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VISUOSPATIAL SKILLS IN CHILDREN AFFECTED BY PRIMARY NOCTURNAL ENURESIS: REHABILITATIVE PROPOSALS

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ABSTRACT

The sphincterial control problems in childhood are very common, with relevant comorbidities (i.e.: difficulty in academic performance, sleep disturbances, minor neurological signs) involved in the complex process of maturation and learning, such as to cause a great deal of discomfort and related disorders in affected subjects.

Enuresis is characterized by the involuntary urination in the absence of a physical disorder, socially unacceptable in places and at one stage of life where such control is acquired by the majority of subjects (about 5 years). The present study aims to evaluate the visuospatial skills in children affected by primary monosymptomatic nocturnal enuresis (PMNE). 31 PMNE children (16 males and 15 females) (mean age 10.87, SD ± 1.68) and 61 healthy children (32 males, 29 females) (mean age 11.03, SD ± 1.85, p = 0687) were evaluated for visuomotor skills with the Visual-Motor Integration Scale (VMI). PMNE subjects show a worse performance on average to VMI, especially in the total visual-motor integration test. This finding emphasizes the importance of a framework for global and more complex than is commonly implemented, across the border but framing the subject of enuretic symptoms in a more global perspective.

Keywords*: nocturnal enuresis, rehabilitation, visuospatial skills.*

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Introduction

The problems related to sphincter control in the developmental age are very common and such as to cause a great deal of related disorders and discomforts in those who suffer from it, being also involved in the complex processes of maturation and learning. In fact, some aspects of sphincter control can be considered as a consequence of the development of biological functions, although social learning plays an

equally important role, when excluded some others pathological conditions[1-3].

The control of the sphincters has as fundamental requirement the correct functioning of the Autonomous Nervous System (SNA), of the smooth bladder and intestinal musculature and of the autonomic afferents connected to the sacral system of the spinal cord[4-7].

Another aspect of voluntary sphincter control is, then, linked to the need for an adequate cognitive level to understand the importance of the need to contain excrement and to warn the urge or evacuation.

The phenomenon of enuresis is characterized by an involuntary (or even intentional according to the DSM-5 criteria)[1] urine emission in the absence of a physical disorder such as: bladder incontinence from neurological pathology, generalized convulsive epilepsy or anatomical malformation of the urinary apparatus, in socially unacceptable places and in a phase of life in which such control is acquired by the majority of subjects (about 5 years of life). Enuresis, therefore, cannot be diagnosed in a child under 5 years of age, in consideration of the fact that at the age of 2 years a child has reached a degree of neurophysiological maturation such as to perceive the sensation of bladder filling, control that becomes practically total and voluntary at the age of 4 years and about 6 months. The consequent ability of the child, then, to verbalize their need to minge, (conditioned to the degree of its neuropsychic development), represents the first step for a gradual learning of a more and more sophisticated voluntary control[8-10].

Furthermore, according to the criteria of the Standardization Committee of the International Children's Continence Society (ICCS), enuresis can be distinguished in monosymptomatic and not monosymptomatic in relation to the presence or absence of associated symptoms of diurnal urinary dysfunction[11-13].

The only nocturnal enuresis, only diurnal, or nocturnal and diurnal (mixed form) can be primary (representing an abnormal prolongation of physiological infantile incontinence with a reflex mechanism of emptying) or secondary (arising after a period in which the bladder control was acquired and maintained for at least six consecutive months).

The primary form is considered as a consequence of a delay in the maturation of the physiological mechanisms of continence, which would leave the child always susceptible to relapses, whereas in the secondary form, situations of strong stress or discomfort would play a more decisive role[14-18].

In general, in addition to the key role of CNS and hypothalamic factors, three important factors are involved in the pathogenesis of monosymptomatic enuresis:

1. nocturnal polyuria;
2. hyperactivity of detrusor muscle;
3. low state of "arousability" and / or alteration of the “nicturition” reflex.

However, it is equally evident that due to the considerable integration of these mechanisms into the CNS, the enuretic subject should not only be considered for sphincter alteration.

The aim of the study is to evaluate visuospatial abilities in a population of children affected by PMNE.

