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Ocular injuries from carbonated soft drink bottle explosions

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SUMMARY Sixteen cases of ocular injuries serious enough to require admission to Ibn-Sina Hospital, Kuwait, Arabian Gulf, due to explosion of glass bottles of carbonated soft drinks are reported over a period of 14 months from the beginning of July 1981 to the end of August 1982. Prevalence was much greater in the summer months and among children. Explosions of bottles without prior agitation occurred in 11 cases (68·7%). High environmental temperature and defective bottles were the most important predisposing factors. Preventive measures we suggest are better standards for manufacturers, more careful inspection of returnable bottles to detect defective ones, a separate detailed warning label on all bottles, and health education especially of school children about this and other risks of serious injury to the eyes and other parts of the body.

There are only few reports of few cases of ocular injuries due to explosion of carbonated beverage bottles.[1,2] The first report was by Moyes and Andrews in 1962.[3] They reported 7 cases of injuries, including a case of perforating ocular injury. A report in German appeared in 1963.[1] Seventeen eye injuries were described, 7 of which resulted in blindness or loss of one eye. Twelve out of these 17 accidents were due to defective bottles. Mondino *et al.*[2] reported eye injuries due to the explosion of carbonated beverage bottles in 1978. They described 3 cases of perforating ocular injuries in adults collected over 6 years; no children were included.

We now describe 16 cases of ocular injuries requiring admission to the Eye Department at Ibn-Sina Hospital between 1 July 1981 and 31 August 1982 as a result of beverage bottle explosions. Our purpose is to show the frequency of this type of injury in a warm climate like Kuwait and the greater frequency of childhood ocular injury from this kind of accident. Ocular concussion has not previously been reported as a result of such accidents, but our series include 3 cases.

Materials and methods

Most cases of ocular trauma in Kuwait are admitted to the Eye Department in Ibn-Sina Hospital. We examined the records of all casualty admissions in the 14 months from 1 July 1981 to the end of August 1982. Out of a total of 352 such admissions 16 (4·5%) were due to explosion of carbonated soft drink bottles. Details were obtained of age, sex, date of admission, place and manner of accident, and whether there was any agitation of the bottle before the accident, the type of injury, and final corrected visual outcome.

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Results

Table 1 shows the details of 16 cases of ocular injury due to exploded carbonated beverage bottles. The accidents were all domestic. In only 5 cases was there a definite history of improper handling of the bottle such as shaking, knocking, or dropping before the accident. The bottle cap was responsible for concussion in 2 cases. In most of the others pieces of flying glass damaged the eyes (no patient was wearing spectacles at the time of injury).

The age groups represented ranged from 2 to 50 years, with a mean of 16 and median of 10·5. Ten patients (62·5%) were 12 years of age or less. The male to female ratio was 1·6:1. The prevalence in 6 summer months was much greater (12 cases: 75%) than in 6 winter months (4 cases: 25%).

CLASSIFICATION OF INJURY

There were 9 cases of perforating corneal or scleral

Table 1 *Details of 16 cases of ocular injury due to exploding beverage bottles*

No.	*Age*	*Sex*	*Date of admission*	*Eye affected*	*Type of injury*	*Visual outcome*
					Perforating injuries	
1	12	M	July 1981	L	Perforating scleral wound with vitreous prolapse	6/9
2	5½	M	Aug. 1981	R	Perforating corneal wound with lens damage and vitreous loss, vitreous haemorrhage	HM
3	10	M	Aug. 1981	R	Corneal perforating wound, macular oedema and retinal haemorrhage	6/24
4	2	F	April 1982	R	Perforating corneal wound with iris prolapse, traumatic cataract, and posterior pole oedema	4/60
5	50	M	May 1982	L	Perforating corneal wound with lens damage	6/12
6	35	F	March 1982	R	Corneal perforating wound with iris prolapse and retinal haemorrhages	6/18
7	3	M	July 1982	L	Perforating corneal wound with traumatic cataract and fibrovascular membrane	6/60
8	11	F	Aug. 1982	R	Corneoscleral wound with iris and ciliary body prolapse and total hyphaema	6/18
9	7½	F	Aug. 1982	L	Perforating corneal wound with iris prolapse	6/12
					Concussion injuries	
10	22	M	Sep. 1981	L	Hyphaema	6/6
11	45	M	Oct. 1981	L	Traumatic iritis	6/12
12	25	M	Feb. 1982	L	Hyphaema and corneal abrasion	6/9
					Lacerations of lids and superficial wounds of the globe	
13	2	F	Aug. 1982	R	Conjunctival wound with laceration of upper lid involving the canaliculus	—
14	2	F	March 1982	L	Laceration of upper lid and conjunctiva	—
15	20	M	July 1982	L	Nonpenetrating corneal wound and subconjunctival haemorrhage	6/6
16	5	M	Aug. 1982	R	Nonpenetrating scleral wound with laceration of lower lid	6/9

wounds (56%). There were no posterior segment perforations, and no intraocular foreign bodies were detected. Seven of the 9 cases of ocular perforation (77%) were in children of 12 years or under. Four cases had lens damage on presentation, and 2 of these cases had vitreous loss in addition. All cases had general anaesthesia for repair. No enucleations were required, and a cosmetically satisfactory result was achieved in all cases.

