

LASER TREATMENT OF PATIENTS WITH HEREDITARY MENTAL RETARDATION

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Laser treatment has been successfully used in many diseases of the central, peripheral and vegetative nervous system, in particular in neurosis, multiple neuropathies, neuritis, perinatal encephalopathy and infantile cerebral palsy. Activation of redox and energy processes in cells, change in receptor sensitivity, faster nervous impulse transmission, change in enzyme activity and improvement in myelination are a rationale for low-intensive laser therapy in patients with mental and speech retardation of various origins, including genetic forms. However, the use of laser therapy has not been reported in diverse hereditary diseases.

Disease entities associated with mental retardation deserve special attention. In the absence of treatment, mental retardation usually progresses to a severe degree and leaves patients socially maladapted. Phenylketonuria (PKU) is a hereditary amino acid metabolic disorder which is underlied by deficiency of the enzyme phenylalanine hydroxylase and which is inherited in an autosomal recessive mode. Symptoms of central nervous system damage are dominant in PKU - mental and speech retardation, seizures, muscle tone disorders. Patients also show eczematous lesions and deficient pigmentation of the skin and hair. Laboratory evidence of PKU is excess blood and urinary phenylalanine levels and higher renal excretion of phenylalanine metabolites.

A cardinal clinical symptom of Rubinstein-Taybi, Williams, Gregg and Coffin-Lawry genetic syndromes is mental retardation coexisting with facial minor anomalies. Chromosomal diseases are associated with severe mental disorders combined with somatic, vision and hearing defects, and a set of minor developmental anomalies. Chromosome diseases are underlied by numerical chromosome abnormalities in cells or structural lesions of one or several chromosomes.

Laser stimulation has been first used in the department of congenital and hereditary diseases of this institute in combination with drug, dietary, psychological and speech therapy of children with hereditary oligophrenia.

Seventy-five children with hereditary mental retardation were enrolled for treatment in three groups:

(1) probands with PKU (n=75);

(2) children with chromosomal diseases (n=17), including with the fra-X syndrome (n=9), Down syndrome (n=3), cri du chat syndrome (n=2), a partial trisomy 4p+ (n=1), trisomy 22 (n=1) and 46 XX, del 15 (q-q21) syndrome (n=1);

(3) probands with monogenic hereditary syndromes, including the Williams syndrome (n=4), Gregg syndrome (n=1), Coffin-Lawry syndrome (n=1) and Rubinstein-Taybi syndrome (n=1).

The patients ranged in age from 2 to 14 years. Most (n=67) were aged 2 to 7 years by the start of laser therapy. There were 39 girls and 36 boys in the groups.

Stimulation of mental and linguistic development used a helium-neon laser with radiation power density of 10 mW/sq.cm. Exposure of each of corporeal points was 10 s and of auricular points 8 s. The stimulation course comprised eight treatments. Laser regimens were individualized for each patient.

Only four of 75 patients were given a single course of laser treatment. The rest received repeat therapy, an average two times a year at a six-month interval.

Evaluation of neural and mental development comprised

- psychomotor milestones of infancy and a history of seizures;
- the status of the central nervous system which was assessed by a degree of psychomotor and verbal retardation, reflexes, muscle tone, the presence/absence of motor and sensory disorders, local symptoms, microcephaly and seizures;
- psychological qualitative and quantitative tests of Vygotsky, Sakharov, Zeigarnik, Rossolimo and Segen by which emotional, communicative and verbal skills, constructive praxis, visual and spatial gnosis, memory and behavioral control were elucidated. Quantitative evaluation used 10-score standard tasks and tests with a final statistical score which was an equivalent of the intelligence quotient (IQ) for children older than 3 years and developmental quality (DQ) quotient for children under 3;
- electroencephalography using an eight-channel Medicor device with standard frontal, temporal, central, parietal and occipital leads. These studies elucidated age-specific electrogenesis and evidence of subcortical dysfunction, residual organic or focal abnormalities and seizures;
- pathopsychological and neuropsychological evaluation was carried out before and after laser treatment, at 6 and 12 months following repeat treatment and further on at six-month intervals. The follow-up of most of the patients (64 of 75) was two years and longer (maximum, five years). Four probands who got one course of laser therapy were followed up for a month.

Effectiveness of laser stimulation of psycholinguistic development was judged by change in

- intelligence quotient;
- motor performance;
- speech;
- generalization skills;
- behavioral control;
- neurological status;
- electroencephalographic findings.

Analysis of effectiveness showed significant improvement of mental development in children with phenylketonuria and hereditary syndromes associated with mental retardation. The response to therapy was most prominent in children with mild mental abnormalities and presented as general functional improvement and better mental performance, concentration of attention, improvement of fine motility and grammar. Marked improvement of verbal skills was seen as an enhanced passive and active vocabulary, phrasing and general activation of verbal development. The treated patients also showed improvement of behavioral control (better social adaptation, self-care skills, elements of task performance).

Less change was seen in children with severe mental retardation associated with chromosomal diseases. What improvement was seen occurred as general mental activation, emotional stabilization, regress in motor disinhibition, and improvement of behavior, adaptation in everyday life, speech skills and motor development of young children.

Analysis of psychometric findings showed an IQ increase in most of children.

Comparison of pre- and posttreatment mental development of children with hereditary oligophrenia suggested its significant improvement after the addition of laser stimulation to multimodality therapy. Thus laser treatment of 14 patients with PKU was conducted during dietary therapy and vitamin supplementation without psychostimulating drugs. This group showed significant improvement of psycholinguistic development during laser stimulation, especially marked as progress in speech skills and social adaptation in older probands. In younger children, improvement occurred as faster development of locomotor function.

Comparison of neurological examination findings before and after one course of laser treatment showed a higher posttreatment reflex excitability in about half of the patients (n=33). The psycholinguistic response was most prominent just in this group.

Six probands showed a dramatic activation of tendon reflexes, with expansion of reflexogenic areas and signs of anisoreflexia after laser therapy. Behaviorally, the onset of motor disinhibition and hyperexcitability was seen in these children. Laser therapy induced no change in the neurological status of the rest of patients.

EEG findings before and after one course of laser therapy were ambiguous. Signs of mesencephalic dysfunction ameliorated in four patients, EEG deteriorated in four and no change was seen in 48. Besides, follow-up EEG after repeat courses showed a nonspecific stimulating effect of low-intensive laser radiation on the cerebral bioelectric activity, presenting as a reduction in abnormal potentials and enhancement of the alpha activity, a major cortical rhythm.

A special group were four PKU patients who developed seizures during laser treatment combined with intramuscular cerebrolysin. Of note, these were children with severe mental retardation and microcephaly. Three had a history of seizures, and the history of one was negative. In addition, a stronger subcortical irritability and a lower threshold of seizure vulnerability were seen on EEGs of three probands during the treatment with a similar combination and in one patient whose therapy comprised the laser and the drug cogitum, suggesting a depression of cortical neuron reactivity. This warrants caution in adding psychotropic drugs to laser stimulation of psycholinguistic development.

CONCLUSIONS

Hereditary mental retardation in phenylketonuria, chromosomal diseases and monogenic syndromes is an indication for laser stimulation of psycholinguistic development. There is the need for further studies to develop new low-intensive laser therapeutic modalities for mentally retarded patients.