PROLONGED APNOEA FOLLOWING SUXAMETHONIUM CHLORIDE

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Since the introduction into clinical practice of the ultra-short-acting relaxant suxamethonium chloride there have been a number of reports of prolonged apnoea attributed to its action.

Before apportioning blame care must be taken to differentiate between apnoea due to muscular paralysis and that caused by the central effect of such respiratory depressants as morphine, thiopentone and pethidine, given individually or in combination. Taking this into consideration, however, enough has been published, notably by Hurley and Monro (1952), Hewer (1952), Love (1952), Harper (1952), Forbat, Lehmann and Silk (1953), Harrison, Seward and Skinner (1954) and Cowan (1954), to establish that suxamethonium may give rise to paralysis prolonged beyond its normal limits. Such abnormal prolongation rarely exceeds half an hour, but Cowan (1954), has reported a case in which apnoea lasted for over nine hours.

The mode of action of suxamethonium and its fate in the body would lead one to expect in these cases a significant lowering of the serum-cholinesterase level, and this has been shown to exist by Bourne et al. (1952), Evans, Gray, Lehmann and Silk (1952), and Forbat, Lehmann and Silk (1953).

A low serum-cholinesterase level may be caused by severe liver disease, malnutrition and exposure to the organic insecticides and weed killers, but it may also occur in the absence of these conditions.

The treatment of prolonged apnoea due to suxamethonium includes the maintenance of adequate respiration, the continuance of light anaesthesia to guard against return of consciousness during the period of paralysis, and transfusion of whole blood or serum to replace the deficient serum-cholinesterase. Neostigmine tends to prolong paralysis by its action on cholinesterase and is contraindicated.

The following two cases of suxamethonium sensitivity, occurring in childhood and old age, are interesting as in neither was there anything clinically to suggest the low serum-cholinesterase levels which were found on subsequent blood examination. In the child apnoea lasted for forty-five minutes, in the old woman for nearly five hours.

Case I

A boy aged 8 years was admitted to hospital following the unsatisfactory reduction in the Casualty Department of a fractured right radius and ulna. He appeared a normal healthy child. Weight 50 lb. (22.7 kg.). No history of previous illness.

6.25 p.m. Premedication: papaveretum 11.0 mg., scopolamine 0.22 mg.
7.15 p.m. Induction: thiopentone 300 mg. 
Maintenance: nitrous oxide 5 litres/min. and oxygen 2 litres/min. 
by the semi-closed method, and minimum trichlorethylene.

7.20 p.m. Respirations well established. 
Suxamethonium 25 mg. Rapid relaxation. Fracture reduced and 
immobilized after check X-rays.

7.35 p.m. Apnoea persisting.
7.50 p.m. Still completely apnoeic.
8.5 p.m. Feeble voluntary respirations 
returning, diaphragmatic in char-
acter.

8.10 p.m. Respirations well established.
8.45 p.m. Recovered consciousness.
He made an uneventful recovery and appeared 
none the worse for his experience. Blood exami-
nation showed a low serum-cholinesterase level: 
serum-cholinesterase activity: 70 micromols/ml. 
/hr. (normal 130–310). Repeated one month 
later: 50 micromols/ml./hr.

CASE I

A woman aged 84 years was admitted to hospi-
tal with a sub-capital fracture of the left femur. 
Her condition was poor. Incontinent of urine.
Pulse irregular. Moist sounds at both bases. 
Estimated weight 170 lb. (77.2 kg.). B.P. 170/82. 
Hb 85 per cent Sahli. In view of her general 
condition it was decided to facilitate nursing and 
and obtain early mobility by the insertion of a Smith 
Petersen pin.

4.30 p.m. Premedication: atropine 0.64 mg., 
pethidine 50 mg.

5.20 p.m. Induction: thiopentone (2½ per cent 
soln.) 200 mg., suxamethonium 50 mg. No. 9 orotracheal tube passed. 
Maintenance: nitrous oxide 6 litres/min. and oxygen 2 litres/min. 
by the semi-closed method, supple-
mented by pethidine 25 mg.

Throughout the operation her condition was 
satisfactory. Colour good. Pupils moderately con-
tracted. Pulse rate 80/min., regular but soft. 
There was a striking absence of bleeding at the 
operation site. Voluntary respirations, however, 
did not return.

6.00 p.m. Operation completed. Still apnoeic. 
Nikethamide 5 ml. intravenously.

6.30 p.m. P.R. 90/min. B.P. 170/80. During 
the next half-hour she received 
nalorphine 40 mg. in divided doses.

7.15 p.m. P.R. 90/min. B.P. 170/80. Blood 
transfusion started.

7.30 p.m. Anaesthetic discontinued. Still 
complete apnoea. She appeared to 
be deeply unconscious. Larynx insen-
sitive to stimuli. Respirations 
maintained by a Bragg Paul Pul-
sator, supplemented by intra-
tracheal oxygen. Colour good. Re-
turned to the ward.

8.45 p.m. P.R. 128/min. Resp. rate 24/min. 
B.P. 170/86.

10.00 p.m. P.R. 128/min. Resp. rate 24/min. 
B.P. 140/76. Still complete apnoea.

10.15 p.m. Slight movement of right leg 
noticed.

10.30 p.m. Pulssator switched off and voluntary 
respirations found to be well estab-
lished. Pulssator discontinued.

10.45 p.m. P.R. 136/min. Resp. rate 20/min. 
B.P. 90/?

