

THE DIAGNOSIS OF CHRONIC LATENT TETANY IN ADULTS.

(With special reference to a Hyperventilation Test).

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THE diagnosis of acute tetany rarely presents difficulty as the symptoms and signs are characteristic. Where, however, a patient has a lowered serum calcium over a long period the usual tetanic manifestations are trivial, atypical or even absent. The diagnosis then depends on the history, which may be misleading, the presence of an underlying disease which predisposes to tetany and signs of latent tetany.

The main object of this paper is to compare the diagnostic value of the standard bedside criteria of latent tetany (Chvostek's and Trousseau's signs) with the response to experimental hyperventilation (O'Donovan, 1943), using patients with a lowered serum calcium. It may safely be assumed that a lowered serum calcium is fairly reliable evidence of latent tetany. There has been no previous serious attempt to apply hyperventilation to the diagnosis of latent tetany. Some individual case-reports of hypo-calcæmic patients have mentioned the apparent hypersensitivity to hyperventilation, but without reference to controls or even to the rate of respiration used.

The clinical material chosen in the present study consisted of nineteen adult patients who had (i) a subnormal serum calcium, (ii) a disease which predisposes to tetany (malabsorption, dietary deficiency or hypoparathyroidism) and (iii) who had a previous history of carpal spasm. Patients diagnosed as having malabsorption include not only examples of gross steatorrhœa but also cases with normal stools and with a history suggesting steatorrhœa perhaps many years previously. The persistence of some degree of enteric disease was confirmed in these cases by general clinical findings and by x-ray examination of the small intestine, such as was reported in a previous communication (O'Donovan, Boland and McGrath, 1942). None of the hypoparathyroid cases included had any form of vitamin D therapy for at least three weeks prior to the time of observation.

Each patient was tested as outlined below on a few separate occasions for the presence of latent tetany. Only a single typical response of each patient is recorded in Table I, but where two very different types of response were observed both are included. None of the patients in this series have been reported previously, except preliminary observations on Case 14.

Erb's phenomenon is not considered here, as it was found unreliable in the type of patient under investigation. A person who has symptoms of tetany almost entirely localised to the face or larynx could

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hardly be expected to have latent tetany in any nerve or muscle tested at random. Furthermore, in a nervous patient the very performance of the test is liable to induce latent tetany owing to hyperventilation. Another source of error is the degree of vascularity of the skin, which will vary while doing the test and therefore cause variations in the minimal electrical response. It has the further disadvantage that it cannot readily be carried out in general practice. It will be considered fully in a later publication.

Methods of Investigation.

The serum calcium was estimated by the method of Clarke and Collip and the normal range in twenty-three adults was 9.5 to 11.7 mgs. per cent. Chvostek's sign was graded in three degrees of intensity: plus 3 being a spasm of the whole side of the face; plus 2 being a coarse twitch involving the angle of the mouth and the ala nasi; plus 1 being limited to the angle of the mouth. Feeble and inconsistent reactions seen on the upper lip near the middle line (trace response) were ignored as they are seen so frequently in normal people.

Trousseau's sign was done with a tourniquet applied for not more than 4 minutes or until spasm of the hand was characteristic. The pressure used was sufficient to occlude the pulse. Usually the reaction was studied on one arm only, as there may be a refractory period for a variable length of time after the initial spasm when no further contraction can be elicited either by the re-application of the tourniquet or by hyperventilation. If both arms are therefore tourniqueted initially and bilateral spasm induced, the reaction in the hands to hyperventilation may be negative. To eliminate further the possibility of the refractory phase it is advisable to apply the tourniquet only just until the first appearance of characteristic spasm.

The general procedure and method of experimental hyperventilation has already been described (O'Donovan, 1943). A respiratory rate of 55-60 per minute does not produce tetany in a normal person in less than 120 seconds. The onset of some objective sign of tetany within 120 seconds is therefore considered evidence of latent tetany. This standard is now based on the response of 109 young adult females. (Normal males are much less sensitive.) It was originally decided to delay the hyperventilation test until about 15 minutes after the release of the tourniquet, lest the pain and discomfort of the latter may have provoked some degree of hyperventilation. This proved by experience to be an unnecessary precaution, and later, for reasons discussed below, the hyperventilation test was started almost immediately after release of the tourniquet in patients who did not show a positive tourniquet reaction (combined test).

