Eye injuries from car battery explosions

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SUMMARY Ten cases of serious eye injury from car battery explosions are reported. A survey of the instructions supplied with car batteries and battery chargers has been carried out. The mechanism and methods of prevention of such injuries are discussed.

Car battery explosions are an increasingly common cause of eye injuries.^{1,2} This report draws attention to such injuries, and considers how their incidence and severity may be reduced by appropriate safety measures. We report 10 cases of serious injuries associated with car battery explosions. These are summarised in Table 1. Three cases are described in more detail.

Case reports

CASE 1

An 18-year-old engineer was measuring the charge of a car battery which had been on overnight trickle charge, when there was a spark and the battery exploded, injuring his left eye. On examination the corrected visual acuity was found to be 6/4 R and 6/24 L. There was an extensive acid burn of the left conjunctiva and cornea and a secondary uveitis. Intra-ocular pressure was 37 mm/Hg. The fundus was not clearly seen. He was treated with irrigation, topical steroids, and oral acetazolamide. Three days later the anterior segment had healed but the left visual acuity had deteriorated to 6/60. Examination revealed vitreous and retinal haemorrhage inferiorly and a full thickness macular hole (Fig. 1).

CASE 2

A 42-year-old company director was disconnecting the charger from a car battery which had been charging overnight when there was an explosion. His spectacles shattered, and he sustained a severe injury to his left eye. Visual acuity was 6/6 R and hand movements L. There were acid burns of both anterior segments and a penetrating injury of the left eye resulting in iris prolapse and traumatic cataract. After

a successful primary repair and a later extracapsular cataract extraction he recovered 6/6 vision with a contact lens correction.

CASE 3

A 38-year-old car mechanic injured his right eye when a battery exploded while on charge. The cause of the explosion is unknown. His initial visual acuity was perception of light R and 6/9 L. There was a right corneoscleral penetrating injury with traumatic aphakia, and vitreous incarceration in the wound. A right relative afferent pupil defect and dense vitreous haemorrhage were also present. A primary repair was carried out, and the wound healed well. An ultrasound examination showed a dense vitreous haemorrhage

Fig. 1 L fundus photograph showing a macula hole caused by an exploding car battery.

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Table 1 Details of cases

Case No.	Age	Sex	Occupation	Work/home	Sequence of accident	Type of injury	Days in hospital	Final visual acuity
1	18	M	Engineer	Work	Testing newly charged battery	Lid laceration; bilateral anterior segment acid burns; vitreous haemorrhage; macular hole	Nil	6/4R 6/60L
2	42	M	Company director	Home	Disconnecting charger leads from battery after overnight charge	Lid laceration; acid burns to both eyes; penetrating left eye injury; traumatic left cataract	25	6/6R 6/6L
3	38	M	Mechanic	Work	Battery exploded while on charge	Right penetrating injury; traumatic aphakia; vitreous haemorrhage; retinal detachment	29	CFR 6/9L
4	40	M	Garage manager	Work	Testing newly charged battery when spark caused explosion shattering battery (See Fig. 2)	Facial lacerations; bilateral anterior segment acid burns	Nil	6/6R 6/9L
5	38	M	Farmer	Work	Tripped on charger lead to tractor battery, causing battery explosion	Bilateral anterior segment acid burns	7	6/4R 6/4L
6	30	M	Driver	Home	Using jump leads	Bilateral anterior segment acid burns; left corneal laceration; left hyphema, vitreous haemorrhage, angle recession and secondary glaucoma	11	6/4R 6/4L
7	60	M	Actuary	Home	Disconnecting charger from battery after overnight charge	Bilateral anterior segment acid burns	7	6/6R 6/5L
8	70	M	Delivery driver	Work	Tripped on lead from battery charger to battery, causing explosion	Facial lacerations; bilateral anterior segment acid burns	2	6/9R 6/9L
9	39	M	Caretaker	Home	Newly charged car battery exploded	Bilateral anterior segment acid burns	5	6/5R 6/6L
10	25	M	Gamekeeper	Work	Recently charged industrial battery exploded. Right eye hit by fragment. Cause of accident unknown	Right optic nerve injury	10	HMR 6/9L

CF=counting fingers. HM=hand movements.

but a flat retina. Three weeks after the injury a right pars plana vitrectomy was performed. This revealed an inferior retinal detachment with subretinal blood and incarcerated retina. There was a small choroidal tear and yellow deposits around the disc thought to be myelinated nerve fibres or extruded myelin from an optic nerve injury. The macula appeared normal. 360° cryotherapy and an encircling procedure were carried out, and the retina subsequently reattached.

