METALLIZED PLASTIC SHEETING

Sir,—I believe that the article by Radford and Thurlow (1979) concerning the use of metallized plastic sheeting in the prevention of hypothermia during surgery should be read in conjunction with that of a theatre electrocution (Chambers and Saha, 1979).

Several years ago my surgical colleagues suggested that space blankets might counteract peripheral vasoconstriction during vascular surgery. Having previous experience of a diathermy burn in a patient, which resulted in a fatality, I first wrote to the Technical Department of the D.H.S.S., and the essence of the reply I received was: "the insulation layer in metallized plastic films is so thin that breakdown is inevitable. Under no circumstances should such blankets be used in conjunction with surgical diathermy due to the serious risk of diathermy burns from aberrant earthing."

I apologize for my intellectual isolation in only banning space blankets from Lewisham District theatres. Obviously theatre users elsewhere need to be reminded of the electrical hazards of space blankets used with diathermy and metal operating tables. Indeed, if the practice is widespread, as your authors suggest, then a hazard warning notice from the D.H.S.S. is surely justified.

J. M. CUNDY

References


Sir,—There is no doubt that metallized plastic sheeting is used in several theatres in this country in an attempt to keep patients warm. Our trial was to assess the efficacy of this material; no protection from hypothermia was demonstrated.

Our advice from the D.H.S.S. Technical Department (personal communication) is that there is a slight but definite risk of burns caused by aberrant grounding of diathermy current if there is a fault in the earth lead of the diathermy equipment.

Since metallized plastic sheeting is neither effective in patients undergoing neurosurgery, nor safe for patients in conjunction with diathermy, we must conclude that this material has little place in the operating theatre.

PATRICK RADFORD
A. C. THURLOW
Carshalton, Surrey

In view of the importance of Dr Cundy's remarks, the Editor invited Dr D. W. Hill to comment on this problem.

Sir,—It must first be stressed that it is a very serious matter for surgical diathermy equipment to be used with a fault on the plate electrode or its return lead. In the absence of a proper return path the radio frequency potential on the patient is likely to seek alternative paths back to earth either via a patient touching an earthed object or via capacity of a coupling to earth. When a properly attached plate electrode is in use one would not expect there to be a risk of burns arising from the use of the metallized plastic sheeting as the diathermy current would normally flow back to the diathermy set via the plate electrode.

Should there be a fault on the plate electrode and the plastic covering of the metallized sheet not be punctured, then it is reasonable to suppose that there would be a capacitive coupling of the sheet not punctured, then it is reasonable to suppose that there would be a capacitive coupling of the sheet back to earth. However, this would be a general distributed capacitance over the surface area of the patient covered by the sheeting and I would have thought the surface area through which the current would flow would be sufficiently large that there was not much risk of a burn occurring to the patient. If the plastic cover of the sheeting becomes punctured then there may be a risk of a localized burn if the surface area of the metallized layer exposed to the patient is small. However, it is quite likely that the sheet would puncture in more than one place and so there is less of a risk of a burn.

Without the benefit of having conducted some experiments, this argument has to be somewhat problematical. The manufacturer's literature supplied on the space rescue blanket says that it will keep people warm despite violent weather conditions such as snow and freezing temperatures. However, Dr Radford's letter indicates that in his trial the use of the space blanket did not give any protection from hypothermia.

Unfortunately I have no details of his tests, but assuming that his conclusion is correct, then clearly there is no point in recommending the use of these metallized blankets during surgery. This appears to be the over-riding consideration. I am doubtful whether the risk of a burn arising to the patient would be much greater if such a blanket was employed than would happen in any case if the plate electrode connection came open-circuited. It is not feasible to see that the use of the metallized blanket would substantially reduce any risk of burn to the patient.

If the performance of the blanket is poor in respect of its heat-loss properties then I think this is the end of the matter. I must stress the need to ensure that there is an adequate maintenance schedule for the surgical diathermy and its plate electrode.

It is essential to try to minimize the number of radio frequency burns which arise during surgery.

D. W. HILL

London

THE TOAD IN THE HOLE: AN HYPOTHESIS

TO EXPLAIN THE ACTION OF ANAESTHETICS

Sir,—Any theory which attempts to account for the action of volatile general anaesthetic agents must explain these three phenomena. First, the nature of the state of general anaesthesia. Second, the vast variety of volatile general anaesthetic agents which are pharmacologically active. Third, the antagonism between the effects of general anaesthetics and those of increased atmospheric pressure.