Calcium gluconate was given intravenously in a few cases to observe if some atypical manifestation observed with hyperventilation would be abolished when the hyperventilation was repeated after the injection. This test was used to confirm that such atypical responses were tetanic in nature. The dose of calcium gluconate was roughly 1 ml. of 10 per cent. solution per 5 lbs. body-weight; this was injected slowly over 3-5 minutes, and no alarming reactions were experienced. The inhibitory effect of the injection on the reactions to the tests for latent

tetany were also studied in some cases. It is advisable to wait at least 10 minutes for the full inhibitory effect of intravenous calcium. The increase in the serum calcium 15 minutes after this injection in 7 hypocalcæmic patients averaged 2.5 mgs. per cent. (max. 4.0, min. 1.3).

TABLE I.

Patient	Age and Sex	Disease	NORMAL LIMITS.				No. of observations
			9.5—11.7 mgs. %	Nil or +1	Nil	Nil before 120 sec.	
			Serum Calcium	Chvostek	Trousseau	Hyperventilation	
1A	37 F.	Malabsorption	8.1	Neg.	Neg.	+ 90 sec.	2
1B	"	"	8.8—9.1	Neg.	Neg.	Neg.	3
1C	"	"	8.8	Neg.	+ 60 sec.	+ 65 sec.	1
2	27 F.	"	6.6	+3	+ 30 sec.	+ 50 sec.	4
3	70 F.	Malabsorption and Fractured Hip.	6.5	Neg.	+ 70 sec.	Not Done	2
4	29 M.	Malabsorption	5.3	+2	Neg.	Neg.	2
5	48 F.	"	7.5—8.8	Neg.	+ 80 sec.	Neg.	3
6	42 F.	"	8.0	Neg.	+ 90 sec.	+ 65 sec.	3
7A	15 M.	"	9.0	+3	+ 120 sec.	Neg.	1
7B	15 M.	"	8.5	+1	Neg.	Neg.	1
8A	17 F.	"	6.8	Neg.	+ 90 sec.	Neg.	1
8B	17 F.	"	7.9	Neg.	Neg.	Neg.	4
9	46 F.	"	7.3	+ 1 or neg.	Neg.	Neg.	5
10	17 M.	"	9.0	Neg.	Neg.	Neg.	1
11	22 F.	Dietary Deficiency.	5.4	Neg.	+ 4 min.	+ 75 sec.	4
12	24 F.	Hypoparathyroidism.	6.2—8.0	+ 3 R. + 1 L.	+ 60 sec.	+ 50 sec. Laryngospasm.	5
13	28 F.	"	7.8	+ 2 R.	+ 90 sec. R., Neg. on L.	+ 60 sec.	3
14A	42 F.	"	6.0—7.8	Neg.	+ 40 sec.	+ 50 sec.	8
14B	42 F.	"	4.0—7.6	Neg.	Neg.	+ 60 sec.	3
15	44 F.	"	7.6—8.0	Neg.	+ 45 sec.	+ 40 sec. petit-mal.	5
16A	28 F.	"	6.3	+3	Neg.	+ 55 sec. in face.	2
16B	28 F.	"	7.3	+3	+ 150 sec.	+ 100 sec. in face.	1
						TOTAL	64

R.=Right. L.=Left.

Chvostek's Sign.

The data given in Table I show that Chvostek's sign is a very unreliable sign of chronic latent tetany. In ten patients in whom the serum calcium was low it was usually negative. In five patients it was in general agreement with the other indications of tetany (2, 7, 12, 13, 16). In Case 4 it was in more consistent agreement with the serum calcium than either the tourniquet or hyperventilation tests.

