Neurology, Posturology: what kind of advance?

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The birth of Neurology was an act of intelligence. Neurologists have established a link between what they observed clinically at the bedside and what they had learnt from anatomists. A paralysis of the right third pair is associated with a left hemiparesis, immediately the sketches of the nerve cords and centers remind us that these two cords intersect at the midbrain, there are therefore strong reasons to think that these two cords are damaged in this area... That's obvious... that's wonderful!

Yet this anatomo-clinical intelligence has some limitations. It says absolutely nothing about the treatment of the lesion. When I was an extern at the Salpêtrière, in the late forties, we did not know how to treat our patients. When we had finished discussing the diagnosis of a patient, when we had come to an agreement, there was not much else to do than wait for his/her necropsy to check that we had not made a mistake...

Similarly, the anatomo-clinical intelligence says nothing about the patients who do not show a lesion. Apparently, Babinski is the first to have noted this limit in a book he wrote with Froment, and published at the beginning of the Great War (WWI)[1]. But the authors did not give an explanation, they simply distinguished the functional disorders from the mental disorders; were they right?

These original boundaries of neurology have had to be overcome by a series of historical developments, some of which are particularly related to posturology, which entitles us to speak in this field.

The first step forward was made by the French neurologists during WWI. At the front, they were in an expert position, and they did not know how to react with the soldiers having skull injuries, whose lesions had no link with their subjective symptoms. There is no evidence that they do not simulate. This issue has become particularly acute in 1916, in the middle of the war, when soldiers began to desert and military courts sent deserters to the firing squad. In this context, it was impossible not to discuss about the skull injured people. A meeting of the French Neurological Society was held on 6 and 7 April 1916. All the great names of neurology of that time attended: Babinski, of course, Vincent, Villaret, Sicard, Jumentié, Froment, Guillain-Barré, Lortat-Jacob, André Thomas, Bonnier, etc.. All agreed that these patients were all saying the same thing, with the same words, it was unthinkable that they had agreed about what was to be said to doctors... This consensus, reported by Pierre Marie [2, 3],

has a major importance in the evolution of neurology because the logic that underlies this decision, more philosophical than medical, applies to all the patients that give the same clinical picture of a functional disorder: intersubjectivity is the basis of objectivity of functional disorders. Objectivity is no longer the prerogative of the lesion. Any functional patient who states the same subjective symptoms as a series of other patients cannot be rejected in the unintelligible field of lacking objective base diseases.

The scope of this 1916 event may not have been understood all over the world. Otherwise, why should Latin therapists be the only ones interested in functional disorders of the upright postural control system? The book "Posturologie" is translated neither in American nor in Japanese.

Because we lack the necessary knowledge, we will say nothing about the second historic step of neurology due to the discovery of the neurotransmitter role of biogenic amines from the 50s. But this advance is obviously an important one.

The third advance can be dated in 1955, the year when JB Baron submitted his first doctoral thesis on chaotic physiology. After a medical thesis about the heterophoric dizziness, this ophthalmologist wished he could understand the pathophysiology of these disorders, and he began a science thesis [4]. The first step of his protocol was to make an experimental model of heterophoria in animals. The technique used was simple: cutting only a few fibers off an oculomotor muscle would normally lead to a small oculomotor imbalance in animals of experience. In fact, the results proved totally unexpected: A massive unilateral hypertonia of the paraspinal muscles of the animals appeared if, and only if, the snip had led to the emergence of a minimal oculomotor imbalance, less than 4 °. When the oculomotor imbalance was greater than 4 °, the tone of paraspinal muscles was not changed. There was therefore no proportionality between the oculomotor imbalance and the paravertebral hypertonia, the more discreet the imbalance was, the more intense the hypertonia was. Exactly the opposite of what was usually observed.

During more than thirty years, nobody understood this experiment.

Poincaré had indeed discovered the nonlinear dynamic systems in 1889, but that was when he solved the "three-body" problem, well away from the field of the Central Nervous System physiology... [5]. In 1972, Lorenz came across the nonlinear dynamical systems again and drew the attention of the scientific community to the butterfly phenomenon [6]. But it was only in 1992 that, Martinerie and I demonstrated that the upright postural control system does function as a nonlinear dynamical system [7] which was confirmed by various studies [8-17].

This latest advance in the field of neurology emphasizes that anatomy reduces man to a topology not taking his fourth chronological dimension into account. Indeed, the time series of the chained events of a function imposes its structure to the neural network and its mechanisms of transmission of information. Neurological phenomena must be thought about in the phase space, where the system state at time t can be represented according to what it was at time t-1.

Let's make no mistake about it, ethereal theoretical considerations are not the point, but on the contrary the actual structure of the CNS is, revealed in the clinic, determining the effectiveness of our treatments.

Clinically, the integration difficulties appear particularly well during the stabilometric examinations. If, according to the intuition of LM Nashner, we take the trouble to repeat the stabilometric recordings in various conditions that handle different inputs of the upright postural control system, it can be observed some patients control their aplomb all the more as they have less and less information to integrate during their recordings, for instance, suppressing first their glasses, then their vision, last their plantar information. This phenomenon is quite similar to what R. Kohen-Raz described in autism [18].

