Benefits and limitations of steam cleaner for the biocleaning of surfaces

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Introduction

The biological cleaning of premises is an important activity in a health care facility as by working time which is dedicated by the obligation of the result. Some local as the operating theater are cleaned several times a day to avoid any risk of cross-transmission. Other as the kitchen must be cleaned for allowing the handling sensitive foodstuffs without risk of contamination by microorganisms may alter the microbiological quality of food. We wanted to check for these two specific indications, efficiency and interest of Sanivap ® steam cleaner kindly put to our disposal by the company of the same name.

Prior studies by our team within the Haguenau Hospital had been concluding to a large efficiency of steam cleaner for the cleaning and the disinfection (equipment used according to manufacturer's recommendations), at least equivalent to the ones observed by the application of the detergent-disinfectant Surfanios ® (method currently used in the establishment). The studies have focused on visualization of residual blood in the operating theater by use of Bluestar ®, the measurement of ATP residual values and the result of microbiological controls of surfaces after both methods.

For completing these first encouraging results and to validate the efficiency of steam disinfecting process, we applied the method, 5 consecutive days, on both surfaces: the lineoleum and the PVC. We have then measured the residual bacterial contamination each day and observed the appearance of surfaces by electronic microscopy scanning. In parallel, the same observations have been made on samples treated 5 consecutive days by application of Surfanios ®.

The experimental protocol was designed to test the following hypothesis:

- In one application, the steam disrupt the biofilm and releases the bacteria in the biofilm which are easily found on the surface of the contact agar in equivalent quantities to those isolated after application of Surfanios ®.

- The use of the steam during successive several days, of the steam should continue to disrupt biofilm and liberate in term the vast majority of originally present bacteria :
  - microbiological controls should be depleted gradually after each steam treatment,
  - biofilm should gradually disappear (observation by scanning electronic microscopy - SEM).

Equipment and method

Two often present flooring in health facilities have been used: a linoleum (L) and a PVC (P) coating. In both cases, the coatings are old and have been removed from corridors at the time of their renewal. Note that we do not make an artificial contamination of the flooring; the natural contamination of the floor serves as reference.

A prior wet sweeping is performed using a cloth impregnated with vegetable oil to recover the dust. Each floor is delimited in two parties.

Three samples of surface contact agar and a punch for sampling a sample of coating that will be observed in electronic microscopy to scan (SEM) are made on the first part and are noted ' witnesses contaminated » linoleum and PVC (TcL and TcP).

Regarding the second part, we delimit two daily treated areas one for steam (V) and the other for Surfanios ® (S) 5 days consecutive (J1-J5). Three contact agar by area and a sample for SEM are collected every day at the locations. This allows getting the incremental effect of steam on 5 consecutive days on the same area and comparing it to the progressive antibacterial effect of Surfanios ®. Note that these surfaces are not protected from possible environmental contamination between each cleaning and sampling. However, they are not subject to contamination following their usual utilization.

The contact agars are, after sampling, immediately forwarded to the laboratory. The microbiological results after incubation at 30 ° C for 2 days, then 3 days to temperature room. They are expressed in unit forming colony (UFC) for 25 cm^2. For each situation, the average and the standard deviation enable to compare both series and to find a significant (student's t) difference. Curves of decrease of bacterial counts on the basis of the treatment of surfaces and time are plotted and compared between them.

Punched samples are immediately immersed in a medium of fixation (Caco 0, 115M, AFP 2%, Gluta 2.5%, pH7.4), then sent to the laboratory for microscopy for treatment according to the usual procedure of surfaces for observation. From 18 to 27 different photographs (print size 18 x 24 cm) magnification X 80 are obtained for each sample SEM. Gridlines (5 x 6 cm) allows to select by drawing of lot 5 areas to be analyzed from 15 on each photograph. On each of these 5 areas, the particles are counted, the averages for each series of photographs of analyzed samples are compared (Anova, t of student).

Results

Counts bacterial

The average results (n = 3) for each series expressed in logarithms are presented in table 1. Evolution of results over time curves (J1 -J5) shows a decrease in successive bacterial counts in all experimental situations: linoleum (figure 1) and PVC (figure 2) with Surfanios ® or steam. The decrease is more pronounced on the linoleum and on the PVC with the steam process.

