chilling a single limb from which blood samples are collected before and after cooling (Rosenbach test). Stats and Bullova found only oxyhaemoglobin in serum from the chilled limb, and concluded that simple haemolysis occurs without alteration of the blood pigment. Serum from one of our cases also showed oxyhaemoglobin alone, but in the other there was in addition a small amount of a pigment which may have been a mixture of methaemoglobin and methaemalbumin. Although haemoglobinaemia in the single chilled limb is a constant feature in these patients, insufficient pigment enters the general circulation to produce haemoglobinuria during the performance of the Rosenbach test.

There is a wide divergence of views regarding the mechanism of haemolysis. It seems that intravascular stasis in small vessels contributes to haemolysis by allowing more time for the erythrocytes to agglutinate under the influence of cold, and that "cohesion of erythrocytes may lead to their prompt mechanical destruction while in motion in the circulation," as suggested by Shen, Castle, and Fleming (1944). This mechanistic concept is supported by the experiments of Stats (1945), who showed that when mixtures of sera containing cold agglutinins and homologous cells were shaken during refrigeration at 32° F. (0° C.) haemolysis resulted. In contrast with this theory of mechanical fragility, Dacie (1950b) claims to have detected the presence of a haemolysin in the serum. It is demonstrable only by altering the pH of the mixture to the physiological range or a little below it, and the titre is low. We have made repeated attempts, using an identical technique, to detect such a haemolysin in our two cases, but without success.

The anaemia found in patients with this condition is of the haemolytic type. It should be proportional to the extent of intravascular haemolysis as judged by the degree of haemoglobinaemia and haemoglobinuria. However, no distinct relationship between these manifestations and anaemia may be evident. In one of our cases there was well-marked anaemia in the absence of haemoglobinuria.

It is claimed by Benians and Feasby (1941), Helwig and Freis (1943), and Forbes (1947) that the E.S.R. increases when the test is performed at low temperatures owing to the enhanced activity of the agglutinins. However, Stats and Wasserman (1943) maintain that the increased viscosity of blood at low temperatures may retard the E.S.R., and this occurred in the patient reported by Mellinkoff and Pisciotta (1949). In Case 1 a reduction in temperature from 72 to 50° F. (22 to 10° C.) had no significant effect upon the E.S.R., but in Case 2 there was marked retardation.

The treatment of this condition is very unsatisfactory. Some authors have claimed that the use of vasodilator drugs has procured improvement in the Raynaud phenomenon, but in our cases they had no effect. Since there is no evidence that an excessive vasomotor tone contributes to the digital ischaemia, it is not surprising that sympathectomy failed to produce relief in the case recorded by Hanns (1943). The most effective measure consists in avoiding exposure to a cold environment by keeping the extremities well wrapped up and remaining indoors as much as possible during the winter. Attempts have been made to prevent the formation of cold agglutinins or to inactivate them, but without success. Bateman (1949) administered heavy doses of salicylates, which have been shown in animal experiments to be capable of blocking the antigen-antibody reaction, but there was no significant improvement either in the titre of cold agglutinins or in the symptoms. A short course of A.C.T.H. produced no change in one of our patients, and Ferriman *et al.* also noted no benefit from it. More prolonged treatment of the same case with urethane, undertaken in the hope of inhibiting the activity of the reticulo-endothelial system as a producer of immune bodies, was similarly without lasting effect.

Summary

Two cases are reported which readily developed the Raynaud phenomenon and intravascular haemolysis on

exposure to cold. One showed, in addition, bilateral symmetrical gangrene of the finger-tips and severe haemolytic anaemia, while the other was subject to attacks of haemoglobinuria. Examination of the serum of both cases revealed cold agglutinins in high titre. Treatment is unsatisfactory, and the only effective measure is the avoidance of cold surroundings.

