The reasons why medical boards failed to diagnose and exclude these cases from service are discussed, with special reference to the importance of the position and type of the apex beat in diagnosis.

Increased disablement from a purely medical point of view occurred in only 34% of the total. It was caused by recurrent rheumatic fever, bacterial endocarditis, auricular fibrillation, angina of effort, and the occurrence of emboli or cardiac failure.

The importance of radiological examination of the heart and the potential value of mass radiography are discussed.

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DECAMETHONIUM IODIDE AS A CURARIZING AGENT IN GENERAL ANAESTHESIA

BY

A. R. ELLERKER, L.M.S.S.A.

Late Anaesthetic Registrar, Selly Oak Hospital

The following series of 208 cases in which decamethonium iodide (C10) was used as a curarizing agent, in conjunction with most general anaesthetic agents, may prove of interest to those who are not convinced of its value as a substitute for D-tubocurarine chloride.

C10 is the decane derivative of bistrimethylammonium iodide. It is a white crystalline water-soluble salt, which forms a stable neutral solution. On intravenous injection both in experimental animals and in human beings it produces a neuromuscular block with little or no effect on the autonomic ganglia. The fact that it is cheap to synthesize and mixes readily with thiopentone sodium, together with its curarizing properties, makes it an even more attractive proposition.

Clinical Series

In all the 208 cases, with the exception of those in which caesarean section was performed, premedication with "omnupon," $\frac{1}{2}$ gr. (22 mg.), or morphine, $\frac{1}{4}$ gr. (16 mg.), and hyoscine, 1/150 gr. (0.43 mg.), or atropine, 1/100 gr. (0.65 mg.), was carried out between 30 and 60 minutes before operation, and anaesthesia was induced with thiopentone sodium in doses varying from 0.4 to 1 g. For the caesarean sections premedication was carried out with atropine, 1/100 gr., and induction with cyclopropane and oxygen. The ages of the patients ranged from 12 to 79 years. The following are the operations for which the method was used.

Operation	No.
Oesophagoscopy	10
Bronchoscopy	5
Tonsillectomy	18
Mastoidectomy	10
Thyroidectomy	8
Dental operations	20
Facial and neck operations	13
Upper abdominal operations (including gastrectomy, gastro-jejunostomy, perforated peptic ulcers, cholecystectomy)	14

Laparotomy (appendicectomy, colostomy, excision of colon, etc.)	9
Herniorrhaphy	21
Prostatectomy	10
Nephrectomy	4
Anal and rectal operations	12
Thoracic sympathectomy	4
Caesarean section	13
Mastectomy	3
Amputation of leg	3
Laminectomy	10
Orthopaedic, unclassified	11
Unclassified, miscellaneous	10

Administration and Results

C10 may be injected intravenously either as a mixture with thiopentone sodium or by itself. Dosages of from 2 to 5 mg. have been used on different cases, and to produce full muscular relaxation an initial dose of 4 mg. was found to be the best. This produced excellent relaxation of the abdominal musculature for as long as 25 minutes, but also brought about apnoea due to respiratory paralysis for five to ten minutes after the full effect was obtained, which was usually some three to five minutes after the original injection.

Experiments carried out on the conscious patient by Organe, Paton, and Zaimis (1949) indicated that with a dose of 3 mg. of C10 the respiratory musculature was not in any way affected. It has been found here, however, that even with this dose there was apnoea for one to three minutes, while adequate abdominal relaxation was not always obtained. In this respect it differs from D-tubocurarine chloride, which does not always produce respiratory arrest with an equivalent dosage.

Repeated doses have not the cumulative effect that D-tubocurarine chloride has, and a maximum of 15 mg. of C10 has been given without ill effects, recovery taking place as after a single dose.

Continuous or intermittent injections of a thiopentone C10 mixture have been used with success in most of the herniorrhaphies and in a large number of the intra-peritoneal operations, but the resulting apnoea makes it desirable to intubate these patients and to keep them well oxygenated.

The experimental work of Young (1949) on near-term guinea-pigs and rabbits suggests that C10 does not pass the placental barrier, and clinical trials by Organe (1949) indicate that this is so. In the 13 caesarean sections in this series, using doses of 2 to 3 mg. injected 10 to 15 minutes before delivery, we have found that the infant was definitely more flaccid and reluctant to breathe than after cyclopropane, oxygen, ether, or gas-oxygen-ether anaesthesia. It would seem, then, that C10 does cross the placenta into the foetal circulation, although more slowly and in smaller quantities than D-tubocurarine chloride. Recovery of muscle tone in these babies is fairly rapid.

Side-effects.—No deleterious side-effects were noted in any of these cases. One death occurred at the end of a partial gastrectomy for uncontrollable haematemesis. This patient was not, however, in the best condition, and some difficulty was experienced in keeping him oxygenated. Post-mortem examination revealed bilateral basal pneumonitis, with a large amount of purulent exudate and an advanced degree of myocardial degeneration.

Discussion and Conclusions

The use of C10 in short operations is clearly indicated to avoid the respiratory depression so often seen after the use of D-tubocurarine chloride. In all cases in which

intubation is necessary or desirable C10 facilitates the passage of a Magill intratracheal tube without producing complete abdominal relaxation, which is so often unnecessary in E.N.T., orthopaedic, and other classes of operation.

