1. Characteristics of Surgical Gloves

Design	Size							
	5.5	6	6.5	7	7.5	8	8.5	9
Length (mm)	245	265	265	265	265	265	265	265
Width (mm)	70	76	83	89	95	102	108	114
Thickness (mm)								
Fingers				0.10				
Palm				0.10				
Wrist				0.10				

Table 2. Characteristics of Surgical Gloves

Design	Size							
	5.5	6	6.5	7	7.5	8	8.5	9
Length (mm)	245	291	291	305	305	305	305	305
Width (mm)	70	76	83	89	95	102	108	114
Thickness (mm)								
Fingers				0.34				
Palm				0.26				
Wrist				0.21				

Various attempts have been made to reduce the number of bacterial colonies. This effort is divided into 3 perioperative factors that cause surgical wound infection, namely: pre-operative, intra-operative, and post-operative factors. Pre-operative factors include eliminating common bacterial colonies on the skin by cleaning the operating area and preventing the multiplication of microorganisms by using prophylactic antimicrobial therapy. Intra-operative factors include: maintaining the patient's body defenses against infection by preventing wider soft tissue damage, maintaining normothermia, and using consumables such as gowns, masks, headgear, and gloves. Finally, post-operative factors include preventing the access of microorganisms to the incision wound by changing the appropriate dressing and giving post-operative antibiotics. [6]

RESEARCH METHOD

In this study, the researcher(s) wanted to assess the growth rate of bacterial colonies on the surface of single, double, and orthopedic gloves in closed fracture surgery for more than 2 hours (Figure 1).

The researchers assessed the significance between intact gloves and perforations by the number of bacterial colonies formed. Smearing was carried out after the subject had performed surgical handwashing, and after hands were dried. Samples were taken on the hand surface of the index finger of the dominant hand and the palm for 5 seconds. The second sampling was carried out when the operation entered the 120th minute in the same way. The gloves were then tested for perforation by filling them with 1 liter of water to see the water flow or droplets. (Figure 2)

Figure 1. Standard surgical gloves are white and orthopedic gloves are brown

Figure 2. Implanting smears onto agar, leak testing

RESULTS AND DISCUSSION

A total of 36 closed fracture surgeries performed at Hasan Sadikin Hospital were used in this study. It then grouped into 3, consisting of 12 single glove samples in group A, 12 double-glove samples in group B, and 12 orthopedic glove samples in group C. (Table 3).

Table 3. Description of Research Data

Group Statistic		Colonies forming unit After Hand Washing (CFU)	Colonies forming unit in the 120th minutes on hands surface (CFU)	Colonies forming unit in the 120th minutes on gloves surface (CFU)
Single Gloves	Minimum	0	1	0
	Maximum	17	167	84
	Average	4.92	40.25	14.67
	Std. Deviation	6.947	47,136	6.123
Double-Glove	Minimum	0	0	0
	Maximum	19	126	9
	Average	3.83	25.67	2.08
	Std. Deviation	6.548	36.217	3.118
Orthopedic Gloves	Minimum	0	1	0
	Maximum	22	95	1
	Average	7.33	26.17	0.08
	Std. Deviation	8.348	29.972	0.289

The data in table 3 shows that the single-gloves-after-washing-hands group obtained a maximum number of bacterial colonies of 17 CFU, with an average of 4.92±6.947. Then the number of bacterial colonies in the 120th minute on the hand surface was at least 1 CFU and a maximum of 167 CFU with an average of 40.25±47.14. The number of bacterial colonies in the 120th minute on the glove surface was a maximum of 84 CFU with an average of 14.67±6.123. In the double-glove group, the maximum number of bacterial colonies after hand washing was 19 CFU with an average of 3.83±6.55. At 120 minutes on the surface of the hand, the maximum number of bacteria was 126 CFU with an average of 25.67 ± 36.217. At the 120th minute of the glove surface, the maximum number of bacterial colonies was 9 CFU with an average of 2.08±3.118. Meanwhile, in the

orthopedic glove group, after washing hands, the maximum bacteria was 22 CFU with an average of 7.33±8.35. The number of bacteria in the 120th minute on the surface of the hand was obtained at least 1 CFU and a maximum of 95 CFU, with an average of 29.17±29.97. At the 120th minute of the glove surface, the maximum number of bacterial colonies was 1 with an average of 0.8±0.29.

