ment periods would be needed unless treatment effects are very large. Perhaps conventional power calculations are not appropriate here, and further guidance on the appropriate way forward would be welcomed.

In normal clinical practice the placebo effect is deliberately used to enhance the effect of treatments and to encourage patient compliance. It is a valuable medical tool. When *n* of 1 trials are used, doctors will need to decide that, for the particular patient they are treating, the (short term?) potential loss of the placebo

effect is worth the longer term certainty of treatment efficacy. The basis on which this judgment should be made is unclear.

- 1 Yusuf S, Collins R, Peto R. Why do we need some large, simple randomized trials? *Stat Med* 1984;3:409-20.
- 2 Wallenstein S, Patel H, Fava G, *et al*. Two treatment crossover designs. In: Peace K, ed. *Statistical issues in drug research and development*. New York: Marcel Dekker, 1990.
- 3 Guyatt G, Heyting A, Jaeschke R, *et al*. N of 1 trials for investigating new drugs. *Controlled Clin Trials* 1990;11:88-100.

(Accepted 6 June 1991)

Lesson of the Week

Ocular injuries due to exploding bottles of carbonated drinks

P W Sellar, P B Johnston

Glass bottles of carbonated drinks should not be shaken or left in the sun

Several ocular injuries have been seen in this department as the result of glass fragments from exploding bottles of carbonated drinks. The serious nature of these injuries has not been sufficiently highlighted in Britain, and we report six cases to illustrate the danger of glass bottles containing carbonated drinks, especially to young children.

Case reports

Case 1—A 50 year old woman was admitted in 1974 with an injury to her left eye at work after a bottle of carbonated drink exploded. She was found to have a stellate rupture of her left cornea, extending into the sclera superiorly with prolapse of the iris. Visual acuity was 6/6 right, 6/60 left. She had an emergency repair but died postoperatively of a hypertensive stroke. A previously unknown phaeochromocytoma was found at necropsy. The maximum temperature on day of injury was 16.3°C with 3.1 hours of sunshine.

Case 2—A 40 year old shopkeeper was admitted in 1988 having been struck on the left eye with a piece of glass from a bottle of carbonated drink after it had exploded in her hand. The bottle had been undisturbed for about a week. Visual acuity on admission was 6/6 right, accurate projection of light on the left. The right eye was not affected. The left eye had a large multidirectional corneolimbic laceration and prolapse of the iris. The patient also had a laceration of her left index finger. The cornea was repaired and the prolapsed iris excised. Postoperative visual acuity reached 6/18, but 10 weeks after the injury a dense lens opacity developed and acuity dropped to hand movement. Six months after her injury she underwent left extracapsular cataract extraction with posterior chamber lens implantation. The posterior segment was found to be intact, and the postoperative visual acuity was corrected to 6/6. The maximum temperature on the day of injury was 11.6°C with 0.1 hour of sunshine.

Case 3—A 30 year old employee of a bottling company attended the ophthalmic casualty department in 1988 on the day after a glass bottle of carbonated drink had exploded in his face at work and after a fragment of glass had been removed from his right lower conjunctival sac at another hospital. Visual acuity was 6/60 in his right amblyopic eye, 6/6 in the left eye. He had a right convergent strabismus but no evidence of penetrating injury to the right eye nor of an intraorbital foreign body on x ray examination. The maximum temperature on the day of injury was 18.4°C with 3.2 hours of sunshine.

Case 4—A 3 year old boy was admitted in 1988 with a right ocular perforation caused by explosion of a full

one litre glass bottle of carbonated drink which he was carrying across a farmyard. He had minor lacerations on his brow, right upper lid, cheek, and leg. A large inferior corneoscleral laceration was present with prolapse of the iris. The iris was repositioned, the corneoscleral wound repaired, and the anterior chamber reformed. Postoperatively a posterior sub-capsular cataract was noted and a vitreous haemorrhage identified. The retina appeared flat. Four weeks after injury the cataract had increased and a retinal detachment was identified. Examination under anaesthesia disclosed a hypotonous eye with a totally detached retina due to a giant tear in the infero-temporal quadrant. Further treatment was not carried out. The maximum temperature on the day of injury was 23.3°C with 10.9 hours of sunshine.

