ABC of Resuscitation

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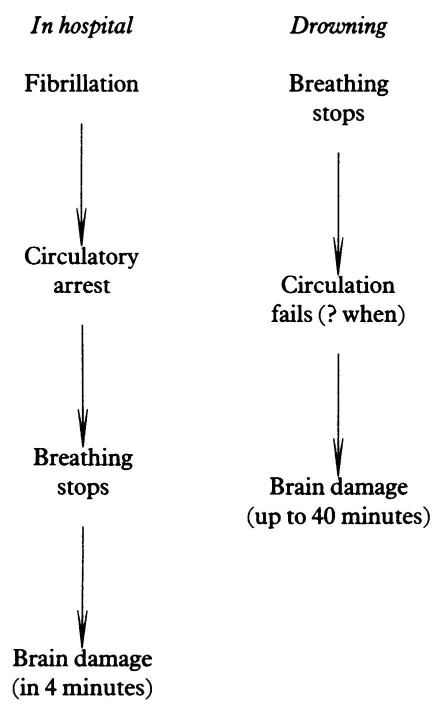
DROWNING AND NEAR DROWNING

Clearing the airway with finger sweeps. The use of abdominal thrusts remains controversial.

Near drowning poses several problems in resuscitation which are not commonly encountered in hospital practice and which, if not handled correctly, may reduce the chances of survival without brain damage. In hospital patient monitoring is relatively simple. Whether or not the patient is breathing can be established with ease, and an electrocardiogram provides instant evidence of cardiac activity. In contrast, making a firm diagnosis of cardiac arrest or even respiratory arrest at the scene of a drowning accident can be very difficult. This, coupled with the knowledge of miraculous survival after prolonged periods of submersion in water, makes the decision when to abandon attempts at resuscitation formidably difficult.

Survival after prolonged submersion



In hospital circulatory arrest usually occurs as a result of ventricular fibrillation and breathing stops soon afterwards. During drowning this sequence of events is reversed. Breathing stops as soon as the head becomes immersed but the heart continues to beat for some time. Just how long blood circulation continues is unknown but clearly this is a crucial factor in determining how much damage is done to the brain. Human beings have been recovered from the water apparently dead but been revived without evidence of brain damage after as long as 40 minutes' total submersion. Since no victim of cardiac arrest in hospital could possibly have survived that length of time without intervention important protective mechanisms must be at work beneath the water.

The diving reflex—Survival after prolonged submersion has been attributed to a diving reflex. Aquatic mammals can hold their breath beneath the water for as much as 10 times longer than man. They do this by shunting blood from tissues that can metabolise anaerobically and redistributing it to the brain and heart, which have little or no anerobic reserve. Slowing in the heart rate and vasoconstriction of vessels in skeletal muscle occurs as a reflex via sensory afferents from the trigeminal nerve stimulated in turn by face immersion. This reflex is reinforced by increasing hypoxia via afferents from the carotid body chemoreceptors.

An additional advantage, unique to some diving mammals and unrelated to the diving reflex, is a large store of myoglobin, which provides a sizeable reserve of oxygen. Although a diving response is demonstrable in many non-diving mammals, it has yet to be shown in man that the diving reflex is anything but vestigial.

Protective effect of hypothermia—For at least 40 years it has been known that in an individual made sufficiently cool circulation can be stopped for around 30 minutes and then restarted without any apparent damage to the brain. The cooler the body, the longer the safe period for which circulation can be stopped, the only limiting factor being the development of ventricular fibrillation (which is very difficult to terminate in deep hypothermia). Circulatory arrest resulting from ventricular fibrillation occurs in children at a lower cardiac temperature than in adults, thus permitting more profound cerebral cooling. This might perhaps explain why so many miraculous recoveries from near drowning have been reported in children or infants.

