WHAM evidence summary: Wound Management: Hydrogen peroxide

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CLINICAL QUESTION

What is the best available evidence regarding hydrogen peroxide for treating wounds?

SUMMARY

Hydrogen peroxide has an oxidising effect; that is, in the presence of tissues and blood rapidly broken down to water and oxygen.[1, 2] *Level 5 in-vitro* studies show hydrogen peroxide is highly toxic to tissues even at low concentrations[3, 4] and clinical reports indicate that there is risk of local and systemic adverse effects related to surgical emphysema and gas embolus induced deaths.[2, 3, 5] Hydrogen peroxide should not be used as a preferred topical wound agent, and its use should be totally avoided in cavity wounds due to risk of surgical emphysema and gas embolus.[2, 3, 5]

CLINICAL PRACTICE RECOMMENDATIONS

All recommendations should be applied with consideration to the wound, the person, the health professional and the clinical context.

Hydrogen peroxide should not be used to irrigate cavity wounds, sinuses or wounds of the joint and should not be applied to any wounds under pressure (Grade A).

SOURCES OF EVIDENCE

This summary was conducted using methods published by the Joanna Briggs Institute.[6-8] The summary is based on a literature search combining search terms related to hydrogen peroxide and wounds. Searches were conducted in CINAHL, Medline, the AFRO Library and the Cochrane Library and for evidence published up to November 2012 in English. Studies were assigned a level of evidence (see Table 1) based on JBI's hierarchy.[6-8]

BACKGROUND

Hydrogen peroxide has been used as a low cost option for cleaning and disinfecting wounds. Hydrogen peroxide has an oxidising effect; that is, in the presence of tissues and blood rapidly broken down to water and oxygen.[1, 2] Due to the effervescence that occurs on application, it has been used to chemically debride wounds.[1, 2] I*n-vitro* studies show hydrogen peroxide is highly toxic to tissues even at low concentrations[3, 4] and clinical reports indicate that there is risk of local and systemic adverse effects related to surgical emphysema and gas embolus induced deaths.[2, 3, 5]Other topical antimicrobials (e.g. silver, chlorhexidine digluconate; polyhexamethylene biguanide) have been shown to have similar or superior effects against isolates without associated tissue toxicity and clinical risk.[3, 9]

Table 1: Sources of evidence and the level

Level 1 Evidence	Level 2 Evidence	Level 3 Evidence	Level 4 Evidence	Level 5 Evidence
Experimental Designs	**Quasi-experimental Designs**	**Observational – Analytic Designs**	**Observational –Descriptive Studies**	**Expert Opinion/ Bench Research**
None	None	3.e Observational study without a control group[1]	4.d Case study[5]	5.c Bench research[3, 4, 9, 10] 5.c Expert opinion, non-systematic literature review[2]

EVIDENCE

Microbiology and histology evidence

In one clinical trial[1] in which histology was conducted on punch biopsies of spilt-skin grafts treated with hydrogen peroxide, there was no microscopic difference in appearance at seven days between wounds treated with hydrogen peroxide and those treated with acetic acid or povidone iodine. All the wounds had an intact epidermis, focal epidermal necrosis and signs of lymphatic infiltrate[1] (*Level 3*).

In-vitro studies showed a moderately high toxicity for tissue samples exposed to 0.03% hydrogen peroxide.[3]Hydrogen peroxide at 3% concentration is highly toxic to both fibroblasts and keratinocytes[4, 10] (*Level 5*).

In-vitro studies on sensitivity of microbes to hydrogen peroxide have varied findings. The following isolates have been shown to be sensitive to hydrogen peroxide in varying concentrations:(*Level 5*):

- *Staphylococcus aureus:* total sensitivity to hydrogen peroxide at 3% concentration,[10] good sensitivity to hydrogen peroxide at 0.03% concentration;[3] no sensitivity at 0.003% concentration[9]
- *Pseudomonas aeruginosa:* moderate sensitivity to hydrogen peroxide at 0.03% concentration;[3] no sensitivity at 0.003% concentration[9]
- *Acinetobacter* spp.: good sensitivity to hydrogen peroxide at 0.03% concentration[3]
- *Klebsiella* spp.: moderate sensitivity to hydrogen peroxide at 0.03% concentration[3]
- *Escherichia cloacae:* no sensitivity to hydrogen peroxide at 0.03% concentration[3]
- *Escherichia coli:* no sensitivity to hydrogen peroxide at 0.03% concentration or below[3, 9]
- *Bacteroides fragilis* and group D enterococcus: no sensitivity at 0.003% concentration.[9]

Improvement in wound healing outcomes

In one clinical trial (n = 40) there was no statistically significant decrease in time to complete epithelialisation between split skin grafts treated with hydrogen peroxide and those treated with normal saline, acetic acid, povidone iodine or a non-stick fine mesh with no topical agent[1] (*Level 3*).