The author has noticed that the Chvostek reaction is frequently negative during a severe attack of tetany, or in any patient with latent tetany who complains of tightness of the face. Presumably increased tonus of the facial muscles prevents the appearance of the typical response. Another objection to the test is that it is an index not alone of latent tetany but also of recent tetany. This can be deduced from the daily reaction of a patient recovering spontaneously or responding to treatment. Chvostek's sign is the last sign of tetany to disappear, sometimes long after the serum calcium has attained the normal level. Also, intravenous injection of calcium does not alter a positive Chvostek reaction, as was shown in four cases (2, 12, 13 and 16).

The real clinical value of Chvostek's sign in adults must depend on the intensity of the reaction. Grade I is sometimes seen in nervous subjects or normal students and it has no clinical significance. The author has noted that such students do not develop tetany with experimental hyperventilation before others who have an initial negative facial response. A plus 2 or 3 reaction is, however, rarely if ever seen in normal adults and it probably signifies the presence or recent presence of latent tetany, since it is reduced to nil or plus 1 by adequate vitamin D therapy. This latter observation was confirmed on five patients (2, 7, 12, 13 and 16). The above conclusions are not quite so pessimistic about the value of Chvostek's sign as those of Graham and Anderson (1924) working with children of 5 to 15 years. They concluded it had little significance in diagnosis. It is of course more reliable in acute or recent tetany, and some of the above patients had a history of plus 3 reaction at first which gradually disappeared.

Trousseau's Sign or Tourniquet Test.

Trousseau's sign appears to be a more reliable index of chronic latent tetany, as it was positive in 41 observations on 13 patients. It was, however, negative in 23 observations on 8 patients (1, 4, 7B, 8B, 9, 10, 14B and 16A). The positive response was not completely abolished even one hour after intravenous calcium injection although it was delayed and diminished in intensity (patients 2, 3, 11, 12, 13, 14A and 15).

The major advantage of Trousseau's sign is that it is easy to carry out, and although it may be absent in some cases of well established latent tetany it is strong evidence of latent tetany when it is positive. A possible source of error may be its unilateral distribution, as exemplified in patient 13. She had bilateral carpal spasm in her spontaneous attacks, but the cramps were more severe in the right arm. On repeated examination she did not give a positive Trousseau response in the left arm, while the right arm was very sensitive.

The Hyperventilation Test.

This test was relatively accurate in the detection of chronic latent tetany, being in complete agreement with the level of serum calcium in 41 observations on 9 patients (1, 2, 6, 11, 12, 13, 14, 15 and 16). It was negative in 3 cases where the serum calcium was just subnormal (1B, 7, 10), suggesting that it is not a sensitive sign in mild cases. It was also negative in 4 patients (15 observations) in whom the serum

calcium was definitely subnormal (4, 5, 8 and 9), while the Trousseau sign was consistently positive in only one of these patients (No. 5). The failure of the hyperventilation test in this patient could be attributed to chronic bronchitis and emphysema, which prevented full aëration of the lungs. It is notable that in 14 observations on 6 patients both hyperventilation and tourniquet tests failed to confirm the existence of latent tetany (1B, 4, 7B, 8B, 9 and 10).

A striking feature of the hyperventilation response was the prompt return to normal after intravenous calcium salts. This was demonstrated successfully more than once on seven cases (1A, 2, 11, 13, 14A, 14B and 16), but in one instance (No. 15) although the serum calcium was pushed to 10·1 mgs. per cent. and 9·0 mgs. per cent. in two experiments she still remained abnormally sensitive to hyperventilation, *e.g.*, carpal spasm in 40 seconds before and 70 seconds after injection.

Certain difficulties are inherent in the test, as it needs some co-operation by the patient, and it is therefore of little value in children. In Case 2 it could not even be attempted as the patient had a fractured hip. It is, however, readily carried out in most cases with ease, and there is no real inconvenience to the patient if it is stopped within 10 seconds of the first appearance of obvious spasm. Any temporary discomfort can be cut short by placing a towel over the patient's mouth so that CO₂ is retained, although this is rarely necessary. The only instance in which a disturbing type of response was experienced occurred in Case 12, in whom a laryngeal spasm gave rise to noisy respiration.

