Case reports

Convulsive syncope resulting from arrhythmia in a case of congenital deafness with ECG abnormalities

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In 1957, Jervell and Lange Nielsen[1] described a rare syndrome characterized by congenital bilateral deafness, attacks of unconsciousness, and prolongation of the Q-T time in the electrocardiogram (ECG). We consider it useful to describe a female patient who showed the characteristics of this syndrome. The attacks of unconsciousness in this case proved to result from cardiac arrhythmia.

Case report

History. The patient was an 8-year-old girl with deafness since infancy which necessitated the use of a hearing aid. Diabetes insipidus had become manifest at the second year of life. When the child was about 30 months old she had suffered a syncope characterized by acute pallor followed by a convulsion. The face demonstrated flushing after this attack. The attack had since recurred several times at varying intervals and the frequency had increased in the sixth year of life. The intensity of the attacks varied from something resembling a momentary lapse to attacks of the grand mal type with generalized clonic contractions. Neurological examination had never disclosed unmistakable abnormalities. Administration of phenobarbital, trimethadione, and amphetamine resulted in temporary improvement.

The frequency of the attacks increased again in the eighth year of life, and the patient was admitted to an epileptic center for further examination. While an electroencephalogram (EEG) was being recorded the patient had an attack, and the pulse became irregular. A simultaneously recorded ECG showed the characteristics of ventricular tachycardia, turning into ventricular fibrillation. In view of these findings the patient was transferred to our hospital for further observation.

Examination. The patient was a girl who showed retardation of growth (height, 119 centimeters; weight, 24.4 kilograms). She suffered from bilateral deafness and used a hearing aid; her speech was normal. The pulse was irregular. The blood pressure, as measured in the upper arm, was 110/80 mm. Hg. There were no symptoms suggestive of heart failure. A soft systolic murmur was heard over the heart. The heart sounds were normal. This examination revealed no further abnormalities.

Laboratory data. Urine tests for protein, glucose, urobilin, and bilirubin yielded negative results. There were no abnormalities in the sediment, and no aminoaciduria. There was polyuria (2 to 5 L. per 24 hrs.); the specific gravity was 1.005 Gm. per milliliter. The pattern of diuresis did not change following administration of pitressin. The creatinine clearance was 30 ml. per minute. Blood tests yielded the following results: hemoglobin, 12.3 Gm. per 100 ml.; leukocyte count, 8,500 per cubic millimeter with normal differential count; erythrocyte sedimentation rate, 9 mm. after one hour; urea, 0.49 Gm. per liter; creatinine, 9 mg. per liter; calcium, 5 mEq. per liter; phosphorus, 51 mg. per liter; electrolytes, normal; glucose tolerance test, normal; bilirubin, 3 mg. per liter; alkaline phosphatase, 297 millimoles per minute per liter; thymol turbidity, 0.35 U.;

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transaminase activity, normal; protein pattern, undisturbed; cholesterol, 2.48 Gm. per liter; uric acid, 74 mg. per liter; antistreptolysin titer, normal; toxoplasma tests, negative; lupus erythematosus test, negative; rheumatoid arthritis tests, normal; syphilis serology, negative. Arterial blood gas analysis produced normal values.

Electrocardiogram. There was sinus rhythm with some sinus arrhythmia and many multifocal ventricular extrasystoles. The Q-T time was unequivocally prolonged: 0.62 sec. at a heart rate of 56 per minute. In the precordial leads from VI through V_5 the T deflection was negative (Fig. 1).

Phonocardiogram. A normal first sound was followed by a fusiform murmur, mainly of medium frequency and ending prior to the inconstantly split second sound. A low to medium frequency atrial sound was observed over the apex. The arterial and venous pulse and apex tracings were normal.

Radiographs. A chest x-ray showed no pulmonary abnormalities. The heart shadow was not enlarged.

Otological examination. Bilateral perceptive deafness (average 60 db.) was found.

Ophthalmological examination. No abnormalities were found.

Family study. The patient was from a family with four children, all in good health. There was no consanguinity and no history of particular disease, especially no deafness or convulsions. The ECG was found normal in all these individuals, as were the creatinine and uric acid values in the blood.

