Cerebral palsy (CP) is one of the most common non-progressive encephalopathies. The psychomotor rehabilitation of a child suffering from cerebral palsy is a basic requirement of the therapy. Nevertheless, pharmacotherapy, though does not eliminate the source of the disturbances – acting mainly symptomatically, is a very important element of the comprehensive rehabilitation process. All CP symptoms linked to motor or posture dysfunctions can be alleviated or removed by properly applied medications. However, taking into consideration chronic and permanent character of the pathologic process, it should be remembered that the pharmacological substances used ought to be characterized by: high safety, low toxicity, beneficial psychotropic properties, organoleptic properties accepted by children.

KEY WORDS: pharmacotherapy, cerebral palsy.

PHARMACOTHERAPY AND NEUROREHABILITATION OF A CHILD WITH CEREBRAL PALSY

FARMAKOTERAPIA A NEUROREHABILITACJA DZIECKA Z MÓZGOWYM PORAŻENIEM DZIECIĘCYM

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Summary

Cerebral palsy (CP) is one of the most common non-progressive encephalopathies. The psychomotor rehabilitation of a child suffering from cerebral palsy is a basic requirement of the therapy. Nevertheless, pharmacotherapy, though does not eliminate the source of the disturbances – acting mainly symptomatically, is a very important element of the comprehensive rehabilitation process. All CP symptoms linked to motor or posture dysfunctions can be alleviated or removed by properly applied medications. However, taking into consideration chronic and permanent character of the pathologic process, it should be remembered that the pharmacological substances used ought to be characterized by: high safety, low toxicity, beneficial psychotropic properties, organoleptic properties accepted by children.

KEY WORDS: pharmacotherapy, cerebral palsy.

Streszczenie

Mózgowe porażenie dziecięce (mpd) stanowi jedną z najczęstszych encefalopatii nie postępujących. W terapii mózgowego porażenia dziecięcego podstawową rolę odgrywa usprawnianie psychiczne dziecka. Niemniej, leczenie farmakologiczne, mimo iż nie likwiduje źródeł zaburzeń, a działa jedynie objawowo, jest metodą która ma bardzo istotne znaczenie w rehabilitacji kompleksowej. Wszystkie objawy mpd związane z dysfunkcjami ruchu i postawy a także inne, wymienione wyżej, mogą być łagodzone lub likwidowane poprzez dobor odpowiednio działających leków.

Należy jednak pamiętać, po uwzględnieniu przewlekłego i trwałego charakteru procesu chorobowego, że stosowane substancje farmakologicznie czynne powinny charakteryzować się: dużym zakresem bezpieczeństwa, małą toksycznością, korzystnymi właściwościami psychotropowymi, właściwościami organoleptycznymi akceptowalnymi przez dzieci.

SŁOWA KLUCZOWE: farmakoterapia, mózgowe porażenie dziecięce.

Introduction

Cerebral palsy (CP) is one of the most common non-progressive encephalopathies. Among clinical symptoms, motor and posture disturbances are predominantly observed. These are neurological and motor disturbances that manifest themselves as spasticity, pareses, involuntary movements, disturbances in muscle tension, ataxia, or somatosensory problems. Types of motor problems and other accompanying disorders in a child depend on the area of brain damage, its severity, and the child’s developmental stage. CP does not constitute a separate disease, as it is not caused by just one etiopathogenic factor. In about 50% of cases, CP is caused by prenatal factors, including disturbances in neural migration or hydrocephalon, in 16% it may be assigned to perinatal problems, in 14% – circulatory problems, and in 2% – mechanical problems [1]. Post-birth factors are responsible for about 15% of CP cases. Aside from the quality of a causing factor, also time point of its action should be taken into consideration, that is, the developmental stage of the child’s nervous system. Preterm birth and growth disturbances in prenatal period are also traditionally regarded as risk factors in CP. The upper age limit for the occurrence of CP has not yet been established, though clinicians usually agree that 3rd–4th year constitute such a limit [1].

It is difficult to establish precise incidence of CP occurrence, as there is no consensus regarding the age at which the condition should be diagnosed. This ratio seems not to alter much in subsequent years, and, on average, is 1.5 to 2.5 per 1,000 live births [1]. This number does not change significantly with advancement of perinatal care.

Psychomotor rehabilitation

The clinical pattern of CP is dominated by disturbances in motor functions of various intensities. The most common clinical symptoms are:

1 – disturbances of muscular tonus, i.e. spasticity or flaccidity;
2 – dyskinetic problems (atetosis, choreoatetosis, dystonia), ataxia, psychomotor and reflexive retardation;
3 – paralysis, pareses, i.e. loss or limitation of voluntary movements that may apply to all four limbs (quadruplegia), three limbs – two lower and one upper (triplegia), two limbs on one side of the body (hemiplegia), two lower limbs with no or limited affection of upper limbs (diplegia), and, very rarely, just one limb (monoplegia);

4 – retardation of psychomotor development;

5 – disturbances in the development of primary reflexes, the appearance and fixation of pathological motor reflexes instead of proper physiological ones;

6 – mental retardation;

7 – disturbances of sucking, chewing, and swallowing;

8 – epilepsy with various kinds of seizures [2].