Case 5—A 4 year old boy was admitted in 1988 after dropping a 300 ml bottle of carbonated drink, which then exploded. A piece of glass struck his right eye. A superior full thickness corneoscleral laceration with prolapse of the iris was found. A small laceration was present on his right upper lid. The prolapsed iris was repositioned, the cornea sutured, and the anterior chamber reformed. Four weeks after surgery visual acuity was 6/18 right, 6/6 left. Right visual acuity deteriorated to 6/60 at eight weeks after injury despite one hour of left ocular occlusion a day. Corneal sutures were removed 12 weeks after injury, and right acuity improved to 6/18. The maximum temperature on the day of injury was 21.9°C with 10.0 hours of sunshine.

Case 6—A 60 year old woman was admitted in 1988 having been struck on the right eye by fragments of glass when a bottle of carbonated drink exploded in her face. She had a small brow laceration and bruising of the right lower lid. A right conjunctival laceration was present inferonasally. Visual acuity corrected to 6/9 right, 6/9 left. There was no evidence of intraorbital glass on x ray examination, but a small vitreous haemorrhage was located inferiorly. The conjunctival laceration was explored under anaesthesia, and a large full thickness scleral tear was found with vitreous incarceration. Postoperatively visual acuity remained 6/9 in her right eye. An area of retinal haemorrhage was noted as the vitreous gel cleared. When last seen the retina was flat. Follow up was continued elsewhere.

Discussion

In some countries trauma due to accidents with bottles of carbonated drinks amounts to a sizable proportion of serious ocular injuries. A recent study of eye injuries in urban Brazilian children found that up to 4% were due to exploding bottles of carbonated

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BMJ 1991;303:176-7

drinks, most of them being severe.¹ In a study in Israel exploding bottles of carbonated drinks accounted for 2% of all eye injuries and broken glass for a large proportion of the total cases requiring early enucleation and of cases of retinal detachment.² As many as 16% of cases of ocular trauma in patients admitted to a unit in India were the result of such explosions.³ A report on ocular injuries due to exploding glass bottles of carbonated drinks in Kuwait indicated a greater risk (62%) of such injuries to children and found that most (56%) were perforating injuries.⁴ In temperate climates fewer such injuries are seen from this source, accounting, for example, for 1.5% of penetrating ocular injuries in an American study.⁵

Several reports described ocular injuries due to bottle caps.^{3,4,6-9} Though an Israeli survey of patients admitted to hospital with ocular injuries found that 80% of injuries due to bottles of carbonated drinks were due to bottle caps compared with 20% due to glass fragments,⁶ a series of patients in hospital in Kuwait showed the reverse, with only 12% of such injuries being due to bottle tops.⁴ Injury from champagne corks has also been described,¹⁰ but there are no reports of champagne bottles exploding.

Ocular injuries caused by such explosions have received scant attention in Britain. We have described several serious injuries from these glass bottles of carbonated drinks and have been alarmed by their severity and the need to prevent them. The infrequency of these injuries in Britain is probably a measure of its temperate climate and the availability of alternative drinks. Bottlers of carbonated drinks have also tended to move towards safer plastic bottles, and screw tops have generally replaced pressed metal bottle caps. Our six patients show the general severity of injuries from exploding glass bottles of carbonated drinks. Considerable force is built up within such bottles by agitation of their contents or a rise in temperature, both of which cause a release of dissolved carbon dioxide into the gas phase with a rapid increase in pressure. Sudden breaking of the bottle may therefore release glass fragments with considerable force or the increase in pressure may be adequate to explode a weakened bottle. Children are especially at risk of serious trauma from such sources, perhaps because full glass bottles are fairly heavy and easy to drop or because shaking a fizzy drink is fun.

Though manufacturers of bottles are doing much to make their products safer, there is clearly room for

further measures to make glass bottles of carbonated drinks safer. Failure to do so will result in further such injuries and litigation against the bottling companies, as occurred in all these reported cases. We suggest that all such bottles carry clear hazard warnings that they should not be shaken, agitated, or left in a warm room or in direct sunlight. Responsible parents and retailers should not allow small children to carry sealed bottles as they are especially at risk of injury. Bottles might also carry the advice that they should be stored in a cool place, especially before opening, and that they should be opened away from the face. The bottling companies should also insist that employees wear safety goggles while working on the bottling process.