Comparative analysis of bacterial growth rates on the three glove surfaces was carried out using the Kruskall Wallis test, shown in table 4.

Table 4. Comparison of the number of bacterial colonies in the three treatments on the glove surface.

Variable	Treatment	N	Average	P Value
Colonies forming unit in 120th minutes on gloves surface	Single Gloves	12	14.67±6.12	0,011
	Double-Glove	12	2.08±3.12	
	Orthopedic Gloves	12	0.08±0.29	

Table 5. Comparison of the number of bacterial colonies on the surface of the gloves between treatment groups.

Variable	Group	N	Average	P Value
Colonies forming unit in 120th minutes on gloves surface	Single Gloves	12	14.67±6.12	0,016
	Double-Glove	12	2.08±3.12	
	Single Gloves	12	14.67±26.12	0,008
	Orthopedic Gloves	12	0.08±0.29	
	Double-Glove	12	2.08±3.12	0,128
	Orthopedic Gloves	12	0.08±0.29	

Discrimination test using Kruskall Wallis was to determine the average number of bacteria on the surface of the glove. The mean on single gloves was 14.67±6.12, double-glove was 2.08±3.12, and orthopedic gloves was 0.08±0.29, with p=0.011<0.05. It means that there was a significant difference between using single, double, and orthopedic gloves at 120th minutes of glove surface. Because the results of the Kruskall Wallis test showed significant results, the Mann Whitney test was to further determine the bivariate between treatment groups.

From the Mann Whitney test, the average value in the single glove group was 14.67 ± 6.12 and the double-glove group was 2.08 ± 3.12 with a p-value = 0.016 < 0.05. It means that there was a significant difference in the number of bacterial colonies between the surface of the single glove and double-glove in the 120th minute.

The mean value of the single glove group was 14.67 ± 6.12, and the orthopedic glove group was 0.08 ± 0.29 with p-value = 0.008 < 0.05 meaning that there was a significant difference in the number of bacterial colonies between the surface of the single glove and orthopedic glove at 120th minutes.

The mean value of the double-glove group was 2.08±3.12, and the orthopedic glove group was 0.08±0.29 with p=0.128>0.05, meaning that there was no significant difference in the number of bacterial colonies between the surface of the double-glove and orthopedic glove at 120th minutes.

Comparative analysis of the number of perforations in single, double, and orthopedic gloves using the Chi-square test method is presented in table 6.

Table 6. Comparison of perforated gloves

Variable	Perforation	Intact	Total	P Value
Single Gloves	6 (50%)	6 (50%)	12	0,012
Outer Layer of Double-Glove	3 (25%)	9 (75%)	12	
Inner Layer of Double-Glove	0	12 (100%)	12	
Orthopedic Gloves	0	12 (100%)	12	

Based on the estimation results presented in the table above, it is known that the single glove sample has several perforations as much as 50%, the outer layer of the double-glove sample is perforated by 25%, there are no perforations in the inner layer of double-glove and orthopedic gloves.

In the Chi-square test, the p-value obtained was 0.012 or smaller than the specified significance level (<0.05). It means that there is a significant difference between the three treatment groups in the number of perforated gloves.

CONCLUSION

From the results of this study, it can be concluded that the use of double and orthopedic gloves in closed fracture surgery for more than 2 hours shows that the number of bacterial colonies formed is fewer than single gloves. There was a significant difference in the rate of perforation between standard surgical gloves and orthopedic gloves.

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