The human central nervous system has $10^8$ neurons and $3.6 \times 10^1$ input axons. Each input will therefore react with about $3 \times 10^2$ neurons before finding an output. It is probable that vital activities like control of respiration or circulation involve circuits which have a small number of synapses in series and the higher activities such as consciousness involve circuits having a large number of synapses in series. It is also probable that general anaesthesia is a state in which the circuits involving large numbers of synapses in series are interrupted while the simpler circuits are unaffected. Thus consciousness is lost but the vital activities
continue. A general anaesthetic will therefore be an agent which has a low probability of blocking a synapse, so that when a large number of synapses in series is affected the probability of interruption becomes high.

Many proteins have a structure in which one or more polypeptide chains are curled roughly into a ball having the polar groups pointing outwards and the non-polar groups directed inwards. The chain may enclose a central void which a volatile anaesthetic, being a small non-polar molecule, may enter. If a protein molecule of this nature is subjected to increased pressure one would expect it to become compressed so that the central void is reduced in volume; however, if the central void is already occupied by an anaesthetic, like a toad in the hole, the protein would be more resistant to compression.

When a patient receives a general anaesthetic a large number and variety of protein molecules will have their central voids occupied by the molecules of volatile anaesthetic agents. In the majority of cases their physiological activities are unaffected; however, there are grounds for concluding that the action of the acetylcholine receptor protein molecule is profoundly affected and that this action is responsible for the phenomenon of general anaesthesia. The receptor protein is a tetramer enclosing a central pore which is normally closed but which opens under the influence of acetylcholine or increased pressure to permit a flow of ions which depolarizes the neuronal cell membrane and generates an action potential. It is likely that, when the central pore opens, the central void of the receptor protein molecule is reduced in volume. The characteristics of this reaction, namely the dissociation constant of acetylcholine and its time constant, indicate that the energy required to compress the molecule must be quite small, so that it would be especially susceptible to the "toad in the hole" effect; in addition, at the correct dose a sufficient proportion of synapses would be blocked to cause general anaesthesia.

The central void, being of an irregular shape, can contain non-polar molecules of a large variety of shapes provided they do not exceed a certain size, and this may explain why such a large variety of volatile non-polar molecules can act as general anaesthetics. Most pharmacological actions involve attachment to a surface where the conformational conditions are specific; however, when a molecule is contained within a void, a greater variety of molecules may be admitted and retained.

It is difficult to determine with certainty to what extent the circulation of nerve impulses which may constitute the objective embodiment of consciousness is dependent on transmission across central cholinergic synapses. However, it is likely that the majority are cholinergic, but when they are not cholinergic it is possible that the receptor protein has to undertake an allosteric transformation which is also vulnerable to interference by the presence of an anaesthetic molecule in its central void. Although a great number and variety of proteins will be affected by non-polar molecules in this way, it would seem probable that the synaptic protein molecule is the most vulnerable in this context.

B. James
Marlow, Bucks

PANCURONIUM PLASMA CLEARANCE AND AGE

Sir,—It is now widely accepted that age can influence drug disposition, and the report by McLeod, Hull and Watson (1979) of a reduced plasma clearance of pancuronium with increasing age is another example of age-dependent pharmacokinetics. Nevertheless, it seemed appropriate to compare these results with those of Somogyi (1978).

Thirty-eight patients aged 15–77 yr were studied; their weights were in the range 45–88 kg and all received general anaesthesia for elective surgery. They included patients given single (n = 11) and multiple (n = 6) bolus and infusion (n = 21) regimens of pancuronium and were all free from renal, hepatic and neuromuscular disorders. The anaesthetic technique, analysis of pancuronium and pharmacokinetic analysis have been described previously (Somogyi, Shanks and Triggs, 1978). The plasma clearance of pancuronium as a function of age is shown in figure 1.

\[
\begin{align*}
\text{PANCURONIUM PLASMA CLEARANCE (ml min}^{-1} \text{)} & \\
\text{AGE (yr)} & \\
0 & 50 \\
10 & 150 \\
30 & 200 \\
50 & 250 \\
70 & 300 \\
80 & 350 \\
\end{align*}
\]

\[n = 38; r^2 = 0.006 \text{ (ns.)}\]

**Fig. 1.** Pancuronium plasma clearance as a function of age.

There was no statistically significant \((P > 0.05)\) linear relationship between these two variables. The reasons for the differences between these results and those of McLeod and his co-workers are speculative, but it would appear that more detailed studies are required to investigate this and other aspects of the disposition of non-depolarizing muscle relaxants in surgical patients.

A. Somogyi
Bonn, Germany

**REFERENCES**

