SPONTANEOUS HYPOGLYCAEMIA

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(With Special Plate)

The occurrence of spontaneous hypoglycaemia has been noted in the literature several times, and it is probable that mild degrees of the condition occur more frequently than is usually supposed. It therefore appears of interest to report the following case.

HISTORY OF THE CASE

The patient, an unmarried children's nurse, aged 44 years, was admitted to the Manchester Royal Infirmary on February 24th, 1931, complaining of recurring attacks of dizziness and loss of consciousness.

For some years before 1923 she had been employed as a children's nurse in a doctor's family. In that year, however, there was a marked alteration in her general behaviour and temperament. She became alternately sulky and self-assertive, often attempting to treat her employers like children (these facts were confirmed by her employer, Dr. Brunwin of Lancaster).

In 1925, having moved to another district, her diet consisted largely of tinned meats, with very little carbohydrate. From that time onwards she began to complain of attacks of faintness and trembling, but did not lose consciousness. These symptoms persisted till 1927, when she began to experience momentary losses of consciousness, in which she would fall down. Between these attacks she suffered from continual tiredness.

In 1928 the symptoms again altered. There were no more losses of consciousness, but she was often assailed by confusion of ideas while out in the street, and on recovery would, to her surprise, find herself walking in an entirely different neighbourhood from that in which the attack began.

In 1929 the attacks of loss of consciousness returned, recurring every day and followed by severe headache. About this time it was noted that her knee-jerks were absent, and that the pupils were unequal and exhibited the Argyll Robertson phenomenon.

In September, 1930, she was admitted as an in-patient to the Bradford Royal Infirmary as a possible case of tabes dorsalis. The Wassermann reaction and colloidal gold curve were, however, found to be negative. During her stay in this hospital she began to lose consciousness almost every day in the early morning, at the same time becoming pale, with profuse sweating and a very weak pulse. These symptoms suggested to Dr. Eurich, under whose care she was, the possibility of hypoglycaemia. Accordingly the blood sugar was estimated and found to be 0.046 per cent. Glucose (up to 1/2 lb. daily) was given, and her symptoms improved. She was discharged from hospital with the blood sugar at 0.064 per cent. The symptoms of dizziness and twitching returned after a few weeks, and she was admitted to Manchester Royal Infirmary on February 24th, 1931. On admission she seemed physically normal, but her manner suggested a neurotic temperament. Inquiry into her family history elicited nothing of importance.

CLINICAL EXAMINATION

General Condition.—Well nourished. On the face and hands a red papular eruption. Tongue, teeth, tonsils: no abnormality. Weight, 7 st. 3 lb. 5 oz.

Heart.—No evidence of enlargement. Mitral pre-systolic murmur and reduplicated second sound; accentu-

ated aortic second sound; accentuated pulmonary second sound. Blood pressure, 115/75.

Lungs.—Slight dullness and increased vocal resonance medial to the inferior angle of the right scapula.

Abdomen.—Tenderness in right iliac fossa and over the course of the transverse colon.

Central Nervous System.—Pupils miotic, irregular, and of Argyll Robertson type; lateral nystagmus both sides; fundi normal; cranial nerves normal; tendon jerks absent; plantar response extensor on both sides; sensation normal; muscular power normal; sphincters normal.

SPECIAL INVESTIGATIONS

Blood Count.—Erythrocytes, 5,030,000 per c.mm.; haemoglobin, 84 per cent.; colour index, 0.84; leucocytes, 12,200 per c.mm.—polymorphs 77 per cent., lymphocytes 17.3 per cent., large mononuclears 4 per cent., eosinophils 1.7 per cent., basophils nil. Platelets abundant. Nucleated red cells nil. Slight anisocytosis. Occasional poikilocytosis. Wassermann reaction negative. Cerebro-spinal fluid: total protein, 30 mg. per 100 c.cm.; globulin, no increase; glucose, 25 mg. per 100 c.cm.; chlorides, 705 mg. per 100 c.cm. The fluid was slightly opalescent, mobile, under normal pressure, and gave rise to no coagulum. There were two lymphocytes per c.mm. In addition, there were a number of granular bodies, which resembled degenerated cells.

