The initial assessment was usually made on the admission of the patient to hospital, and was enlarged during routine examinations and examination before recertification. If necessary the matron or the chief male nurse and nursing staff were consulted with regard to the patient's social behaviour.

Every certified patient in the hospital was submitted to psychological testing; also, most of the licence cases were recalled to hospital for a short period so as to complete their assessment. Unfortunately, we were unable to get the assessment of all patients who were on the hospital books. Our list of exceptions includes 30 patients: 13 males and 3 females on licence, living over 100 miles from the hospital, one male patient who absconded from the hospital two years ago; one male and two female patients with whom we were unable to make any contact owing to superimposed psychosis from which they suffer; six male and two female blind patients; and one male and one female with gross speech defect. We have omitted the blind and speech-disorder patients purposely, as, although they have been assessed, we do not regard their assessment as fully valid, because of their physical disabilities. So out of a total number of 1,041 patients we have been able to secure data of 1,011 patients of both sexes who were on the hospital books on December 31, 1953. We have not included in our table data obtained from 68 patients who have been transferred or discharged, or have died since the beginning of our inquiry.

For the routine testing we used the revised Stanford–Binet intelligence scale F.L., the Alexander performance scale, the progressive matrices, and occasionally the Kent oral and Rorschach test.

We found the revised Stanford–Binet test, with all its shortcomings, still most useful when dealing with low-grade patients and children. The Alexander performance scale, beginning with 7 years' practical ability, was not so often used as the revised Stanford–Binet because of its limited range.

We found the progressive matrices of very limited value with mental defectives. We obtained only a few significant results with patients whom we would prefer to call socially or morally defective rather than mentally defective. However, we would like to mention that the behaviour and reactions of a patient when he is tested individually on matrices, irrespective of scores, can sometimes throw light on his personality. The Kent oral test we used very infrequently, and then mostly with blind patients.

Table II shows the results obtained on testing 84 feeble-minded patients by the revised Stanford–Binet intelligence scale F.L.; this particular test was chosen for our purposes because it agrees in most cases with the clinical assessment.

TABLE II.—*Distribution of I.Q.s of a Group of 84 Feeble-minded Patients Between 16 and 30 Years of Age*

| I.Q. | Male | Female |
|---|---|---|
| 50–54 | 22 | 8 |
| 55–59 | 11 | 4 |
| 60–64 | 11 | 3 |
| 65–69 | 4 | 4 |
| 70–74 | 3 | 2 |
| 75–79 | 1 | 1 |
| 80–84 | 4 | 1 |
| 85–89 | 1 | 1 |
| 90–94 | 3 | |
| Total | 60 | 24 |
| Mean I.Q. | 62·50 | 61·91 |

### Comparison with Another Series

Our results are compared with those of O'Connor and Tizard with regard to the classification of mentally defective patients and with regard to I.Q.s of a group of feeble-minded between 16 and 30 years of age (Tables III and IV). There may, of course, be quite a number of factors which are responsible for the discrepancy between two sets of results.

TABLE III.—*Difference in Classification and Percentage of Mental Defectives*

| | No. of Cases under Investigation | Idiots | | Imbeciles | | Feeble-minded | |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % |
| O'Connor and Tizard .. | 592 | 35 | 5·9 | 247 | 41·7 | 310 | 52·3 |
| Present series .. .. | 1,011 | 246 | 24·3 | 509 | 50·3 | 256 | 25·3 |

TABLE IV.—*Difference of Method and Numbers and I.Q. Mean of Two Groups of Feeble-minded, Whose Ages are Between 16 and 30*

| | No. of Patients under Investigation | F.-M. Group Ages 16–30 Selected Group | F.-M. Group Ages 16–30 Actually Tested | Mean I.Q. Ages 16–30 |
|---|---|---|---|---|
| O'Connor and Tizard .. | 592 | 102 | 49 (group matrices) | 74–75 boys only |
| Present series .. .. | 1,011 | 84 | 84 (on R. Stanf.-Bin.) | 62·2 both sexes |

If the "sample" figures produced by O'Connor and Tizard give a true account of the actual population of the 12 mental deficiency hospitals under review, then it would appear that there are marked differences in approach to the question of mental defectives in hospital and perhaps different criteria concerning the function which a mental deficiency hospital is supposed to serve.

### Summary

The preliminary findings from the assessment of 1,011 patients in a mental deficiency hospital are discussed.

Comparison with the figures given in a similar survey, recently published, shows a wide variance in the results obtained.