Materials and methods

The test population consists of 31 subjects with primary nocturnal enuresis (PNE), (16 M) (mean age 10.87, SD ± 1.68) and 61 healthy children (32 M) (mean age 11.03; SD ± 1.85; p = 0687). All subjects underwent evaluation of the visuo-motor integration skills through the administration of the Visual-Motor Integration Developmental Test (VMI) and the respective additional tests (Visual Perception and Motor Coordination). All the subjects of both groups were recruited within the same urban area, Caucasian and homogeneous by socio-economic level. The diagnosis of primary nocturnal enuresis (PNE) was established according to the DSM-5 criteria[1].

The exclusion criteria were: mental retardation (IQ <70), genetic syndromes (eg Down syndrome, Prader-Willi syndrome, X-fragile syndrome), hypothyroidism, psychiatric disorders (schizophrenia, mood disorders, ADHD), motor disorders, muscular disorders, epilepsy, obesity and breathing disorders in sleep. All assessments were made after informed consent from the parents and where appropriate by the same subjects under consideration.

Beery-Buktenica Developmental Test of Visual-Motor Integration (VMI). All subjects were given the Developmental Test Of Visual-Motor Integration (VMI), a “paper and pencil” test, in which the subject is asked to copy an evolutionary sequence of geometric shapes. The form used was the complete one with 27 items administered individually to the test subjects in about 10-15 minutes. Additional tests were administered, able to identify specific deficits

in individual competences (visual and / or motor): The Visual Perception test in which geometric shapes, absolutely identical to VMI stimuli, must be chosen, one at a time among others that differ for a few details. The task is to identify the greatest number of forms among the 27 stimuli. In the second supplementary test, that of Motor Coordination, the task is simply to trace the stimulus forms with a pencil without leaving the margins of the printed path; administration takes 5 minutes. The two additional tests, which allow the comparison of visual skills with the motor skills of a child, were administered individually after the complete form of the VMI. The standard score reflects the accuracy of the copy capacity and ranges from 0 to 19; according to the distribution of the scores a standard score equal to 6 (15 centile) is considered borderline and a standard score of 5 or less (5 centile) as pathological[19].

The test used makes it possible to make a statistical comparison between the three tests in a simple and immediate way using a graphic profile, thus obtaining a complete definition of the abilities of visuo-motor integration of the subject.

Statistical analysis

For the determination of the comparability of the two groups in question, the t-test was applied and, where appropriate, the Chi-square test. For the comparison of mean and standard deviation of the results obtained in the tests from the two groups under examination the t-test was applied.

Values of $p < 0.05$ were considered statistically significant. Statistical analysis uses the STATISTICA software (data analysis software system, version 6, StatSoft, Inc. 2001).

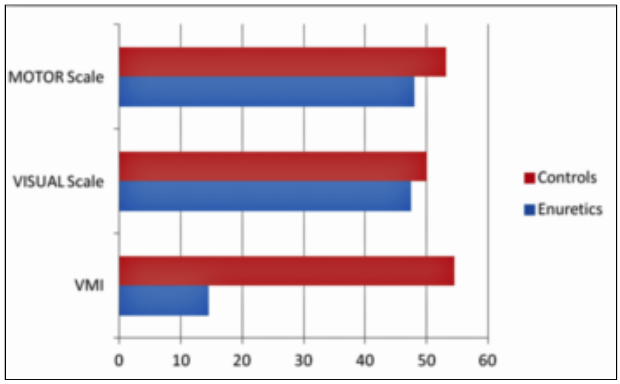
Results

The two groups of subjects considered in the final study (31 PNE vs 61 Controls) were statistically comparable for age (10.87 ± 1.68 vs. 11.03 ± 1.85; $p = 0.687$), gender distribution ($p = 0.886$), and BMI ($p = 0.317$).

Enuretic subjects show an average worse performance at the VMI. Specifically, enuresis show a significantly worse performance in the visuo-motor integration test (14,516 ± 12,268 vs. 54,590 ± 6,921; $p = 0,000$), in the presence of a result in the additional tests as a whole superimposable to that of the control subjects (Table 1; Graph 1)

	Enuretics (n=31)	Controls (n=61)	p
VMI	14.516 ± 12.268	54.590 ± 6.921	0
VISUAL	47.548 ± 25.216	50.065 ± 11.930	0.516
MOTOR	48.064 ± 20.599	53.147 ± 14.246	0.169

Table 1: shows the comparison between the averages in the enuretic subjects and in the percentile scores checks at the Visual Motor Integration test (VMI) and the additional tests of Visual Perception (VISUAL) and Motory Coordination (MOTOR), according to the t-test.
Values of $p < 0.05$ were considered statistically significant.



