IMPACT OF LAUNDERING ON BACTERIAL PENETRATION IN SURGICAL GOWNS

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ABSTRACT... Objectives: The objective of this study was to compare the mean bacterial penetration % in surgical gowns at different laundering cycles which were used in three different categories of Hospital. **Material & Methods:** Fifty, locally available reusable surgical gowns were collected from all the major teaching hospitals of Lahore as sample. Samples were analyzed and compared against international standards. Samples were tested at different laundering cycles (after 0, 5, 10, 15, & 20 washings). The gowns were laundered at Mayo hospital laundry services. The surgical gowns were subjected to multiple laundering cycles. The bacterial penetration test was performed at Microbiology Lab., PCSIR (Pakistan Council of Scientific & Industrial Research) Laboratories Complex, Lahore. Data was analyzed by using SPSS 16 versions and for comparison Repeated measurement ANOVA was used. A p-value less or equal to 0 .05 will be considered as significant. Results: Overall the mean ± S.D penetration of bacteria in all samples was as under, at 0 Washing (86.47±2.91%), 5th washing (91.53±1.72%), 10th washing (95.60±0.91%), 15th washing (08.53±0.34%) and at 20th washing (99.47±0.13%). While comparing on different laundering intervals or times the penetration of bacteria (%) was statistically increased from 86.47±2.91% to 99.47±0.13 %, p-value 0.001. **Conclusions:** When studied for change in porosity after laundering reusable surgical gowns set up of hospitals in Pakistan resulted in increased porosity and hence more penetration of bacteria across the fabric used for manufacture of surgical gowns. The loss of barrier effect of surgical gown is further compounded by lack of standardization of laundering technique, infra-structure use of improper detergent and other cleaning agents. This loss of fabric characteristics results in more bacterial contamination of surgical wound risk of infection to the patient.

Key words: Surgical gowns and Bacterial penetration

INTRODUCTION

Surgical gowns play a crucial role in asepsis by reducing the transfer of bacteria from the skin of the surgical staff to the air in the operating room. Wearing surgical gowns and other medical apparel (i.e. surgical masks, gloves, etc) is vital because there will always be microorganisms on or in the human skin, even after conducting strict hygienic and sterilization procedures. The purpose of surgical gowns and other protective clothing is not only to keep bacteria from entering surgical wounds, but to also protect the surgical staff from blood, urine, saline, or other chemicals and bodily fluids during surgical procedures.

Surgical gowns with impermeable areas and edges block the transfer of bacteria, viruses, infections, blood borne pathogens, and other harmful agents and chemicals to and from the patient. Surgical gowns are widely considered to be the foremost item of protective equipment today. Nonetheless, surgical gowns and surgical apparel have not been in standard use for very long. Carbolic acid solution was used to sterilize surgical instruments, surgical incisions, and dressings in an effort to prevent gangrene and other infections1. A major concern for healthcare workers (HCW) is the problem of transmission of pathogens and bacteria from their patients to themselves and the reverse contamination. Dusaj (1993)[2] reported that about one-half of all surgical procedures resulted in an accident where at least one medical worker was contaminated with blood. Any blood contamination could pose a risk of transmission of bacteria[2,3]. Because of this potential contamination, protection is a major concern. Healthcare workers' uniforms (HCWU), which include surgical gowns, scrub suits, lab coats, and nurses' uniforms, are often used as barriers to help eliminate or reduce the risk of infection for both the doctor and the patient[4,5].

Surgical gowns, which were used as early as the 1800s, are traditionally made from cotton fabrics[6]. Although cotton gowns are comfortable for the wearer, unfinished cotton does not protect against bacterial penetration, or the penetration of biological liquids (e.g., blood, body fluids) and associated bacteria[7,8,9]. Leonas, concluded that bacterial penetration increased after laundering, which indicates that the fabrics had a more open structure and that microorganisms and even liquids could pass through the fabric structure more easily. Through this study we want to determine the bacterial penetration in surgical gowns which are used in different categories of Pakistani hospital.

Objectives

The objective of this study was to compare the mean bacterial penetration % in surgical gowns at different laundering cycles which were used in three different categories of Hospital.

MATERIAL & METHODS

Approximately 50 Locally available verities of reusable surgical gowns were selected from all the major teaching hospitals of Lahore as sample. Samples were analyzed and compared against international standards. Samples were tested at different laundering cycles (after 0, 5, 10, 15, & 20 washings). The gowns were laundered at Mayo hospital laundry service. The surgical gowns were subjected to multiple laundering cycles. The basic formula and procedure is presented in table. All gowns were exposed to the same laundering conditions depending on soil level. The gowns were first rinsed 3-4 times in water. Then soap + ICI soda ash + bleach were added to front load washer. The gowns were put into the washer and washed at 70˚C. After washing, the gowns were spun and then dried. After drying, the gowns were sent to the folding room and ironed. The gowns were later sterilized with the help of steam for 1.5hr at 130˚C.