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REFERENCES

- Bateman, J. C. (1949). *Arch. intern. Med.*, **84**, 523.
 Benians, T. H. C., and Feasby, W. R. (1941). *Lancet*, **2**, 479.
 Carey, R. M., Wilson, J. L., and Tamerin, J. A. (1948). *Harlem Hosp. Bull.*, **1**, 25.
 Dacie, J. V. (1950a). *Nature, Lond.*, **166**, 36.
 — (1950b). *J. Path. Bact.*, **62**, 241.
 — and de Gruchy, G. C. (1951). *J. clin. Path.*, **4**, 253.
 Erf, L. A. (1945). *Amer. J. clin. Path.*, **15**, 210.
 Ferriman, D. G., Dacie, J. V., Keele, K. D., and Fullerton, J. M. (1951). *Quart. J. Med.*, n.s. **20**, 275.
 Forbes, G. B. (1947). *British Medical Journal*, **1**, 598.
 Hanns, A. (1943). *Sang.*, **15**, 506.
 Helwig, F. C., and Freis, E. D. (1943). *J. Amer. med. Ass.*, **123**, 626.
 Hennemann, H. H. (1951). *Ärzt. Wschr.*, **6**, 413.
 Iwai, S., and Mei-Sai, N. (1925). *Jap. med. Wld.*, **5**, 119.
 — (1926). *Ibid.*, **6**, 345.
 McCombs, R. P., and McElroy, J. S. (1937). *Arch. intern. Med.*, **59**, 107.
 Marshall, R. J., Shepherd, J. T., and Thompson, I. D. (1953). *Clin. Sci.* In press.
 Mellinkoff, S. M., and Pisciotta, A. V. (1949). *Ann. intern. Med.*, **30**, 655.
 Shen, S. C., Castle, W. B., and Fleming, E. M. (1944). *Science*, **100**, 387.
 Stats, D. (1945). *J. clin. Invest.*, **24**, 33.
 — and Bullova, J. G. M. (1943). *Arch. intern. Med.*, **72**, 506.
 — and Wasserman, L. R. (1943). *Medicine, Baltimore*, **22**, 363.

CONTINUOUS SUCCINYLCHOLINE CHLORIDE WITH PETHIDINE IN ABDOMINAL SURGERY

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The sequence of thiopentone, nitrous oxide and oxygen, and a relaxant and controlled respiration, aptly described by Gray and Rees (1952) as a pyramid having as its base apnoea with sides consisting of narcosis, relaxation, and analgesia, has for some time held an important place in anaesthesia for abdominal surgery. This technique produces excellent operating conditions, but the use of longer-acting relaxants such as D-tubocurarine chloride and gallamine triethiodide creates special problems, in particular the difficulty in controlling the duration of relaxation without the use of antidotes. The anaesthetist, faced with the problem of obtaining relaxation for peritoneal closure, is loath to give a further injection of a long-acting relaxant, and may use some less satisfactory alternative.

Even when relaxants are withheld during the latter stages of a major abdominal operation the patient is often left in a state of partial curarization, and the anaesthetist must either accept this or administer neostigmine. Here one encounters varying opinions, some advocating neostigmine in every case, some never. However, the decision to give or withhold neostigmine is a delicate one, and each case must be judged on its merits.

The side-effects of neostigmine, such as bradycardia, salivation, and vomiting, and the occasional occurrence

of collapse or bronchial spasm, all of which may occur in a patient well under the influence of atropine, make the routine use of this drug potentially dangerous, so that the antidote may well be more dangerous than the condition for which it is given. Macintosh (1949) and Clutton-Brock (1949) report two fatalities immediately after the injection of neostigmine at the end of operation. On the other hand, the patient who is allowed to return to the ward in a partially curarized state following an abdominal operation may become critically hypoxic and later develop pulmonary complications.

The short-lived but potent action of succinylcholine should make it an ideal agent for prolonged relaxation in abdominal surgery when given by intravenous drip. Thesleff and von Dardel (1951) used the iodide by this method in a series of 132 operations, mainly abdominal, employing a 0.1% solution at a rate of 2 to 8 mg. a minute in patients whose ages varied from 11 to 70 years. They did not aim at complete apnoea, but found muscular relaxation excellent. No toxic effects were noted, even in poor-risk patients. Bourne, Collier, and Somers (1952) used succinylcholine chloride ("scoline") for abdominal relaxation in 68 cases, an unspecified number of which were by continuous drip. They thought the method cumbersome and found that a steady rise in blood pressure often occurred and that respiration was sometimes slow to recover. Foldes (1952), however, criticized what he thought to be the excessive dosage used by these and other British workers, stating that adequate relaxation without apnoea could be obtained with approximately one-fifth of the dosage used in this country. Green (1952, 1953) had good results in 146 abdominal operations, using a 0.1% solution and giving a test dose to the conscious patient. Apart from the initial thiopentone, he used only nitrous oxide for maintenance of anaesthesia, and stressed the need to effect early saturation, a point well demonstrated earlier by Brennan (1952).

