THE INFLUENCE OF ETHER, MORPHINE AND NEMBUTAL ON MORTALITY IN EXPERIMENTAL BURNS*

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The present communication deals with experiments showing that the early mortality following severe thermal injury is profoundly influenced by the type of sedation and anesthesia used. In the first paper of this series\(^1\) the combination of nembutal and morphine used produced a good anesthesia during the injury itself, as well as a fairly prolonged sedation afterwards. Following the publication of this data, Dr. Alfred Blalock wrote that he had repeated these experiments and had observed a much lower mortality; indeed, only two deaths occurred under 24 hours in a series of 12 experiments in which a thermal stimulus of \(85^\circ\) to \(90^\circ\) centigrade for 5 to 15 seconds, up to the axilla, was employed. With a similar degree of injury, our mortality was 100 per cent. The fact that he used a smaller dose of morphine without nembutal plus a short ether anesthesia during the burn stimulus suggested that the pronounced difference in mortality might perhaps be due to the type of anesthesia used. In order to study this supposition, a series of experiments were carried out in which a somewhat more severe burn stimulus (immersion up to the axilla at \(100^\circ\) centigrade for 10 seconds) was employed in a series of ten experiments each; various doses of morphine in combination with nembutal or ether were used in each group.

**Experimental Findings.**—Table I records the essential findings, which indicate clearly the deleterious effect of morphine and nembutal, particularly the former, on the 24-hour mortality.

### Table I

<table>
<thead>
<tr>
<th>No. of Experiments</th>
<th>Nembutal (i.v.) mg./Kg.</th>
<th>Morphine* mg./Kg.</th>
<th>Ether during Burn</th>
<th>24-Hour Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>30</td>
<td>6-10</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
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<tr>
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<td>0</td>
<td>6-10</td>
<td>yes</td>
<td>80%</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>3</td>
<td>yes</td>
<td>20%</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>yes</td>
<td>10%</td>
</tr>
</tbody>
</table>

* These doses, because the dog is much less susceptible than men, are well within therapeutic range.

Hemoconcentration curves were obtained in these experiments, but only those in the three groups given ether are of significance. There was little difference in the two groups receiving both morphine and ether. However, *Aided by a grant from the Commonwealth Fund.*

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the group anesthetized with ether, but without morphine, showed a higher peak both in the nine survivals and in the one fatality. From this, it may be inferred that morphine has little influence on the hemoconcentration in burns; if anything, it tends to decrease it. Its deleterious influence, therefore, must be connected not with the physical changes in the blood produced by the burn, but rather with a toxic effect on respiration or on some other vital function.

**Comment.**—The deleterious effect of morphine on the mortality in experimental burns seems quite clear from the present findings. When ether was used during the burn stimulus, the mortality was lowest when no morphine was employed, but increased to 80 per cent when the dose of morphine was 6 to 10 mg. per kilogram. The deleterious effect of nembutal with morphine is shown by the fact that a 100 per cent mortality followed this combination of agents. The inference that nembutal alone is deleterious because it produced a mortality of 50 per cent must be qualified in that the dose employed did not achieve complete anesthesia so that the relatively high mortality might have been due in part to an incomplete central suppression of the afferent impulses during the stimulus. The wide differences in mortality herein observed show how important it is to evaluate the effect of the anesthesia in experimental burns before drawing inferences from the value of various therapeutic procedures. In shock due to other injury contrasting findings have been reported. Thus, experiments with hemorrhagic shock have shown no difference in mortality between those given morphine as compared with controls. Another study, together with an analysis of preceding work, showed that shock from intestinal manipulation is delayed with barbiturate as compared with ether anesthesia, but that in shock from hemorrhage there was no significant difference.

Practical inferences may be drawn from the present study in view of the almost universal use of large doses of morphine in the treatment of human burns. While no one will question the beneficial effect of morphine in the presence of really severe pain, its cautious use must be emphasized when such pain does not exist. The present author has observed many severe human burns in which pain was completely absent at the time the patient was first seen. Indeed, the sensorium was often dulled in the severe cases. It is quite probable that by the time the burned patient is able to receive medical care, pain has disappeared almost entirely except for the memory of the intense pain at the very moment of the injury. Under such conditions, large doses of morphine should certainly not be used, inasmuch as it may lead to harmful effects, perhaps even increasing the mortality in spite of the use of other beneficial therapy.

**Conclusions**

Morphine increases the 24-hour mortality (up to 100 per cent) in severe experimental burns, particularly when given in large doses and with nembutal. Practically no 24-hour mortality occurred when ether alone was employed.
ANESTHESIA IN BURNS

It is inferred that large doses of morphine, when used in the absence of pain, may increase the early mortality in severe human burns.

REFERENCES

1 Elman, R., and Brown, F. L., Jr.: War Medicine, 3, 477, May, 1943.