Convulsions During Diabetic Ketosis

A Case Report

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The diagnosis of diabetic coma is seldom difficult, but may be so when there are bizarre signs or symptoms or in the presence of intercurrent disease. A clear-cut history of diabetes accompanied by dehydration, acetone in the breath and air hunger, enables the diagnosis to be made with reasonable certainty before the results of laboratory studies are available. The importance of early diagnosis does not need to be emphasized. But a patient who is mentally confused or violent, in whom there may be an additional cause for coma, can present problems in both diagnosis and treatment. Troubles of this nature arose when a newly diagnosed diabetic had a series of epileptic fits while in coma. This case is reported herewith.

CASE HISTORY

One month before admission this forty-six-year-old woman noticed loss of weight and constipation, for which she underwent gastrointestinal investigations at another hospital. For two days before admission to King's College Hospital she had complained of thirst and polyuria. Ten hours before arrival she became comatose after a brief period of irrational behavior, and when examined appeared to be in severe diabetic ketosis. As she was being transferred from the ambulance a nurse suggested that there might have been a short generalized convulsion, the significance of which was not immediately realized. No personal history of other significant disease was obtained, but a maternal grandfather was known to be diabetic.

Physical examination. She was severely dehydrated, smelled of acetone, had air hunger, was deeply comatose and in a state of vascular collapse with blood pressure 80/60 mm. Hg and mouth temperature of 95°F (35°C). Both plantar reflexes were extensor and an unusual finding in diabetic coma was considerable inequality of the pupils, which did not react to light.

Initial laboratory investigations. Urine: Sugar ++++; Rothera +++; Gerhardt +++; Albumen +. Blood electrolytes: Serum sodium 153; potassium 4.3; plasma chlorides 123; alkali reserve 6 mEq/L; blood urea 54 mg./100 ml. Blood sugar: 860 mg./100 ml., (Folin-Wu).

Treatment and progress. Soluble insulin was given immediately, 100 units subcutaneously and 40 intravenously, and intravenous 0.9 per cent saline was commenced. Before any appreciable quantity of fluid had been given she had a generalized epileptic fit with tonic and clonic phases during which she became deeply cyanosed. The blood sugar at this time was 890 mg. but she was given 20 gm. of glucose intravenously, followed by 2.0 gm. of calcium gluconate, intramuscular vitamin B complex, and 180 mg. of sodium phenobarbitone, the saline infusion being continued. Five hours later after 80 additional units of soluble insulin her blood sugar had fallen to 540 mg. and her blood pressure was 130/80 mm. Hg. Unfortunately in the next twelve hours she had eight more convulsions in spite of sedation. In none of these was the blood sugar low nor were there signs of tetany or persistent alteration in muscle tone. Although her stomach had been aspirated she inhaled vomitus and required simultaneous gastric and endotracheal suction for prolonged periods. Later that night she was more deeply comatose than expected in view of the biochemical and circulatory improvement, but there were still no signs to suggest localized intracranial disease other than inequality of the pupils. She regained consciousness after thirty-six hours with no serious disabilities. For the following two years she has remained well and the diabetes has been stable with about 40 units of insulin zinc suspension (Lente) daily.

Other investigations. Lumbar puncture (second day): Pressure 120 mm. water; Queckenstedt's test positive; white blood cells 1 per cmm; protein, 30 mg./100 ml.; Wassermann negative; Lange, zero curve. Skull X ray: normal. Chest X ray (on admission): normal. Hb.: 130 gm./100 ml. Serum calcium: 9.8 mg./100 ml. Electro-encephalograms (EEG): 1. (third day) An abnormal record with irregular low potential theta activity at 3 to 7 cycles per second (c.p.s.) and short bursts of 2 to 3 c.p.s. activity in the temporal region. No specific diagnosis was suggested. 2. (twenty-eighth day) Less abnormal with 9 to 10 c.p.s. Alpha activity of up to 60 microvolts dominant posteriorly, plus excessive theta activity of a lesser degree than previously. 3. (two years) Still a little abnormal but there has been further improvement since the first tracing. There is an excess of theta activity at 3 to 6 c.p.s. but there are no localizing signs and the appearances are in favor of a constitutional abnormality, compatible with latent epilepsy.