In the present series of 289 abdominal operations the sequence of thiopentone, nitrous oxide, continuous succinylcholine chloride, and intermittent intravenous pethidine was used. After some experiment, a 0.15% solution of succinylcholine in normal saline was decided upon as giving simple control without excessive fluid, 750 mg. being added to 500 ml. of saline in the usual transfusion bottle. Most of the patients were adults, but the ages varied from 14 to 82 years.

Description of Technique

Fit adults received "omnupon," 1/3 gr. (22 mg.), and scopolamine, 1/150 gr. (0.43 mg.), one hour before operation. Elderly or seriously ill patients were given atropine,

1/100 gr. (0.65 mg.), with or without a small dose of morphine. Thiopentone, 0.3 to 0.5 g.—a dose which need rarely be exceeded—was followed by 40 to 50 mg. of succinylcholine, and the succinylcholine drip was then started through the same needle, preferably not smaller than size 12, just fast enough to prevent clotting. In one patient to whom a test dose of succinylcholine was given before thiopentone painful muscular contractions resulted, and the method was therefore abandoned.

After inflation of the lungs with oxygen, the cords and trachea were sprayed with 4% lignocaine hydrochloride, and in most cases a cuffed tube was then passed orally. For the next 10 to 15 minutes the patient was hyper-ventilated with 6 litres of nitrous oxide to 2 litres of oxygen, and the succinylcholine drip was speeded up sufficiently to keep the patient just apnoeic. This is an adjustment of some delicacy and one greatly facilitated by the use of a drip control attached directly to the upright of the drip stand and actuated by a large milled head, as shown in the photograph. This arrangement was specially useful to the single-handed anaesthetist engaged in manipulating the bag.

Drip control attached to upright of drip stand.

When saturation with nitrous oxide was considered adequate, the closed circuit was used with 1 litre of nitrous oxide to approximately 300 ml. of oxygen and an intentional leak in the circuit. Before the peritoneum was opened 10 to 20 mg. of pethidine was given, and this dose was repeated at the most traumatizing stages of the operation, particularly in gastrectomies and other major abdominal procedures. The succinylcholine drip was stopped as the peritoneum was being closed.

Details of the operations, together with the average doses of thiopentone, succinylcholine, and pethidine, and the average times taken to resume breathing, are shown in the accompanying Table.

Operation	No.	No. of Emergencies	Average Age	Average Length of Operation	Average Dose of			Average Time to Start Breathing after Stopping Drip	Average Time to Resume Normal Breathing
					Thiopentone	Succinylcholine	Pethidine		
				Minutes	g.	mg.	mg.	Minutes	Minutes
Partial gastrectomy	42	4	50	94	0.4	650	65	1.9	5.8
Cholecystectomy	20	—	49	48	0.4	350	35	2.5	6.0
Splenectomy	6	—	30	45	0.35	300	30	1.0	3.0
Prostatectomy	11	—	64	40	0.35	350	35	1.0	4.0
Appendectomy	30	16	35	30	0.35	200	25	1.5	4.0
Hysterectomy	40	—	44	72	0.45	620	36	2.6	4.5
Wertheim's hysterectomy ..	4	—	50	150	0.45	1,150	75	4.0	13.0
Miscellaneous gynaecological ..	32	8	43	55	0.4	420	30	3.5	6.0
Caesarean section	11	—	30	40	0.3	300	25	0.6	3.0
Intestinal obstruction	18	18	50	62	0.35	320	30	2.0	6.0
Perforated peptic ulcer	5	5	55	25	0.3	200	25	1.5	4.0
Hernia	15	2	52	25	0.45	200	20	0.5	2.5
Bladder operations	4	—	62	46	0.4	376	25	1.5	4.5
Closure of colostomy	4	—	58	38	0.4	190	30	0.25	2.5
Others	47	6	52	55	0.35	300	35	2.0	4.5
Total	289	59							