Observation report and supplemental studies. Attacks were observed from the first day after the child's admission. At the onset of an attack the girl began to cry, and a brief syncopal attack usually followed after a few seconds. At that moment the face was pale. In more protracted attacks convulsions occurred, sometimes with urinary incontinence. As consciousness returned, the face briefly assumed a bright red color. The pulse was rapid at the onset of the attack, and subsequently was no longer perceptible.

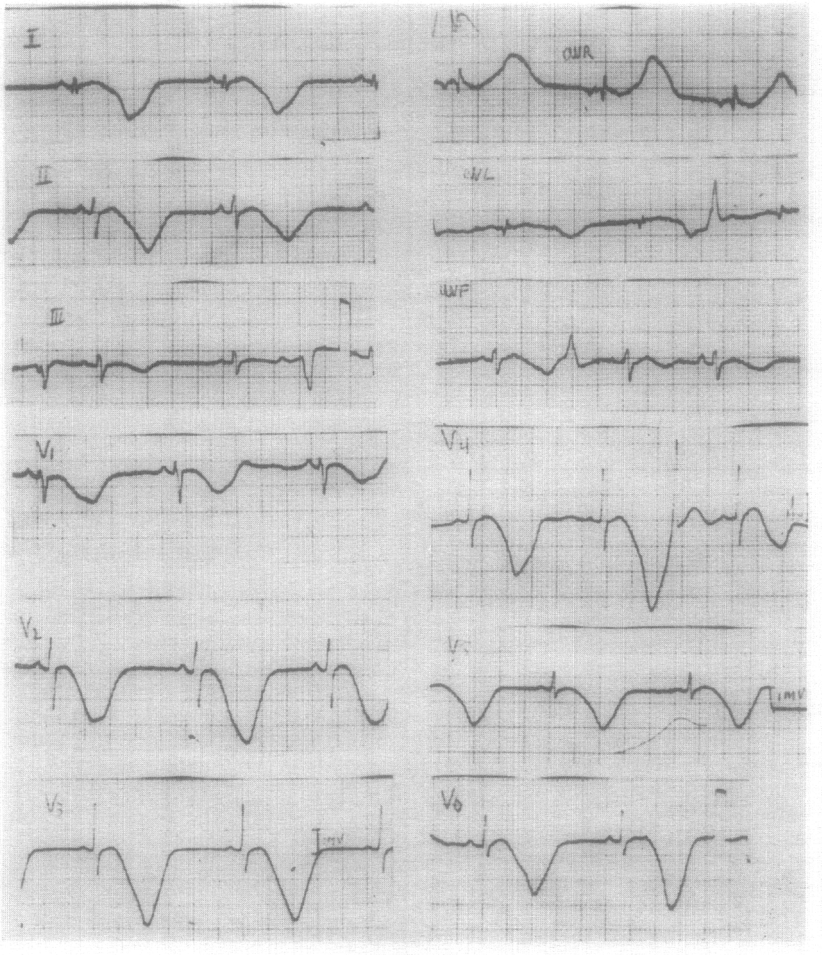

Fig. 1. ECG after admission. Sinus rhythm with very long Q-T time and broad negative T waves in the standard leads AVL and the precordial unipolar leads. A few supraventricular extrasystoles in Lead III show aberrant conduction.

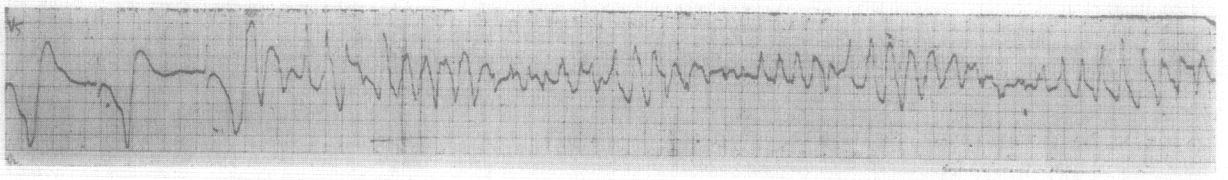

Fig. *2*. ECG during syncope. Sinus rhythm and ventricular fibrillation after a ventricular extrasystole.