DISCUSSION

The course of diabetic ketosis is usually gradual and restlessness or violence is fortunately rare. We have not previously encountered a patient in whom epileptic fits developed during hyperglycemia without there being an additional cause. Were these convulsions to be attributed to the metabolic upset or to some other occult disease? The severity of the ketosis, depletion of alkali reserve, the blood sugar of 890 mg. and the characteristic history strongly suggested diabetes mellitus rather

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than a disturbance of carbohydrate metabolism secondary to an intracranial lesion. Since the first fit occurred before treatment had begun such causes as air embolism or unusual drug sensitivity could be excluded. The possibility of intracranial disease was considered carefully, but the absence of papilledema and localizing neurological signs and the subsequently normal cerebrospinal fluid ruled out subarachnoid or cerebral hemorrhage, meningitis, and brain abscess or tumor. It was also unlikely that cerebral thrombosis secondary to dehydration was responsible since as time went on there were still no signs of residual damage.

Another possible factor was pyridoxine deficiency, in spite of the absence of obvious evidence of vitamin B deficiency. Although Gyorgy[1] considers that such a deficiency in adults does not induce fits as in children, Coursin[2] has shown that the abnormal electro-encephalogram found in infants with epilepsy due to lack of pyridoxine will return to normal within five minutes of injecting the vitamin. The persistently abnormal EEG in the absence of fits rules out such a cause in this patient.

Other etiological factors considered included hypoglycemia, magnesium deficiency, intracellular electrolyte imbalance, anoxemia and of course idiopathic epilepsy. Hypocalcemia should have responded to intravenous calcium gluconate, and in the lack of a serum calcium estimation at that time the absence of tetany provides good evidence against such a disturbance. Without appropriate studies we can not say whether or not magnesium deficiency might have been present. Urinary loss of magnesium is known to be high during the polyuria of untreated diabetes, and in animals and man depletion leads to increased muscular excitability and to convulsions.[3] The administration to our patient of cellular repair fluid containing 240 mg. of magnesium chloride per liter did not appear to do any good. Intracellular overhydration or sudden changes in relative osmolarity may certainly provoke convulsions in the idiopathic epileptic, but this woman's attacks began when she was dehydrated and continued after fluid and electrolyte balance had been returned toward normal. Gans[4] thought that some such fluid-electrolyte imbalance affecting the cerebral cortex might have been responsible for the fits which he observed in a twenty-one-day-old ketosed diabetic infant. Lastly hypoglycemia, a potent epileptic trigger, can be excluded since the blood sugar during the first fit was 890 mg. and 260 during the last, and at no time was there a response to intravenous glucose.

We were therefore at a loss to explain these convulsions and could do no better than treat the diabetes on conventional lines, taking care to avoid hypoglycemia, and giving sedatives to reduce cortical excitability. The discovery of the abnormal EEG on the third day was of interest but it was still difficult to decide whether the record was a sequela of diffuse brain damage or an indication of latent epilepsy. The studies of Izzo[5] were relevant since he had shown that no characteristic EEG pattern was to be expected in diabetics after episodes of hyperglycemia with blood sugars of over 400 mg. per 100 ml. At the time of the second tracing she was in good health and adequate diabetic control, but the findings were still not normal. After three months there was a further improvement in the EEG, but two years later the excess of theta activity persisted and was thought to be compatible with an epileptic constitution.

