METALLIZED PLASTIC SHEETING IN THE PREVENTION OF HYPOTHERMIA DURING NEUROSURGERY

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SUMMARY

Metallized plastic sheeting (m.p.s.) was found to be ineffective in the prevention of hypothermia in adult patients studied during neurosurgical operations. Twenty patients were wrapped in m.p.s. and 22 patients acted as controls. Mean oesophageal temperature in the m.p.s. group decreased from 36.2 °C to 35.4 °C after 3 h (control 36.5 °C to 35.4 °C). It was concluded that active warming systems are needed to maintain normothermia in patients undergoing neurosurgical operations.

Surgeons are most comfortable when the operating theatre temperature is 18 °C whereas anaesthetists prefer a temperature of 22 °C (Wyon, Lidwell and Williams, 1968). Morris and Wilkey (1970) showed that anaesthetized patients became hypothermic if the environmental temperature was less than 21 °C and Morris (1971) found that a significant proportion became hypothermic if the temperature in the operating theatre was between 21 and 24 °C. Thus, most anaesthetized patients will become hypothermic unless the temperature of the room is greater than that producing optimal working conditions.

The following techniques have been described in the attempt to decrease the loss of heat in patients during surgery:

- pre-warmed gel-filled mattresses (Winder and Vale, 1970),
- blankets with circulating warm liquid (Newman, 1971; Morris and Kumar, 1972),
- suits with circulating warm liquid (Goldblatt and Miller, 1972),
- humidification of inspired gases (Newton, 1975), and
- metallized plastic sheeting (m.p.s.) (Dyde and Lunn, 1970).

Since active methods of warming carry the risks of overheating or burning patients and humidification increases the risk of bacterial contamination in the breathing circuit, we decided to look further at the value of m.p.s.

The type of m.p.s. studied was the heavier of the two made by Thermos under the name of "Space Blanket". Each blanket consists of two layers of m.p.s. separated by an artificial fibre layer and measures 2.11 m by 1.42 m. Dyde and Lunn (1970) had used m.p.s. previously in thoracic surgery but, although several neurosurgical centres in this country use m.p.s. routinely, there is no report of its use in neurosurgery.

METHODS

All the patients studied were undergoing craniotomy for intracranial tumours or aneurysms at Atkinson Morley’s Hospital, London. Patients less than 14 years old and those with pyrexia before operation were excluded. Surgery was performed with all patients in the supine position. The patients were allocated randomly to a study group (m.p.s.) or a control group (without m.p.s.).

The patients were premedicated with either atropine 0.3–0.6 mg or hyoscine 0.2–0.4 mg given i.m. Patients with intracranial aneurysms and a normal level of consciousness were given papaveretum 10 mg i.m. at the same time.

Anaesthesia was induced, in the anaesthetic room, with thiopentone or methohexitone. Suxamethonium 100 mg was given to facilitate the passage of an armoured latex orotracheal tube. Anaesthesia was maintained with nitrous oxide in oxygen, supplemented by halothane (up to 0.5%) in some patients, and a narcotic, in all patients. Artificial ventilation of the lungs was performed using a Cape–Waine ventilator. Tubocurarine was given to produce neuromuscular blockade which was antagonized at the end of the operation by the administration of atropine and neostigmine. If necessary an infusion of trimetaphan was used to provide arterial hypotension.

Venous and arterial cannulae were inserted in the
anaesthetic room. Throughout the operation arterial pressure and the e.c.g. were monitored.

Following intubation, a thermocouple temperature probe was passed into the oesophagus. It was positioned so that its tip was estimated to be at the nipple line. This was taken to approximate to the mid-oesophageal point. The first temperature recording occurred as soon as the patient had been moved into the operating theatre and placed on the operating table.

Each patient wore a cotton gown and was covered by one cotton blanket. In addition, each patient in the study group was wrapped in m.p.s. The head and shoulders were left exposed, as was the distal part of any limb with an arterial or venous cannula in place. Oesophageal temperature was noted (to the nearest 0.1 °C) hourly until completion of surgery. Theatre temperature was noted (to the nearest 1 °C) at the beginning and the end of the operation. No active warming system was used. The anaesthetic gases were not warmed or humidified. Infused blood, which was given rarely, was warmed; other infusions were not warmed.

Two Sierex and one Roche oesophageal temperature probes were used in the study. Each had been checked against a mercury-in-glass thermometer, through the appropriate range. Room temperature was measured using an alcohol-in-glass thermometer hung in the same position in each of the two theatres used.

RESULTS

Forty-two patients were studied of whom 20 were in the study group (with m.p.s.) and 22 were in the control group (without m.p.s.).

Table I lists relevant general data. The two groups were similar in sex distribution, age, intracranial pathology, time from induction to first temperature measurement, theatre temperature, use of halothane, use of trimetaphan and initial temperature.

Table II shows the decreases observed in the oesophageal temperature at 1, 2 and 3 h relative to the initial measurements. There was only 0.01 °C difference between the changes in mean temperature in the two groups at 1 h. At 2 h there was no difference. At 3 h the decrease was greater in the control group (1.18 °C) than in the study group (0.94 °C), however, this difference was not significant (Student's t test, P>0.05).

DISCUSSION

Our results show that m.p.s. was not effective in preventing core hypothermia during neurosurgery.

