

THE EFFECT OF COLA ON CORNEAL EPITHELIAL DAMAGE IN RABBITS

Zerrin KAPICIOĞLU, M.D., Yavuz Selim DAYIOĞLU, M.D., Nuri KALYONCU, M.D

Karadeniz Technical University School of Medicine, Department of Ophthalmology, Trabzon, Turkey
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SUMMARY

Purpose : Cola drinks are strongly acidic (pH 2.5). Epithelial damage may be caused by dietary acids. Reports have shown that beverage bottles cause serious ocular injuries. Because Cola drinks contain carbon dioxide, drops of beverage may squirt in the eye when bottles are opened. Therefore, in this study we analysed the interaction of Cola drinks and corneal epithelial damage. **Methods :** Fifteen mature male white rabbits were used in the experiments. The animals were anesthetized and divided into three groups. Each group included five animals and therefore ten eyes. The groups received saline (pH 7.0) or hydrochloric acid (HCl) (pH 1.0) or Coca Cola (pH 2.6). A circular piece of plastic was placed on the cornea. Then saline or 0.1 N HCl (pH 1.0) or Coca Cola (pH 2.6) was applied to the cornea by hypodermic syringe. After 10 seconds, the cornea was rinsed for 5 seconds with saline solution. Subsequently fluorescein dye was used to identify the corneal epithelial damage through staining the cornea. The dye was instilled in the conjunctival sac. Excess dye was irrigated with sterile saline. The corneal epithelium stained bright green in the area of a diseased or absent corneal epithelium. **Results :** In the control group, no corneal epithelial damage was observed. In the Coca Cola group, corneal epithelium was normal in 2 cases; punctate staining existed in 2 cases, epithelial damage of about 1/5 corneal diameter in 4 cases and less than 1/3 corneal diameter in 2 cases. The lesion score of the Cola group was different from that of the control group ($p < 0.001$). In the 0.1 N HCl group, the observations were: Normal (1), punctate keratopathy (2), more than 1/3 corneal diameter of epithelial injury (7). The 0.1 N HCl group lesion score was statistically different from both the control group ($p < 0.001$) and the Coca Cola group ($p < 0.01$). **Conclusion :** Because Cola drinks are strongly acidic, exploding beverage bottles may cause corneal epithelial damage. These results may have broad public health implications for any country where consumption of Cola drinks is widespread.

Key words : Beverages, Carbonated Beverages, Eye Injuries, Citrus, Rabbits.

INTRODUCTION

Chemical burns of the cornea and adnexal tissue are among the most urgent of ocular emergencies. They occur frequently because

strong alkali or acid substances are found in many common household and industrial products. Although the majority of chemical burns are minor, strong alkalies and acids have devastating effects on the ocular tissue (1).

Acids generally cause less severe, more localized tissue damage. The corneal epithelium offers moderate protection against weak acids, and little damage is seen unless the pH is 2.5 or less (1).

Cola beverages, containing phosphoric and citric acid, have been shown to have erosive effects (2-4). Cola drinks were chosen as a physiological exogenous acid load drunk by millions of people every day. Cola drinks are strongly acidic (pH 2.5). Epithelial damage may be caused by dietary acids. Reports have shown that exploding beverage bottles can cause serious ocular injuries (5-7). Therefore, this study analyses the relation of Cola drinks and corneal epithelial damage.

MATERIAL and METHODS

Fifteen mature male white rabbits weighing between 2-3 kg were used in the experiments. The animals were anesthetized with a combination of Ketamine - xylocaine (25 mg/kg

Table 1 : Measurement with fluorescein dye on saline, Coca Cola and 0.1 N HCl acid-induced corneal epithelial damage in rabbits.

Epithelial Damage	Control (Saline) (n:10)	Cola Beverage (n:10)	0.1 N HCl (n:10)
Normal	10	2**	1**
Punctate	0	2	2
1/5 corneal diameter	0	4	0
Less than 1/3 corneal diameter	0	2	0
More than 1/3 corneal diameter	0	0	7†*

*p<0.01, **p<0.001 difference from control

†p<0.01 difference from Cola Beverage

BW ketamine plus 10 mg /kg BW xylocaine im) for anesthesia. The rabbits were divided into three groups. Group 1 (5 animals, 10 eyes) received saline. Group 2 (5 animals, 10 eyes) received 0.1 N hydrochloric acid (HCl) (pH 1.0). Group 3 (5 animals, 10 eyes) received Coca Cola (The Coca Cola Comp. Istanbul-Turkey)(pH 2.6).