X-ray Examination.—No intracranial abnormality; pituitary fossa normal. No abnormality or displacement of gastrointestinal tract. Basal metabolism increased by 23 per cent. Stools: total fat, 24.3 per cent.; unsoaped fat, 7.7 per cent.; combined fatty acids, 16.6 per cent. Glucose, nil. Urine: lactic acid, nil; diastase figure, 10. Blood sugar: periodic blood-sugar estimations were made (see table). The highest

Date	Drugs	Diet	Blood Sugar
March 3rd...	—	Fluids only	Per cent. 0.031
March 4th...	—	Fluids only	0.028
March 7th...	G	Minced meat, potatoes, and milk puddings, etc.	0.081
March 10th...	GP	" "	0.089
March 20th...	A	" "	0.063
April 1st...	GA	" "	0.039

G = During period of administration of glucose.

P = During period of administration of pituitrin.

A = During period of administration of adrenaline.

reading was 0.089 per cent., and most of the readings were considerably below this. A sugar tolerance test was performed, and a series of estimations were made following the administration of adrenaline (see graph). From these figures

it will be seen that even when the blood sugar rose to a normal figure it very quickly fell again. The effect of atropine upon the blood sugar was negligible.

PROGRESS

On March 1st (five days after admission) the patient became comatose. She was grinding her teeth and sweating profusely. The limbs were flaccid, but attempts to move them were resisted. She could not be roused to answer questions, and she became incontinent of urine

and faeces. She remained comatose for five days, when she received 5 minims of 1 in 1,000 adrenaline. She then partly regained consciousness, and for a short time could be roused to answer questions. On the same day she received 10 c.cm. of 20 per cent. glucose intravenously. This did not have any observable effect.

On March 7th she received 400 c.cm. of 20 per cent. glucose intravenously, and the coma rapidly became less profound until she was practically normal.

On March 8th she began to receive 1 lb. of glucose daily by mouth, and marked improvement resulted. She became fully conscious of all that went on, but lay in bed more or less inertly, with an expressionless face. She spoke, only in direct answer to questions, with a slow monotonous drawl. She received glucose in this way throughout her stay in hospital. At one time she also received a small dose of pituitrin twice daily, and at another period adrenaline twice daily. Neither of these drugs produced any effect.

On April 16th she began to have epileptiform attacks. These occurred mostly during the night, and alternated with attacks of hysteria, which were always controlled by the administration of glucose.

On April 22nd laparotomy was performed by Mr. Charles Roberts. There was no evidence of pancreatic abnormality, but the gall-bladder contained stones and the appendix was distended by mucus to a size 6 by 1½ inches (see Plate). Cholecystectomy and appendicectomy were performed. After operation her condition improved for about a week, when the hysterical attacks returned.

On June 10th she was transferred to the convalescent hospital at Cheadle, on a daily dose of 1 lb. of glucose. While there her condition remained the same.

DISCUSSION

In this rather complicated clinical picture the low blood sugar is the most striking fact. How far the other symptoms can be attributed to this is not quite clear. There is no doubt that the administration of glucose improved the condition, and, as shown by the sugar tolerance test, raised the blood sugar for a time. Nevertheless, although glucose prevented coma, the patient continued to have attacks of apparent hysteria even while receiving 1 lb. of glucose daily.

A certain amount of experimental work has been done on this subject,^{1 2 3 4 5 6} and from the results we can form some idea of how far the symptoms in the present case depended upon the low blood sugar content. It has been shown^{1 2 3} that when hypoglycaemia is induced in normal individuals a symptom-complex occurs similar to the present case. Experiments upon animals gave rise to the same type of symptoms; and in animals, at all events, the condition appears to be hereditary.⁴ Sevringhaus and his co-workers⁵ produced hypoglycaemia by injection of insulin into normal people, and found that the blood sugar was lowered by various amounts down to 0.05 per cent. This gave rise to slight incoordination and confusion of ideas, resembling those described in the earlier stages of the present case. This would suggest that the condition was progressive, and gradually became more severe up to the time when the patient came under our care. Sendrail and Planques⁶ cite eight authorities who agree that any reading below 0.09 per cent. constitutes hypoglycaemia, so that between this and the readings in the present case there are likely to be symptoms of all degrees of severity. Milder cases, in which attacks of coma have not occurred, respond to a more liberal diet, with frequent meals.⁷ More severe cases require the administration of large amounts of glucose.^{8 9}

CAUSES OF HYPOGLYCAEMIA

These have been set forth at length by some writers,^{10 11 12} and they fall into five groups: (a) pancreatic, (b) endocrine, (c) hepatic, (d) renal, (e) nervous.