It has the advantage over other tests that it picks out the part of the body most sensitive to tetany. This is exemplified by Case 16, in whom spontaneous attacks were mostly localised in her face, and by Case 14B, who throughout one year rarely experienced the usual carpal spasms but instead suffered from repeated attacks of loss of consciousness for short spells. These *petit mal* manifestations were the only symptoms induced by hyperventilation and they did not occur after calcium injection. The test also serves as an instruction to patients on how many of their spontaneous attacks are induced by uncontrolled respiration in periods of stress and emotion.

Combined Trousseau and Hyperventilation Test.

In the course of the above study it was accidentally noted that if the tourniquet reaction was negative and if the hyperventilation test was done immediately after releasing the tourniquet the same arm went into spasm very early and before the opposite arm was affected. It was therefore considered that hyperventilation could be used to elicit an otherwise negative Trousseau phenomenon in a patient with hypocalcæmia.

The combined test was therefore studied in a group of normal controls, consisting of 26 adult females attending hospital for irrelevant diseases, together with 22 female and 10 male medical students. After release of the tourniquet hyperventilation was begun and continued until carpal spasm appeared, but for not longer than three minutes, and at 55-60 respirations per minute. None of the hospital patients developed unilateral carpal spasm before 100 seconds, and

in most cases spasm was bilateral in its onset, although more intense in the previously tourniqueted arm. Seven of the female medical group were much more sensitive and developed unilateral carpal spasm after from 60 to 120 seconds. This difference in the sensitivity of the more intellectual female group was already noted in the earlier control series. It was arbitrarily decided as a temporary standard, pending a more extended study, that the lower limit of normal for the combined test be taken as 80 seconds. The onset of unilateral carpal spasm before this time would therefore signify a state of latent tetany. The limit of 80 seconds was decided on by ignoring those whose respiratory rate tended to exceed 60 per minute.

TABLE II.—COMBINED TEST.
(In Cases with Negative Tourniquet Reaction.)

Patient and Sex	Serum Calc.	Hyperventilation Started after Release of Tourniquet	No. of Observations
1. F.	8.7-9.0	55 sec. (unilateral carpal spasm) ..	4
4. M.	5.8	Nil at 120 sec.	2
7. M.	8.5	45 sec. (unilateral carpal spasm) ..	1
8. F.	7.9-8.0	60-80 sec. (unilat. carpal spasm) ..	3
8. F.	8.3	Nil at 120 sec.	1
9. F.	7.5	70 sec. (unilateral carpal spasm) ..	2
10. M.	9.0	Nil at 120 sec.	1
17. M.	7.5	45 sec. (unilateral carpal spasm) ..	1
17. M.	7.2	50 sec. (unilateral carpal spasm) ..	1
.. ..	8.0	60 sec. (unilateral carpal spasm) ..	1
.. ..	8.7	75 sec. (unilateral carpal spasm) ..	1
18. F.	7.8	45 sec. (unilateral carpal spasm) ..	1
19. M.	6.7	35 sec. (unilateral carpal spasm) ..	1
		16 positive : 4 Negative. TOTAL	20

The combined test was then applied to the patients who had given a negative tourniquet reaction (Table II). In 20 observations on 10 patients this method revealed evidence of latent tetany in 16 instances. Two patients failed to respond, in one of whom (No. 10) the serum calcium was only 0.5 mg. per cent. below normal; he had not experienced any spontaneous cramps during the preceding six months. The second, also a male (No. 4), had had neither spontaneous attacks nor symptoms of tetany during the preceding four months. It is apparent that this test increases the range of sensitivity of the tourniquet reaction fairly considerably.

The following points in technique should be remembered so that results of other workers would be comparable. Hyperventilation should be started within 30 sec. after release of tourniquet. The subject is sitting with hands resting on knees and looking down to avoid distraction. The rate of respiration is controlled by the observer marking time with one hand at the rate of one per second. He may also assist in obtaining complete expiration by keeping his other hand on the subject's shoulder and exerting synchronous pressure. Violent and noisy respirations must be avoided in female subjects; all that is required is an easy continuity of full expiration into the following inspiration. The end-point is reached when the hand

assumes a typical carpal spasm and this must be confirmed by feeling the stiffness of the muscles on moving the thumb.