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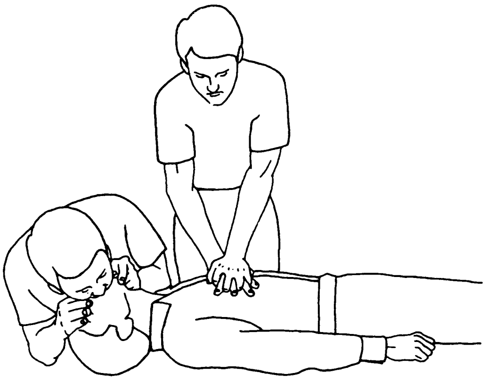
Practical problems with resuscitation



Whatever the mechanisms influencing survival, rescuers have been trained to assume that every patient is potentially recoverable however gloomy things may at first appear. They are trained to continue resuscitation for at least an hour before giving up.

Water poured into fresh cadavers can be retrieved from the stomach by inverting the corpse, but not from the lungs. Most rescue services have therefore abandoned drainage procedures. Notwithstanding this, data collected from actual resuscitation attempts indicate that in around two thirds of them rescuers experience difficulty in clearing the upper respiratory tract of water. A lifeguard described to me his repeated failure over 15 minutes to inflate the lungs until he finally resorted to an abdominal thrust, which decanted some water from the patient's mouth and promptly cleared the obstruction. Despite this, the practical value of abdominal thrusts or back blows remains to be proved.

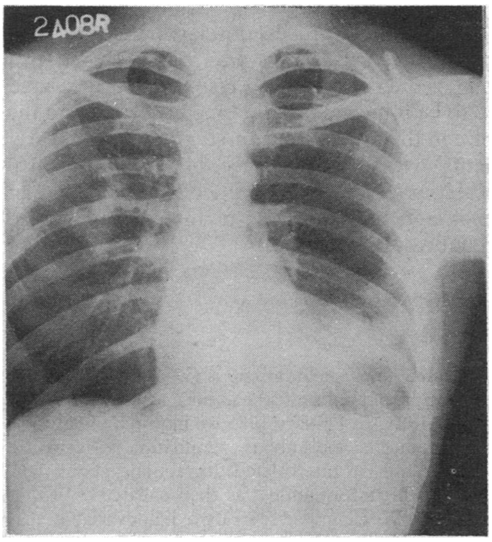
Because of the difficulties encountered in finding the pulse rescuers are recommended to palpate the carotid artery for at least 10 seconds, having first successfully inflated the chest. If no pulse is felt then combined heart-lung resuscitation proceeds along standard lines for at least one hour without interruption.

The problem of exhaustion can be eased by using two rescuers, one performing mouth to mouth resuscitation and one performing chest compression, changing roles from time to time. Considerable practice is required to perfect this technique and the importance of training cannot be overstated. It is almost impossible to continue chest compression while transporting the patient over even short distances, so it is now routine to try to re-establish a pulse at the accident site before moving the patient. Support of breathing while on the move is less of a problem.

Fresh and salt water and serum electrolytes

Changes in serum electrolyte concentrations large enough to be clinically important do not occur after either fresh or salt water immersion. Hypokalaemia is seen after both salt and fresh water aspiration and hypernatraemia is a constant feature of salt water immersion, perhaps due to ingestion from the stomach. Marked hyponatraemia is seen in infants who suffer near drowning in fresh water.

Secondary drowning, dry drowning, and pulmonary and cerebral oedema



Shadowing in the left lower zone and right mid zone represents aspirated water. The patient is at risk from adult respiratory distress syndrome.

Acute pulmonary oedema with normal left atrial pressure (adult respiratory distress syndrome) may develop but only within the first 24 hours after the immersion incident. This is referred to sometimes as secondary drowning. Although the cause is not clear, the syndrome develops in association with aspiration of salt or fresh water into the lungs. The presence of lung crackles audible by direct auscultation of the chest at the accident site provides a certain sign that water has been inhaled and therefore identifies the patient at risk. Further evidence of aspiration is available later from the chest radiograph and from arterial gas measurement, which typically shows a low Pao_2 while breathing air. For reasons which are not understood 12% to 20% of patients die from asphyxiation without having aspirated any water at all—so called dry drowning.