Pancreatic Causes

Any factor which leads to an over-production of insulin may be expected to bring about hypoglycaemia. Pancreatic tumours may do this, and a number of such cases have been reported.^{13 14 15 16} The tumours have been either simple adenomas or carcinomas. In one case¹⁵ there was a primary carcinoma with secondaries in the liver, and from these insulin was recovered. In contrast to this is a case¹⁶ in which the patient showed the symptoms of hypoglycaemia, and at necropsy tumours were found in the liver, but no insulin could be recovered from them. Six cases^{17 18} were discovered at operation, and the tumours were removed, with complete relief of symptoms. Another case¹⁹ showed no tumour, but hypertrophy of the islets. This again indicates an over-production of insulin as the cause of the symptoms. The reverse condition was found in a case reported by Pemberton²⁰ in which the patient had shown symptoms similar to those we have described, but post-mortem examination revealed a fibrotic pancreas devoid of islets. It is not obvious how this could have given rise to hypoglycaemia—hyperglycaemia would have been more understandable. Cases have been noted^{21 22} in which hypoglycaemia occurred with a normal pancreas, and the symptoms were relieved by resection of part of the normal organ. From this it would appear that a normal pancreas may be overactive, or else the cause of hypoglycaemia in these cases was non-pancreatic.

Endocrine Causes

Decreased blood sugar is known to be associated with hyperthyroidism and with pituitary dysfunction. In the present case there was no obvious goitre, but the basal metabolic rate was increased by 23 per cent. This may indicate some hyperthyroidism, but not sufficient to account for the very severe symptoms. We found nothing to indicate pituitary dysfunction, and x-ray examination revealed no gross change in the region of the pituitary fossa.

Hepatic and Renal Causes

We were not able to investigate the hepatic and renal functions as carefully as we should have liked. Absence of sugar in the urine indicates that the condition was not due to a lowered renal threshold.

Nervous Causes

The signs in the eyes suggested the possibility of increased vagal action as a cause for the hypoglycaemia. However, the administration of atropine, although it was repeated on several occasions, had no effect upon the blood sugar.

CONCLUSIONS

Cases of hypoglycaemia associated with widely different pathological states are recorded. The majority appear to be connected with progressive lesions of the pancreas. In our case, however, so far as could be seen from a naked-eye examination of the pancreas, no demonstrable lesion was present. The only pathological conditions discovered were gall-stones and a greatly distended appendix, and the prominent physical signs—namely, Argyll Robertson pupils, extensor plantar response, and irregular pupils—suggested a lesion of the central nervous system. Therefore it has occurred to us that the dysfunction of the pancreas, leading to hyperinsulinism, may be a reflex phenomenon secondary to an infected gall-bladder; and, in view of the fact that temporary insulinism produces absence of reflexes with extensor plantar responses, persistent insulinism may produce this condition permanently—also dysarthria and Argyll Robertson pupils—by acting on the bulb and mid-brain.

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COMPRESSION FRACTURE WITH COMMUNITION OF BODY OF THIRD LUMBAR VERTEBRA AND NEURAL ARCH OF FOURTH VERTEBRA WITH PARAPLEGIA

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(With Special Plate)

Watson Jones (*British Medical Journal*, February 21st, 1931) published for the first time a safe and simple method of treating crush fractures of the spine. Hitherto these cases had been looked upon apathetically, and the results of the usual simple recumbency method of treatment had inevitably been followed by serious deformity and crippling. Davis of Erie (Pa.) had devised a method where traction and forcible hyperextension were combined with suspension of the anaesthetized patient by the heels from the roof of the operating theatre, and Hersikoff described a case of reduction in which four strong men had combined to exert traction on the patient's spine.

Aetiology of Crush Fracture

The mechanism in crush fracture of the vertebral body is indirect injury—that is, a bending or hyperflexion of the spine, associated in some cases with compression in the long axis of the column. Falls on the back of the neck from a height, or a heavy weight falling on the back while it is in a stooping position, are examples of this.

