Successful out-of-hospital defibrillation for ventricular fibrillation complicating solvent abuse

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SUMMARY

The Authors describe the case history of a child who suffered a cardiac arrest with ventricular fibrillation after deliberate inhalation of 1,1,1-Trichloroethane in type writer correction fluid thinners. Successful out-of-hospital defibrillation was carried out and the patient made a full recovery. The literature relating to this particular form of volatile substance abuse is reviewed.

INTRODUCTION

Intentional mis-use of solvents has been prevalent amongst young people in the United Kingdom since the 1970's. Peak age is 13–15 years and boys are 10 times more frequently involved than girls (Watson, 1978). The real prevalence is unknown but Police figures from the Grampion region (population 475,000) revealed 31 new cases in 1981 and 186 in 1982 (Anderson *et al*; 1985). In the United States it was estimated in 1980 that 9.8% of all 12–17 year olds and 16.5% of 18–25 year olds had abused solvents at some time during their lives. (Fishburn *et al.*, 1980). A survey of one comprehensive school in Glasgow revealed an overall involvement of one child in ten (Ramsey, 1982). Against this level of extent of solvent abuse the number of cases admitted to hospital is relatively few. In one year the Guy's Hospital Poisons Unit received 324 enquiries concerning patients in whom solvent abuse was suspected (Frances *et al.*, 1982) and the Grampion data revealed only 29 cases in 1981 and 6 cases in 1982 reported by Accident & Emergency departments. Solvent abuse does not, therefore, generate a numerically large problem of morbidity and mortality. This is particularly true of halogenated hydrocarbons but fatalities do occur. Two hundred and eighty three deaths were reported in the United

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Kingdom between 1971 and 1983 and of these Trichloroethane was implicated in 42 cases (Anderson, 1985). Cardiac arrhythmia is the most common cause of death.

CASE REPORT

A 12-year-old girl with a history of solvent abuse collapsed in a busy City centre street shortly after inhaling the vapour from a container of typewriter correction fluid thinner. Bystander cardiopulmonary resuscitation was quickly initiated by a doctor and an advanced trained ambulanceman who happened to be passing. They diagnosed cardiac arrest and began external chest compressions and expired air ventilations. Another passer-by called the Emergency Services and a Flying Squad vehicle was subsequently despatched from an accident & emergency department less than a mile away. An A&E registrar and a nurse were in attendance with the vehicle. When they arrived at the scene 2 min. later the patient was found to be in coarse ventricular fibrillation. She reverted to sinus rhythm after a single DC shock of 200 joules. Further treatment at the scene consisted of endotracheal intubation and ventilation and an intravenous injection of lignocaine. The patient was transferred to hospital and an intravenous infusion of lignocaine was started. Level of consciousness quickly improved and extubation was possible in the resuscitation room. Plasma electrolyte estimation and arterial blood gases were normal. Blood alcohol estimation was negative. A 12 lead ECG showed no evidence of myocardial injury.

The patient was admitted to a critical care bed and later to a children's ward. She made a full recovery and was allowed home after 5 days.

DISCUSSION

Typewriter correction fluid is a liquid used to eradicate typing errors. It contains inert white pigment and a chlorinated hydrocarbon solvent, usually trichloroethylene or 1,1,1-Trichlorethane. The solvent is also available separately as 'thinners' which is used to reconstitute the correction fluid when it becomes dried up.

1,1,1-Trichloroethane is a colourless liquid with a boiling point of 74° celcius. In addition to its use in typewriter correction fluid it is also widely used as a solvent in dry cleaning and in plaster removal. It is rapidly absorbed by inhalation and causes an acute intoxication with initial excitement followed by dizziness, light headedness and ataxia. Small amounts are metabolized to Trichloroethanol and Trichloroacetic acid which are excreted in the urine but it is mainly excreted, unchanged, through the lungs. Cardiac arrhythmias may occur after inhalation or ingestion and Trichlorethane is also nephro-toxic and hepato-toxic (Reynolds 1989). The solvent is widely available at stationers and office supplies outlets, a container of 20 mls usually costs less than £0.50. Sale of solvents such as trichlorethane to persons under 18 years of age is restricted by the Intoxicating Substances

Supply Act of 1985. However, they are usually sold in small containers which are easy to steal. Our patient had apparently stolen four containers of the liquid just prior to her cardiac arrest.

The intoxication syndrome produced by inhaled volatile solvents is characterized by an initial cerebral excitement, disinhibition and euphoria not unlike that of alcohol. These substances though are cheaper and more available to the adolescent. Adverse effects are usually mild; nausea, vomiting and diarrhoea being the most common. Physical addiction is not seen. Toluene, the constituent of adhesives, which causes intoxication in 'glue sniffers' can cause a more severe encephalopathy with convulsions, coma and respiratory arrest. Halogenated hydrocarbons are less often associated with direct organic injury. Experimental animals can be subjected to high concentrations of 1,1,1-Trichloroethane for prolonged periods without ill effects (Adams *et al.*, 1950). The most dangerous effect of intoxication with this type of solvent, however, is due to its ability to sensitize the heart to endogenous catecholamines (Davies *et al.*, 1969). In laboratory experiments dogs subjected to loud noises after inhaling halogenated hydrocarbons showed a high incidence of ventricular tachycardia (Mullin *et al.*, 1972). When fatalities have occurred in human subjects after deliberate mis-use of these agents, it has been postulated that massive catecholamine release has occurred when physical exertion is linked to the intoxication (Bass, 1970), an effect potentiated by alcohol (White & Carlson 1981).

Sudden death after inhalation of 1,1,1-Trichloroethane has been previously described (King *et al.*, 1985, MacDougal *et al.*, 1987). Belfast workers have also reported a successful out-of-hospital defibrillation after solvent abuse. In their case, however the substance involved was a toluene based glue and the patient was shown to have suffered a myocardial infarction due to intense coronary artery spasm (Cunningham *et al.*, 1987).

Pre-hospital cardiac care was probably life saving in the case reported here. In our area such care is provided by means of a hospital based Flying Squad. Elsewhere such measures as definitive airway management, defibrillation and the administration of cardiac drugs are achieved out-of-hospital by mobile coronary care units, paramedics or general practitioners. In the United States it has been shown that excellent survival figures can be achieved after cardiac arrest provided the event is witnessed, basic life-support begins within 4 min and defibrillation and other advanced methods are initiated within 8 min (Eisenberg *et al.*, 1979). Forty three percent short term survival can be achieved in these circumstances, even in patients suffering from heart disease. It is likely that when ventricular fibrillation complicates other incidents such as drowning, electrocution or intoxication, as in this case, still better survival can be expected. The time taken to deliver life support methods is therefore the most important indicator of outcome with ventricular fibrillation. The case described here illustrates the value of extending our capabilities in the delivery of cardiac care in the pre-hospital situation.

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