Resistance of disposable drapes to bacterial penetration

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ABSTRACT

Purpose. To test the bacterial penetrability of disposable non-woven drapes used specifically for total hip arthroplasty.

Methods. 12 round agar plates were inoculated with $10^7$ colony-forming units/ml of coagulase-negative staphylococci (CNS) and incubated in air at 37°C for 18 hours to obtain a semi-confluent growth of organisms. Six brands of disposable drapes were tested; each was assigned to 2 plates. Each disposable drape was placed between a round agar plate and an inverted square agar plate filled with blood agar. After 30 and 90 minutes, the square agar plates were removed and incubated for 48 hours and inspected for growth of CNS.

Results. Bacterial penetration was time dependent. Certain brands of drapes were more impenetrable than others; none was impenetrable at all time points, but most remained so or allowed passage of fewer than 100 colony-forming units at 90 minutes.

Conclusion. It is recommended that drapes be rigorously tested with regard to their resistance to bacterial penetration.

Key words: arthroplasty; bacteria; Staphylococcus

INTRODUCTION

Wound infection caused by intra-operative contamination increases morbidity, mortality, and costs of total joint arthroplasty.1 Measures such as prophylactic antibiotics, laminar flow, and occlusive clothing are effective in reducing both wound infection2 and contamination,3 as are pulse and chlorhexidine lavage.4,5 Surgical technique and operating time also affect infection rates6; longer operating time confers higher risk of infection.7 The passage of bacteria through drapes is a potential source of wound contamination. Disposable non-woven drapes are superior to reusable woven cotton/linen drapes in resisting bacterial penetration.8

We aimed to test the bacterial penetrability of 6 brands of disposable drapes used specifically for total hip arthroplasty.
MATERIALS AND METHODS

12 round agar plates, 90 mm in diameter, were filled with Columbia agar (Becton Dickenson; Oxford, UK) containing 8% whole horse blood (TCS BioSciences; Botolph Claydon, UK). The plates were pre-incubated for 12 hours at 37°C and inspected for bacterial growth. Then they were inoculated with $10^7$ colony-forming units (CFU)/ml of coagulase-negative staphylococci (CNS) and incubated in air at 37°C for 18 hours to obtain a semi-confluent growth of organisms.

Six brands of disposable drapes were tested; each was assigned to 2 plates. Each disposable drape was placed between a round agar plate and an inverted square agar plate, 100x100 mm in size, filled with blood agar. After 30 and 90 minutes, the square agar plates were removed and incubated for 48 hours and inspected for growth of CNS. The experiment was repeated 4 times to check for reproducibility.

The 6 brands of disposable drapes were: 3M Steridrape (St Paul [MN], USA), Allegiance Hip Pack (McGaw Park [IL], USA), Medline Hip Set (Mundelein [IL], USA), Molnlycke Barrier Brand (Goteborg, Sweden), Molnlycke Klinidrape (Goteborg, Sweden), and Vygon Unidrape (Ecouen, France).

RESULTS

The following results are presented anonymously, using a logarithmic scale for CFUs. Bacterial penetration was time dependant. Certain brands of drapes were more impenetrable than others; none was impenetrable at all time points, but most remained impenetrable or allowed the passage of $<100$ CFU at 90 minutes (Fig.).

Drape 1 was impenetrable in all except the second experiment in which there was a passage of $<10$ CFU at 90 minutes. Drape 2 was also impenetrable in all except the second experiment in which there was a passage of $<10$ CFU at 30 minutes and $<10^2$ CFU at 90 minutes. Drape 3 was impenetrable at
30 minutes in all except the second experiment in which there was a passage of <10 CFU; at 90 minutes it was impenetrable only in the first experiment and there was a passage of <10 to <10⁰ CFU in the other experiments. Drape 4 was impenetrable in all except the first experiment in which there was a passage of <10 CFU at both 30 and 90 minutes. Drape 5 was impenetrable at 30 minutes in experiments 3 and 4, but there was a passage of <10⁴ CFU in experiment 1 and <10⁵ CFU in experiment 2; at 90 minutes there was a passage of <10² to <10⁴ CFU in all experiments. Drape 6 was impenetrable in all except the first and second experiments in which there was a passage of <10² CFU at 90 minutes.

DISCUSSION
The methodology of assessing bacterial penetrability of drapes is well-established.⁸⁻¹⁰ Other studies have reported the resistance of drapes to fluids¹¹ and tracer particles,¹² but we consider bacteria have greater clinical significance. A modification of this method has been used to assess the penetrability of gowns to bacteria.¹³ CNS was used because it is the most common source of infection in total joint arthroplasties.⁴,¹⁴

In our experiments, drapes were directly exposed to the heavily contaminated agar (10⁷ CFU). This is much more demanding than the situation usually encountered in total hip arthroplasty. The highest penetration of any drape was 10⁴ CFU, which was a considerable reduction in bacterial load. Previous studies have shown that reusable cotton/linen drapes performed much worse than disposable drapes under similar conditions.⁸

A small inoculum of bacteria can cause deep infection in a cemented arthroplasty.¹⁵ It is recommended that drapes be rigorously tested with regard to their resistance to bacterial penetration.

REFERENCES