Temperature changes during operation are affected by age, the nature of operation, the type of anaesthetic and the ambient temperature (Goldberg and Roe, 1966; Goldblatt and Miller, 1972). Holdcroft and Hall (1978) found, however, that the decrease in temperature was not always related to the type of anaesthetic used or to body fat cover. The two groups in this trial were similar in respect of relevant factors. Thus, it is unlikely that the results have been biased by a difference between the groups in an important variable.

Our clinical impression before this trial was that m.p.s. was effective in reducing heat loss during neurosurgery. Indeed, Dyde and Lunn (1970) found that the use of m.p.s. reduced the decrease in deep and surface temperatures in patients during thoracic operations. However, they measured deep temperature in the nasopharynx and rectum, sites that are
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less reliable than the oesophagus (Hall, 1978). Their control and study groups, which were small and not similar in sex ratios or duration of operation, were consecutive and not concurrent. Unlike Dyde and Lunn, we did not measure surface temperature and so cannot say whether m.p.s. has any effect on its maintenance.

Whitby and Duncan (1971) did show that the lowest fourth of the oesophagus was the optimal site for temperature measurement and corresponds most closely with the temperature of the brain. While it is accepted that the mid-oesophageal site can be affected by cooling as a result of ventilation, in this trial the tidal volumes and rates of ventilation were similar in both groups. Thus, we feel that it is unlikely that any cooling by ventilation would invalidate the comparison.

M.p.s. works by reducing the heat loss caused by radiation. However, the main loss of heat from the body is by convection. Another theoretical drawback of m.p.s. is that the infra-red reflecting property of the metallic surface is reduced by condensed perspiration. Therefore, it is not surprising that m.p.s. is of little value in preventing hypothermia during neurosurgery. Indeed, Marcus (1977) found that m.p.s. was not effective as an aid to survival in a cold climate.

Inadvertent hypothermia is a serious problem in neurosurgery because of the duration of the operation. Although induced hypothermia has been used to protect the brain from transient ischaemia the technique is now used less frequently because of the lack of demonstrable benefit. It is unlikely that the mild hypothermia shown to occur in patients in this trial would have any protective effect. Indeed, it is our impression that patients undergoing neurosurgery and who are cold are more likely to develop acute arterial hypertension, which has potentially dangerous consequences, immediately after surgery than are those who are warm.

Hall (1978), in a review article, emphasized the dangers of allowing an anaesthetized patient to cool. Benzinger (1967) established that, if the core temperature becomes less than 37 ºC and the superficial temperature is less than 33 ºC, there is an increase in metabolic rate. It seems reasonable to believe that this increase may cause the cardiovascular or respiratory reserves of an ill patient to be exceeded. Roe and others (1966) demonstrated that oxygen consumption in the period soon after operation was greater if the patients were cold.

Another potential danger with hypothermia during anaesthesia is that there may be difficulties with neuromuscular blocking drugs and their antagonism (Miller, Van Nyhuis and Eger, 1975; Miller and Roderick, 1977).

Therefore, on balance, it seems desirable to keep the body temperature of neurosurgical patients normal. We have shown that a passive system, such as the use of m.p.s., is unable to do this if the theatre temperature is comfortable for the staff. A system for active warming of the patient is needed. It is probable that the low initial temperature of our patients resulted from cooling during induction and insertion of arterial and venous lines. Ideally, therefore, a warming system should be put into use before the induction of anaesthesia.

ACKNOWLEDGEMENTS

We would like to thank the neurosurgeons and operating theatre staff at Atkinson Morley's Hospital for their cooperation.

REFERENCES


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**FEUILLE DE PLASTIQUE METALLISE POUR LA PREVENTION DE L'HYPOTHERMIE PENDANT LA NEUROCHIRURGIE**

**RESUME**

On a trouve qu'une feuille de plastique metallise (m.p.s.) etait inefficace pour prevenir l'hypothermie chez les malades adultes que l'on a surveilles pendant des operations neurochirurgicales. On a enveloppe 20 malades dans du m.p.s. alors que 22 autres malades ont servi de temoins. La temperature oesophagiennne moyenne a diminue dans le groupe m.p.s. de 36,2 °C a 35,4 °C apres 3 h (alors que les temoins indiquaient 36,5 °C/35,4 °C). Il en a ete conclu qu'il faut des systemes de chauffage actif pour maintenir la normothermie chez les patients subissant des interventions neuro-chirurgicales.

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**METALLISIERTE KUNSTSTOFFTUCHER ZUR VERHUTUNG VON HYPOTHERMIE BEI NEUROCHIRURGIE**

**ZUSAMMENFASSUNG**


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**HOJAS PLASTICAS METALIZADAS PARA LA PREVENCION DE HIPOTERMIA DURANTE NEUROCIRUGIA**

**SUMARIO**

Se descubrio que las hojas plasticas metalizadas (m.p.s.) son inefectivas en la prevencion de hipotermia en los pacientes adultos estudiados durante operaciones neuroquirurgicas. Veinte pacientes fueron envueltos en m.p.s. y 22 pacientes sirvieron de controles. La temperatura esofagial media en el grupo de m.p.s. disminuyó desde 36,2 a 35,4 °C al cabo de 3 h (control desde 36,5 a 35,4 °C). Se concluyo que se requieren sistemas activos de calentamiento para conservar normotermia en pacientes sometidos a operaciones quirurgicas.