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ORIGINAL ARTICLE

Effect of sticky mat usage in control of nosocomial infection in Motahary Burn Hospital

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ABSTRACT

Background and Objectives: Infection is the most common cause of death among burnt patients and infection control decrease the rate of mortality. The use of sticky mat can control contamination by preventing the entrance microorganisms into the hospital wards. This study was designed to evaluate the sticky mats effect in reduction of microorganism's entry by personnel shoes to burn intensive care unit (BICU).

Materials and Methods: This is a simple cross sectional study. We tested outer soles of personnel's shoes with swap and cultured them before and after sticky mat contact in the entrance of BICU. Results were analyzed with IBM SPSS version 22 software. McNemar and Wilcoxon Signed Ranks tests were used.

Results: We analyzed 60 outer soles of the shoes before and after contact with sticky mats. Coagulase negative Staphylococci, Gram positive bacilli, *Staphylococcus aureus, Aspergillus fumigatus, Pseudomonas aeruginosa* and *Acinetobacter baumannii* were isolated before contact from 57 (95%), 32 (53%), 4 (6.7%) and 3 (5%) cases, respectively. Coagulase negative Staphylococci, Gram positive bacilli, *Staphylococcus aureus, Aspergillus fumigatus, Pseudomonas aeruginosa* were isolated after contact from 36 (60%), 30 (50%), 16 (26.6%), 2 (3.3%) and 3 (5%) cases, respectively. No *Acinetobacter* was isolated after contact with sticky mat. Total isolated colonies before and after contact with sticky mats were 2573 and 830, respectively. There were significant statistically differences between the colony counts of coagulase ngative staphylococci, Gram positive bacilli, and *Staphylococci aureus* before and after contact with sticky mats (P. < 0.001).

Conclusion: Regarding to statistical analysis, the effect of mat in removing the microorganisms was 56%. It confirms the effectiveness of sticky mat controlling the infection and reducing the amount of hospital contamination.

Keywords: Sticky mat, Nosocomial infection, Burn

INTRODUCTION

Burn is a major trauma which includes more than 1% of all diseases around the world. It has economical, social and psychological consequences with high

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mortality and morbidity in burnt patients (1). More than 195000 deaths happened due to burn annually and burn is the 7th causes of mortality among children between 5-14 years old. Given that each patient needs special care, equipment and well-trained, educated staff, the various stages of burn treatment are sophisticated, expensive and time consuming. Therefore prevention of burn injuries is not only more efficient but also reduces costs. More than 100,000 burns happen in Iran annually; about 21000 of them admit in hospital according to ABA trauma criteria. The most common cause of burn was fire (53%), and 92% of them were accidental. The mean TBSA (Total Body Surface Area) was 23% and the most common admitted patients were in 25-35 and then 15-25 years old. It shows that the burn happens more in young people. During the last year, there were 3200 admission in Motahari Hospital which is a tertiarywell equipped burn center in Iran. About 78(2.4%) patients died due to burn complications, which is higher than other developing country (2).

The most common cause of death in our patients was sepsis and the wound infection was the most common source of sepsis (2) whereas, in developed countries pneumonia is the most common cause of infection in burnt patients (3). So, infection control has a crucial role in reduction of wound infection and its mortality.

Renovation construction projects which are happened repeatedly in our old hospitals increase hospital acquired infection outbreaks. The causative pathogens of these outbreaks were usually *Aspergillus* species, but Zygomycetes and other fungi were occasionally reported. Aspergillus most commonly causes pulmonary infection. The overall mortality of construction/renovation-associated fungal infection was approximately 50% (4).

Hospital cleaning is a measure of cleanliness based on visual appearance that includes dust and dirt removal, waste disposal and cleaning of windows and surfaces which needs floors and baseboards are free of stains, visible dust, spills and streaks (5). Control measures to reduce the amount of dust during hospital renovation are necessary. Currently, there is a little study that compared different control measures for effectiveness through mechanical removal of dust. Yahara and coworkers examined the capacities of two control measures of weather stripping (0.15 mm poly film and adhesive tape) to reduce the amount of blowing dust during two different hospital renovations (in 2008 and 2009). They revealed that the weather stripping used in 2009 (adhesive tape) was significantly more effective than the measures taken in 2008 (0.15 mm poly film) to reduce the amount of dust during the renovations ($p < 0.001$), while in both years the amount of dust became significantly higher during the renovations than before the renovations. Differences in the effectiveness of weather stripping during renovations between floors of the hospital were not significant in both 2008 and 2009 (6).

Kenneth and coworkers evaluated the effectiveness of adhesive mats, contamination control flooring, and shoe covers in decreasing the presence of microbial agents on animal holding room floors and footwear. They found that use of contamination control flooring or shoe covers significantly reduced the amount of organic material present on floors and bacterial contamination of footwear was significantly lower after the use of shoe covers than after the use of adhesive mats or contamination control flooring (7).

We decided to use sticky mat to decrease contamination and the amount of microorganisms entry to hospital wards especially in BICUs (Burn Intensive Care Unit). We evaluate the effect of sticky mats in reduction of microorganisms which enter by staffs outer soles in BICU.

METHODS

This is a simple cross sectional study in which we tested outer soles of personnel's shoes in BICU of Motahary hospital. Cotton swap impregnated with BHI broth used for sampling. The swaps were cultured on Macconkey agar, Blood agar, and Sabouraud Dextrose agar, directly. Then 10^1 and 10^2 dilutions were prepared, and cultured with 50 landau on Macconkey, Blood agar, and Sabouraud Dextrose agar. The MacConkey and Blood agar plates were incubated at 35±2 ºC and Sabouraud plates incubated at 25 ºC for 48h. These plates were incubated for 21 days. IBM SPSS version 22 software was used for statistical data analysis in order to determine the statistical significance of data before and after mat contact. McNemar test was carried out for comparison of number of infected shoes and Wilcoxon Signed Ranks test was performed for comparison of specific and total bacterial count.