Graph. 1: The Graph 1 shows the mean differences between the two groups (PMNE and Controls) for VMI, Motor and Visual scales.

Discussion

Central nervous system (CNS) certainly plays an important role in achieving continence, turning a reflex act into a voluntary act. The mechanisms of this maturation are still unknown, but scholars believe that enuresis can be interpreted as the expression of a delay in maturation of the CNS due perhaps to a perinatal insult that compromises neuronal development. This is not limited to the bladder control mechanism alone but involves the various areas of growth and acquisition of skills. In fact, as regards the staturo-weight growth, enuretic patients have a lower growth rate and bone age compared to healthy subjects and greater difficulties in language; moreover, they are often premature or low birth weight babies and lower Apgar index compared to controls[20-25].

From the motor point of view, the subjects present a compromise of coarse motor skills and fine motor skills. In the past some Authors have also detected a higher incidence of adiadococinetic and core movements, though data have not found further confirmation.

Von Gotard conducted a study on the execution of repetitive movements by associating the recording of visual evoked potentials (PEV), brain evoked potentials, P300 and PPI. Previous data obtained from functional imaging had identified the cortical areas involved in the execution of these movements, these are represented by: primary motor area, dorsal premotor cortex, accessory motor cortex (all contralateral) and a cerebellar area. The study of evoked potentials seems to confirm that the maturational deficit should reside in the contralateral motor cortex[26]. Moreover, the cognitive profile of the enuretic subjects would be normal as regards the total value of the IQ, but with a peculiar distribution of skills that allows the identification of the most immature structures in the frontal lobe[27-28] and in the cerebellum.

In 2003 Bosson et al. took advantage of the figure of Rey-Osterrieth to investigate the visual, motor, planning, problem solving, and memorization functions of enuretic subjects, who showed pathological results[29].

Our results highlight one for a reduction of visuo-motor integration abilities in enuretic subjects compared to controls. Further confirmations come from studies carried out on working memory; Day and Bing, even if separately, reach the same conclusions. Enuretic patients have a normal intellectual level, but have a fall in the skills of arithmetic, digit-symbol, coding and in the parameter M / C (obtained from the sum of the three previous fields).

The application of functional magnetic resonance imaging (fRMN) shows significant differences in the activation of the frontal lobe and the posterior left lobe of the cerebellum, structures involved in the acquisition of motor patterns, working memory and visual memory[30-35]. These alterations, often somewhat nuanced, affect the subject's ability to learn; in fact, enuretic child is described as inattentive[36] and slower than the peers to the point of configuring a difficulty in learning, particularly in reading, and a "border-line" intellectual level[37-39]. The results of the study go in this direction, precisely to underline the importance of a global and more detailed framework of what is commonly implemented, overcoming the borderline of the symptom but framing the enuretic subject in a more global perspective.

Rehabilitation proposals

The identification of the difficulties and the intervention must be as precocious as possible, to allow the child to identify effective strategies of organization, thus limiting the secondary problems of falling self-esteem, already undermined by the enuretic symptom, .and of potential limitation of social interaction and the perception of one's own emotions and those of others[40-42].

The methods of articulation of the intervention are diversified according to the age group and the type of associated disorders. In the light of these data and rehabilitative experiences, a model of intervention seems to be proposed, necessarily integrated not exclusively of an environmental nature (under penalty of substantial ineffectiveness), in which the active approach to the cognitive, conscious and guided task is encouraged and stimulated.; at the same time, a check and a gradation of the proposed stimuli should be carried out in order to have elements that can be used and contextualized in an appropriate manner, integrating the attention to the sensory stimuli and the (central) cognitive guide to the approach to the task[43-47].

So, generally speaking, we could identify ways of approaching the task and the setting, which favor an active and conscious involvement in situations where we think a specific intervention is opportune: a) A welcoming environment attentive to the control of the distractors and of the characteristics of the stimuli proposed (also in terms of complexity / request of visuoperceptual and visuospatial integration, as well as of the "motor" complexity of the presented and proposed material); the contextualization of the task and the calibration of the duration, as well as the sharing of objectives, motivation and active involvement b) A therapist who reinforces the evolution with the ability to introduce and graduate facilities; supporting with verbal guide and imitation (if effective) also in the functional use of the error; increasing operational autonomy without replacing and acting as a link to allow the extension of the effectiveness of the strategies set up outside the rehabilitation context[48-52].