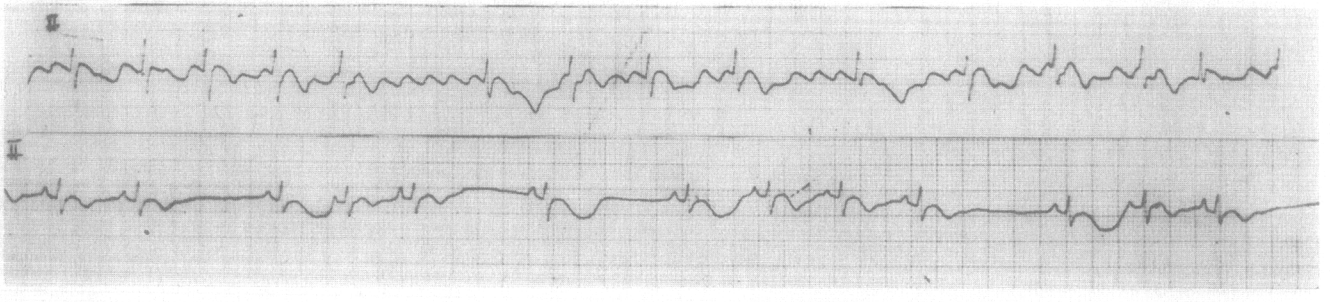

Fig. *3*. (Top) Atrial flutter with varying A-V block and normal intraventricular conduction (top curve); sinus rhythm with pronounced sinus arrhythmia. (Bottom) ECG during syncope. Sinus rhythm and ventricular fibrillation after a ventricular extrasystole.

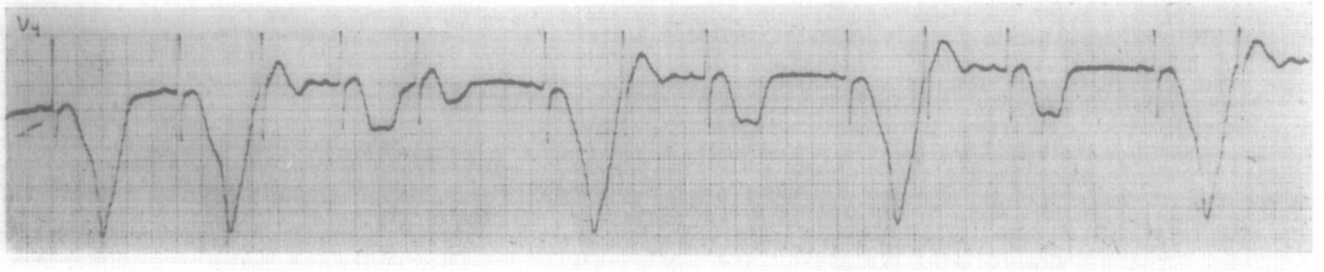

Fig. *4*. ECG: Sinus rhythm with pronounced sinus arrhythmia; varying width, shape, and amplitude of T waves.

An ECG recorded during an attack disclosed the features of ventricular tachycardia with coarse ventricular fibrillation (Fig. 2). As a rule the ECG showed bizarre features with multiple ventricular extrasystoles originating from several foci. Moderate sinus tachycardia existed following an attack. In general there was a sinus rhythm with normal A-V conduction, but on two occasions an atrial flutter (330 per minute) with varying A-V block was recorded (Fig. 3). A pronounced sinus arrhythmia sometimes occurred (Fig. 3, bottom curve). The depth and shape of the T waves varied greatly, not only at different times but also during a single recording. There seemed to be some correlation with the length of the preceding diastole (Fig. 4). In the precordial leads the T waves were usually large, pointed, and negative.

In view of the nature of the ECG changes with predominance of heterotopic impulse formation, the child was treated with quinidine sulfate and Atarax. On the third and fourth day of this medication, very frequent attacks, with the mentioned arrhythmias, occurred for hours. After discontinuation of the quinidine sulfate medication, attacks diminished.

Administration of digitalis, prednisone, adenosine triphosphate, insulin with additional glucose administration, and phenobarbital never had any distinct effect.

Further studies had meanwhile revealed that the polyuria had to be of renal origin, in view of the disturbed concentrating function following fluid restriction and the negative result of pitressin administration. The nature of the renal disorder was not established. The creatinine clearance of 30 ml. per minute indicated distinct renal insufficiency. Because of the arrhythmia only a superficial investigation could be done.