Advantages and Disadvantages

Advantages of Pethidine.—Although a few early cases in the series were maintained on nitrous oxide, oxygen, and succinylcholine alone, the occasional slight movement of a limb or eyelid showed that analgesia was not adequate. The use of small doses of pethidine has, in our experience, prevented such reflex disturbances, has diminished appreciably the amount of succinylcholine required, and has, by providing analgesia with little narcotic effect, contributed materially to the good post-operative condition of the patient. Moreover, its action as a bronchodilator facilitates inflation of the lungs.

Use of the Cuffed Tube.—Succinylcholine provides such perfect intubating conditions that an oral cuffed tube can be passed easily and leisurely. While this was done in all lengthy operations, or in those in which there was any risk of regurgitation of stomach contents, equally good results were obtained by one of us (E. J.) using a simple airway in shorter non-emergency operations such as appendectomy and herniotomy. However, in view of the possibility of inflating the stomach during hyperventilation, we think that most anaesthetists would prefer to have an endotracheal tube in position.

Indications and Contraindications.—The cases in this series comprise a fairly representative selection of abdominal operations, in all of which extremely good operating conditions were provided. Some of the cases used in this trial were of rather short duration, and, while the method produced ideal conditions for appendicectomies and herniotomies, it should perhaps be reserved for cases in which surgical difficulty is anticipated. Again, a single appendectomy will probably be over too quickly to justify its use, but where the operation is one of a list, there is no greater difficulty in setting up the succinylcholine drip than in giving repeated injections of D-tubocurarine or other relaxant. However, we found that the method was seen to its best advantage in the more lengthy and extensive abdominal operations—for example, gastrectomy, hemicolectomy, and cholecystectomy. In emergencies, too, it was found that the method gave excellent operating conditions, and that the patient's condition at the end of operation was most satisfactory.

Some Special Cases

Eleven cases of caesarean section (lower segment) were anaesthetized by this technique. In one of them the infant was lively and cried immediately, while the mother's condition was excellent. In another case, a toxæmia of pregnancy, anaesthesia was induced with 0.35 g. of thiopentone, and the infant was sleepy and did not cry for five minutes. It was thought that the induction dose of thiopentone was rather high in this case, and that this was responsible for the sleepy condition of the infant.

For gynaecological operations in which the surgeon was satisfied with a moderate Trendelenburg position, the technique was found satisfactory, but where the maximum table tilt was used the technical difficulty of maintaining the succinylcholine drip made the method scarcely worth while. One patient, a very fat woman of 61 undergoing a Wertheim's hysterectomy, required 1.5 g. of succinylcholine in two and a half hours. Although respiratory movements returned within three minutes of stopping the drip, the respirations remained shallow and diaphragmatic in type for a further twenty minutes. Apart from oxygen no special treatment was given, and at the end of this time the respirations had become normal and recovery was uneventful. This is the longest time noted in the series for the return of normal respiration.

A few cases not included in this series have been given continuous succinylcholine for haemorrhoidectomy. Here again operating conditions were excellent, but in one case (a muscular man of 41) the surgeon stated that the anal sphincter was not relaxed, although it was noted at the

time that there was perfect relaxation of the abdominal wall. This is the only case in which failure of relaxation with succinylcholine has been noted. Clearly, however, haemorrhoidectomy is too short an operation to justify the use of a drip, and intermittent injection of succinylcholine would appear to be more suitable.

An Emergency Laparotomy

This case is cited to show that the technique can be used successfully, even in grave emergency, provided that only minimal quantities of anaesthetic and relaxant are used.