With regard to specific rehabilitation processes, however, within the theoretical framework of reference, it seems possible to introduce differentiated paths based on age and outcome of evaluations, and especially the types of tasks that you want to address / propose, defining objectives and with attention to appropriateness.

Therefore, it is possible to foresee paths aimed at the objectives of:

• improvement of the visuoperceptual and visuospatial analysis;

• improvement of visuoconstructive skills;

• improvement of the praxic organization and motor control. With particular attention to the improvement of the visuoperceptual and visuospatial analysis will be carried out with particular attention to the tasks whose success is linked to a better integration of perceptive and spatial information, favoring the visual exploration, integration between shape / color variables and spatial information, analysis and sequential programming.

It is useful (and to be extended to extra-educational contexts) above all to favor strategies for the visuospatial organization of the task (scans, points of reference / alignment, analysis of spatial relations), especially during the course of activities (with concrete or graphic material). These activities are to be reported in an operational context and therefore oriented towards "consciously doing"; nevertheless, possessing efficient strategies in the acquisition of information also allows greater effectiveness of control over the work. Therefore, where necessary, a targeted path can allow to improve the operation and voluntary control, thanks to a greater ability to use the visuoperceptual information; often this step is necessary to deal more effectively with a targeted path more visuoperceptual skills, because they are the basis for effective strategies in the use of the model.

The improvement of visuoconstructive skills is an area of intervention very linked to the organization skills and task planning with concrete and graphic material, as well as attentional skills (sustained attention but also shift of attention) and working memory; it requires the ability to use and analyze the model (with graduation of complexity, with attention to the perceptive and spatial characteristics of the proposed material[29] and foresees the progressive enlargement of the inferential capacities (visible / not visible). we arrive at more complex proposals and in which the spatial and constructive component is central and that can favor organization and planning (for example, use and construction of cognitive maps). Part of the intervention in this area is linked to the identification of suitable strategies of intervention and facilitating tools, if on the one hand, in fact, it is possible to identify methods of use of the model (such as color guide), on the other hand the research in a therapeutic alliance of executive facilitations can make the task facilitated and not rejected[53-60]. The use of the PC is certainly a facilitation, but still requires planning skills effective and control over the operation: Other instruments can be tested and used outside the rehabilitative setting (from the timbres to the reference grids, from the type of pencil / pen to the characteristics of the sheet). The strategies and compensation identified will have operational repercussions, so they will be transferred, even in school settings, with effects on learning performance: the difficulties in using the model and its reproduction (visuospatial and visuoconstructive component, therefore) often result in poor performance in the geometric / technical requests that in the spatial organization of the sheet (column and more generally "order"), with cascade consequences, while the possibility of writing not exclusively in italics (possibility given to secondary school, while the writing system seems to central today in the primary) can turn out to be the keystone of a change in the approach to the written language it.

The improvement of the praxic organization and of the motor control must foresee the planning of activities aimed at making more aware, to promote strategies and mobilize compensation in motor tasks with increasing complexity, both at the large motor level (with control capacity), also environmental variables and their physical and spatial characteristics and up - motor (usually refers to the ability to read and write) and sequential[54-57]. The possibility of using imitation, when present, is an important resource, as well as that of following a verbal guide, while the difficulty of maintaining sequencing is very common; useful analysis strategies of the task with respect to the objective and planning of intermediate verification steps (well organized spatially and clearly perceptively) with respect to the trend are useful. An improvement of the postural control, as well as of the devices to facilitate the control of the gestures, are useful both for the improvement of the performance, and for the favorable relapse with respect to the self-esteem[58-70].

The slowness of execution is often the price that children have to pay for greater accuracy; it, in itself, is not particularly influenced by an effective treatment, even if over time it tends to decrease[71-85]. Often the rehabilitative intervention with these objectives has the characteristics of the short cycle, aimed more at identifying personalized strategies than training, preferring to keep a remote control on the use and effectiveness of the modalities identified in the daily living environment. on the other hand,

the procedural memory, roughly preserved, allows over time (at least theoretically) an effective automation of the strategies learned in the first phase, explicitly[86-96].

In conclusion, our study wants to underline the need to consider the affected subject in a holistic way from primary nocturnal enuresis, so that even its recovery can be considered global with sure positive repercussions also on pharmacological management and related disorders.

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