Post-operative Results
There was no difference in the severity of the post-operative hypoxæmia measured half-an-hour after operation between the gamma-OH and thiopentone groups of patients. In the two days after anæsthesia and operation both groups of patients retained sodium equally well and there was an almost equal loss of potassium and nitrogen in the urine. Similarly, the potassium/nitrogen ratio in the urine of the two groups was nearly identical.

The most striking result of this work came when the arterial-oxygen tensions taken in the first half-hour after surgery were compared with the amount of nitrogen lost in the urine in the two post-operative days. There was a statistically significant correlation between the severity of the hypoxæmia in the first half-hour post-operative period and the amount of nitrogen loss, potassium loss and the urinary potassium/nitrogen ratio. These results have great implications and are to be investigated further. It may well be that many of the reports by different workers of improvement in the catabolic phase following various metabolic regimes may be due to better care of their patients by reducing tissue hypoxia rather than to the various different dietetic regimes.

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Clinical Application of Gamma Hydroxybutyric Acid as a Sleep Cover in Lumbar Epidural Block

Gamma hydroxybutyric acid (gamma-OH), which has been extensively used in obstetrics for vaginal delivery and Cæsarean section (Alfonsi & Massi 1964, Chartier *et al.* 1962, David & Gaillemain 1963), in general surgery (Solway & Sadove 1965), in pædiatric surgery (Szanto *et al.* 1965), in neurosurgery (Laborit *et al.* 1961) and for cardiac catheterization (Bizot & Laborit 1965), was employed as a sleep cover in 160 cases where surgery was carried out under extradural or some other form of nerve block: that is, where the sleep agent was not expected to contribute to relaxation or to the damping down of the flow of afferent impulses.

Premedication: This was directed towards preventing side-effects of the drug – sialorrhœa, bradycardia and extrapyramidal motor activity manifesting itself as gross muscular movements and producing an unsatisfactory induction. After trial of various combinations of drugs, it was found that pethidine 50 mg with promethazine 100 mg gave satisfactory results. The agents used for the epidural block were bupivacaine, prilocaine and lignocaine; most of the surgery was concerned with the female reproductive organs.

Dosage: The dose most commonly recommended is 70 mg/kg supplemented initially by a small increment of thiopentone; we found that epidural block allowed the latter to be omitted and the dose of gamma-OH to be reduced to 50 mg/kg, which was injected intravenously at a rate approximate to that of thiopentone.

Onset of sleep: After injection of gamma-OH there is an interval of two to ten minutes before the patient falls asleep; during this time no manœuvres, such as epidural injection, should be attempted: the reaction which follows if this is done suggests the preponderance of the hypnotic over the anæsthetic effect of the drug. There was a fall of blood pressure in over 60% of cases, the mean being down to about 85% of the control reading; bradycardia occurred in about the same proportion of cases even when atropine was given. Transient extrasystoles were noted twice at times of maximum surgical stimulus: electrocardiographic studies (D J Woodgate 1968, personal communication) showed minor S-T changes of doubtful significance. There was a consistent slight slowing of respiratory rate and in 4 cases a 'Cheyne-Stokes' type of periodic breathing was noted.

Duration and nature of sleep: The average duration of sleep following injection of 50 mg/kg of gamma-OH was approximately two and a quarter hours, during which time no attempt was made forcibly to wake the patient. The facies was relaxed but not flaccid, capillary tonus was good, the skin was dry and of normal colour and there was a close overall resemblance to natural sleep. There was considerable amnesia; most patients spoke of waking from a refreshing sleep, though some noted much distortion of background sound during the awakening period. It seemed that the drug intensified the subjective impressions, pleasant or unpleasant, occurring during or even before induction.

Complications
Some 80% of patients woke quietly without any disturbance; a few others showed a moderate degree of restlessness. There were, however, 11 instances of quite definite mental disturbance

which occurred after awakening, giving an overall incidence of unfavourable reaction in 7–8% of the series. The typical picture was one of hypomania with acute restlessness and agitation, accompanied by hallucinations and delusions. There was compulsive talking of a paranoid nature, with a background of anxiety and feelings of persecution. The commonest delusion was of hearing nurses and other patients discussing the size and the inoperable nature of the cancer supposedly found in the patient: this was almost invariable. In some instances, guilt feelings of sexual lapses or inadequacies were manifested. The crisis did not necessarily occur on awakening but could appear four to six hours later, possibly due to the prolonged effect of promethazine.

