The effectiveness of Peracetic Acid decontamination in an ambulance –Study

Authors

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Summary

The current sanitary climate leads us to assess the quality of disinfection procedures. Our study aims to compare and evaluate in real conditions the biocidal efficacy, through the use of peracetic acid of the product Ventum® One-Touch™. The experiment is carried out by vaporization in front of a quaternary ammonium solution conventionally used in disinfection in sanitary vehicles.
We strategically placed biological indicators containing standardized ultra-resistant bacteria in the health cell of an ambulance. The procedure consists of carrying out disinfection by air either by the peracetic acid product in the test arm or by the quaternary ammonium product in the control arm. We compared the effectiveness of disinfection procedures by respecting the contact times between the biological indicator and the biocidal agent. These were fixed at 15 minutes in the control arm and 5 minutes in the test arm in accordance with the recommendations of the professionals. After each disinfection procedure, the indicators are collected, incubated and the residual bacteria quantified.

The study of the product Ventum® One-Touch™ showed significantly higher efficiency than the quaternary ammoniums tested, with an efficiency of 100% in the test arm, and 7% in the control arm *($p < 0.001$).*

Keywords

- Decontamination
- Biocide
- Peracetic acid
- Ambulance
- Misting

Introduction

More than ever, the issue of having effective biocidal agents that are safe and easy to use is leading the health community to rethink its procedures. Many biocidal products exist with varying efficacy.

Peracetic acid is known to be both virucidal and themost effectivebiocidal agent on Gram+ and Grambacteria. However, the packaging of precursor products to the synthesis of peracetic acid is a real problem solved by an appropriate degassing solution used in the Ventum® One-Touch™ device.

This product uses a formula validated in the laboratory according to conventionally accepted standards.

In the appendix:
NF T72-281; EN 14,476; EN 1276; N 13,610; EN 13,623; EN 13,624; EN 13,704; EN 13,727; EN 13,348; IN 1650; EN 14,561; EN 14,562; EN 13,697; EN 1040; EN 1275; IN 1650

The evaluation of the effectiveness of products in the laboratory and in a context of daily use is different. Health actors confronted with the obligation to disinfect or decontaminate repetitive objects and surfaces in contact with patients may present a difficulty. The company Ventum Biotech has developed a vaporization system claiming stability and efficiency.

Our objective isto compare the efficiency of use of the *Ventum® One-Touch™* product compared to a device sold in specialized trade usedby institutions and health companies.

Method

This is a prospective interventional study comparing two ambient diffusion decontamination procedures in a health cell of an ambulance. The study takes place in simple knowledge compared to a control product.

The *Ventum® One-Touch™* product tested is dispersed by a pressure device, containing 110ml of peracetic acid to disinfect a volume of $10m^3$, at the Log 4 concentration. The percussion of the device allows the complete release of the product in the form of misting. The contact time of the biocidal agent is divided over different periods of 5 minutes before sampling of biological indicators. The control product on the market is used in dispersion mode by vaporization distributed in the space of the cell, according to the same protocol.

The biological indicator is a capsule containing 10^4 bacteria of Bacillus Staerothermophilus wrapped in a support cardboard. The reading is done in the laboratory, responding in a binary way to the presence or absence of residual bacteria. Six strategic locations were chosen to arrange these indicators dispersed within the health cell to control the dispersion of the product in the atmosphere, nooks and crannies, or areas of manual contact. These sites correspond to the worktop at the front of the sanitary cell (site #1); inside the upper drawer under the worktop (site #2); the middle of the stretcher (site #3); the upper closet located at the front of the cell (site #4); another suspended from the ceiling of the upper closet located at the back of the cell, (site #5) and the last one on the back door handle (site #6). During the decontamination phase, drawers and closet doors remain open. The two comparative tests are done with the same contact time, ventilation cut off, windows and doors closed and out of human presence.

The primary outcome is the presence or qualitative absence of a remnant of bacteria (all-or-nothing test) ref. on biological indicators after a disinfection protocol with the TEST or CONTROL arm.

The secondary outcome is a subgroup analysis of the primary outcome for each site.

We estimated the number of tests to be performed based on unpublished preliminary results, based on a 50% improvement in observed efficacy, with a risk α to 5% and a potency of 90%. The number of tests needed is 7 per arm. The analysis of the results will be done by Student test for the calculation of the averages observed according to a normal distribution, and a Mann-Whitney test when they do not follow

a normal distribution. The statistics were made from the software of the BIOSTATGV website *[Faculty of Paris VI (http://marne.u707.jussieu.fr/biostatgv/), based on the statistics software R© (The R Foundation for Statistical Computing*Platform). The significance level (p) was chosen at 0.05.

Results

Between December 2020 and January 2021, we performed the procedures of both arms, repeated seven times each including their results.

