EVALUATION OF HYDROGEN PEROXIDE AND SILVER CATIONS VS. ACTIVE CHLORIDE DISINFECTION PROCEDURES FOR ERADICATION OF MULTIDRUG-RESISTANT ORGANISMS

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Objectives

The objective of this study was to evaluate the effectiveness of two disinfection procedures based on a micro-nebulization of hydrogen peroxide and silver cations vs. active chloride, by evaluating the reduction of microbial contamination of room surfaces and operating theatres areas in a tertiary hospital in the north of Italy.

Methods

Active chloride (5.000 ppm) and saturated steam vapor (180 C°), vs. decontamination system based on a solution of 5-8% hydrogen peroxide and 60 ppm active silver ions (1mL/m^3 intensity of treatment) were compared.

Microbial colonisation was assessed in **30 hospital rooms** located in different wards in the Departments of Medicine, Surgery and Rehabilitation of the Hospital of Lodi (Italy) previously occupied by patients infected with:

MRSA (5 cases);

VRE (3 cases);

XDR-*A. baumannii* (5 cases);

MBL-*P. aeruginosa* (3 cases);

KPC-*K. pneumoniae* (8 cases);

ESBL-*K. pneumoniae* (2 cases),

ESBL-*E. coli* (2 cases),

S. maltophilia (2 cases);

and in **6 operating rooms** with patients submitted to surgery and colonized with KPC-*K pneumoniae*.

Environmental colonisation was valuated before cleaning and after disinfection procedures, by use of pre-moistened with sterile saline cotton tipped sterile swabs. The swabs were used to sample surface areas approximately 57 cm^2 by standardized swabbing in two directions at right angles. All swabs were inoculated on blood agar plates and in broth and incubated for 48 hours at 37°C.

Cleaning effectiveness of surfaces was evaluated by quantifying the total number of aerobic organisms from a sampled area (total aerobic colony count) and expressed in colony forming units (CFU) per cm^2. Organisms were identified by standard microbiological methods.

Environmental samples were taken from 10 high touch rooms' surfaces which included: room door handle, headboard, footboard, bed frame, bedside table top, bedside table handle, light switch, floor corner, sink taps, soap dispenser and from 21 high touch operating rooms surfaces.

Results

1260 samples from swabs were collected from rooms surfaces as follows: 660 from hospital rooms treated with hydrogen peroxide and 240 with active chloride plus steam vapor, 360 from operating rooms treated with hydrogen peroxide. Results are shown in Figure 2.

a. Before cleaning the rooms' surfaces all samples collected resulted colonised, with a median density of mesophile organisms of 32 CFU/57 cm^2. MDROs were isolated from samples collected in 20/30 rooms respectively.

b. After manual cleaning with detergent followed by active chloride disinfection, the median density of organisms was reduced to 20 CFU/57 cm^2. In two rooms MDROs grew only after enrichment.

c. After disinfection with active chloride plus saturated steam vapor, a median density of organisms of 20 CFU/57 cm^2 was observed. MRSA were found from samples collected in 2 rooms.

d. After hydrogen peroxide disinfection procedure a range between 0 and 3 CFU/57 cm^2 was observed without any MDRO growth.

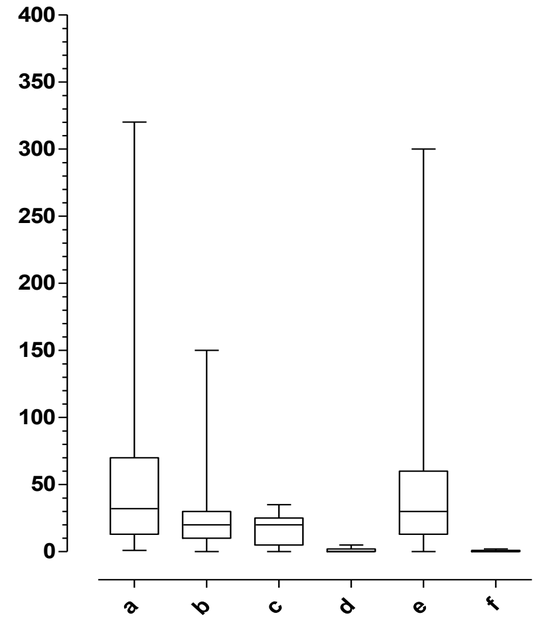
e. Before cleaning the operating rooms a median density of mesophile organisms of 30 CFU/57 cm^2 was found.

K. pneumoniae-KPC was detected in one of them.

PFGE analysis of the *K. pneumoniae* strains isolated from stools of a patient submitted to surgery, from stools of his roommate and from surfaces of the operating room identified a single clone type named A (Figure 1).

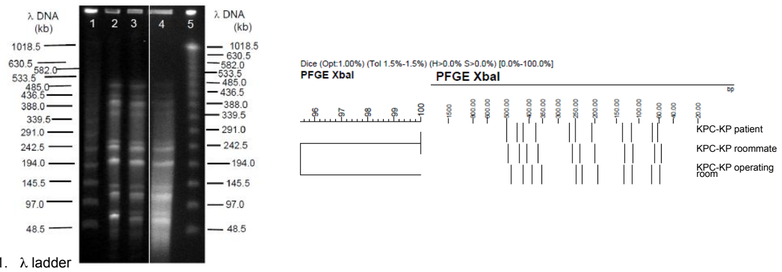
f. After hydrogen peroxide disinfection, a density of bacteria in the range of 0 and 2 CFU/57 cm^2 was observed and no MDROs were found.

Figure 2. Hospital and operating rooms density of mesophile organisms (CFU/57 cm^2) in pre- and post- disinfection processes.



a. Hospital rooms: before cleaning the surfaces
b. Hospital rooms: after active chloride
c. Hospital rooms: after active chloride + steam vapor
d. Hospital rooms: after hydrogen peroxide disinfection
e. Operating rooms: before cleaning the surfaces
f. Operating rooms: after hydrogen peroxide disinfection

Figure 1. PFGE and comparison of isolates using Fingerprinting II version 3.0 software (Bio-Rad) with the unweighted pair-group method with arithmetic averages (UPGMA).



1. λ ladder
2. KPC-KP patient
3. KPC-KP roommate
4. KPC-KP operating room
5. λ ladder

Conclusions

The residual contamination of some surfaces treated with active chloride and saturated steam vapor might be explained by an inadequate preparation of the solution and/or the difficulty of cleaning all surfaces because the disinfection process was performed manually. The dry-mist of hydrogen peroxide and silver cations diffuses over a wide area, reaching even inaccessible or critical sites that may be missed by manual wiping.

Hydrogen peroxide resulted effective in minimizing the overall microbial load and eradicating MDROs on the hospital's wards and operating room surfaces.