ANÆSTHESIA IN SURGICAL SHOCK

BY

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The following observations on the reaction of shocked patients to varied types of anaesthesia represent merely the personal experience of the writers during the last five years, and particularly during the more recent months.

From the anaesthetist’s point of view shock may be defined as a condition of acute depression of the respiration and circulation, and as such presents a combination of factors producing anoxaemia of the tissues. Patients in this state are unsuitable for operation and, whenever possible, treatment is postponed until the condition improves. Recent advances in chemotherapy have made it safer to delay operation than was previously the case, but there is a large number of patients who require immediate operation, and who therefore will require pre-operative measures to improve the general condition.

Treatment consists of:

(1) Rest.
(2) Relief of pain.
(3) Warmth.
(4) Fluid replacement.
(5) Stimulants.

The question of fluid replacement is one of some importance to the anaesthetist as three factors may have been responsible for the original loss, and replacement should be carried out in accordance with the resultant blood picture, otherwise too concentrated or too watery blood may result. The following table shows roughly the various conditions:
Anaesthesia in Surgical Shock

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<th><strong>CAUSE OF SHOCK</strong></th>
<th><strong>TREATMENT SUITABLE</strong></th>
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<tr>
<td>Bloodless injury with fluid loss into tissues.</td>
<td>Intravenous injection of concentrated solution of dried serum.</td>
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<tr>
<td>Lacerations with gross blood loss whether internal or external.</td>
<td>Whole blood transfusion.</td>
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<tr>
<td>Combination of bloodless injury with blistering or other fluid loss as in burns.</td>
<td>Dried serum as in first case but not in concentrated solution.</td>
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**Premedication.** The disadvantages of morphia are more than counterbalanced by the relief of pain afforded. Omnopon gr. 1/3 with scopolamine gr. 1/100 is a good routine mixture and may be reduced if necessary. Should the patient have had a recent injection of morphia on account of pain it is sufficient to give the scopolamine alone.

The barbiturates and bromine-containing basal anaesthetics are all respiratory depressants and are, therefore, to a certain extent contra-indicated. When used the doses should be smaller than those normally given (see below).

**Choice of anaesthetic.** The anaesthetic has to satisfy the following four requirements:

(1) To prevent further shock.
(2) To abolish pain.
(3) To enable the surgeon to proceed without muscular resistance.
(4) To offer the minimum of toxicity.

All anaesthetic reagents are toxic and should, therefore, be used in the smallest possible quantities consistent with the first three requirements. Five main methods may be considered:

(1) **Local analgesia.** Except for scalp wounds and for the reduction of minor fractures there are few occasions in which local infiltration is of use in traumatic surgery. The presence of local contamination is an absolute bar. When
used, the solutions should be weak, i.e. novocaine half per cent or one per cent, percaine 1/200.

(2) **Regional analgesia.** This provides excellent relaxation and nerve block is useful for injuries of the leg or chest, but not so satisfactory in the arm on account of these patients usually being restless, and because complete brachial block requires rather a large amount of novocaine, 25 c.c. to 30 c.c. of two per cent solution.

(3) **Spinal analgesia** is not suitable for patients already shocked, and should not be given unless the systolic pressure is over 100 mm. Hg. In perforating abdominal wounds caused by missiles it is most unsuitable for the following reasons:

(a) High spinals reduce blood-pressure still further.
(b) The internal injuries may be far more widespread than is apparent from without, and what was at first expected to be a pelvic operation may become high abdominal or even thoracic.
(c) It may be found necessary to tilt or rotate the patient, and these movements do not improve the general condition.

(4) **Intravenous barbiturates.** These drugs have many advantages, and give excellent results when used in moderation. They are easy to administer, and provide a pleasant and rapid induction; give good relaxation and require the minimum of apparatus. There are, however, the following disadvantages:

(a) Where veins are collapsed they are not easy to enter, and in restless patients it is easy for the needle to become dislodged during the injection.
(b) Shocked patients are more susceptible to these drugs than are healthy patients, even so small a dose as 0.20 grams of pentothal given in five per cent solution has been seen to produce extremely deep narcosis.
(c) There is further respiratory depression with consequent increase of anoxaemia.
(d) Resulting from (c) there appears to be an increased incidence of post-operative pulmonary complications as compared with similar cases given simple inhalation anaesthetics.