Biochemical studies revealed marked hyperuricemia, which of course may have resulted from the disturbed renal function. There was no family history of gout. The possibility of a primary gout, however, cannot be ruled out. Gout is known to be associated sometimes with cardiac disorders,[2-4] and hyperuricemia has been described in patients with perceptive deafness.[5] Since no treatment so far instituted had been efficacious, we decided to start Benemid medication in increasing doses up to 250 mg. 3 times a day, combined with sodium bicarbonate. This medication was continued for about two months. The attacks rapidly diminished in frequency, and ultimately disappeared completely. Hearing showed distinct subjective improvement. The patient no longer used her hearing aid. The polyuria gradually diminished from an average 3.5 to 2.5 L. per 24 hours, and renal function seemed slightly improved after two months, when the clearance was 47 ml. per minute. The blood uric values were normalized (Fig. 5). The urinary uric acid excretion averaged 310 mg. per 24 hours before institution of treatment. On the third day of treatment the excretion was measured as 1976 mg. per 24 hours. The subsequent urinary excretion averaged 600 mg. per 24 hours.

After two months treatment the unfortunate decision was made to reduce the Benemid dosage to 250 mg. once a day. The child suffered a fatal attack on the eighth day. The ECG features were those of

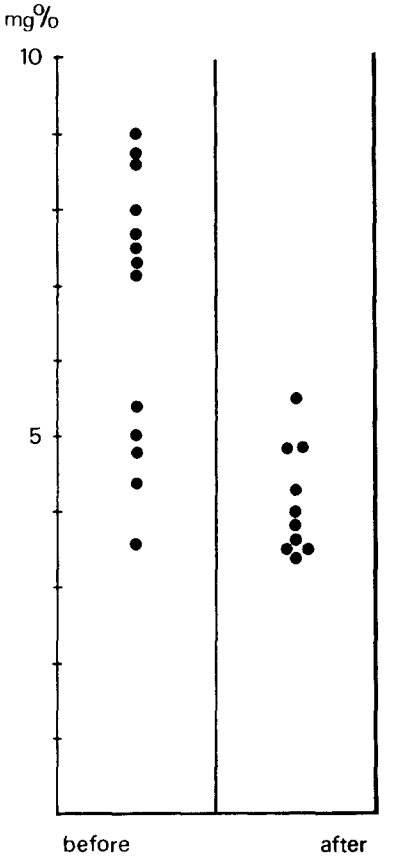

Fig. 5. Blood uric acid values before and after start of Benemid medication.

ventricular fibrillation. Immediate attempts at resuscitation with electrical defibrillation failed.

Postmortem findings. The heart weighed 145 grams. Both ventricles were slightly dilated. The foramen ovale was closed. The endocardium showed no swelling. Valves and ostia appeared to be normal. No focal abnormalities were found in the myocardium. The left kidney weighed 35 grams and the right weighed 85 grams.

Microscopic examination disclosed normal features of myocardial tissue. The renal sections showed considerable autolysis. Some Bowman capsules were swollen. No other abnormalities were observed.

Discussion

In 1949 Levine and Woodworth[6] examined an 8-year-old male deaf-mute suffering from attacks of unconsciousness. The ECG showed conspicuous prolongation of the Q-T time and varying aberrant shapes of the T waves. Sudden death occurred at age 13.

In 1957 Jervell and Lange Nielsen[1] described a Norwegian family in which four of the six children suffered from congenital

bilateral deafness and syncopal attacks in which the ECG showed a prolonged Q-T time. Three of these children died.

An ECG study among children with bilateral perceptive deafness in English and Irish institutions made by Fraser and associates[7,8] disclosed nine cases with significantly prolonged Q-T times. Eight of them had a history of syncopes. An attack was observed in two children, in one of whom the pulse could not be felt during a full minute.

More patients with this syndrome have since been described,[9,10] bringing the total number of known cases to 18.

Recently, moreover, there have been reports[11-13] on patients with syncopes whose ECG's showed the characteristic Q-T prolongation and T changes although they had normal hearing. It is of interest that an ECG recorded during an attack showed ventricular fibrillation in two of these cases. Ventricular extrasystoles were observed in another child.

