THE USE OF HYPOTHERMIA IN SURGICAL TREATMENT OF CEREBRAL VASCULAR LESIONS

A PRELIMINARY REPORT

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(Received for publication January 31, 1955)

The present-day approach to some of the cerebral vascular lesions is limited and hazardous because the neurosurgeon cannot approach the lesion with sufficient control of the circulation.

We believe that in certain carefully picked cases hypothermia may afford the neurosurgeon the necessary protection to enable him to deal with the lesion definitively. A mortality of roughly 50 per cent is to be expected if the aneurysm ruptures during the intracranial exposure. Hypothermia is not without risk and the calculated risk taken must be balanced by the risk offered to the patient by other avenues of approach.

In animals, we have found that at 25°C. the cerebral metabolic rate is reduced to between 23 and 35 per cent of normal and that these animals will survive ventilation with 100 per cent nitrogen for as long as 15 to 22 minutes without physiological or histological evidence of cerebral damage. Hence it seemed probable that human cerebral cells at 25°C. would survive arterial occlusion 3 or 4 times as long as they do at normal body temperatures.

In December, 1953, there were 2 patients on the Neurosurgical Service of the Massachusetts General Hospital, who appeared to be excellent candidates for a trial with hypothermia. The results of its use are reported below.

METHOD

The patients were anaesthetized with thiopental and intubated in the usual fashion. The jugular vein on the right side was cannulated with two polyethylene tubes. The end of one tube was inserted into the right atrium and the end of the other into the jugular bulb. The tube leading to the right atrium was used for continuous venous pressure recordings and for blood samples. The other tube was used for blood samples.

In the first patient, the carotid artery was dissected and a loop was passed around the internal carotid in order to control the blood flow to the right side of the brain. In the second patient, both carotid arteries and vertebral arteries were dissected and loops were placed around all four. A Cournand needle was placed in the radial artery for continuous recording of

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the blood pressure. Electroencephalographic and cardiographic leads were connected with the patient and a continuous recording of the total body oxygen consumption was taken using a Benedict-Roth spirometer. A rectal thermocouple and a centigrade thermometer were inserted into the rectum in order to obtain continuous recordings of the rectal temperature (Figs. 1 and 2).

Below is a list of the data recovered from each patient:

1) Rectal temperature
2) Continuous intra-arterial pressures
3) Electroencephalogram
4) Electrocardiogram
5) Arterial blood pH and CO2 content
6) Right atrial venous pressure
7) Total body oxygen consumptions
8) Arterial serum lactate
9) Arterial serum pyruvate
10) Arterial O2 content in vol. %
11) Jugular venous serum lactate
12) Jugular venous serum pyruvate
13) Jugular venous O2 content in vol. %
14) Right atrial venous O2 content
15) Arterial serum K
16) Arterial serum Na
17) Arterial serum Cl
18) Arterial hemoglobin
19) Arterial hematocrit
20) Arterial serum citrate
21) Arterial serum Ca
22) Arterial serum total protein

We should like to point out that not all these determinations are necessary in order to control a hypothermic patient, but we feel that this type of data would be ideal in order to give us a more thorough understanding of the physiological changes occurring. The first six, however, are necessary. These basic data were obtained at normothermic temperatures and following the taking of blood samples the patient was placed in an ice-water bath.

In the first case, an ordinary bath-tub was used, which was in the anaesthetic room, and this was found to be unsatisfactory because transportation of the patient to the operating table necessitated disconnecting and reconnecting all the recording devices.

For the second patient, a special monel metal trough was devised which fits on to the operating room table,* and into this can be circulated ice water or warm water when so desired. The patient’s temperature was lowered by immersing his body in ice water as described above and the listed blood samples were taken and data recorded as his temperature dropped. When the