Six of the 9 eyes (66%) had some degree of visual dysfunction. Four of these six cases had between 6/18 and 6/60 visual acuity. In 2 of these 4 cases retinal haemorrhage was the cause, in the third fibrovascular membrane in the anterior chamber, and in the fourth gross astigmatic error. Two cases had less than 6/60 vision—in one case because of traction retinal detachment, and in the other because of unsuccessful cataract extraction and capsulotomy and fibrous tissue in the posterior vitreous followed by divergent squint. Two cases of lacerated wounds of lids and conjunctiva in children had general anaesthesia for examination and repair. Visual function could not be assessed because of their age. Two cases of superficial wounds of the globe had better than 6/12 vision. Three cases of concussion injuries also had 6/12 or better vision. Two of these were caused by the cap of the bottle and one case seemed to be caused by the concussive air blast.

Discussion

Hospital records in Ibn-Sina show that ocular trauma is responsible for 22% of the total admissions to ophthalmic wards. One of the many causes of eye injuries, which is becoming more frequent, is explosion of carbonated beverage bottles. Kuwait had a population of 1 357 952 in 1982.[4] Accordingly the incidence of such injury is approximately 1·2/100 000 of the general population.

In Kuwait carbonated beverages are consumed in large quantities, especially in the summer months and especially by children. The children's presumed higher consumption, shorter arms, ignorance of dangers and lack of precautions (e.g., face turning), and tendency to agitate the bottle (5 cases) for fun before opening probably increase the risk.

Explosion of beverage bottles has previously been noted to be a cause of serious injuries in warm climates.[3] Bottles which contain carbonated drinks must be more hazardous than bottles filled with non-carbonated drinks because the internal pressure of the carbon dioxide may cause an explosion or propulsion of the bottle cap.[5] We have not found any reports of injuries from explosions of alcohol-containing bottles, but the corks from champagne bottles have been incriminated in concussion injuries of the eye.[6] Carbonated beverages are bottled and

sealed under pressure, but the container should be able to withstand such pressure at ordinary temperatures.[5] When the solubility of gases in solution decreases with rise in temperature, there is a risk that a beverage bottle may explode when subjected to minor trauma or agitation.[3] However, even for new bottles of good quality the internal pressure may increase within the bottle to a level that approaches the danger zone. On many occasions beverage bottles have exploded with normal handling and without agitation while standing on the shelf, on the floor, or in the refrigerator. A defect in either the bottles or the bottling process is thought to be the cause.[2]

There is a greater risk of explosion with returnable bottles.[5] But returnable bottles are thicker, heavier, and when new can probably withstand greater internal pressure than the light-weight nonreturnable bottles. On the other hand it is estimated that a returnable bottle averages 16 or more round trips during which process it may become cracked or abraded and suffer substantial reduction in strength. On reuse no structural tests are done by bottlers, and only brief inspection is performed.[7] In our series mishandling of bottle was a casual factor in 5 cases, but in the other cases 'spontaneous' explosion of the bottle occurred.

To summarise, there are 2 basic predisposing factors: high environmental temperatures and defective bottles. Finally, we would stress that carbonated soft drinks bottles are potential bombs in the house and a health hazard for a significant number of children who have had ocular perforations which were serious injuries, with poor visual outcome. There may well have been many more children who suffered injuries to the face and neck, fortunately not to the eyes, who did not attend our hospital, and many other children who suffered minor ocular injuries which did not necessitate admission.

Health education about the risk of ocular injury in particular as well as of injuries in general would help to prevent them. School pupils should be the major target population and they in turn might educate their parents and other adults.

We support previously suggested preventive measures[2 8] and would add some others: (1) bottlers should (*a*) have uniform standards in order to eliminate defective bottles and to ensure that the internal pressure within a bottle does not exceed its strength; (*b*) warn the public by a separate printed label on the bottle of the potential danger of exploding beverage bottles (including the details in (2) below). (2) Consumers should: (*a*) store the bottle in a cool protected place near the floor to reduce the hazards if it should fall; (*b*) refrigerate it prior to use; (*c*) avoid undue agitation such as shaking or knocking bottles together; (*d*) direct the cap away from the face when opening the bottle. However, the use of carbonated beverages in metal or plastic containers, which is becoming more and more popular, will help to reduce the hazards of explosive bottles in the future.

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