In male subjects the respiratory movements are more violent; this partly obviates the necessity of having separate sex standards. It is interesting that the most sensitive normal male observed in the control series developed tetany at 85 seconds; this helped to confirm the same limits of normal as established in females. The results on patients also show very little difference in the sexes.

Discussion.

The importance of a simple clinical test for latent tetany is that it indicates the necessity for serum calcium estimation and other special investigations for a possible cause of tetany in patients with a positive reaction. Judged by this standard it is of interest to consider the 64 observations in Table I. In two instances (3 per cent.) the sole evidence of latent tetany was given by Chvostek's sign. In a further 41 instances (64 per cent.) Trousseau's sign was positive, and there was therefore no particular necessity to operate the hyperventilation test. Out of the remaining 22 observations the hyperventilation test was positive in seven instances (11 per cent.) leaving fourteen failures (22 per cent.). Judging by the results in Table II, most of these failures would have been avoided if the combined test had been used, and it is not unlikely that this test would also have been positive in the above seven instances depending on the hyperventilation test. It is therefore apparent that for routine clinical work the hyperventilation test *per se* had little practical value except in atypical cases such as Case 14B. It is, however, of major diagnostic importance if it is carried out immediately after a negative Trousseau sign. This combined test has the added advantage that hyperventilation needs to be continued for only 80 seconds, and the resulting spasm is strictly localised. There is not, therefore, the objection of the possibility of generalised spasms or other disturbing symptoms. The test must, however, be based on a larger group of controls before its real value can be assessed.

TABLE III.

Test	No. of Observations	Positive Reactions	% Positive	% Negative
Chvostek's Sign, Grade II or III	64	18	28%	72%
Trousseau's Sign	64	41	64%	36%
Separate 2 min. Hyperventilation test	62	41	66%	34%
Combined Test	20	16	80%	20%

N.B.—Assuming that the combined test had been done in all cases where Trousseau's sign had been negative, then these two methods alone would reveal latent tetany in 93 per cent. of cases.

A summary of the results with the four tests is given in Table III. It will be noted that Trousseau's sign followed when necessary by hyperventilation appears to confirm the existence of latent tetany in 93 per cent. of cases.

Summary.

A review of 84 clinical examinations for chronic latent tetany in 19 adult patients is reported. Chvostek's sign was found an unreliable index of latent tetany, while Trousseau's sign was much more dependable. Experimental hyperventilation was found approximately as efficient in diagnosis as Trousseau's sign, although it has the disadvantage that it needs the co-operation of the patient. When Trousseau's sign is negative, the use of a fourth test which combines both the tourniquet and hyperventilation is described (the combined test).

There is no single reliable bed-side test for chronic latent tetany, but using all four tests only one patient gave completely negative results. His serum calcium was almost normal and he had no symptoms of latent tetany during the preceding six months.

It is suggested that for routine purposes only three tests are needed: (i) Chvostek's sign; (ii) Trousseau's sign and, where it is negative, (iii) hyperventilation for approximately 80 seconds, starting immediately after release of tourniquet. This combined test was positive in 16 out of 20 instances and it therefore greatly increases the usefulness of the tourniquet test.

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LOCAL AUTHORITY TUBERCULOSIS SCHEMES: SUGGESTIONS FOR THEIR BETTER DEVELOPMENT.

By MORGAN CROWE.

THIS country has, during recent years, become increasingly tuberculosis-minded: many articles dealing with the disease have appeared in this and other journals, and of late frequent criticisms of the way it is tackled are voiced by lay bodies.

It is a disease against which, for more than thirty years, local authorities have adopted special counter-measures described as County or City Tuberculosis Schemes. These have never been of a really comprehensive nature, and it is only within the past few years that attempts have been made to lighten the economic burdens usually associated with this complaint. Their main contribution has been to arrange for diagnosis and treatment, but even in this medical facilities have not been properly used, and there is a general impression that the official services have not won the confidence of doctors or public.