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# TREATMENT OF TETANUS WITH SUCCINYLCHOLINE

BY

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The first report on the use of muscular relaxant drugs in the treatment of tetanus was by Spencer Wells (1858–61), who in 1858 treated three cases with woorara (a crude preparation containing curarine). With the development of modern anaesthesia more such drugs have been introduced for the treatment of tetanus. Among these are curare (Godman and Adriani, 1949), gallamine triethiodide (Smith and Thorne, 1952), mephenesin (Hamilton Smith, 1953), and succinylcholine (Woolmer and Cates, 1952).

The case reported here was treated with continuous intravenous infusion of succinylcholine for five and a half days. For much of the time spontaneous respiration was so reduced that oxygenation had to be artificially maintained, and the case was dealt with in a manner very similar to that advocated by Lassen (1953) for the treatment of poliomyelitis with respiratory paralysis.

### Technique

Tracheotomy was performed as soon as it became obvious that the degree of relaxation required to overcome the spasms made artificial respiration necessary; the tracheotomy tube selected was fitted with a side-arm through which the gases used were delivered. Respiration was assisted by the

bag ventilation method. The mouth and nose were occluded with an anaesthetic mask.

For a large part of the time light anaesthesia was maintained with a mixture of 4–5 litres of oxygen and 2–3 litres of nitrous oxide per minute; additional sedation was obtained by the *ad hoc* administration of paraldehyde intramuscularly. The bronchi and pharynx were kept free of secretions by hourly aspiration, using a Jacques catheter attached to a Venturi sucker; at a later stage the foot of the bed was raised on a high trestle, the patient being supported by a strong cotton jacket attached to the foot of the bed by webbing straps. The trestle and jacket were made in the hospital, copied from a design suggested by Jacoby (1953). He was returned to the horizontal position from time to time for nursing purposes. Fluids were administered by the intravenous route, a "polythene" cannula leading from two bottles connected by a Y tube being used; one of these bottles contained 0.2% succinylcholine in glucose-saline, and the other glucose-saline or normal saline as required. Urine was collected for measuring the daily output with the help of a length of Paul's tubing. At some time during each day all drugs were withdrawn in order to assess the patient's progress. He was given soluble penicillin, 500,000 units twice a day, and A.T.S., 25,000 units daily. A member of the medical staff was with the patient throughout.

### Case Report

A farmer aged 42 pierced his right foot with a potato fork on August 24, 1953. He developed a spreading cellulitis, for which he attended his doctor on August 29; he was given penicillin and sulphonamides. The following day the local condition was showing signs of improvement; he was given 1,000 units of A.T.S. That evening he first noticed aching and stiffness of his back. The following day these symptoms were worse, and he was admitted to hospital in the evening. He had never been immunized against tetanus. On admission (August 31) he was seen to be a healthy and powerfully built man; there was continuous rigidity of the muscles of his neck, pectoral girdle, abdomen, and back, but there was no trismus and his limbs were relaxed. The small wound on the dorsum of his right foot had practically healed. He was given 100,000 units of A.T.S. intravenously and 100,000 units intramuscularly, morphine sulphate, ¼ gr. (16 mg.), and sodium amytal, 6 gr. (0.4 g.).

On the next day the first reflex spasm occurred; this was followed by others in increasing frequency and of greater severity, in spite of sedation with intramuscular paraldehyde and the administration of mephenesin both orally and parenterally. On September 3 treatment with succinylcholine was started.

*September 3.*—Treatment was started at 1 a.m. with the continuous intravenous infusion of a solution containing 0.2% succinylcholine. The spasms were kept within tolerable limits and respiration was not unduly depressed on a dose of 2–3 mg. of succinylcholine per minute; the more severe spasms tended, however, to break through. These were controlled by increasing the rate of infusion so that 15–20 mg. was given in a few seconds. This often produced severe respiratory depression, and the lungs were inflated with oxygen through a face-mask until spontaneous respiration was re-established. (At 9.30 a.m. a major convulsion occurred with opisthotonos, laryngeal spasm, and extreme cyanosis; muscular contraction caused obstruction to the vein which contained the cannula and arrested the flow of succinylcholine; 75 mg. was given by syringe into another vein and respiration was controlled as before.) Tracheotomy was performed at 12 noon; this gave far better control over respiration and enabled the bronchi to be cleared of secretions by suction. The patient was kept quietly asleep with the aid of a mixture of oxygen and nitrous oxide, respiration being assisted for most of the time. If the nitrous oxide were withheld he would wake up within a few minutes, and at times could take fluids by mouth. These periods of consciousness usually ended in a severe spasm which could be rapidly controlled by injection of 10–20 mg. of succinylcholine into the tubing of the intravenous apparatus. The maintenance dose of succinylcholine remained 2–3 mg. per minute.