When the spine is forcibly flexed the first effect is a compression of the bodies of the vertebrae and of the intervertebral disks. The upper vertebrae tend to be displaced forwards, but are held behind by the articular processes, which prevent any further movement. Should the flexion continue, the lower articular processes of the upper vertebrae rise and jump the upper processes of the vertebrae below, and a dislocation takes place. Compression fracture of the vertebral body without displacement is met with in the dorsal and lumbar regions, par-

ticularly the twelfth dorsal and the first lumbar vertebra, and also in the upper part of the dorsal vertebrae in the region of the fourth. The latter is frequently associated with a fracture of the sternum opposite the second rib. The cause is always an indirect injury compressing the vertebral column in a vertical direction, and causing hyperflexion. The soft, spongy bone is compressed between the upper and lower laminae of compact bone. Owing to the presence of the pedicles behind, the posterior part is strengthened, the crushing being more marked in front than behind. The result may be a complete comminution of the soft cancellous bone, which may be broken up into innumerable fragments and displaced in all directions—usually forwards, as this is the direction of the violence.

Anatomical Considerations

The anterior common ligament is a strong band of fibres which extends along the anterior surfaces of the bodies of the vertebrae. It is broader below than above, thicker and narrower in the thoracic than in the cervical and lumbar regions, being somewhat thicker and narrower opposite the bodies of the vertebrae than opposite the intervertebral fibro-cartilages. It consists of dense longitudinal fibres, which are intimately adherent to the intervertebral fibro-cartilages and the prominent margins of the vertebrae, but not to the middle parts of the vertebral bodies. In the latter situation the ligament is thick, and fills up the concavities on the anterior surfaces, and makes the front of the vertebral column more even. It is composed of several layers of fibres, of which the most superficial are the longest, and extend between four or five vertebrae. The intermediate fibres extend between two or three vertebrae, and the deepest reach from one vertebra to the next. At the sides of the bodies the ligament consists of a few short fibres, which connect adjacent vertebrae (Gray). Reduction depends on the integrity of this anterior common ligament. The process of hyperextension puts this ligament into tension, which in its turn presses the fragments back into position, and so moulds the vertebrae back into form. Thus pressure on the cord by the laminae of the intact vertebrae above is immediately released, and unless irrevocable damage, such as crushing or severance, is effected, recovery takes place.

CASE RECORD

This is well illustrated by the following case.

J. D., aged 50, was admitted to Queen Mary's Hospital on August 11th, 1931, having been knocked down by a lorry. He did not lose consciousness, and remembers being crushed between the front axle of the lorry and the ground—that is, his shoulder being under the front axle, his trunk in a position of hyperflexion.

On admission he was suffering from shock, and complained of pain in the small of his back, inability to move his legs, and also that "he could not feel them." He was immediately turned over on his face, and nursed in that position until two days later, when reduction was effected.

On examination the spines of the dorsal and upper lumbar region were normal until the mid-lumbar region, when a depression was felt, the spine above forming an elevation with a depression for two spines level below this. X-rays taken in lateral and antero-posterior positions showed marked comminution of the body of the third lumbar vertebra, with forward displacement of the greater part of the body into the abdominal cavity, and fracture of the spine and neural arch of the fourth (Fig. 1 on Plate).

Examination of lower limbs showed: in the right leg, flaccid tone with complete motor paralysis; all reflexes and sensation absent. Left leg: flaccid; complete paralysis, barring an ability to contract the quadriceps extensor muscle; sensation, touch, and sense of position were absent, and the patient was unable to void urine and evacuate the bowels. Catheterization was performed.

R. J. A. BERRY AND R. M. BATES: PORENCEPHALIC IMBECILITY

FIG. 1.—External surface, right cerebral hemisphere.

FIG. 3.—Cerebellum: inferior surface.

FIG. 2.—External surface, left cerebral hemisphere.

FIG. 4.—Internal surface, left cerebral hemisphere.

ALBERT RAMSBOTTOM AND CYRIL G. EASTWOOD: SPONTANEOUS HYPOGLYCAEMIA

Gall-bladder and appendix from a case of spontaneous hypoglycaemia.