Step	Water level	Water temp. (C˚)	Time (min.)	Additives/ purpose
Rinse	High	38	3	Remove blood
Wash	Low	60	3	Detergent (pH=12.5)
Suds bath	Low	70	2	Detergent
Bleach	Low	68-70	7	15% chlorine
Rinse (3 times)	High	68 60 54	2 2 2	Remove residual chemicals
Sour	Low	38	5	Sour (pH=3) Softener (final pH=5.5-6.0)

An indication slip was kept in the gown which changed color when gown was sterilized, and if sterilization was not done properly the other color of slip remained unchanged.

Measurement of bacterial penetration

Organism used: staphylococcus aureus (24 hours old culture)

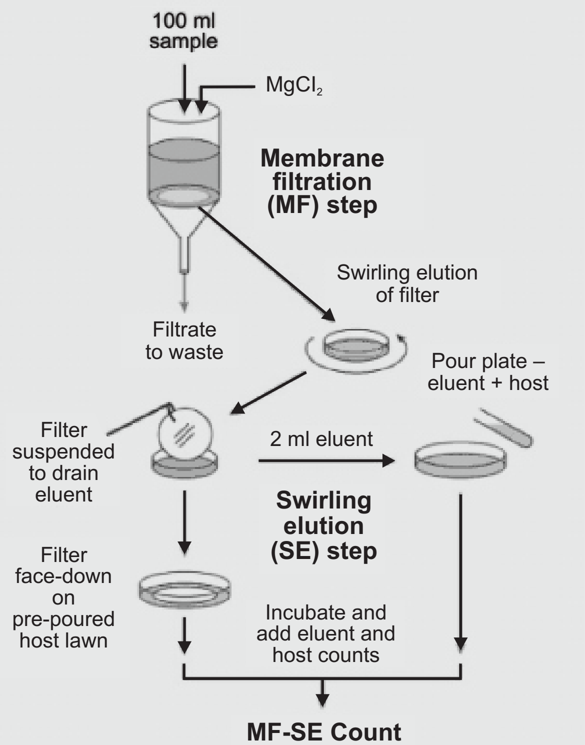
Saline solution for washing of agar slants of staphylococcus aureus was used. The saline solution was prepared by adding 9g of sodium chloride to 1 L of deionized water. Bacteria were introduced into the saline solution by washing agar slants of the microorganism. Bacterial count is obtained by 24 hours incubation at 37c^{O} (control). Fabric was placed in filter assembly instead of filter paper. The solution of saline containing bacterial growth was passed through fabric placed in filter assembly apparatus, using vacuum pump (membrane filtration method).

1 ml of filtration is poured in Petri plates of braid parker Agar (pour plate method), incubated at 37c^{O} for 24-48 hours. After incubation bacterial count is calculated using colony counter and compare with control.

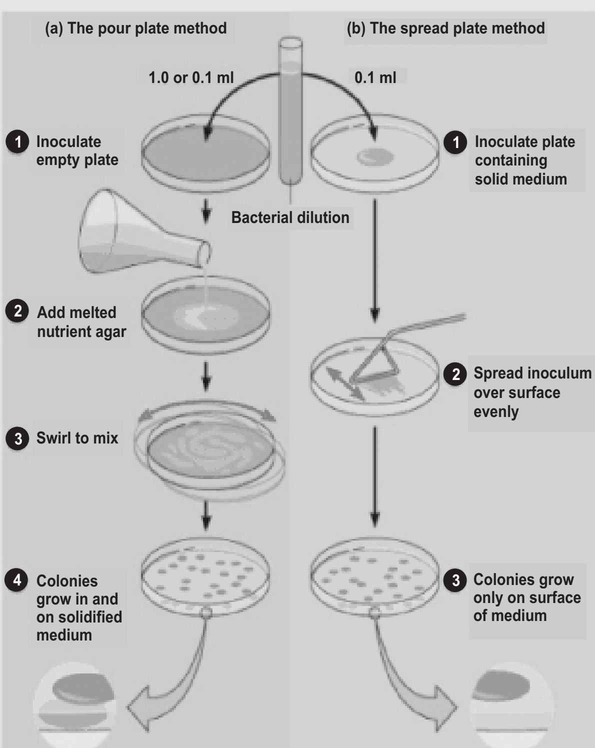
The results were evaluated and compared within the experimental and control group and to the international standards. Data was analyzed by using SPSS 16 versions and for comparison Repeated measurement ANOVA was used. A p-value less or equal to 0 .05 will be considered as significant.

RESULTS

In Category A hospital the mean bacterial penetration at 0 cycle was 82.80 ± 15.06 %, at 5th cycle was 91.80±6.34%, at 10th cycle 95.80±3.56%, at 15th cycle 98.80±.84% and at 20th cycle the mean bacterial penetration was 99.40±0.55%. In Category B hospital



Membrane filtration method



Pour plate method

the mean bacterial penetration at 0 cycle was 85.60 ± 11.15 %, at 5th cycle was 88.80 ± 8.67%, at 10th cycle 95.00 ± 3.74 %, at 15th cycle 98.60±1.14% and at 20th cycle the mean bacterial penetration was 99.60±0.55%. Similarly in Category A hospital the mean bacterial penetration at 0 cycle was 91.00±7.11%, at 5th cycle was 94.00±6.69%, at 10th cycle 96.00±4.06%, at 15th cycle 98.20±1.92% and at 20th cycle the mean bacterial penetration was 99.40±0.55%.