*September 4.*—Treatment was continued on similar lines as before. During the day his pulse rate rose and he became progressively cyanosed; at 5 p.m. it was seen that the respiratory movements of the right side of the chest were diminished. A catheter was introduced to the limit of the right main bronchus and suction was applied. A large quantity of tenacious mucus was obtained and his condition improved as a result. Soon after this, a portable chest film showed segmental collapse in the right lower lobe. As a result of this it was decided to turn him on each side every hour and attempt to clear the entire bronchial tree by suction. Reflex spasms occurred unabated if the succinylcholine was withdrawn.

*September 5.*—His condition began to deteriorate, his pulse and respiratory rates rose, and cyanosis appeared. At the same time it was becoming difficult to keep the bronchi clear of secretions, and it was at this point that the foot of the bed was raised on the trestle. His condition soon began to improve, and, although much mucus was removed from the pharynx thereafter, little could be obtained from the trachea and bronchi. There was no sign of lessening of the spasms.

*September 6.*—His general condition and colour remained good, but during a trial without drugs a periodic respiratory rhythm appeared, similar to Cheyne–Stokes respiration, and muscular tone was seen to wax and wane in parallel with this rhythm. Complete relaxation accompanied apnoea, while powerful contractions occurred at the height of the respiratory phase. As the effect of the drugs wore off, so the muscular spasms became more pronounced, and within 15 minutes it was necessary to give further relaxant. Another phenomenon noticed this day was the appearance of peripheral circulatory collapse when the bed was lowered to the horizontal position; this was corrected when the bed was replaced on the trestle.

*September 7.*—His condition remained quite good, although it was noted that his ears had become cold and dusky; his pulse rate was labile and ranged from 85 to 125. In the evening he was without succinylcholine for one and a half hours, during which time he was given 10 ml. of intramuscular paraldehyde, but in the end spasms of such strength occurred as to require further relaxant. During this time he became conscious to the extent of being able to nod or shake his head in response to direct questions.

*September 8.*—Succinylcholine was withdrawn at 10.15 a.m., and at 10.40 a.m. he was given 10 ml. of intramuscular paraldehyde and the nitrous oxide was turned off. Apart from two short periods to cover the removal of secretions, no further succinylcholine was given. He was lowered by stages to the horizontal position. He did not recover consciousness, and the pulse rate rose to 140 and was of poor volume, the temperature began to rise, and respiration became rapid, shallow, and at times periodic in rhythm; he became deeply cyanosed. At 4.30 p.m. another portable chest film showed opacities in both upper lobes, the right being more extensive than the left. Large quantities of purulent sputum were aspirated from the bronchi. Muscular twitchings and periodic tightening of the pectoral and abdominal muscles occurred, but no severe spasms. Aureomycin, 500 mg. intravenously, was given six-hourly. He was turned on each side every hour and his back pummelled. The pulse rate reached 160 by 6 p.m.

*September 9.*—His condition gradually improved during the day, and he regained consciousness in the afternoon. Hourly turning and back-thumping was continued. Feeding was begun with milk fortified with "casilan" and glucose given through a Ryle's tube.

He gradually regained health and strength. The tracheotomy tube was coughed out on September 10. A chest film on September 11 showed complete clearing of the shadows seen on September 8. Muscular rigidity, which was partially controlled by oral mephenesin, persisted until September 20.

His right lower lobe collapsed on September 13, and this was re-expanded after a large quantity of purulent sputum was aspirated through a bronchoscope. He developed a deep venous thrombosis of the left leg on September 18 and anticoagulants were given for a week. He was discharged from hospital on October 2.

### Conclusion and Summary

The powerful, rapid, and short-lived action of succinylcholine would appear to make it the most useful muscular relaxant drug for the control of the reflex spasms of tetanus. It can rapidly overcome the severest convulsions, while full respiration and muscular power will return soon after it is withdrawn.

The case described was given a dose varying from 1.5 to 3 mg. per minute for five and a half days, with additional larger doses in times of difficulty; a total of 22.5 g. was given without toxic side-effects.

Light anaesthesia was maintained with nitrous oxide for most of the time; this produced restful sleep without any apparent untoward effects, but whenever it was withdrawn consciousness would return in a few minutes. It is interesting to note that the patient had no memory of the events which occurred during the period of treatment.

Adequate bronchial drainage was ensured by frequent aspiration through a tracheotomy tube, and by a high angle of tip.

