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The Role of Hypothermia and the Diving Reflex in Survival of Near-Drowning Accidents

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Source: Victoria E. McMillan (Bedford/St. Martin's 2006)

ABSTRACT

This paper reviews the contributions of hypothermia and the mammalian diving reflex (MDR) to human survival of cold-water immersion incidents. The effect of the victim's age on these processes is also examined. A major protective role of hypothermia comes from a reduced metabolic rate and thus lowered oxygen consumption by body tissues. Although hypothermia may produce fatal cardiac arrhythmias such as ventricular fibrillation, it is also associated with bradycardia and peripheral vasoconstriction, both of which enhance oxygen supply to the heart and brain. The MDR also results in bradycardia and reduced peripheral blood flow, as well as laryngospasm, which protects victims against rapid inhalation of water. Studies of drowning and near-drowning accidents involving children and adults suggest that victim survival depends on the presence of both hypothermia and the MDR, as neither alone can provide adequate cerebral protection during long periods of hypoxia. Future lines of research are suggested and related to improved patient care.

State aims and scope; concisely summarize major points.

INTRODUCTION

Drowning and near-drowning incidents are leading causes of mortality and morbidity in both children [1,2] and adults [3,4]. Over the past 30 years, there has been

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considerable interest in cold-water immersion incidents, particularly the reasons for the survival of some victims under seemingly fatal conditions. Giebrecht [5], for example, has reviewed some of this literature. Research suggests that both hypothermia and a "mammalian diving reflex" (MDR) may account for survival in many near-drowning episodes [6]. However, the extent to which these two processes interact is not fully understood. Controversy also exists regarding the effect of the victim's age on the physiological responses to cold-water immersion. In this paper, I provide an overview of recent research on the protective value of hypothermia and the MDR in cold-water immersions. I also examine hypotheses concerning the effects of age on these processes and conclude with suggestions about future lines of research that may lead to improved patient care.

Hypoxia during drowning and near-drowning incidents

The major physiological problem facing drowning victims is hypoxia, or lack of adequate oxygen perfusion to body cells [1,7]. Hypoxia results in damage to many organs, including the heart, lungs, kidneys, liver, and intestines [7]. Generally, the length of time the body has been deprived of oxygen is closely related to patient prognosis. Only 6-7 s of

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hypoxia may cause unconsciousness; if hypoxia lasts longer than 5 min at relatively warm temperatures, death or irreversible brain damage may result [8]. However, some victims of immersion in cold water have survived after periods of oxygen deprivation lasting up to two hours [7]. . . .

[The student goes on to highlight the major controversies and to add interpretation and analysis.]

Use original number assigned to reference when citing it again.

CONCLUSIONS

Recent research on cold-water immersion incidents has provided a more complete understanding of the physiological processes occurring during drowning and near-drowning accidents. Our current understanding is that the cooperative effect of the MDR and hypothermia plays a critical role in patient survival during a cold-water immersion incident [6]. However, the relationship between the two processes is still unclear. Because it is impossible to provide an exact reproduction of a particular drowning incident within the laboratory, research is hampered by the lack of complete details surrounding drowning incidents. Consequently, it is difficult for comparisons to be drawn between published case studies.

Conclude with suggestions for future research, links to broader issues.

More complete and accurate documentation of cold-water immersion incidents — including time of submersion; time of recovery; and a profile of the

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victim including age, sex, physical condition — will facilitate easier comparison of individual situations and lead to a more complete knowledge of the processes affecting long-term survival rates for drowning victims. Once we have a clearer understanding of the relationship between hypothermia and the MDR — and of the effect of such factors as the age of the victim — physicians and rescue personnel can take steps to improve patient care both at the scene and in the hospital.

With their permission, acknowledge people who assisted with the paper.

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Include all references cited. Numbers correspond to order in which references were first mentioned in the text. For journal articles, CSE format calls for author's last name, followed by initials, then article title, abbreviated journal title, publication date, volume and issue numbers, and inclusive page numbers.

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