Following the technique of Levinston et al (8) a circular plastic ring with a 7 mm inner diameter was placed on the cornea. Saline (n:10) or 0.1 N HCl (pH 1.0) (n:10) or Coca Cola (pH 2.6) (n:10) was then applied to the cornea by hypodermic syringe. After ten seconds, the cornea was rinsed for five seconds with a saline solution. Subsequently fluorescein dye was used to stain the epithelium of the cornea in order to identify the corneal epithelial damage (the Bowman zone has an affinity for fluorescein) (9).

The dye was instilled in to the conjunctival sac and excess dye was irrigated with sterile saline. The corneal epithelium stained bright green in the area of diseased or absent corneal epithelium. Epithelial corneal damage was described as normal or damaged- punctate stained, larger than 1/5 corneal diameter, smaller or larger than 1/3 corneal diameter.

RESULTS

The results are summarized in Table 1 and Figure 1. In the control group, no corneal epithelial damage was observed. In the Cola beverage group, corneal epithelium was found normal in two cases, punctate staining was noted in two cases, epithelial damage of about 1/5 corneal diameter in four cases and less than 1/3 corneal diameter in two cases. Also, the lesion score of the Cola group was different from the control group (p<0.001). In the 0.1 N HCl group, the observations were as follows: normal 1, punctate epithelial lesion 2, more than 1/3 corneal

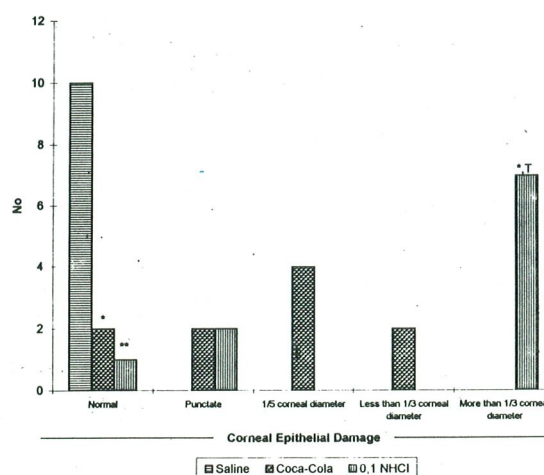


Fig - 1 :Measurement with fluorescein dye of saline, Coca Cola and 0.1 N HCl acid-induced corneal epithelial damage in rabbits (*p<0.01, **p<0.001 difference from control, †p<0.01 difference from Coca Cola.

diameter of epithelial injury in seven cases. The 0.1 N HCl group lesion score was statistically different from both the control group ($p < 0.001$) and the Coca Cola group ($p < 0.01$).

DISCUSSION

Cola drinks have been chosen as a physiological exogenous acid drunk by millions of people every day. Cola drinks are strongly acidic (pH 2.5). Epithelial damage may be caused by dietary acids. Reports have shown that exploding beverage bottles can cause ocular injuries (5-7). Because Cola drinks contain carbon dioxide, drops of beverage may squirt in the eye while opening the bottles. In this study we demonstrated that Coca Cola induced significant corneal epithelial damage in rabbits although not as much as HCl acid.

Those acids that are clinically important for chemical eye injuries are sulfuric acid, sulfurous acid, hydrofluoric acid, hydrochloric acid, nitrous acid and acetic acid (10). Hydrofluoric acid is a weak inorganic acid that produces skin burns and severe ocular injury, mainly because of the toxicity of the fluoride ion (11). The fluoride ion penetrates easily into the corneal stroma, where it produces rapid destruction of cell membranes (11). Hydrochloric acid, despite its reputation from movie thrillers, produces severe ocular injury only irregularly. Because of its poor penetration and its tendency to produce heavy reflex tearing, severe injuries occur only where there is prolonged contact (10).

As with alkali injuries, the severity of injury after exposure to acidic compounds is related to the area of exposure and the penetration. The coagulation of proteins in the corneal epithelium and superficial stroma caused by acids tends to function as a barrier to further penetration, limiting and localizing the injury (12). Because of poor corneal penetration, acid injuries tend to be less severe than alkali injuries and result in fewer corneal stromal and intraocular complications. The ocular surface complications, however, including vascularization and scarring of the cornea, can be just as severe (13). The corneal epithelium offers moderate protection against weak acids and little damage is seen unless the pH is 2.5 or less. Coca Cola contains phosphoric and citric acid which have been shown to have erosive effect (2-4). It may be concluded that

Cola drinks may cause corneal epithelial damage when their beverage bottles explode. These results may have broad public health implications for any country where consumption of Cola drinks is widespread.

Correspondence to: Zerrin KAPICIOĞLU, M.D.
Karadeniz Teknik Üniversitesi
Göz Hastalıkları Anabilim Dalı
61080 TRABZON - TÜRKİYE
Phone : 462 - 325 30 11 / 5547
Fax : 462 - 325 22 70

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