Hydrogen Peroxide Vapourised from Surface of Fiberscope after Low Temperature Hydrogen Peroxide Sterilisation

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1. Background

Several types of flexible fibrescopes are indicated to be sterilised by low-temperature hydrogen peroxide gas plasma (HPGP: STERRAD NX® Johnson & Johnson). However, residual hydrogen peroxide (HP) on the surface of the endoscope after HPGP sterilisation has not been reported yet. This paper evaluates residual HP vapourised from the surface after sterilisation.

2. Methods

Two dummies each of bronchofiberscopes (BF-260®, Olympus) and cystonephrofiberscopes (CYF-5A®, Olympus) shown in Figure 1 were custom-ordered. They were sterilised by HPGP, and HP vapourised from the surfaces was detected by an electrochemical detector (Polyton 7000®, Dräger, sensitivity: 0-300 parts per million (ppm)) continuously. Each was sealed in a stainless steel container as shown in Figure 2, and HP vapour in the containers was detected every 10 minutes. The maximum concentration of every 10 minutes was collected by a data logger.

3. Results

The maximum concentrations of HP in the containers are shown in Figure 3. It required almost 18 to 40 hours after sterilizations for the concentrations of HP vapourised from the surfaces of the fibrescopes in the containers to become less than 10ppm.

4. Discussion

The analytic procedure for HP in air recommended
by the Occupational Safety & Health Administration (OSHA) is a midget fritted glass bubblers (MFGB)-colorimetric procedure. It has been shown that this colorimetric method is useful in the range from 2 μg H₂O₂ up to about 100 μg H₂O₂, which corresponds to 0.06 to 3.0 mg H₂O₂/m³ for a 100 litre air sample, i.e. less than 2.2ppm. The range of the detection method we employed in this study is 0 to 300ppm. The OSHA permissible exposure limit (PEL) for HP vapour is 1 ppm of air (1.4 milligrams per cubic metre (mg/m³)) as an 8-hour time-weighted average (TWA) concentration [Code 29 of Federal Regulations (CFR) 1910.1000], and the National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) for HP of 1 ppm (1.4 mg/m³) as a TWA for up to a 10-hour workday and a 40-hour working week [NIOSH 1992] which is based on the risk of eye, mucous membrane, and skin irritation [NIOSH 1992].

The list of adverse events of HP exposures in the Manufacturer and User Facility Device Experience (MAUDE) database of the Food and Drug Administration (FDA), include many cases with symptoms, although the relations between those symptoms and HP exposures have not been clearly proved.

In the NIOSH Pocket Guide to Chemical Hazards, irritation of the eyes, nose, and throat, corneal ulceration, erythema (skin redness), skin vesiculation, and bleaching of hair are reported to be possible symptoms as a result of exposure. In the guide, NIOSH and OSHA recommend any supplied-air respirator for up to 10ppm, any supplied-air respirator operated in a continuous-flow mode for up to 25ppm, any self-contained breathing apparatus with a full facepiece or any supplied-air respirator with a full facepiece for up to 50ppm, and any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode for up to 75ppm.

This study found that a higher concentration of HP vapour spilled out from the residue on the surface of the fiberscope right after HPGP sterilization, which continued for hours. The adverse events affecting mucous membranes have not yet been proven; however, healthcare workers should carefully observe the occurrence of adverse events among patients in order to maintain safety. Further research is required on the safe selection of plastic materials for fiberscopes with low HP residue on the surface after HPGP sterilization.

Reference
1) Occupational Safety and Health Administration.
1）Occupational Safety and Health Administration. Hydrogen Peroxide. 
(accessed on 26 March 2012)

2）Occupational Safety and Health Administration. Occupational Safety and Health Guideline for Hydrogen Peroxide. 
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http://www.cdc.gov/niosh/npg/npgd0335.html 
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4）FDA. Manufacturer and User Facility Device Experience. 
http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMAUDE/search.cfm 
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*Search MAUDE Database: Brand Name (STERRAD)→Event Type (Injury)→Date Report Received by FDA (mm/dd/yyyy) (ex: 1/1/1999 to 2/29/2012)→Records per report page (ex: 500)→Search