Why should this woman have a disastrous series of fits while severely ketosed, having been free of such attacks all her life? Acidosis is a factor in reducing cortical excitability and in former days ketogenic diets were used to control idiopathic epilepsy. The observations of Kety et al.[6] that cerebral anoxemia could occur during diabetic coma in spite of a normal or increased cerebral blood flow are pertinent. Lawrence et al.[7] pointed out the histological similarity of the cerebral changes seen in cases of fatal hypoglycemia and in anoxemia, and suggested the term *oxyachrestia* to indicate inability to utilize oxygen secondary to the lack of glucose. Yet if cerebral oxygen lack was a factor in this case it is difficult to understand why fits should be so rare during diabetic coma, particularly in the epileptic. The exact cause of this woman's trouble remains uncertain. The persistently abnormal EEG suggests that she has a constitutional predisposition to epilepsy and that the metabolic disturbance of diabetic coma was the trigger mechanism. In exceptional instances it may be permissible to attribute convulsions to diabetic ketosis in the absence of other signs of disease, but such an occurrence is rare.

SUMMARY

A forty-six-year-old woman with a short history of diabetic symptoms developed severe ketosis and became comatose. Before and during treatment she had a series of major epileptic fits over a period of twelve hours, no cause for which could be determined. In the absence of other disease these appear to have been due to latent idiopathic epilepsy with the metabolic disturbance of diabetic ketosis in some way acting as the trigger mechanism.

SUMMARIO IN INTERLINGUA

Convulsiones Durante Cetosis Diabetic: Reporto de Un Caso

Un femina de quaranta-sex annos de etate con un breve historia de symptomas diabetic disveloppava sever cetosis e deveniva comatose. Ante e durante le tractamento, illa habeva un serie de major accessos epileptic, occurrente in le curso de un periodo de dece-duo horas sed non associabile con ulle causa apparente. In le absentia de altere morbo, il pare que le accessos esseva debite a latente epilepsia idiopathic e que le disturbation metabolic de cetosis diabetic ageva in un maniera o un altere como mechanismo precipitatori.

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EDITORIALS

DIABETIC NEUROPATHY

Although the neurologic manifestations have been recognized in diabetes since 1864, they have not received the detailed analysis usually given to other neurologic conditions. Because of their frequency they are entitled to more attention. Among the twenty million estimated diabetics throughout the world undoubtedly there are probably hundreds of thousands of cases of "diabetic neuropathy." The latter term is generally applied rather loosely, referring to involvement of peripheral nerves only (in the previous sense of "neuritis") in some instances and to more widespread involvement (both motor and sensory) emanating from spinal cord lesions in others. Garland urges that the designation neuropathy be restricted to disorders of the peripheral nerves leaving "myelopathy" for cases in which the cord alone is involved.

In 1953, Garland and Taverner reported three diabetic patients suffering from a purely motor disorder which appeared to them to be a syndrome probably of cord origin. The patients were over fifty years of age and gave a recent history of diabetes of mild degree. The neurologic picture was limited to the legs and included diffuse pain, weakness, atrophy and areflexia, and usually it was asymmetrical. Other features which appeared less constantly were extensor plantar responses, an elevated protein content of the cerebrospinal fluid, and electromyographic changes in the affected muscles. In none was there any sensory loss. The condition was found only in patients who, though usually being treated, had not been strictly regulated. At the same time manifestations were largely or totally reversible.

Subsequently, Garland reported twelve cases suffering from this neurologic entity (*British Medical Journal*, Nov. 26, 1955). The findings were not always limited to the lower extremities, the upper extremities being affected occasionally. Because the manifestations were not always uniform the author selected the term "diabetic amyotrophy" in preference to myelopathy to describe this condition. Although most of the author's cases had been overlooked, probably because it does not coincide with other more readily recognizable neuropathies, the syndrome is by no means rare. Other diagnoses which were tentatively considered by referring physicians in these cases were sciatica, lumbar arthritis or motor neurone disease. The condition is always reversible with the achievement of total diabetic control. Recovery is somewhat hastened by use of exercise, calipers and crutches.

Garland stresses the use of electromyography as a diagnostic aid. Affected muscles showed electromyographic changes in all cases which are subject to wide variations suggesting a cord lesion in some cases but not