Quebec Cooperative Study of
Friedreich's Ataxia

# Clinical and Electronystagmographic findings in Friedreich's Ataxia.

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SUMMARY: *A thorough investigation of vestibular function has been carried out in 16 patients with typical Friedreich's ataxia. Electronystagmography and caloric tests revealed a number of inconstant abnormalities. Most abnormal findings were related to ocular dysmetria, disorganized pursuit and square waves.*

RÉSUMÉ: *Une étude complète des fonctions vestibulaires a été accomplie chez 16 patients avec ataxie de Friedreich typique. L'électronystagmographie ainsi que les tests caloriques ont révélé un certain nombre d'anomalies, mais de façon inconstante chez les mêmes patients. Les résultats les plus anormaux concernent la dysmétrie oculaire, la poursuite irrégulière du pendule et des ondes carrées.*

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## INTRODUCTION

In the course of the present Quebec collaborative study on Friedreich's ataxia, we have examined oculovestibular function in some cases of Friedreich's ataxia previously reported (Geoffroy et al., 1976). Only a few cases of this disease have had a thorough clinical and electronystagmographic (ENG) investigation. Baloh et al., (1975) have reported vestibulo-ocular function in five cases of Friedreich's ataxia.

## MATERIALS AND METHODS

### *Patients*

Our series includes sixteen patients suffering from Friedreich's Ataxia. Fourteen of them belong to the previous study (group Ia, typical Friedreich's ataxia, complete picture). Two new cases have been added. All of them have the complete picture of typical Friedreich's ataxia and have undergone the diagnostic clinical, neurological and biochemical investigation proving their disease.

The techniques and the parameters used for electronystagmography (ENG) are those suggested by Barber and Stockwell (1976). The apparatus was a mingograph "800 Siemens" with 4 channels (2 AC and 2 DC).

## RESULTS

### *Clinical Vestibular Assessment*

The clinical part of the vestibular study was performed by one of us (B.L.) and the findings are in Table 1. None of the patients complained of vertigo, while nystagmus was found in five patients and partial deafness in one.

### *ENG Study*

A) Nystagmus (Tables 1 and 2)

Gaze nystagmus was frequent (9/16) (Table 1), being present in six patients for horizontal gaze and in 9 patients for vertical gaze. This is similar to the reports of other authors (Baloh et al., 1976).

No spontaneous nystagmus was found in any of the patients, while positional horizontal nystagmus was found in 4. Vertical nystagmus was found in 7 patients. (Table 2).

Finally, there was no rebound nystagmus. This sign is frequently described as of cerebellar origin (Zee et al., 1976). Also, there was no periodic alternating nystagmus as previously described by Gorman and Brock (1950).

B) Calorics (Table 3)

Most of the patients had normal calorics. Like other authors (Baloh et al., 1975; Thibaut and Gruner, 1961), we found a bilateral weakness (the sum of the four calorics being smaller than 40°/sec in four patients with a unilateral weakness in one patient), but in no patient did we find an absence of response.

C) Oculomotor Disturbances (Table 4)

The most numerous abnormalities were found in this category. Ocular dysmetria and disorganized pursuit were frequent as previously reported (Baloh et al., 1975). We could also demonstrate fixation instability in one patient and saccadic slowing in another patient. Six subjects presented bursts corresponding to ocular myoclonus.



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TABLE 1 CLINICAL AND ENG DATA IN FRIEDREICH'S ATAXIA

| CASE NO. | AGE | AGE OF ONSET | VERTIGO | DEAFNESS | CLINICAL NYSTAGMUS | POSITIONAL NYSTAGMUS (ENG) 1* | 2* | 3* | 4* | 5* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 16 | 4 | 0 | 0 | + | 0 | 0 | 0 | + | 0 |
| 2 | 12 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 |
| 3 | 11 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 |
| 4 | 15 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 |
| 5 | 10 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 16 | 7 | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 |
| 7 | 7 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 |
| 8 | 17 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | 28 | 8 | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 |
| 10 | 23 | 7 | 0 | 0 | + | + | 0 | 0 | 0 | 0 |
| 11 | 14 | 9 | 0 | 0 | 0 | + | 0 | 0 | + | 0 |
| 12 | 19 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | 26 | 15 | 0 | + | + | 0 | 0 | 0 | + | 0 |
| 14 | 19 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 30 | 7 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 |
| 16 | 26 | 7 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 |