CONSIDERATIONS FOR USE

Adverse events and contraindications

In one clinical trial in which split skin graft sites were treated with hydrogen peroxide every six hours until complete epithelialisation occurred (n =1 0), all wounds developed at least one fluid-filled bullae with potential to develop into ulcers without discontinuation of the hydrogen peroxide treatment.[1] (*Level 3*).

One non-systematic review[2] presented clinical evidence from 62 cases in which venous gas embolism (in some cases resulting in death) followed application of hydrogen peroxide to open surgical wounds (particularly orthopaedic surgery involving the joint) and under pressure (i.e., syringed) to closed cavity wounds. When hydrogen peroxide breaks down, there is a risk of oxygen entering the venous system, particularly when applied under pressure or close to major vessels or organs[2, 5] (*Level 4 and 5*).

The following points could be considered when making clinical decision on use of hydrogen peroxide in wound management:

- The concentration of hydrogen peroxide required to achieve broad spectrum antibacterial activity is toxic to fibroblasts, significantly reducing the appropriateness of its use as a topical antimicrobial.
- Experts report that hydrogen peroxide is an effective wound debridement agent; however, there is no supporting clinical research.

CONFLICTS OF INTEREST

The author declares no conflicts of interest in accordance with International Committee of Medical Journal Editors (ICMJE) standards.

ABOUT WHAM EVIDENCE SUMMARIES

WHAM evidence summaries are consistent with methodology published in

Munn Z, Lockwood C, Moola S. The development and use of evidence summaries for point of care information systems: A streamlined rapid review approach, Worldviews Evid Based Nurs. 2015;12(3):131-8.

Methods are provided in detail in resources published by the Joanna Briggs Institute as cited in this evidence summary. WHAM evidence summaries undergo peer-

review by an international review panel. More information on the website: http://WHAMwounds.com

WHAM evidence summaries provide a summary of the best available evidence on specific topics and make suggestions that can be used to inform clinical practice. Evidence contained within this summary should be evaluated by appropriately trained professionals with expertise in wound prevention and management, and the evidence should be considered in the context of the individual, the professional, the clinical setting and other relevant clinical information.

PUBLICATION

This evidence summary was published in The Joanna Briggs Institute library of evidence summaries in 2012.

REFERENCES

1. Gruber RP, Vistnes L, Pardoe R. The effect of commonly used antiseptics on wound healing. Plast Reconstr Surg, 1975. Apr;55(4):472-6.
2. Reid C, Alcock M, Penn D. Hydrogen peroxide – a party trick from the past? . Anaesth Intensive Care, 2011;39:1004-8
3. Echague CG, Hair PS, Cunnion KM. A comparison of antibacterial activity against Methicillin-Resistant Staphylococcus aureus and gram-negative organisms for antimicrobial compounds in a unique composite wound dressing. Adv Skin Wound Care, 2010;23(9):406-13.
4. Wilson JR, Mills JG, Prather ID, Dimitrijevich SD. A toxicity index of skin and wound cleansers used on in vitro fibroblasts and keratinocytes. Adv Skin Wound Care, 2005;18(7):373-8.
5. Hussain-Khan Z, Soleimani A, Farzan M. Fatal gas embolism following the use of intraoperative hydrogen peroxide as an irrigation fluid. Acta Medica Iranica, 2004;42(2):151-3.
6. Aromataris E, Munn Z, editors. Joanna Briggs Institute Reviewer's Manual. https://reviewersmanual.joannabriggs.org/ JBI; 2017.
7. Joanna Briggs Institute Levels of Evidence and Grades of Recommendation Working Party. New JBI Grades of Recommendation. Adelaide: JBI, 2013.
8. The Joanna Briggs Institute Levels of Evidence and Grades of Recommendation Working Party. Supporting Document for the Joanna Briggs Institute Levels of Evidence and Grades of Recommendation. www.joannabriggs.org: JBI, 2014.
9. McKenna P, Lehr G, Leist P, Welling R. Antiseptic effectiveness with fibroblast preservation. Ann Plast Surg, 1991;27(3):265-8.
10. Lineaweaver W, Howard R, Soucy D, McMorris S, Freeman J, Crain C, Robertson J, Rumley T. Topical antimicrobial toxicity. Arch Surg, 1985.;120(3):267-70.