The major late complications of near drowning are pulmonary oedema and cerebral oedema. Warning of impending pulmonary oedema is reflected in a falling Pao_2 while breathing air. The mainstay of treatment for increasing hypoxia is positive end expiratory pressure (PEEP) respiration, and up to 30 cm H_2O of positive end expiratory pressure may be required to achieve satisfactory oxygenation of the blood. Fortunately the myocardium of near drowned victims is usually healthy, and vigorous expansion of the plasma volume is desirable if positive end expiratory pressure ventilation is to be used.

Recent events have shown that the heart can indeed be restarted even after two hours under the water. The limiting factor appears to be the state

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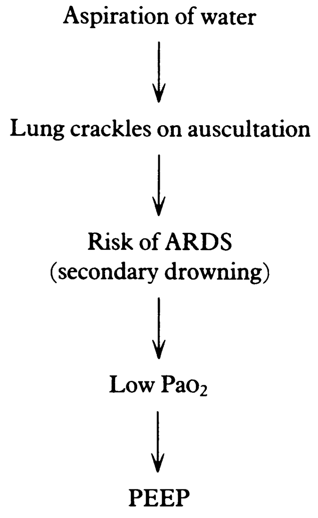

of the brain. The problem is to reduce cerebral oedema, which develops as the patient begins to warm up. Much of the pioneering work in this field has been done in Canada in paediatric victims of near drowning.

Rewarming is slowed by packing the patient in ice. In addition, mechanical hyperventilation reduces cerebral oedema by lowering the Pa_{CO_2}. Intracranial pressure is monitored throughout. The use of barbiturates to reduce brain damage has become controversial.

A child has left hospital after 40 minutes' submersion in water without brain damage. This year the heart of a child who was found after two hours submerged in icy water was restarted successfully by simple resuscitative measures, although the child later died. With improved understanding of the unique combination of physiological events encountered in near drowning, it can only be a matter of time before an individual, possibly a child, will survive submersion for an hour or more.

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Medical Education

Prospective survey of performance of medical students during preclinical years

I C McMANUS, P RICHARDS

Abstract

The performance during the preclinical course of 517 students who had applied to this medical school for admission in 1981 and who had been accepted by the school or by another British medical school was analysed in relation to variables measured at the time of application to find factors that predicted success in the preclinical course, whether students chose to take an intercalated degree, and the class achieved in the intercalated degree.

Thirty one of the 507 students who entered medical school withdrew from the course or failed their examinations; these students were particularly likely not to have an A level in a biological science. O level grades were of minimal predictive value for performance during the preclinical course. A level grades discriminated between successful and unsuccessful students but had too low a specificity or sensitivity to be of use in individual prediction. Mature entrants performed better overall than school leavers. Background variables accounted for only 14·2% of the variance in performance, implying that motivation and personality may be more important in determining performance. The 80 students who chose to take an intercalated degree were more likely to be men and not to be mature entrants; for a further 50 students intercalated degrees were obligatory. Performance in the intercalated degree related to performance during the preclinical course and to assessments made at the selection interview but not to achievement at O or A level.

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Introduction

We have previously described the process of selection in a national sample of applicants to medical schools who had included this medical school as one of their choices.[1-5] We subsequently related variables considered to be important at the time of selection to the students' performance in the preclinical course, trying particularly to predict the students' overall performance during the first two years of the preclinical course (second MB); their decision to take an intercalated degree or not; and the class of intercalated degree awarded. We report our results.

Method

The Universities' Central Council on Admissions (UCCA) informed us that 517 students in our sample of applicants[1-5] had been awarded places at medical schools in October 1981. In January 1985 we inquired about their progress. We asked their medical schools about examination performance during the first two years, about an intercalated degree, and about their choice of a clinical school. This information was then collated with that obtained in the original survey. We examined several predictor variables that have been described in detail elsewhere[1-5]—namely, demographic measures (seven variables); details of applications to UCCA (six variables); education (10 variables); assessments at the time of selection by the dean (PR) (four variables) and interviewers (four variables); measures of personality (seven variables); measures of social, ethical, and political attitudes (10 variables); and measures of cultural activities (six variables). Assessments by inter-

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