My thanks are due to Dr. W. D. Brinton, under whose care this case was admitted, for his kind permission to publish this article; to Dr. R. P. W. Shackleton, whose advice as anaesthetist was paramount; to Mr. Gordon Midgley, who performed the tracheotomy; and to those members of the medical staff (consultant, registrar, and resident), who did their two-hour shift with the patient, day and night, for five and a half days.

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# Medical Memorandum

## A Case of Phaeochromocytoma without Hypertension

The following case of phaeochromocytoma, which did not fall into any of the usual categories, may be found of interest.

### CASE HISTORY

A builder aged 43 was first seen in April, 1952, and was admitted to hospital on four separate occasions between then and January, 1953, on account of recurrent vomiting. His attacks followed a similar pattern—he had a queer sensation in the epigastrium rising in the midline to the throat, he would have a shivering sensation starting in his legs and spreading upwards over the rest of his body, then he would be sick and would have epigastric pain going through to the back. Attacks of vomiting occurred two or three times daily for four to five days, after which he would remain well for about two months.

On examination the patient was rather hirsute and not wasted. He was restless during an attack, would throw off his bedclothes, would throw himself about the bed, and tended to adopt weird postures. His agitation at these times contrasted strongly with his normal quiet manner. His mucosae were pink; his skin was blotchy; pulse 84, temperature 99° F. (37.2° C.), blood pressure 95/55. There was no clinical abnormality in his cardiovascular, respiratory, or central nervous system. His abdomen was normal to palpation.

The history was not suggestive of peptic ulcer. Barium-meal examination showed nothing abnormal; occult blood was negative. In view of the vomiting the patient naturally became salt-depleted, his urinary and plasma chlorides were found to be low, and this was easily corrected by salting his drinks. The low blood pressure and vomiting suggested Addison's disease, but against this were his low urinary chlorides, his blood urea of 44 mg. per 100 ml., and a blood sugar of 130 mg. per 100 ml. His Wassermann and Kahn reactions were negative. On more than one occasion while in hospital his temperature varied between 99° and 100° F. (37.2 and 37.8° C.) and this was thought to point to a septic focus in the abdomen. His white-cell count was 19,000 per c.mm., but his midstream urine and cholecystogram were normal.

Eventual laparotomy was carried out on January 13, the findings being as follows: "The gall-bladder, stomach, duodenum, and left kidney were normal. There was a rounded and fairly soft mass about 2 in. (5 cm.) in its greatest diameter in the retroperitoneal tissue medial to the right kidney. This was enucleated without any great difficulty, and seemed to be closely associated with the right suprarenal gland."

*Histological Report.*—"Section shows a tumour consisting of irregular polygonal cells with oval vesicular nuclei. There is a piece of suprarenal cortex in the immediate vicinity of the tumour and many of the tumour cells exhibit a yellow pigment after fixation in chrome salts, thereby demonstrating that it is a phaeochromocytoma. There is no evidence of malignancy."

On his return to the ward post-operatively, the blood pressure was 65/30 and it had to be artificially raised for a fortnight by injections of adrenaline in oil and "eucortone." When discharged on February 7, 1953, the patient had no abdominal symptoms, there was no suggestion of recurrent pyrexia or vomiting, he had stopped all injections, and his blood pressure was 125/80. He has since continued to keep well.

### COMMENT

In a comprehensive review of this subject Walton (1950) divides the clinical picture of phaeochromocytoma into five categories: (1) paroxysmal hypertension, (2) persistent hypertension, (3) malignancy, (4) Addison's disease due to compression of the suprarenal cortex, and (5) asymptomatic. This patient cannot be said to fall into any of these categories. His blood pressure had been taken pre-operatively on no fewer than 12 occasions; it was usually around 125/70, often it was lower, on a solitary occasion it was 140/100. Swan (1951) has mentioned the problem of recognizing "the possibility that phaeochromocytoma is the cause underlying a story of paroxysmal disturbance in a patient with normal blood pressure when seen." Even during attacks this patient's blood pressure was normal. The only feature which could be considered to point to the diagnosis in this case was paroxysmal disturbance, which did not fit into any of the well-recognized clinical syndromes. In retrospect, the leucocytosis, the low-grade pyrexia, and the anxiety state are features that have been described in phaeochromocytoma, and direct questioning after the diagnosis was made revealed that the patient sweated a lot during strenuous exercise and also with his attacks of vomiting.

This history, however, seems to suggest that, in an otherwise healthy person, paroxysmal disturbance, even in the absence of paroxysmal hypertension, should make one think of phaeochromocytoma.

I thank Dr. J. W. Todd and Mr. S. C. Raw for permission to publish this case, which was under their care; Dr. C. C. Thomas for the histological report; and Dr. E. H. Hemsted for helpful advice.

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