Table I : Decimal logarithm of the average results of successive bacterial counts carried out from J0 to J5 on the linoleum (lino) and the PVC (pvc) after daily application of detergent-disinfectant Surfanios ® (surfanios), or the Sanivap ® steam process.

	SL Lino surfanios	**VL lino steam**	**SP PVC Surfanios**	**VP pvc steam**
J0	1.4	1.4	1.2	1.2
J1	0.9	0.5	0.7	0.6
J2	0.6	0.5	0.3	0.0
J3	1.0	0.4	0.8	0.6
J4	0.7	0.6	0.7	0.4
J5	1.1	0.7	0.7	0.2

Figure 1 : Evolution of results over time (from J1 to J5) of successive bacterial counts on linoleum with Surfanios ® or steam.

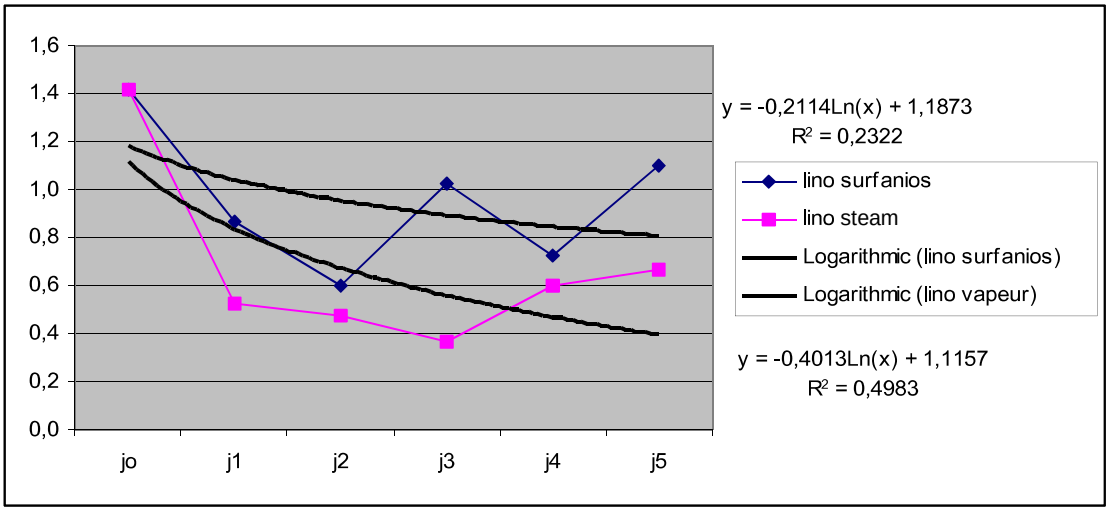
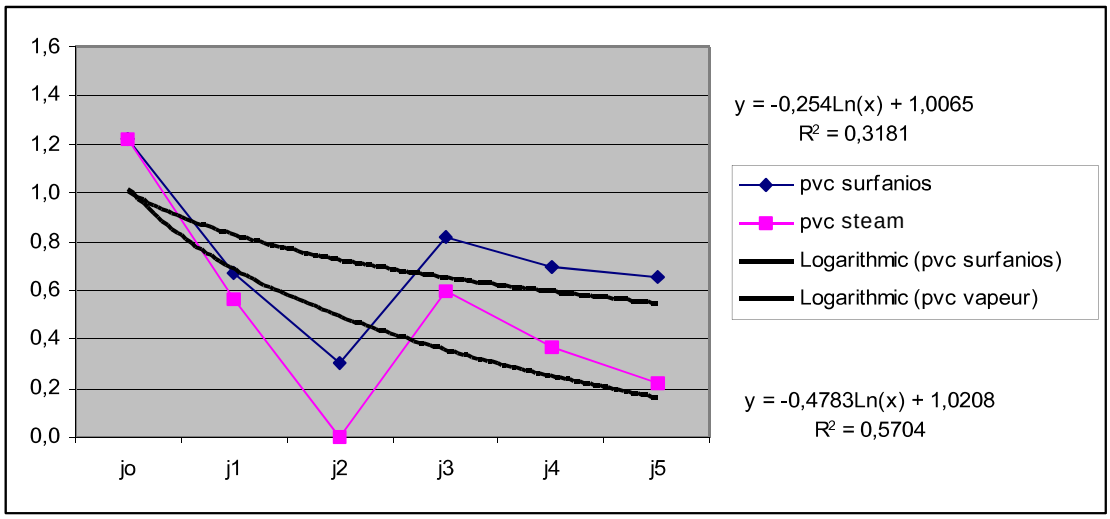


Figure 2 : Evolution of results over time (from J1 to J5) of successive bacterial counts on PVC with Surfanios ® or steam.