The patient, a woman of 59, was admitted in a moribund condition following severe haematemesis, which had been preceded for some weeks by vague dyspeptic symptoms. The blood pressure on admission was not recordable, and her respiration was gasping in character. After a rapid transfusion of 4 pints (2.3 litres) of blood, however, the general condition improved slightly, and the surgeon considered that operation offered the only hope of arresting the bleeding. Just before operation the systolic blood pressure was 50 mm. Hg and the pulse rate 120. Anaesthesia was induced with 0.15 g. of thiopentone followed by 20 mg. of succinylcholine. After a cuffed oral tube had been passed, anaesthesia was continued with a 50% mixture of nitrous oxide and oxygen. The patient was apnoeic for only two minutes at the start—perhaps a tribute to the cholinesterase content of fresh transfused blood—and was kept apnoeic during the 60 minutes of the operation by 100 mg. of succinylcholine. Pethidine was not given. Laparotomy showed a cirrhotic liver, a stomach distended with clotted blood, and large freely bleeding oesophageal varices. Attempts to arrest the bleeding were only temporarily successful, but the pulse rate and blood pressure remained almost unchanged throughout the operation. Respiration started almost as soon as the succinylcholine drip was stopped, and was adequate within three minutes. The patient died one hour after operation from fresh and massive haemorrhage.

Characteristic Effects of Continuous Succinylcholine

In these cases the relaxation of the abdominal wall was always excellent, and the peritoneum during closure was described by one surgeon as "hanging in festoons." A few patients, for purposes of observation, were allowed to breathe spontaneously for a short time, but we found that respirations of any depth were accompanied by the return of tone in the lateral muscles of the abdominal wall. The work of Gray and Rees (1952) and Dundee (1952), who demonstrated the effect of controlled respiration in decreasing the dosage of thiopentone and relaxant, would seem to apply equally well to succinylcholine.

Bleeding in these cases was described by the surgeons as moderate, with little tendency to oozing. Many of the patients awoke on the table, and the others had active reflexes within a very short time. As stated above, post-operative analgesia was provided by the pethidine, and there was little tendency to restlessness. The post-operative condition of the patients was good, and there was very little deterioration during the immediate post-operative period, in contrast to the picture often seen when cyclopropane, or to a lesser extent ether, are withdrawn. The pulse rate tends to remain slow and stable both during and after operation, in contrast to the characteristic changes seen with cyclopropane, gallamine triethiodide, and neostigmine. No case of arrhythmia was observed. The blood pressure sometimes showed an initial fall, ascribed to the thiopentone, followed by a rapid restoration to the normal level. Where pethidine was not used, as in some of the very early cases, the climbing type of blood-pressure chart was sometimes met with, especially in long gastrectomies, and this in spite of adequate lung ventilation. With pethidine, however, this picture was not seen, and the blood-pressure charts pursued a constant course.

The most pleasing observation in these cases has been the spontaneous return of normal respiration within a few minutes of cessation of the drip, although the peritoneum has been perfectly relaxed for closure. The average time taken for the return of respiratory movements in these cases has been one and a half minutes, with a further period of two and a half minutes before full normal intercostal breathing returned. The figures showed considerable individual variation, but the impression was formed that in those cases which took longer than usual to start respiratory movements the return of normal respiration was quicker. No doubt the dosage of thiopentone, pethidine, and succinylcholine, and the degree of ventilation of the lungs, all influenced these figures, but the relative importance of each of these factors in prolonging apnoea is difficult to assess.

Summary

A technique for anaesthesia in abdominal surgery is described, using thiopentone, succinylcholine by continuous drip, intermittent pethidine, and controlled respiration with nitrous oxide and oxygen.

The succinylcholine drip gives a flexibility of control not obtainable with other relaxants, while respiration is quickly restored after the drip has been stopped. No case of prolonged apnoea has been met with. Given a well-trained nurse, the method is no more cumbersome than repeated injections of D-tubocurarine or other relaxant, even for the single-handed anaesthetist.

The technique is suitable for both planned and emergency abdominal surgery, in both fit and seriously ill patients.

The use of pethidine minimizes reflex disturbances and adds greatly to the post-operative well-being of the patient.