The observation of biological indicators after disinfection procedure reveals that in 7% of cases, they no longer have bacteria on their surface. In the TEST arm, this observation is 100% of the indicators. The TEST arm appears to be statistically superior in efficiency to the CONTROL arm ($p<0.001$, 95% confidence interval [0.8692; 1.0084]).

In our subgroup analysis, we find this same trend, as reported in Table 1:

Table 1. Average of biological indicators after disinfection protocol comparing the TEST arm to the CONTROL arm.

	CONTROL arm	TEST arm	
	N=7	N=7	*p*
Site #1	0%	100%	<0.001
Site #2	14%	100%	0.002
Site # 3	14%	100%	0.002
Site # 4	14%	100%	0.002
Site # 5	0 %	100%	<0.001
Site # 6	0 %	100%	<0.001

Discussion

In their study, Varona-Barquin and Al, showed that the door handles, or stretcher were locations with a high risk of contamination. A second study showed the importance of mist disinfection to obtain effective disinfection of surfaces hidden or potentially forgotten by disinfection procedures that are too complex. Our study is the first of its kind, to evaluate with biological indicators in a professional context, the potential effectiveness of a biocidal agent, to operate on the different surfaces or corners of an ambulance.

Rescuers are confronted with many pathogens when caring for patients. The time constraints incompressible to the realization of a decontamination procedure range from a few minutes for the fastest to a few hours if we want to be effective and exhaustive. This problem has been exacerbated in the current climate dominated by the COVID-19 pandemic.

The main difficulty in conventional procedures is the ability of biocidal agents to be in contact with all surfaces, whether by means of wiping, misting, or ultraviolet light. We believe that the Ventum Biotech device allows a sufficient saturation of the atmosphere to cover all contact surfaces, whether door handles, or stretchers, and even the coverings of cupboards and drawers in ambulance cells.

It is clear that the results of the TEST arm are much higher than the CONTROL arm.
The disproportion in the results between the CONTROL and TEST arms raises questions, especially since the contact time between the biocidal agent and the biological indicator is shorter. It should be noted that in biology, the effectiveness of the result of a contact time between an agent and a biocide is a fundamental element.

Several aspects are to be discussed. The biological indicator capsules all contain the same reference bacteria, in the same concentration. The control arm product recognized with biocidal standards EN 1040 and EN 1276 should therefore have biocidal activity on the spectrum of bacteria contained in the biological indicator. Two hypotheses can then be suggested. First, the product is not able to diffuse between the atmosphere and the capsule of the biological indicator through a blotting paper, which would introduce into our study a measurement bias. Secondarily, the product volume of the CONTROL arm is under dosed which would result in a realization bias. We can see that when the CONTROL test has been effective, sensitive biological indicators are located in the center of the cell (site #2, #3 and #4). As the technique of conditioning and deconditioning of the biological indicators was done by the same operator, respecting the same procedures, we can then think that the few seconds of spraying will more easily concentrate in the central area of the ambulance cell. Given the small amount sprayed during these few seconds, its diffusion can obviously not be optimal. This is what we have noticed in unpublished preliminary tests, where we have varied the volume of product of the test arm sprayed and the spray position. In these tests, we were able to observe that the central position in the ambulance cell was the most relevant to achieve 100% efficiency. As for the volume, it is necessary to obtain a spray of 12 mL/ m^3. For a higher volume, all tests have confirmed its complete effectiveness. On the other hand, for a volume of 9 mL/ m^3 the product showed only 75% efficiency. Thus, one could discuss the reliability of the comparison of these two procedures. Outside can we really talk about bias when the procedure applied is the one promoted by the professional.

The volume dispersed at each intervention being different, we took into account this problem. The tests were reproduced with a sufficient time interval in the same ambulance. To limit the appearance of a confusion bias, by the persistence of biocidal agent between each intervention we were careful to ventilate the cell and wipe any residues after each intervention.

Reading these encouraging results, it seems appropriate to continue the investigations comparing the ventum product with other products or procedures.

Conclusion

The management of the decontamination of ambulance health cells is an ongoing problem, and a current issue. The study showed the effectiveness of spraying peracetic acid respecting a short contact time in the decontamination of the different surfaces of an ambulance sanitary cell.

Bibliography

- Varona-Barquin
    - A cross-sectional study was performed in 10 emergency basic life support ambulances operating in Bilbao, Spain, to assess surface bacterial contamination. Presence of clinically relevant bacterial contamination suggests that disinfection of the studied basic life support ambulances was not optimal and represents a potential risk of infection...
- Daifallah Alrazeeni
    - Objectives: To evaluate infection control and the incidence of bacterial pathogens in Emergency Medical Service (EMS) ambulances in Riyadh, Saudi Arabia. The effectiveness of fumigation techniques used for these ambulances to minimize the spread of infection to transported patients and pre-hospital care providers was also assessed.