Observation with the scanning electronic microscope

Only 3 samples on the PVC support, significant and likely to respond questions asked have been studied by scanning electronic microscopy: "witness PVC contaminated" and "Surfanios to 5 j", and " steam to 5 j". The magnification X 80 has been chosen to have the vision of a sufficient area and to allow counting particles. For the surface witness contaminated, the average of particle observed (5 areas on 15) on each photography (n = 27) is 105.3 (standard deviation: 53.23). On the surface treated 5 consecutive days by application of Surfanios ®, the average (n = 22) is 82.27 particles (deviation: 27.02). Finally, on the surface treated 5 consecutive days by the steam process, the average of observed particles (n = 18) is 66.11 (deviation: 24.17).

The differences observed between the results of the three samples are significant (risk α of 5%;) Anova) and lie between the witnesses and one or other of the methods. Nevertheless, if a better result in terms of the number of residual particles seems to be obtained with steam method (66,11 particles in average versus 82.27 particles after Surfanios ®), the difference is not significant. It can however be concluded that the steam process to test is at least as effective as the repeated use of Surfanios ® in this experience.

Discussion

Effective disinfection of all surfaces must be performed after each operating act according to the instructions described in the validated institutional procedure. This biocleaning is essential as it ensure to get one room without risk for a new patient and this, regardless of the diseases treated at the surgical and history of patient. The quality of this biocleaning guarantees the non-transmission from potentially pathogenic microbial agents of previous patients, the environment or professionals of the operating theater.

Several methods allow of validate the efficiency and the quality of biocleaning implemented: the visual control, the evidence of residue of blood by the Bluestar ®, the auditing of practices, the microbiological samples from surfaces, the ATP measures on the surfaces. They have an undeniable educational virtue and allow sensitizing professionals to

the need of the biological cleaning and the required quality. The results validate the procedure and the quality of its implementation.

On the floor and the high surfaces high of operating theater, the steam process ensures an easy cleaning and visually effective. The cleaning is easy to do, fast and effective. The steam allows eliminating traces of blood not visible to the eye and leaves cleaned surfaces. Nevertheless, in this last indication, it is require having guarantees in term of disinfection for eliminating the microbial loads from the operating theater (flora pathogen of patients).

Bacterial counts obtained in our preliminary studies in the operating theater showed that there's no difference in bacterial reduction after a treatment by Surfanios ® or Sanivap ® steam process, both on the floor and on high surfaces.
In addition, two successive applications of steam result in an increase in the number bacteria removed from the surface by the contact agar. The steam would remove more bacteria which are then made accessible for removing from the surfaces.

On the basis of these two information, bacteriological swab have been made during several successive days by using both methods to verify the effectiveness in the long term of steam cleaning that will eliminate gradually, at each passage, the biofilm in place. Our latest results confirm this assumption. The difference is significant on microbiologically ground. The results are better with steam than with the Surfanios ® after 5 days. Photomicrographs according to our method show that the number of particles decreases significantly with the steam or the Surfanios ® with an advantage that is not significant (t of student) for the steam. In conclusion, the results obtained with Surfanios and steams on PVC are at least equivalents.

Our study protocol tests the efficiency of methods in real situations in situ, from surfaces contaminated only by their sole usage. No microbial overload or organic matter has been added on tested surfaces. The present bacteria are probably installed in a biofilm that only longer treatment might eliminate.

Conclusion

All of the results obtained by comparing the application in one or several successive treatment of the tested surfaces, Surfanios ® or the Sanivap ® steam process show at least equivalence of both methods, or the superiority of the steam process for the cleaning and the disinfection of surfaces. The benefit listed above of the Sanivap ® steam process show that this technique can be privileged and has its place in the hospitals for the biocleaning of surfaces.