RESULTS

We analyzed 60 culture results of outer soles. The most common isolate before contact was coagulase negative staphylococci (57 case, 95%), then Gram positive bacilli (51 cases, 85%), *Staphylococcus aureus* (32 cases, 53%), *Aspergillus fumigates* (4 cases, 6.6%), *Pseudomonas aeruginosa* (3 cases, 5%) and *Acinetobacter baumannnii* (3 cases, 5%) were isolated.

Coagulase Negative Staphylococci, Gram positive bacilli, *Staphylococcus aureus*, *Aspergillus fumigatus, Pseudomonas aeruginosa* were isolated after contact from 36 (60%), 30 (50%), 16 (26.6%), 2 (3.3%), 3 (5%) cases, respectively. There was no *Acinetobacter* isolation after contact with sticky mat.

We isolated 43 cases (71.6%) out of 60 samples after contact with sticky mats and in 17 cases no microorganisms were cultured. Total isolated colonies were 2573 before contact in which 1515 colonies (58.9%) were coagulase negative Staphylococci. 540 (20.9%) Gram positive bacilli, 354 (13.7%) *Staphylococcus aureus,* 82 (3.2%) *Acinetobacter,* 78 (3%) *Pseudomonas* and 4 (1.5%) *Aspergilli* colonies were isolated (Table 1).

Besides, after contact with sticky mats, total isolated colonies among 60 cases, were 830 colonies in which 520 (62.5%) coagulase negative staphylococci, 170 (20.5%) Gram positive bacilli, 126 (15.2%) *Staphylococcus aureus,* 12 (1.4%) *Pseudomonas,* and 2 (0.2%) *Aspergilli* colonies were isolated. No *Acinetobacter* was isolated (Table 1).

In results, colonies of coagulase negative Staphylococci, Gram positive bacilli, *Staphylococcus aureus* were decreased after contact with sticky mats, with significant differences (P.<0.001). Colony count of *Aspergillus* and *Pseudomonas* had no significant differences before and after contact with mat.

Acinetobacter was not isolated after contact but there was no significant statistical difference, probably due to small sample size (Table 1).

Regarding the statistical analysis, and the calculated mean, the effect of mat in depletion of microorganisms was effective in infection control.

DISCUSSION

Nowadays, lots of resistance bacteria such as methicilin resistant *Staphylococcus aureus,* vancomycin resistant entrococci, *Corynebacterium stratium, Acinetobacter baumannii, Steothrophomonas maltophilia* and *Aspergillus fumigates* have essential role in health care associated infection in hospitals (8). These microorganisms induce pneumonia, urinary tract, and other infection especially in immunocompromised patients. There are a few studies about mats with different results. In some studies, mats reduced the amount of different bacteria in ICUs (9, 10), but others reveal that mats, disinfectants and shoe covers have no role in control of nosocomial infections (11).

Gaya's research in Brompton hospital in London, has declared the mats can protect the hospital wards from dusts and *Clostridium* spores, but have no role in reduction of hospital infections (12).

In NDSC guideline which has published about *Aspergillus* infection, the sticky mats have mentioned as

Table 1. Specific and total bacterial and fungal population before and after mat contact

Organisms	Number of infected shoes			Maximum bacterial count		Total bacterial count		
	Before (%)	After (%)	P Value[a]	Before	After	Before (%)	After (%)	P value[b]
Coagulase negative Staphylococci.	57 (95)	36 (60)	<0.001*	140	60	1515 (58.9)	520 (62.6)	<0.001*
Gram positive Bacilli	51 (85)	30 (50)	<0.001*	100	30	540 (20.9)	170 (20.5)	<0.001*
Staphylococcus aureus	32 (53)	16 (26.6)	<0.001*	50	23	354 (13.7)	126 (15.2)	<0.001*
Aspergillus spp	4 (6.6)	2 (3.3)	0.687	1	1	4 (1.5)	2 (0.2)	0.414
Acinetobacter spp	3 (5)	0 (0)	0.250	43	0	82 (3.2)	0 (0)	0.109
Pseudomonas spp	3(6.7)	3 (5)	1	37	7	78 (3.0)	12 (1.4)	0.109
Total	60 (100)	43 (71.6)	<0.001*	154	77	2573 (100)	830 (100)	<0.001*

[a]P value of McNemar Test

[b]P value of Wilcoxon Signed Ranks Test

an efficient way for reducing *Aspergillus* infection in hospital wards during constructions (9).

According to CDC guideline mats have a little role in reducing outer soles contaminations and controlling the hospital infections unless used in the entrance of the wards with constructions. It can inhibit the entrance of dusts and some spores (11).

In this study, in Motahary burn hospital among 60 cases, in all samples different bacteria were isolated before contact with mat. After contact with mat bacteria were isolated from 43 cases (71.6%). This difference is statistically significant (p-value<0.001). Also, there is significant difference between the colony count of some bacteria before and after contact with mats such as coagulase negative Staphylococci (before contact 95% and after contact 60%), *Staphylococcus aureus* (before contact 53% and after contact 26.6%), and Gram positive bacilli (before contact85% and after contact 50%) (p-value<0.001). No *Acinetobacter* had been cultured after contact with mat. Thus, in this study, sticky mats reduced bacterial contamination, but had no effect on *Aspergillus.*

CONCLUSION

Unlike the results of previous studies, sticky mat can reduce contamination at hospital wards, especially at BICUs. Therefore, it needs further studies with more samples to reevaluate the role of mats in hospital infection control, especially in ICUs and burn wards. It seems essential to reconsider the use of mats at hospital wards.

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