



## Letter to the Editor

**Hydrogen peroxide in the operating theatre: Too dilute to dilute?\***

Dear Sir,

Lacerations, open fractures and human and animal bites make up a large proportion of emergency admissions under surgical specialties and the health service as a whole. Initial management of these patients includes careful wound washout often with antibiotic treatment. A proportion are taken to theatre for a formal washout and debridement plus repair of any damaged underlying structures. In our experience, solutions such as hydrogen peroxide are commonly used to washout these wounds and the way in which they are used vary from surgeon to surgeon, often without a sufficient evidence base.

Hydrogen peroxide ( $H_2O_2$ ) is a biocide that is commonly used as an antiseptic in hand surgery. It is a clear, colourless liquid that has been used in medicine since the beginning of the 20th Century [1].  $H_2O_2$  acts by disrupting essential cell components via the formation of hydroxyl free radicals [2]. It has a broad spectrum of activity against viruses, bacteria (and associated spores) and yeasts.  $H_2O_2$  is environmentally friendly: not only is it naturally occurring in vivo, but its only degradation products are water and oxygen [2]. The release of oxygen aids wound cleaning via providing a degree of mechanical debridement.

$H_2O_2$  is commercially available from 3 to 90% and makes up part of the basic stock found in most UK operating theatres. In our experience within plastic, general and orthopaedic surgery across multiple UK NHS Trusts, when  $H_2O_2$  is requested by the surgeon, it is diluted at a ratio of 50:50 with normal saline. The authors would like to examine and question the theory behind this behaviour. The  $H_2O_2$  now found in the majority of operating theatres nationwide is at a concentration of 3%, which according to the manufacture, does not require dilution and is sold over the counter in most pharmacies [3].  $H_2O_2$  shows good activity against most bacteria, however at concentrations lower than 3% has a reduced effect in organisms that express catalase or other peroxidases [4]. Studies have demonstrated that despite the 3% solution's cytotoxic effects, it does not have any deleterious effects on wound re-epithelialization and actually promotes vascular perfusion and wound healing [4].

Interestingly, the 6%  $H_2O_2$  used to be the solution found in UK operating theatres and in this case, the manufacturers indeed recommend dilution with equal parts water. Perhaps the ongoing dilution of the 3% solution is an old habit that needs updating to ensure optimal activity against any potential organisms

contaminating the wound. The other, slightly more concerning explanation, is that surgeons don't actually know the concentration of  $H_2O_2$  that they are given by the scrub staff, nor what the correct concentration should be.

Concerns relating to hydrogen peroxide include possible deleterious effects on articular cartilage and the possibility of air embolism. Although no human studies have been performed, cell-based studies have demonstrated inhibition of chondrocyte activity and cartilage synthesis leading to the recommendation that  $H_2O_2$  should not be used in native joints [4]. There have been documented cases of  $H_2O_2$  resulting in pneumocephalus and air embolism from the formation of oxygen gas when used in closed cavities such as the spine and femoral medulla respectively [4]. We would therefore advise that  $H_2O_2$  should not be used to washout open joints, nor in closed cavities or in proximity to breached dura.

$H_2O_2$  is an excellent antiseptic that is able to rid most wounds of potentially troublesome microorganisms. We believe that it should only be used for superficial, open wounds and the 3% solution (that is most commonly used) should not be further diluted. Wounds should then be thoroughly washed out with normal saline following use. The authors hope that this brief review of the literature helps surgeons make an informed decision of when and how to use  $H_2O_2$  safely and effectively. In addition, we implore surgeons to treat  $H_2O_2$  like any other drug used in the operating theatre: check the concentration prior to use and understand the contraindications.

**Conflict of interest**

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