LATE ETHER CONVULSIONS.

DERANGEMENT OF THE HEAT-REGULATING MECHANISM OF THE BODY AS A MAJOR FACTOR IN THEIR CAUSATION.

A PRELIMINARY NOTE.

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ABOUT ten years ago I was practising in a country where cases suffering from the effects of heat were comparatively common. It has appeared to me subsequently, both as a patient and when working in the average operating theatre, that, on some occasions, conditions were such that it would be quite feasible for a case of heat exhaustion, or heat hyperpyrexia to arise.

Wheeler has noted that hot theatres are uncomfortable to work in, that they increase the degree of shock and tend to produce subsequent respiratory complications.

In 1933 Dickson Wright published an article in the *British Medical Journal* entitled "Nembutal in Ether Convulsions." The excellent clinical report on this case appeared to be typical of a case of heat hyperpyrexia, and in a comment on it I pointed out that the recognition of this fact threw a new light on the subject of ether convulsions.

Ether convulsions appear to have come into prominence from about the year 1926 and, although many suggestions have been put forward as to their origin, none of these have been completely satisfactory. Since both heat hyperpyrexia and ether convulsions are conditions about which little is known, the proof of their relationship is difficult, as many factors are involved in their causation. The point I am attempting to make is that late ether convulsions are, in effect, a manifestation of heat hyperpyrexia.

The older textbooks of anaesthetics either do not mention ether convulsions or devote little space to this subject, but good descriptions can be found in several of the more recent editions, Nosworthy and others; the recognition of the danger of late ether convulsions is stressed.

Some confusion arises in articles on convulsions in anaesthesia generally; some of the writers appear to group such things as ethyl chloride spasm, jactitation under gas and ether clonus with late ether convulsions. Articles by Wilson, Pinson, Hadfield, Sykes and Ross Mackenzie in this country, and King, Sears and Bowman in the United States give a good summary of the present views; Sykes and Ross Mackenzie cover most of the previous writings. The earliest cases in this country were recorded by Kirby Thomas who saw five cases from 1913 to 1926.

A useful classification of convulsions under anaesthesia may be found in a current monograph by the Baker Institute of Medical Research. They are classified as follows:—
1. Occurring in connection with organic disease, brain tumour, poisonings, cerebral vascular disease, etc.
2. Anoxæmic convulsions under gas, ethyl chloride spasm.
3. Ether clonus and late ether convulsions.
4. With chloroform.
5. Under local anaesthesia.

Many factors, both primary and secondary, have been put forward to account for late ether convulsions, as follows:
1. Impurities in either ether, oxygen, N₂O, CO₂ or apparatus.
2. Simple overdosage of ether, with or without oxygen.
3. Under- or over-oxygenation, including Kemp's theory of carbon dioxide lack and Pinson's of CO₂ excess.
4. Suppuration and toxæmia, causing instability of the central nervous system.
5. Warmed ether or theatres.
6. Epilepsy.
7. Lack of pre-medication.
8. MacDonagh's biochemical theory.
9. Idiosyncreasy to ether.
10. Atropin poisoning.
11. Youth, and possibly the female sex.
12. Posture—low position of the head.
13. Histamin.
15. Ketosis.
16. Renal origin.

These theories are discussed and adequately dealt with in papers by Hadfield, Sykes and Ross MacKenzie. They prove that no one of these factors taken singly accounts for the condition, but that it may be a result of some combination of the above. However, interesting points with regard to some of these arise.

Martindale says that the pharmacological result of extreme etherization is always depression and not excitement; that atropin is a mixture of levo- and dextro-hyoscyamine and that levo-hyoscyamine is twelve times as strong as dextro-hyoscyamine. Presumably, if it were possible to give the usual dose of atropin (which actually contains a large percentage of levo-hyoscyamine) some untoward results might be expected. There is complete agreement that atropin can play a large part in the retention of heat in the body.

Hadfield has noted that in the cases which he summarised heat appeared to be the only common factor, but he says that many patients are operated upon in hot theatres without ill-effects. The same argument might be applied to the many sick and debilitated persons who dwell in hot or temperate climates, as only a very small percentage (usually unacclimatised) suffer from the effects of heat.

Those who used the Pinson bomb apparatus appear to have had quite a high percentage of cases in their practices; this has not been noticeable with the Shipway apparatus. In those cases relieved by raising the head, it is presumed that the coverings were