*ENG 1: Positional nystagmus with eyes closed - Direction fixed.
2: Positional nystagmus with eyes closed - Direction changing.
3: Positional nystagmus - Direction changing in a single head position.
4: Vertical nystagmus upward (with eyes closed).
5: Vertical nystagmus downward (with eyes closed).

TABLE 2 ENG DATA IN FRIEDREICH'S ATAXIA

| CASE NO. | BILATERAL GAZE NYSTAGMUS | UNILATERAL GAZE NYSTAGMUS | REBOUND NYSTAGMUS | PERIODIC ALTERNATING NYSTAGMUS | UPBEATING NYSTAGMUS E.O. | E.C. | DOWNBEATING NYSTAGMUS E.O. | E.C. | SQUARE WAVES E.O. | E.C. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + | + |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + |
| 3 | 0 | + | 0 | 0 | + | 0 | 0 | 0 | + | 0 |
| 4 | + | 0 | 0 | 0 | 0 | + | 0 | 0 | + | + |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 |
| 6 | 0 | + | 0 | 0 | 0 | 0 | + | 0 | + | + |
| 7 | 0 | 0 | 0 | 0 | 0 | + | 0 | 0 | + | + |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + | + |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + | + |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 | + | 0 |
| 11 | 0 | + | 0 | 0 | + | + | 0 | 0 | + | + |
| 12 | 0 | + | 0 | 0 | 0 | 0 | + | 0 | + | + |
| 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + | + |
| 14 | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 | + | + |
| 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + | + |
| 16 | 0 | + | 0 | 0 | 0 | 0 | + | 0 | + | + |

TABLE 3 CALORIC DATA IN FRIEDREICH'S ATAXIA

| CASE NO. | NORMAL RESPONSE | NO RESPONSE | UNILATERAL WEAKNESS | BILATERAL WEAKNESS | DIRECTIONAL PREPONDERANCE | HYPERACTIVE RESPONSE | FAILURE OF FIXATION SUPPRESSION | PREMATURE CALORIC REVERSAL |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | + | 0 | 0 | 0 | 0 | 0 |
| 2 | + | 0 | 0 | 0 | + | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | + | 0 | 0 | 0 | + |
| 5 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | + | 0 | 0 | 0 | 0 | 0 | + | 0 |
| 10 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 | + | 0 | 0 | 0 | 0 |
| 13 | + | 0 | 0 | 0 | + | 0 | 0 | + |
| 14 | 0 | 0 | 0 | + | + | 0 | 0 | 0 |
| 15 | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | + | 0 | 0 | 0 | 0 | 0 | + | 0 |

D) Other Parameters

In two instances there was a failure of fixation suppression (FFS) during the calorics and in two other cases there was a reversal in the calorics (Table 3).

Square waves are often described as a cerebellar or central nervous system sign (Barber and Stockwell, 1976). We recorded 15 patients producing square waves with eyes open and, with eyes closed, 13 patients (Table 2).

## DISCUSSION

The interesting aspect of this study was that we had a large number of patients with proven typical Friedreich's ataxia. Nystagmus has been described as one of the initial findings (Thibaut and Gruner, 1961) and, according to Tyrer (1975), it was part of the clinical picture in several of Friedreich's original patients. However, this sign is considered an inconstant late manifestation. All sixteen patients have undergone an E.N.G. examination. Our intention was to find out whether: 1) a nystagmus was present, 2) the peripheral vestibular apparatus was functioning normally, 3) and also to detect the oculo-motor disturbances which can usually be pointed out by the E.N.G. technique.