Overall the mean penetration of bacteria in cloth was when measured at different intervals it shows an increasing trend with the passage of time [0 Week (86.47±2.91), 5th Week (91.53±1.72), 10th Week (95.60±0.91), 15th Week (08.53±0.34) and at 20th Week (99.47±0.13)]. While comparing on different laundering intervals or times the penetration of bacteria (%) was statistically increased, p-value 0.001.

DISCUSSION

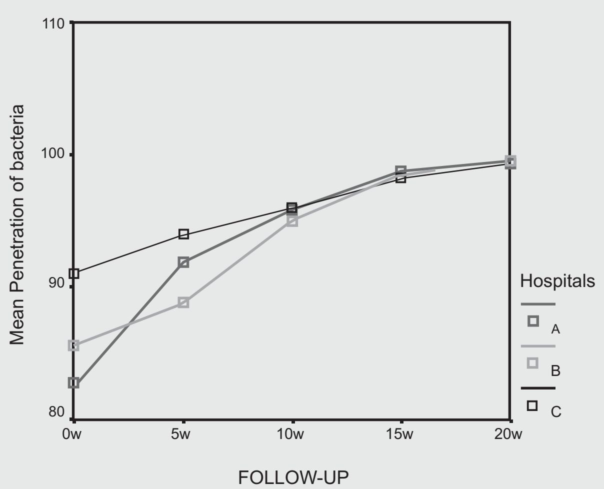
Most infections are caused by bacteria that contaminate the wound during surgery[10]. All sources of potential contamination should be considered when attempting to reduce post operative infection rates. The surgical team is the most important source of bacteria causing infection with thousands of bacteria-carrying particles shed per minute, usually via desquamation[11,12]. The sites of greatest bacterial load are the groin, the perineum and the axillae, with the majority of bacteria shed from below the waist. These organisms may pass from the bodies of the surgical team through gown material via bellows action during movement. Once they have penetrated the gown, they may then be transferred directly to the wound without being airborne[13].

Bacterium cannot move from location to location by itself; instead, it must be transported by a carrier such as blood, perspiration, alcohol, shed skin, or dust[2]. The carrier can be transported by either liquid or air. Liquid transport provides a wet or moist transfer of bacteria. Mean penetration of bacteria in cloth was when measured at different intervals it shows an increasing trend with the passage of time. There was significant increase in bacterial penetration at different time intervals but when mean penetration of bacteria was compared in all hospitals, it showed an insignificant difference to all

Table-I. Comparison of Penetration of Bacteria at different follow ups in Three categories of Hospitals

Penetration of bacteria	Categories of Hospital			
	A	B	C	D
0 washing	82.80±15.06	85.60±11.15	91.00±7.11	86.47±11.27
5 washing	91.80±6.34	88.80±8.67	94.00±4.69	91.53±6.64
10 washing	95.80±3.56	95.00±3.74	96.00±4.06	95.60±3.54
15 washing	98.80±.84	98.60±1.14	98.20±1.92	98.53±1.30
20 washing	99.40±0.55	99.60±0.55	99.40±0.55	99.47±.52

p-value = 0.001 (Penetration of bacteria significantly increased over different follow ups.)



categories hospitals. i.e. (p-value=0.529). This shows progressive deterioration of fabric used in all categories of hospitals. In Leonas study similar observations were recorded, increased porosity after repeated laundering cycles resulted more porosity hence more of bacterial flow across the gowns.

Without sufficient barriers, harmful pathogens can reach and penetrate the skin of surgeons and/or patients, with an associated potential for infection. In addition, when pathogens contaminate HCWU (health care worker's uniform), they can be transmitted to other persons beyond the initial wearer. For the prevention of surgical infection through contamination from aqueous liquids and bacteria, guidelines have been issued for surgical gowns by several organizations. The Center for Disease Control (CDC) proposed that surgical gowns and drapes, either disposable or reusable, should be impermeable to liquids and viruses and be comfortable to the wearer[14].

CONCLUSIONS

When studied for change in porosity after laundering reusable surgical gowns set up of hospitals in Pakistan, resulted in increased porosity and hence more penetration of bacteria across the fabric used for manufacture of surgical gowns. The loss of barrier effect of surgical gown is further compounded by lack of standardization of laundering technique, infra-structure use of improper detergent and other cleaning agents. This loss of fabric characteristics results in more bacterial contamination of surgical wound risk of infection to the patient.

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"Liberty, equality, fraternity, or death; - the last, much the easiest to bestow, O Guillotine!"

Charles Dickens