I N T R O D U C T I O N

The modern systematic investigations of hypothermia in experimental and clinical fields may be said to start from the works of Fay and Smith during 1938-39. Since then a colosal use of the technique has been made in various clinical fields, research and investigation.

In cardiac surgery, the use of hypothermia was initiated by experimental studies on surface cooling carried out in Toronto by Bigelow et al (1950) . The first report of successful application came from Lewis and Taufic (1953) in their attempt to close an atrial septal defect. Thus the simple technique of application of cold by surface cooling offered the best posibility of creating conditions necessary for visual intracardiac surgery. However, experience soon showed that it was dangerous to cool a patient below an oesophageal temperature of 30°C due to occurance of ventricular fibrillation. At this temperature, a circulatory arrest for 8-10 minutes is usually regarded as a safe limit (Drew, 1961), although Swan (1959) proposes a much lower limit of 6 minutes . Such a time interval allows time only for the correction of simple intracardiac abnormalities, like, pulmonary stenosis, uncomplicated persistant osteium

secumdum etc., and makes no room for error in pre-operative diagnosis or for any unexpected complications, once the heart is opened. As is inevitable , because of its limitations, interest in hypothermia gradually began to subside and the use of pump oxygenator which allows long periods of circulatory arrest in open-heart surgery began to gain universal favour. In many centres, hypothermia as a technique was completely abandoned in the field of cardiac surgery. However, deliberate lowering of the body temperature in order to facilitate surgical intervention since thencame in practice in many centres. Following the use of hypothermia in cardiac surgery, it was applied to neurosurgery in about 1953 to improve conditions during operation. Hypothermia was first used in neurosurgery with the idea to diminish the hazards of reduced blood flow to brain produced by lowering of blood pressure or by temporary occlusion of carotids. Although hypothermia was first used for operations on vascular tumours where a low blood pressure could facilitate manipulations or lessen blood loss, its use has now been further extended. It is now used for operations on less vascular tumours, head injuries with high intracranial pressure (Lundberg & Nielsen, 1957)or with considerable cerebral oedema(Cooper & Ross, 1960). The main effects of

hypothermia on the brain is to lower its metabolism so that a reduced circulation is better tolerated.Botterell et al (1956). clamped carotid arteries alone or in combination with vertebral arteries and concluded in case of healthy middle aged or younger individuals that the maximal occlusion period at a rectal temperature of 30°C should not exceed 6 minutes, which at 28°C is 8 minutes. The whole procedure can be successfully monitored by electro-encephalography when appearance of delta wave may be regarded as warning sign. In addition to lowering cerebral metabolism, hypothermia decreases the brain volume, lowers the intracranial pressure and lessens oedema due to brain trauma. Hypothermia in neurosurgery is, therefore, indicated in operations on vascular lesions, carotid arteries, and also when markedly raised intracranial tension is present or in presence of cerebral oedema or where cerebral oedema may develop after operations for cerebral neoplasm or for head injury.

Usually the temperature at which such operations are done there is no significant danger to heart and ventricular fibrillation in particular is not likely to occur. In practice, the circulation to the brain is reduced as little as possible and for as short a time as possible during operation. The duration of operation can perhaps be increased

with obvious advantage by lowering the body temperature still further . While doing so it must always be remembered that the most serious complication during hypothermia is the development of ventricular fibrillation which is of particular importance in neurosurgery where heart is not exposed.

The world over, there are a surprising number of deaths which can be attributed to a reduction in body temperature . Many occur in mountaineers, usually called death from exposure and others as a result of immersion d due to shipwreck and like. During the second world war hypothermia became important as a complication of survival at sea. Shipwreck survivors rescued after prolonged immersion frequently died because of their lowered body-temperature. The evidence that cold caused these deaths is so obvious that it needs no further comment, but hardly a mention is encountered of this in the prevalent literature. It is curious that the importance of cold in immersion death was overlooked so widely and for so long. The heavy loss of life at sea in the 1939-45 war led to the first general realization that survival in water was not just a matter of having floatation equipment to prevent drowning and that the hazards of cold immersion presented some of the most important of all practical problems of human

physiology . The above remarks were made by Sir George Pickering while writing the ' foreword ' of the book entitled " survival in cold water " edited by W.R. Keatinge. The studies made since then have changed the earlier view considerably. The results of such investigation could prevent much of the continuous loss of life if these are made available to people who can make use of them. Victims of near-drowning who are in respiratory trouble or complete respiratory arrest, with normal cardiac activity, are often treated successfully by artificial ventillation. The difficulties, however, arises when heart has developed ventricular fibrillation which is clearly the more difficult of these to treat (Keatinge, 1969).

To make the technique more useful in the clinical field or to carry out some surgical procedures which are impossible at normal body temperature, it is necessary to reduce the body temperature still further to reduce the oxygen consumption sufficiently to give the surgeon time enough for the necessary surgical repair. In order to have the circulation arrested for approximately one hour, it is perhaps necessary to lower the body temperature to a region near about $10^{\circ}C$. The precautions one has to take in achieving this low temperature is to deal with the onset of ventricular fibrillation. Our knowledge about the subject

is still far from complete. A great deal of effort has been made in the last decade to make this possible and so to extend the use of hypothermia into its more useful range.

This particular aspect of hypothermia provides an example of the value of basic research, not immediately applicable to medicine. Out of the early work on isolated tissues and then small mammals arises the possibility of deep hypothermia in man which may bring startling new advances in the treatment of heart disease.

A I M S AND O B J E C T S

With the increasing application of hypothermia in the clinical field and its future possibilities, its therapeutic applications, the problems of cold acclimatization, mountaineering, drowning in cold sea water and the modern space flights all these warrant a renewed investigation in the field in order to know more about the real nature of hypothermic hazard. Ventricular fibrillation as has been mentioned is a dreaded complication and although efforts have been made by many to solve this vexed problem nothing fruitful could be achieved in this direction so far. A study of literature points to a derangement in the normal metabolic process in heart during cold. In brief, there is general agreement upon the fact of the increased metabolic response of homeotherms to cold acclimatization; these responses are associated with morphological and physiological changes in the thyroid (Smith & Hoijer, 1962). A complex neurohumoral response pattern perhaps exists to meet the challenge of exposure to cold and in this, thyroid hormone plays a very prominent role. The present thesis work was aimed at revealing more facts leading to ventricular fibrillation, its mechanism and possible steps for preventing it and the possible role of thyroid hormone under the condition.