In our patient, the syncopes which had the clinical characteristics of Stokes-Adams attacks were caused by ventricular flutter and ventricular fibrillation. Between attacks, moreover, there were ventricular extrasystoles and supraventricular arrhythmic disturbances which had not been previously observed in patients with this syndrome.

We consider it plausible that the syncopes reported in the literature were based on a similar mechanism. In view of the close similarities of ECG changes between our case and those described by Romano, Ward, and Barlow, it is attractive to suppose that their cases, too, were instances of the syndrome described by Jervell and Lange Nielsen. Thus the cardiac anomaly would not per se be linked with the hearing disorders, which may imply that all these cases are based on the same genotypical abnormality, but with varying forms of expression. The remarkable fact remains that no arrhythmia has so far been observed in the cases with deafness.

The significance of the hyperuricemia in our patient and the protracted clinical improvement during Benemid medication is not easily established because the observations concern only a single patient. Other authors, however, obtained normal blood uric acid values in two cases. Nevertheless, the hyperuricemia might have a central position in the syndrome described.

Summary

A description is given of an 8-year-old girl with the syndrome of Jervell and Lange Nielsen consisting of congenital deafness, prolonged Q-T time in the ECG, and attacks of unconsciousness. In addition there were extrasystoles, ventricular tachycardia, ventricular fibrillation, and atrial flutter.

The syncopes proved to be based on circulatory insufficiency as a result of ventricular fibrillation.

The child suffered in addition from diabetes insipidus on the basis of a disturbance in renal function, and hyperuricemia was repeatedly found. The girl died as a result of an attack of ventricular fibrillation, after an initial period of considerable clinical improvement upon Benemid medication.

It is suggested that the recently described combination of Q-T prolongation in the ECG and syncopal attacks as a result of ventricular fibrillation must be regarded as the same genotypical entity. The possibility is mentioned that this case may have presented a symptom complex in association with hyperuricemia.

REFERENCES

1. Jervell, A., and Lange Nielsen, F.: Congenital deaf-mutism, functional heart disease with prolongation of the QT-interval and sudden death, Am. Heart J. **54**:59, 1957.
2. Pund, E. E., Hawley, R. L., McGee, H. J., and Blouns, S. G.: Gouty heart, New England J. Med. **263**:835, 1960.
3. Frant, F., Knight, A. A., and Szanto, P. B.: Specific vascular changes in gout, J. A. M. A. **156**:591, 1954.
4. Prinzmetal, M., and Kennamer, R.: Emergency treatment of cardiac arrhythmias, J. A. M. A. **159**:1049, 1954.
5. Société Internationale d'audiologie: 11e Congrès ordinaire, Paris, Jan. 22-23, 1955.
6. Levine, S. A., and Woodworth, C. R.: Congenital deaf-mutism, prolonged QT-interval, syncopal attacks, and sudden death, New England J. Med. **259**:412, 1958.
7. Fraser, C. R., Frogatt, P., and James, T. N.: Congenital deafness associated with electrocardiographic abnormalities, fainting attacks, and sudden death, Quart. J. Med. (n. s. XXXIII) **131**:361, 1964.

8. Friedman, J., Fraser, G. R., and Frogatt, P.: Pathology of the ear in the cardioauditory syndrome of Jervell and Lange Nielsen (recessive deafness with electrocardiographic abnormalities), J. Laryng. & Otol. **80**:451, 1966.
9. Jervell, A., Thingstad, R., and Endsjö, Th.: The surdo-cardiac syndrome: three new cases of congenital deafness with syncopal attacks and QT prolongation in the electrocardiogram, AM. HEART J. **72**:582, 1966.
10. Lisker, S. A., and Finkelstein, D.: The cardio-auditory syndrome of Jervell and Lange Nielsen: report of an additional case with radioelectrocardiographic monitoring during exercise, Am. J. M. Sc. **106**:458, 1966.
11. Romano, C., Gemme, G., and Pongiglione, R.: Aritmie cardiache rare dell'eta peadiatrica, Clin. pediat. **45**:656, 1963.
12. Ward, O. C.: A new familial cardiac syndrome in children, J. Irish M. A. **54**:103, 1964.
13. Barlow, J. B., Bosman, C. K., and Graiq Cochrane, J. W.: Lancet **II**:531, 1964.