As early as 1982 we observed that the effectiveness of treatment could be subject to the butterfly phenomenon. That year, at the Tours Congress of occupational Medicine for Building and civil engineering, I had presented a pretty good experience of stabilometry showing a manipulation of the plantar entry had the same effect on the amplitude spectrum of postural sway as a manipulation of the visual input [19, 20]. For podiatrists, that was a new development. A podiatrist doctor came then and joined in my consultation to see if this could lead to a new therapeutics. For two years he tested, without any success, his pronator, supinator corners, etc., all of them being more than one centimeter high. After these two years, a young podiatrist, Philippe Villeneuve, trained by Dr. RJ Bourdiol, came to the consultation and explained to us that we mustn't use thick corners, but instead very thin orthoses, 2 or 3 millimeters thick maximum. And it worked!... I do not know where Dr. Bourdiol got this indication, but I do know the intellectual vigor of French podiatrists in the 1950s, as evidenced by their publications; in one of them the author wanted to mention the "Butterfly phenomenon" that he had already observed in the clinic, before that phenomenon was admitted, this author was really disturbed because he did not know in which chapter this observation should be introduced... he shunned the problem putting it in a note at the bottom of a page ! [21].

To conclude, for all these reasons, we think Posturology is historically deeply related to Neurology, of which it represents a step forward. However, we do not think Posturology should be attached to Neurology because Posturology introduces a new representation of the body incompatible with Neurology. All the body's parts belong to this fragmented system that the postural system is. It is up to the other speakers of this conference to show us how the perineum belongs to the postural system and which therapeutic benefits we can deduce... But there, I have no expertise! So I give the floor to them.

References

1- Babinski J, Froment J. Hystérie-Pithiatisme & troubles nerveux d'ordre réflexe en Neurologie de gued. Paris: Masson; 1918.
2- Marie P. Les troubles subjectifs consécutifs aux blessures du crâne. Revue de Neurologie. 1916;4(5): 454-476.
3- Marie P. Les troubles subjectifs consécutifs aux blessures du crâne. Available at: http://ada-posturologie.fr/PierreMarie.htm. Accessed December 19, 2013.
4- Baron J. Muscles moteurs oculaires, attitude et comportement locomoteur des vertébrés: Paris; 1955.
5- Poincaré H. Les méthodes nouvelles de la mécanique céleste. Paris: Gauthier-Villars; 1893.
6- Lorenz E. Does the Flap of a Butterfly's Wings in Brazil set off a Tornado in Texas? Meeting of the American Association for the Advancement of Science; 1972 December 1972; Washington, D.C; 1972.
7- Martinerie J, Gagey PM. Chaotic analysis of the stabilometric signal. In: M Woollacott HF, ed. Posture and gait: control mechanisms. Portland: University of Oregon Books; 1992. p. 404-407.
8- Myklebust J, Prieto T, Myklebust B. Évaluation of non linear dynamics in postural steadiness time series. Ann Biomed Engin. 1995 (23): 711-719.
9- Thomasson N. Traitement du signal stabilométrique par les techniques d'analyses non linéaires. Paris: LENA Salpêtrière; 1995.
10- Cao LY, Kim B.G., Kurths J.M., Kim S. Detecting determinism in human posture control data. Int. J. Bifurcation Chaos, 1: 179-188, 1998. Detecting determinism in human posture control data. Int J Bifurcation Chaos. 1998;8(1): 179-188.
11- Murata A., Iwase H. Chaotic analysis of body sway. 20th annual international conference of the ieee engineering in medicine and biology society; 1998: PTS; 1998. p. 1557-1560.
12- Peterka R. Quiet stance centre of pressure predicted by a simple feedback model of human postural control. Gait and Posture. 1999;9(suppl.1).
13- Micheau P., Kron A., Bourassa P. Analysis of human postural stability based on the inverted pendulum model with time-delay in feedback. 2001 american control conference; 2001; 2001. p. 2297-2298.
14- Sasaki O., Gagey PM, Ouaknine AM. Martinerie J. Le Van Quyen ML., Toupet M., L'Héritier A. Nonlinear analysis of orthostatic posture in patients with vertigo or balance disorders. Neuroscience Research. 2001; 41: 185-192.
15- Sasaki O., Usami S-I, Gagey PM, Martinerie J., Le Van Quyen M., Arranz P. Role of visual input in nonlinear postural control system. Ex Brain Res. 2002;147: 1–7.

16- Peng C.K., Mietus J.E., Liu Y.H., Lee C., Hausdorff J.M., Stanley H.E., Goldberger A.L., Lipsitz L.A. Quantifying fractal dynamics of human respiration: Age and gender effects. Annals of biomedical engineering. 2002;30(5): 683-692.
17- Shimizu Y, Thurner, K E. Multifractal spectra as a measure of complexity in human posture. Fractals-complex geometry patterns and scaling in nature and society. 2002;10(1): 103-116.
18- Kohen-Raz, R., Volkmar, F. Cohen, D. Postural control in autistic children. J of Autism and Develoental Disorders. 1992; 22: 419 - 432.
19- Gagey P.M. Bizzo G., Debruille O., Lacroix D. The one Hertz phenomenon. In: Igarashi M, FO B, eds. Vestibular and visual control on posture and locomotor equilibrium. Basel: Karger; 1985. p. 89-92.
20- Gagey P.M. Bizzo G., Debruille O., Lacroix D. The one Hertz phenomenon. Available at: http://ada-posturologie.fr/One_Hertz.pdf]. Accessed 20/12/2013.
21- Ledos M. Architecture et Géométrie du pied. Paris: Ledos; 1956.