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REFERENCES

- Bourne, J. G., Collier, H. O. J., and Somers, G. F. (1952). *Lancet*, 1, 1225.
 Brennan, H. J. (1952). *Anaesthesia*, 7, 27.
 Clutton-Brock, J. (1949). *British Medical Journal*, 1, 1007.
 Dundee, J. W. (1952). *Ibid.*, 2, 893.
 Foldes, F. F. (1952). *Lancet*, 2, 245.
 Gray, T. C., and Rees, G. J. (1952). *British Medical Journal*, 2, 891.
 Green, R. (1952). *Lancet*, 2, 246.
 — (1953). *Anaesthesia*, 8, 52.
 Macintosh, R. R. (1949). *British Medical Journal*, 1, 852.
 Thesleff, F., and von Dardel, O. (1951). *Nord. Med.*, 46, 1308.

The Alcoholic Research Foundation, Toronto, was set up to conduct and promote research in alcoholism and the treatment and rehabilitation of alcoholics. Its annual report for 1952 gives an account of treatment methods and problems. In dealing with alcoholism of psychological origin the Foundation advocates informal group sessions under the direction of a psychiatrist and consisting in the exchange of experiences, attitudes, and knowledge by the participants. Many patients make real progress from this method. Others have been helped more by short interviews of 5–10 minutes. "Antabuse" continues to be used, although many who might be helped by it are dissuaded from taking it through previous misinformation. In employing antabuse no use has been made of the trial reaction with alcohol after the patient has been on the drug for a few days; it is considered unnecessary to use this test now that clear information is available to the patient. According to the report, there is room for more careful screening and instruction of patients on the use of antabuse if it is to give the maximum benefit. One problem causing concern is the increasing use of sedatives of the open chain ureide group, to which patients often become habituated.

AN UNUSUAL CASE OF SYPHILITIC PARKINSONISM

BY

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Although the recent literature on syphilis as a cause of Parkinson's syndrome is scant, it is an accepted fact that *Treponema pallidum* can cause the features of this condition (Guillain, 1935; Kinnier Wilson, 1940). The signs of involvement of the basal ganglia may appear soon after the original infection or may be delayed for some years. Pires (1935) reports the case of a man aged 32 who had a primary chancre five years previously, and three months after finishing a course of arsenic and bismuth injections developed rigidity in the right arm, pill-rolling movements of the fingers, and loss of facial expression.

Cases of Parkinson's syndrome combined with tabes dorsalis or general paralysis have also been recorded (Chavany and Levy, 1926; Dumas *et al.*, 1928; Urechia and Retezeanu, 1936b).

Urechia and Retezeanu (1936a) describe the case of a young woman, aged 24, whose first symptoms were uselessness of the hand for five minutes after she got out of bed in the mornings. She developed a typical Parkinsonian facies later on. This case was of particular interest in that the blood Wassermann reaction was negative but the cerebrospinal fluid Wassermann reaction was positive.

Cases of oculogyric crises, in association with other Parkinsonian features due to *T. pallidum*, are recorded by Pearson (1927) and Cossa *et al.* (1936).

The following case of syphilitic Parkinsonism seen at this hospital is of particular interest in that the patient, aged 43, appears to be a congenital syphilitic. The Parkinsonian features were well marked and were progressing. A survey of the literature failed to reveal a similar case.

Case Record

A professional fur classer aged 43 had not felt really fit since the removal of a papilloma of the bladder two years previously. Soon after discharge from hospital he began to feel tired in the daytime. During the past six months there had also been a great decrease in his usual energy and he had become rather depressed. Shortly before admission he noticed that his hands were shaking (especially the right) and he had difficulty in writing properly. The writing had become small and the letters were poorly formed. About this time his speech had become thick and slurred. There had been a tendency to fall over, particularly when he went out at night or closed his eyes. He had noted that his method of walking had become shuffling and that his arms had ceased to swing. At times he had difficulty in stopping once he had started walking. Dribbling of saliva was often excessive, particularly at night-time.

For the past two years he had had very severe pain in his right lower leg. He described it as "like a hot knife being pushed through the leg." The pain was always transversely through the leg, never vertically. It nearly always came on when he was in bed at night.

Previous Complaints and Illnesses.—As a baby he was said to have had a troublesome nasal discharge. The two upper permanent central incisor teeth were said to have been peculiar, in that they were shorter than the others and decayed early. He had a severe infection of the eyes at the