The continued use of large, thin walled non-returnable glass bottles for carbonated drinks in Britain needs to be reassessed as it is these that seem to cause most of the serious injuries. The trend towards safer plastic bottles or cans is environmentally unsatisfactory and at variance with that in other European countries. Plastic coated bottles are possibly safer than glass alone but are difficult to recycle. The trend should be towards the type of thick walled returnable glass bottles that are widely used in mainland Europe. These are less likely to explode and are environmentally acceptable.

We thank Professor D Archer and Messrs J Bryars, T Buchanan, P Johnston, and C Maguire for permission to publish details of their patients; and the Belfast Weather Centre for data on the maximum temperatures and the amount of sunshine on the days and at the locations where injuries occurred.

- 1 Moreira CA, Debert-Ribeiro M, Belfort R. Epidemiological study of eye injuries in Brazilian children. *Arch Ophthalmol* 1988;106:781-4.
- 2 Koval R, Teller J, Belkin M, et al. The Israeli ocular injuries study. *Arch Ophthalmol* 1988;106:776-80.
- 3 Gupta AK, Nadiger M, Moraes O. Ocular injury from a carbonated beverage bottle. *J Pediatr Ophthalmol Strabismus* 1980;17:394-5.
- 4 Al Salem M, Sheriff SMM. Ocular injuries from carbonated soft drink bottle explosions. *Br J Ophthalmol* 1984;68:281-3.
- 5 Offutt RL, Shine I. Perforating injuries of the eye due to glass. *Ann Ophthalmol* 1974;6:357-63.
- 6 Avisar R, Savir H. Eye injuries due to explosion of carbonated drink bottles. *Harefuah* 1978;95:69-70.
- 7 Mondio BJ, Brown SI, Grand GM. Ocular injuries from exploding beverage bottles. *Arch Ophthalmol* 1978;96:2040.
- 8 Waikhom JS. Ocular injuries from beverage bottles. *Arch Ophthalmol* 1979;97:975.
- 9 Gupta AK, Moraes O. Ocular injuries from beverage bottles. *Indian J Ophthalmol* 1982;30:47-50.
- 10 Archer DA, Galloway NR. Champagne-cork injury to the eye. *Lancet* 1967;ii:487-9.

(Accepted 10 April 1991)

ANY QUESTIONS

A healthy child has been advised not to eat dairy products in order to reduce frequent daily motions. He is taking soya milk and a well balanced diet. Will he receive sufficient calcium in this diet and if not what calcium supplement is advised?

Avoidance of cows' milk protein and lactose is not easy. Many patients receiving a diet supposedly free of cows' milk are in fact consuming considerable amounts in other foods—for example, weaning foods, confectionery, tinned and packet soups, processed meats, breakfast cereals, and bakery products. Thus misdiagnosis may occur if symptoms disappear when cows' milk is still being consumed unknowingly.

If the child is aged under 5 the soya milk should be one specifically designed for infants and children—that is, Formula S, Isomil, Ostersoy, Prosobee, or Wysoy. Every 500 ml of these formulas contains roughly 300 mg calcium, and if this is added to the calcium from the intake

of other foods, particularly white bread and other bakery foods, then a reasonable calcium intake can be obtained. Although these formulas contain vitamin D, a further supplement of 7-10 µg vitamin D daily should be given to ensure absorption of dietary calcium from all sources. All these soya formulas are prescribable according to the Advisory Committee for Borderline Substances for children under 5 "for proven lactose intolerance" and "proven whole cows' milk sensitivity."

Most instances of diarrhoea caused by intolerance of cows' milk protein abate between 18-36 months of age, and the child can return to a normal diet if a challenge with a graduated amount of milk has not led to any symptoms. All children receiving special diets should have their weight and height checked regularly—three monthly below the age of 2 years and six monthly thereafter. —B A WHARTON, professor of human nutrition, Glasgow, and B J CLARK, chief dietitian, Glasgow