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ORIGINAL ARTICLE

Ototoxicity of boric acid powder in a rat animal model☆

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KEYWORDS
Boric acid;
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Abstract
Introduction: Boric acid, which has antiseptic and acidic properties, is used to treat external and middle ear infections. However, we have not found any literature about the effect of boric acid powder on middle ear mucosa and inner ear.
Objective: The purpose of this study is to investigate possible ototoxic effects of boric acid powder (BAP) on cochlear outer hair cell function and histological changes in middle ear mucosa in a rat animal model.
Methods: Twenty healthy, mature Wistar albino rats were used in this study. The rats were divided into two groups, Group A and Group B, each of which consisted of 10 rats. Initially, the animals in each group underwent distortion product otoacoustic emissions (DPOAE) testing of their right and left ears. After the first DPOAE test, a surgical microscope was used to make a small perforation in both ears of the rats in each group, and a second DPOAE test was used to measure both ears in all of the rats. BAP was applied to the right middle ear of the rats using tympanic membrane perforation, and the DPOAEs were measured immediately after the BAP application. The histological changes and DPOAEs were evaluated three days later in Group A and 40 days later in Group B.
Results: No significant differences were found at all of the DPOAE frequencies. In Group A, mild inflammation of the middle ear mucosa was found on the third day after BAP application. In Group B, BAP caused mild inflammatory changes on the 40th day, which declined over time. Those changes did not lead to significant fibrosis within the mucosa.

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Conclusion: In rats, BAP causes mild inflammation in middle ear mucosa and it has no ototoxic effects on cochlear outer hair cell function in the inner ear of rats.

PALAVRAS-CHAVE
Ácido bórico;
Ouvido;
Emissões otoacústicas;
Ratos

Ototoxicidade de ácido bórico em pó em um modelo animal de rato

Resumo
Introdução: O ácido bórico, que tem propriedades antissépticas e ácidas, é usado para tratar infecções de orelha externa e média. No entanto, não encontramos nenhuma literatura sobre o efeito do ácido bórico em pó sobre a mucosa da orelha interna e da mucosa da orelha média.
Objetivo: O objetivo desse estudo foi investigar possíveis efeitos ototóxicos do ácido bórico em pó (ABP) sobre a função das células ciliadas externas cocleares e alterações histológicas na mucosa da orelha média em um modelo animal de rato.
Método: Vinte ratos Wistar albinos maduros e saudáveis foram utilizados neste estudo. Os ratos foram divididos em dois grupos, Grupo A e Grupo B, cada um dos quais com 10 ratos. Inicialmente, os animais de cada grupo foram submetidos a testes de emissões otoacústicas–produto de distorção (EOAPD), nas orelhas direita e esquerda. Após o primeiro teste EOAPD, utilizou-se um microscópio cirúrgico para fazer uma pequena perfuração em ambas as orelhas dos ratos em cada grupo, e um segundo teste EOAPD foi utilizado para medir avaliar as orelhas em todos os ratos. O ABP foi aplicado orelha média direita dos ratos utilizando perfuração da membrana timpânica e as EOAPDs foram medidas imediatamente após a aplicação de ABP. As alterações histológicas e EOAPDs foram avaliadas três dias depois no Grupo A e 40 dias depois no Grupo B.
Resultados: Não foram encontradas diferenças significativas em todas as frequências da EOAPD. No Grupo A, foi observada uma ligeira inflamação da mucosa da orelha média no terceiro dia após a aplicação de ABP. No Grupo B, o ABP causou leves alterações inflamatórias após 40 dias, que diminuíram ao longo do tempo. Essas alterações não levaram à fibrose significativa da mucosa.
Conclusão: Em ratos, ABP causa inflamação leve na mucosa da orelha média e não tem efeitos ototóxicos na função das células ciliadas externas da cóclea na orelha interna.

Introduction

In addition to commercially available drugs containing antibiotics and steroids, many topical agents are used to treat ear diseases. Antiseptic and acidic ear drops are often used in cases of middle ear inflammation and infection, which accompany external ear infections and tympanic membrane perforations.[1] Topical applications have some advantages in otology. They provide a high concentration of medication in the applied regions, they have less potential to develop bacterial resistance, and they do not cause systemic side effects in patients. In spite of these advantages, after application to the middle ear cavity they can pass through the round window and they could have adverse effects on the cochlear and vestibular apparatus.[2] Studies have demonstrated the ototoxic effects of aminoglycoside group medications such as gentamycin and streptomycin.[3] In addition, some antiseptic solutions have been proven to have ototoxic potential.[4,5] During topical medication, ototoxicity can be caused either by the active substance itself or by the carrier solution. Furthermore, the concentrations of the active substance and the carrier solution affect the ototoxicity.[5]

Boric acid (also known as Boracic) is a white crystalline solid with the molecular formula H_3BO_3. It is a weak acid found in nature (minerals, sea water, and fruits), and it can be produced by reacting borate minerals with sulfuric acid. Boracic has various uses as an insecticide, preservative, lubricant, and industrial agent. Medicinally, it is used as an antiseptic; for example, it is diluted as an eye wash, or it used to treat minor cuts and burns, acne, aphthous lesions, and ulcerated diphtheria lesions, and it is used to treat cases involving flux, such as gonorrhea vaginitis, and cystitis. It is also used to treat fungal and bacterial infections in the external or middle ear. It has been known to be toxic in high doses, especially in infants. It is frequently used as a 4% solution prepared with 70% alcohol or distilled water, and in pure powder form it is used as Boric Acid Powder (BAP).[6,7] BAP contains the highest concentration of boric acid that is used in ototopical medication. To date, the effects of BAP on the inner and middle ear have not been evaluated. This present study investigated the possible