Sixteen weeks postoperatively the best corrected visual acuity was still only counting fingers. There was a dense right afferent pupil defect, clear media, a flat retina, and normal macula. It is likely that he had sustained an optic nerve injury or widespread photoreceptor damage at the time of the accident.

Discussion

There are 3 main mechanisms of injury from car battery explosions. Firstly, the acid released can give rise to chemical trauma; secondly, the concussive

effect can cause injuries such as hyphaema, angle recession, and retinal oedema; and, thirdly, fragments of the battery or spectacles, if worn, can cause penetrating injuries. Fig. 2 shows the battery involved in case 4 and illustrates the number of fragments produced. The 10 cases show examples of all 3 mechanisms of injury (Table 2).

Nine of the patients sustained acid burns to the anterior segment of varying severity; 4 patients had severe contusion injury and 3 penetrating injuries. The patients who had acid injury or penetrating injury alone recovered normal vision. Two of the latter group, however, were rendered aphakic. Three patients had their vision reduced to 6/60 or worse in the injured eye as a result of the accident, and all were due to a contusional injury—to the optic nerve in 2 cases and the macula in one. The average inpatient stay was 9.6 days and the days lost from work would have been in excess of this. In none of the cases were any safety spectacles worn.

During the charging of a car battery hydrogen and

Fig. 2 Exploded battery in case 4.

oxygen are produced by electrolysis of water. Vent holes in the battery allow these gases to escape into the atmosphere. This venting system is thought to be very safe when the car is in normal use. When the

battery is on charge, however, more gases are evolved and there is a greater risk of explosion, especially if safety precautions are not followed. There is no reliable information on the number of battery-related eye injuries, but it is known that the number of people doing their own car maintenance is increasing. A 1977 survey³ estimated that 9.4 million households carried out their own car maintenance, and that there were at least 7.7 million home battery chargers in use, with 1 million new battery chargers purchased in the UK during 1977.

To assess whether adequate instructions and warnings of risks are supplied with batteries and chargers sold in this country we have carried out a small survey. We wrote to 7 manufacturers of battery chargers asking for the literature supplied with their products. Six of the 7 replied. The instructions gave varied advice. This is summarised in Table 3. A similar survey of 8 battery manufacturers produced 7 replies, summarised in Table 4.

Table 2 Classification of injuries in 10 cases

Type of injury	Tissues injured	Number of cases
Acid burn	Conjunctival and corneal burns	9
Contusion injury	Vitreous haemorrhage	3
	Optic nerve injury	2
	Angle recession, secondary	
	glaucoma	1
	Macula hole	1
Laceration or penetrating injury	Choroidal rupture	1
	Retinal detachment	1
	Traumatic cataract	2
	Partial thickness corneal laceration	1
	Penetrating injury	2

Table 3 Battery charger manufacturers: 6 replies from 7 sampled

Safety point	No. of manufacturers mentioning point
1. Removal of battery from car before charging	1
2. Charge in well ventilated area	5
3. No naked flames	4
4. Correct mode of connection	6
5. Mains to be switched off before connecting or disconnecting	6
6. Warning of explosive risk	5
7. Protect eyes	0

Table 4 Battery manufacturers (7 replies from 8 sampled)

Safety point	No. of manufacturers mentioning point
1. Removal of battery from car before charging	5
2. Charge in well ventilated area	6
3. No naked flames	7
4. Correct mode of connection	7
5. Mains to be switched off before connecting or disconnecting	7
6. Warning of explosive risk	7
7. Protect eyes	3

All of the manufacturers who replied to our survey supplied lists of safety precautions to be followed with their products. Most accounts of safety precautions were adequate, but they were not always given prominence in the instruction leaflets. Only 3 manufacturers advised the protection of the eyes while charging batteries. Two failed to warn of the danger of using naked flame, and one manufacturer omitted any mention of the risk of explosion. Six of the 7 battery manufacturers fixed an acid-resistant label to the battery warning of the main risks and listing safety procedures. Since written instructions often become separated from the instrument, it would be helpful if this example could be followed by all battery and charger manufacturers.

Most eye injuries from car battery explosions are caused by neglect of safety procedures. Increasing

public awareness of the risks by providing prominent warnings with batteries and chargers on sale would help to prevent such accidents. Furthermore, if people could be encouraged to wear eye protection, the severity of the injuries could be reduced.

We thank the consultants of the Oxford Eye Hospital, Mr D. McLeod and Mr. D. R. H. Lewis, for permission to report patients under their care, Mrs M. Herlihy and Mrs P. Lovelock for secretarial help, and the manufacturers who replied to the survey.

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