There is little mention of this in the literature: Solway & Sadove (1965) quote 6 instances of readily controlled emergence delirium in a series of 348 cases; Szanto *et al.* (1965) and Jacquenoud (1966) mention the rare occurrence of restlessness or of agitation and Salvini & Gigli (1964) noted its occurrence only when a phenothiazine had not been given. A not dissimilar type of disturbance has also been noted with phencyclidine; Griefenstein *et al.* (1958) noted manic behaviour in 10 out of 64 cases, Johnstone *et al.* (1959) reported similar findings and Gool & Clarke (1964) stated that the addition of haloperidol would diminish but not abolish the incidence.

The possibility of this occurrence being due to hypoxia was excluded because of lack of clinical evidence and because of the favourable oxygen tension and saturation findings in the series (D Browne 1968, personal communication).

An interaction between the drug and the mental state of the patient was suggested by the frequency of the references to cancer during the period of delirium. Accordingly, after a few weeks' interval, each patient was interviewed with the help and guidance of Dr Desmond O'Neill, consultant psychiatrist to the Chelsea Hospital for Women. Ten of the 11 patients who had shown the disturbance were interviewed: it became quite clear that the post-operative upset was the detonation, by the stress of operation, of a deep-seated pre-existing disturbance or anxiety. Concern over past sexual worries was confirmed in 2 cases. In the other 8 it was firmly re-established that there was a deep-seated cancerphobia. Moreover, in 4 of the 8 cases this fear stemmed from the death of a sibling from cancer. These findings were quite unequivocal and the fear always stemmed from the death of a brother or a sister, never from that of a parent. A further feature was that, as well as the marked disinhibition shown at the time of delirium, there seemed to be a long-term cathartic effect, with diminution of the cancerphobia and a more philosophical acceptance of the sibling's death.

The use of gamma-OH for the production of a release phenomenon or a degree of catharsis in acute anxiety states has already been noted (Couédic *et al.* 1964; P E Carlo 1968, personal communication); it seems that this occurred fortuitously, for the large proportion of gynæcological cases in the series made such anxiety more likely to be found. Egbert *et al.* (1963) have stated that patients undergoing surgery of the urogenital tract are more anxious than others; while Eckenhoff *et al.* (1961), in a survey of post-operative excitement, call attention to the pre-existing emotional state, especially cancerphobia. Concerning the high incidence of the fear having sprung from witnessing cancer in a brother or sister, it has been suggested (Steel 1966) that the pain of carcinoma sometimes seems to have a specific and a malign quality which bruises the mind and implants a dread of its return.

Conclusions

In attempting to assess the place of gamma-OH in anæsthesia, the possibility of mental abreaction must be borne in mind, particularly that concerned with fear of cancer. Its ease of administration and relative non-toxicity might make it useful in the anæsthetic procedures of the developing countries (Sadove 1968, personal communication) but, when used in more sophisticated societies, caution is necessary on three grounds: because of the unpredictability of the mental response; because of the possible adverse effect on the morale of other patients in the ward; and because capricious psychological purgings should form no part of the pattern of normal anæsthetic practice.

REFERENCES

Alfonsi P L & Massi G B (1964) *Minerva anest.* **30**, 115
Bizot J & Laborit G (1965) *Agressologie* **6**, 223
Chartier M, Barrier G & Hidden J (1962) *Bull. Féd. Soc. Gynéc. Obstét. franç.* **14**, 649
Couédic H du, Couédic A du & Voisse M (1964) *Agressologie* **5**, 73
David M & Gaillemain J (1963) *Ann. Anésth. franç.* **4**, 15
Eckenhoff J E, Kneale D H & Dripps R D (1961) *Anesthesiology* **22**, 667
Egbert L D, Babbitt G E, Turndorf H & Beecher H K (1963) *J. Amer. med. Ass.* **185**, 553
Gool R Y & Clarke H L (1964) *Anæsthesia* **19**, 265
Griefenstein F E, Devault M, Yoshitake J & Gajewski J E (1958) *Anesth. Analg. Curr. Res.* **37**, 283
Jacquenoud P (1966) *Agressologie* **7**, 201
Johnstone M, Evans V & Baigel S (1959) *Brit. J. Anæsth.* **31**, 433
Laborit G, Kind A & Regil C A (1961) *Presse méd.* **69**, 1216
Salvini L & Gigli M (1964) *Acta anæsth. (Padova)* **15**, 201
Solway J & Sadove M S (1965) *Anesth. Analg. Curr. Res.* **44**, 532
Steel G C (1966) *Ob/Gyn Digest* **8**, 67
Szanto I, Nagy G & Strehlinger L (1965) *Agressologie* **6**, 215