(e) Theoretical unsuitability of sulphur-containing drugs in patients who are candidates for some form of sulphonamide treatment.

Intravenous barbiturates should be given slowly through a fine needle, and on no account should any standard dose be adopted, but each case watched closely throughout the induction. As soon as the patient loses consciousness the jaw must be supported and an airway inserted. As stated above, the tolerance for these drugs is considerably reduced in shock, and the rate of elimination is also reduced. Oxygen may be indicated if there is cyanosis. Picrotoxin and coramine are good analeptics.

(5) Inhalation anaesthesia. Nitrous oxide is unsuitable alone, but when used with oxygen is probably the best and safest of the common anaesthetics for this type of patient. On account of the general depression slightly more oxygen can be given than with normal cases without any loss of efficiency, but should extra relaxation be required it is better to use a combination of gas and oxygen with a lipoid soluble anaesthetic, or in conjunction with regional analgesia by nerve block. Heat loss can be reduced by the use of rebreathing apparatus, and the patient will benefit from the slight CO₂ content. It is of importance that there should be no resistance in this circuit due to sticking valves, or too tightly packed soda lime.

Ether is probably the most popular anaesthetic. It is easy to use, is safe, and satisfies most of the requirements of an anaesthetic. When given by the open method there is some considerable heat loss due to the vaporisation on the mask; this may be reduced by building up towels into a semi-open cone which produces a small amount of rebreathing. When used in conjunction with gas and oxygen in a closed circuit apparatus this loss is cut to a minimum.
Advantages of ether are:

(a) Acts as a stimulant.
(b) May be used in high oxygen concentration.
(c) High safety factor.

Divinyl ether is more expensive than di-ethyl, but has some advantages over it provided that the necessary apparatus is at hand. Vinesthene given in conjunction with gas and oxygen is not unpleasant, is rapid acting, and gives a very complete relaxation. There is slight respiratory depression but this can be compensated for in a closed apparatus. Using such apparatus it is sufficient to give about ten drops per minute, decreasing the quantity as time goes on; strangely enough, increasing the rate of flow does not make anything like a proportional increase in the depth of anaesthesia.

Cyclopropane has three very great advantages. Very high oxygen percentages may be used (75 to 90 per cent), there is a slight increase in blood-pressure, and there is little toxicity or lung irritation. It is a rare gas, and requires complicated apparatus; therefore, its general use is limited.

Chloroform, owing to its high toxicity, is unsuitable in shocked patients, except in the hands of a very few skilled in its use.

Post-operative treatment. These patients have been operated on at a time of lowered resistance and require every precaution to prevent pulmonary complications. In abdominal cases pain may limit the respiratory movements; these patients appear to be more comfortable if the wound is dressed with a firm binder than if it is merely covered with a dressing held in position by a strip of surgical plaster.

Routine breathing exercises with CO₂ and oxygen help to keep the lungs expanded. They should be of short duration (two minutes), and should be given four-hourly for, at any rate, three days after operation.

Casualty cases may not have been in good health before their injuries. Intercurrent disease, such as pulmonary tuberculosis, diabetes, chronic renal disease, should be
detected before operation if possible, but if that is not so, should be detected by routine examination in the early post-operative period, so that suitable treatment may be instituted.

Conclusions

That no patient in the condition of surgical shock should be given an anaesthetic unless immediate operation is absolutely essential.

That the correct anti-shock treatment should be given before such operation, and that the anaesthetist should be fully conversant with the measures taken.

That intravenous barbiturates must be regarded with some suspicion, and given the greatest care.

Gas and oxygen by means of a closed circuit apparatus is the most satisfactory anaesthetic, and that ether and divinyl ether should be used to give extra relaxation when required.

That oxygen lack greatly increases the degree of shock, and that therefore the airway must be kept unobstructed, the oxygen content of the required mixture kept high, and the resistance of the circuit kept low.