11.30 p.m. P.R. 86/min. Resp. rate 20/min. 
B.P. 80/?

12.30 a.m. P.R. 110/min. Resp. rate 20/min. 
B.P. 84/?

3.30 p.m. P.R. 86/min. Resp. rate 20/min. 
B.P. 94/?

She regained consciousness.

10.30 a.m. P.R. 90/min. Resp. rate 24/min. 
B.P. 160/70.

She sat up in bed, but for the next few hours 
experienced slight difficulty in coughing and 
swallowing. Considering her pre-operative con-
dition she appeared remarkably well. She made 
satisfactory progress and developed no chest 
complications.

Blood estimation three days later showed a low 
serum-cholinesterase level. Serum-cholinesterase 
activity: 45 micromols/ml./hr. (normal 130–310).

DISCUSSION

In neither of these cases can prolonged 
apnoea have been due to thiopentone or 
narcotics. In the child, respirations were 
established before the injection of suxa-
methonium. In the adult the small induc-
tion dose of thiopentone did not produce apnoea, and it would be difficult to attribute respiratory depression of five hours duration to the supplementary dose of pethidine. She showed no sensitivity to it when it was given pre-operatively for pain, and later for premedication. It is unlikely that acapnia played any part in either case, as the absorber was not used.

In view of the small quantity of anaesthetic used, it is difficult to explain the delayed recovery of consciousness in Case II—some eight hours after the discontinuance of gas and oxygen and nearly five hours after the return of voluntary respirations. On subsequent questioning she could remember nothing between the time of induction at 5.20 p.m. and 3.30 a.m. the following morning. Cowan (1954) has noted delayed recovery of consciousness in a patient in whom apnoea persisted for nine hours, but in this case recovery coincided with the return of respiration.

An interesting feature of Case II was the absence of bleeding, so striking as to be compared by the surgeon with controlled hypotension produced by hexamethonium bromide. It is unfortunate that no blood pressure readings were taken at the time. The post-operative B.P. was 170/80 mm. Hg, but this was after nikethamide had been given, and half an hour after the completion of the operation. Lehmann and Silk (1953) have shown that succinylmonocholine, a breakdown product of suxamethonium, produces, in rabbits, a hexamethonium-like effect on peripheral blood vessels accompanied by "pooling" of blood in dependent parts of the body. The paralysant effect is prolonged.

As regards the dose of suxamethonium used, I have found 0.5 mg. per lb. (0.45 kg.) body weight to be generally satisfactory in a series of some two hundred children under twelve years of age. In two cases, however, relaxation though profound was too transitory to allow unhurried intubation. There is some evidence that the length rather than the depth of paralysis is proportional to the amount of suxamethonium injected. At the other end of the scale, the aged tolerate the drug well, and a standard dose of 50 mg. can be given, irrespective of age or weight. In a series of sixty-six operations for fracture of the neck of the femur in patients between seventy and a hundred years of age the average period of apnoea produced by this dose was no longer than in a comparable series of young adults.

As sensitivity to suxamethonium is generally due to a low serum-esterase level, blood transfusion is indicated. Harrison, Seward and Skinner (1954) attributed the return of respirations in prolonged suxamethonium apnoea to transfusion of fresh blood. Cowan (1954) reports a dramatic response to fresh blood after a failure of older blood. A blood transfusion was given to Case II, but it is difficult to say how much this effected the eventual recovery of muscle tone.

SUMMARY

Two cases of prolonged apnoea following the administration of suxamethonium chloride are reported. In a child of 8 years apnoea persisted for 45 minutes, in a woman of 84 years for nearly 5 hours. Both subsequently showed low pseudocholinesterase levels. Neither appeared to suffer any ill effects, and it would seem that such fortunately rare occurrences
are more of an embarrassment to the anaesthetist than a danger to the patient.

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REFERENCES

BOOK REVIEW

This book contains 300 pages and 89 illustrations together with 19 tables. The illustrations are more remarkable for their clarity than their beauty. In the preface the following paragraph occurs: “The necessary brevity of Fundamentals of Anaesthesia perforce makes it appear dogmatic. However, an effort has been made to dwell on principles at the expense of detail. Methods of treatment and dosage schedules suggested cannot be considered as ‘routine’ as each patient presents individual problems. It should also be remembered that the choice of drugs and technics is secondary to their judicious and skilled application.”

If this paragraph is kept in mind we can say without hesitation the Committee on Revision has done its work well and achieved its object. It is not a book to read but one to which to refer. It should prove useful to examiners for it provides them with innumerable questions and to students for it supplies them with all the answers. The chapters on the ‘Physiology of Respiration’ and on ‘Chemistry and Physics’ will help the technician to become an anaesthetist. The amount of space allotted to regional analgesia is surely out of all proportion to the importance of the subject, or at least to the relative number of operations done under general anaesthesia on the one hand, and under local on the other. There seems to me a good deal to be said for dealing with the subject of ‘Anaesthesia’ in two separate volumes, one for local and one for general anaesthesia.

The metric system is used exclusively for the doses of drugs, and so we have 16 mg. for ¼ gr. For those of us who are more used to the old system a definite effort of translation has to be made every time a dose is mentioned. There are a number of tables in the appendix, useful certainly, but scarcely necessary to tell us that a milligram equals 0.001 gram. On the other hand the list of ampoules that may and may not be autoclaved is right up to date. The print and paper are both excellent.

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