It may be used in conjunction with D-tubocurarine chloride to produce short-term relaxation of the abdominal muscles when the peritoneum is being closed and it is undesirable to give another dose of D-tubocurarine chloride because of its long action and cumulative effect. Full respiratory excursions will then be established before the patient returns to the ward.

Antagonist.—Pentamethonium iodide, or C5, is the antidote to C10. Hewer *et al.* (1949) have reported its effects. It acts by producing a block of the autonomic ganglia, and would seem to be contraindicated in major surgery. It may produce a profound fall in blood pressure, and the patient may collapse in a very alarming manner. No opportunity has arisen and no attempt been made to use this substance here.

My thanks are due to Dr. T. H. Hobbes, the senior anaesthetist, for his help.

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Medical Memoranda

Volvulus of the Small Intestine

The following case illustrates the difficulty of diagnosis of volvulus of the small intestine. This difficulty is present not only before operation but when the abdomen has been opened. The aetiology of the condition is obscure, and in the case described an adhesion was present round which the gut appeared to have pivoted. This has been described in other cases, but the operator is likely to find no obvious cause whatever.

CASE REPORT

A storekeeper aged 53 was admitted to hospital complaining of acute abdominal pain 1 in. (2.5 cm.) to the left of the umbilicus two days previously. Before this he had always been quite well. There was continuous dull abdominal pain with exacerbations of acute colic. The bowels had been absolutely confined and no flatus passed. Vomiting began a few hours after the onset of pain and had continued.

On admission he had an ashen appearance. His tongue was dry and furred. His temperature and pulse were normal. The abdomen was tympanitic and a little distended but with no real rigidity. No free fluid was discovered and there were no localizing signs of any sort to assist diagnosis. He was vomiting brownish fluid but there was no faecal change in the vomit. Enemas were returned unchanged. Borborygmi were heard over the large intestine. A diagnosis was made of small-bowel obstruction probably due to strangulation by band or internal hernia.

At operation there was a little free fluid and the whole small intestine presented moderately distended and markedly congested but not "plum coloured." In the left hypochondrium a band 3/16 in. (0.5 cm.) in diameter and extending from the splenic flexure downwards and inwards was found to be attached to the middle of the mesentery. This band was part of numerous adhesions tying the whole colon from caecum to sigmoid to the anterior peritoneum. The small intestine was free of adhesions. The large intestine was moderately and normally

distended. Round the band was wrapped a loop of small intestine which was more obviously affected than the rest, as it was plum coloured and more distended. The band was divided and the small loop began to recover in appearance. At first it was thought that the cause of the obstruction had been discovered and dealt with, but the poor condition of the whole small intestine raised doubts, and, on feeling round the abdomen, the typical "band" caused by the twisted mesenteric root was felt and the volvulus diagnosed. The small intestine was everted, the 180-degrees twist that was present was untwisted, and the abdomen closed. The patient made an uninterrupted recovery.

A. J. HOBSON, F.R.C.S.

Aplastic Anaemia Complicating Miliary Tuberculosis

In the following case complete aplasia of the bone marrow developed. This seems to be an unusual complication and the clinical findings are worth recording.

CASE REPORT

The patient, a man aged 41, was healthy until March, 1949. His initial symptoms were non-specific—namely, lassitude, anorexia, and headaches. In June, 1949, he had a severe epistaxis and bleeding from the gums. He was admitted to hospital on August 4. There was no family history of tuberculosis.

On examination he was obviously very ill. He complained of a sore throat. The fauces were injected but not ulcerated. Pallor was pronounced without any evidence of icterus. The superficial lymphatic glands were not enlarged. His temperature was 101.6° F. (38.7° C.) on admission, and a remittent pyrexia, fluctuating between 100 and 103.2° F. (37.8 and 39.6° C.), persisted until the day before death. The pulse was 120. A loud systolic murmur was audible at the mitral area. The blood pressure was 145/80. No abnormal signs were elicited in the lungs. The spleen was enlarged to ½ in. (1.2 cm.) below the umbilicus, and the liver was enlarged 2 in. (5 cm.) below the costal margin.

The urine was normal. A blood count showed: haemoglobin, 36%; red cells, 1,510,000; C.I., 1.2; white cells, 1,200. No primitive cells were seen in the film. The red cells showed anisocytosis and poikilocytosis. Aerobic blood culture was negative. Examination of the sternal marrow smears revealed no primitive cells of either the myeloid or erythrocyte series. The film was diagnostic of aplasia of the bone marrow.

A radiograph of the chest showed a resolving area of consolidation in the left mid-zone. The remainder of the lung fields was clear. There was no enlargement of the mediastinal lymph nodes and no mottling. The patient died on August 21, 17 days after admission.

Permission for a necropsy could not be obtained, but the spleen was removed. This viscus was grossly enlarged and the histological examination showed multiple areas of necrosis with a slight mononuclear reaction around the margins. With Ziehl-Neelsen's stain lesions were seen to contain acid-fast bacilli. The picture was that of an atypical miliary tuberculosis.

COMMENT

There are several features of unusual interest in this case. Aplasia of the bone marrow was caused by an overwhelming toxæmia with a very low resistance. The absence of chest symptoms and minimal radiological findings are very difficult to explain in a case of generalized miliary tuberculosis. The primary focus was probably extrapulmonary. The gross splenomegaly was due to numerous tubercles and there was no evidence of splenic panhaematopenia. The miliary tuberculosis was not seriously considered in the differential diagnosis. Aleukæmic leukaemia was excluded by the marrow findings.