Positional nystagmus is not a specific finding, but is only indicative of a vestibular disturbance. On the other hand, a positional nystagmus changing direction in one single head position points towards a central lesion (one case) (Barber and Stockwell, 1976). Gaze nystagmus is common among patients presenting with central nervous system disease, especially when it is bidirectional (only one patient) and vertical (9 patients). As seen in Table 2 a number of patients presented with upbeating or downbeating nystagmus, especially with eyes closed. On the other hand, cerebellar rebound nystagmus was not found in any patient nor was periodic alternating nystagmus.

Only one patient had a unilateral



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caloric weakness and four had bilateral caloric reduction. Usually a unilateral decrease suggests peripheral vestibular pathology. Bilateral loss is not as specific because it can be encountered in a bilateral peripheral or a central lesion. Barber and Stockwell (1976) also mention "saccadic defect" as a possible cause of bilateral weakness.

Ocular dysmetria is more frequently seen in cerebellar disease, while disorganised pursuit is a more generalized central abnormality. Fixation instability was recognized by a severe inability of one patient to calibrate. This patient's eyes succeeded only in making many hopeless erratic saccades in order to reach the calibration lights.

Another feature was what has been called ocular myoclonia. They consist of coordinated small or large quick to-and-from jerks of both eyes in rapid succession, mostly occurring in series with irregular pauses. Ocular myoclonias differ from nystagmus in the lack of slow phases and in high frequencies, up to 13/sec. Ocular myoclonus has been described in acute encephalitis. The bursts found in 6 of our tracings fitted the description above. It is sometimes seen in the course of a regular tracing, but this is rare. The fact that it was present in six tracings and that it repeated itself more than once in a single examination brought this pattern to our attention.

Failure of fixation suppression, one of the most certain central E.N.G. signs was found in two patients. The premature reversal of caloric nystagmus (with water irrigation) is mentioned here, although it was border-line in one case, i.e. appearing at 137 seconds, its slow phase being 7 degrees per second. The other case appeared at 128 seconds with a slow phase at 6 degrees per second. This sign is considered indicative of central nervous system disease when it reverses before 140 seconds after the onset of the irrigation (Barber and Stockwell, 1976).

Square wave jerks were present in amost all cases. In some examinations they covered the entire tracing, while in others they appeared more irregularly. This pattern is sometimes seen in normals. It is also a central nervous system sign and especially a cerebellar sign. Since our patients showed many other oculomotor abnormalities, we considered this pattern pathological. Finally, optokinetic nystagmus was not investigated during the course of our E.N.G. evaluation.

TABLE 4 SACCADE AND TRACKING TESTS IN FRIEDREICH'S ATAXIA

| CASE NO. | FIXATION INSTABILITY | OCULAR DYSMETRIA | | SACCADIC SLOWING | DISORGANIZED PURSUIT |
|---|---|---|---|---|---|
| | | OVERSHOOTING | UNDERSHOOTING | | |
| 1 | 0 | + | + | 0 | + |
| 2 | 0 | + | + | 0 | 0 |
| 3 | 0 | + | + | 0 | + |
| 4 | 0 | 0 | + | 0 | + |
| 5 | 0 | + | 0 | 0 | + |
| 6 | 0 | + | 0 | 0 | + |
| 7 | 0 | 0 | 0 | 0 | 0 |
| 8 | 0 | + | + | 0 | + |
| 9 | + | + | 0 | 0 | + |
| 10 | 0 | + | + | 0 | + |
| 11 | 0 | + | + | 0 | + |
| 12 | 0 | 0 | + | + | + |
| 13 | 0 | + | 0 | 0 | 0 |
| 14 | 0 | + | 0 | 0 | + |
| 15 | 0 | + | + | 0 | + |
| 16 | 0 | + | 0 | 0 | + |

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