The clinical pattern of CP encompasses also:

- characterological problems,
- emotional disturbances,
- neurovegetative symptoms,
- building-up of neurotic symptoms, manifested as anxieties, neurastenic syndromes, and adaptive difficulties.

CP and its accompanying symptoms, including mental impairment, are the most common causes of handicap in children and constitute an important factor rendering difficult the fulfilment of developmental tasks. As a consequence, CP in a child leads to improper upbringing approaches in the child’s parents, and in turn, further disturbs emotional, cognitive, and social development of the child.

The CP should be diagnosed as early as possible to start proper therapeutic actions: neurorehabilitation accompanied by pharmacotherapy.

If the rehabilitation is to yield the best possible results, a proper physiotherapeutic programme must be introduced. Special attention should be paid to dynamics and harmony of development, as well as the degree and type of functional disturbances, so that the rehabilitation methods can be altered or adjusted at proper time. Distant effects of rehabilitation should also be taken into account, as the organism of a child shows constant development. The brain plasticity is a very important factor underlying rehabilitation of children with damage to central nervous system. This phenomenon consists in permanent functional adjustments in the neuro-network, as a consequence of exposure to specific stimuli. Brain plasticity is observed in children and encompasses formation and maturation of interneuron connections; it is characterized by overproduction of neurons and their apoptosis – programmed cell death occurring in embryonic period and just after birth, as well as excess of synapses at about 2nd-3rd year of life [3, 4]. During this period, intensified metabolic activity of the nervous system is also observed. Physiological brain plasticity allows for improvement of the functional status of a child undergoing a systematic rehabilitation from very early developmental period. Due to the presence of sensitive periods and early appearance of sensitive period for motor development, it is necessary to start rehabilitation at early stage of motor dysfunction diagnosis. Furthermore, in child rehabilitation the reparative plasticity is also very important. It allows for partial or complete restoration of the lost functions of the brain, by making new synaptic connections between non-typical structures and degeneration of the already existing synapses [3]. The functional status improvement depends on systematic training based on learning processes. Through the training-induced learning, durable plastic alterations in brain occur, which consist of the process of making new synaptic connections, and so-called synaptic stabilization, involving apoptosis of some other neural connections. Taking advantage of brain plasticity and compensatory mechanisms the early rehabilitation gives a chance for full recovery and normal functioning of the disturbed mechanisms [5, 4].

The psychomotor rehabilitation of a child suffering from cerebral palsy is a basic requirement of the therapy. Nevertheless, pharmacotherapy, though does not eliminate the source of the disturbances – acting mainly symptomatically, is a very important element of the comprehensive rehabilitation process [6, 7].

**Pharmacotherapy**

All CP symptoms linked to motor or posture dysfunctions, as well as other, as mentioned above, can be alleviated or removed by properly applied medications. However, taking into consideration chronic and permanent character of the pathologic process, it should be remembered that the pharmacological substances used ought to be characterized by:

- high safety,
- low toxicity,
- beneficial psychotropic properties,
- organoleptic properties accepted by children [6].

The symptoms such as involuntary movements disturbing proper motor coordination, increased muscular tension leading to contractures, pain and numbness occurring with each attempt to perform an activity, cause fear, aversion, resistance and negative attitude of a child during rehabilitation. Removal or alleviation of intensity of the symptoms using pharmacotherapy allows for introduction of subsequent rehabilitation methods [7].

The most frequently used drug groups in the cerebral palsy are:

- tranquilizers,
- anxiolytic drugs,
- neuroleptics,
- antidepressive drugs,
- psychoenergizing drugs, improving the brain circulation, limiting muscular tonus,
- anti-epileptic drugs.

**Tranquilizers** allow a child to establish proper emotional contact and suppress fear and anxiety before starting cooperation with the therapist. Properly selected drugs from that group make acceptance of the persons involved in the therapy easier and shorten the time needed for adaptation to new conditions, improve gen-
eral feeling, cause the child to believe in his or her own potential and ability to perform assigned tasks. Lowering of anxiety level allows the therapist to introduce new, more and more difficult motor tasks, and to proceed to subsequent stages of behavioural training, aimed to establish proper attitudes in task situations, toleration of failures and frustrations, and optimal motivation level to start work that is chronic and often not very attractive to a child, possibly also painful. Tranquilizers, apart from anxiolytic and relaxing effects, also exert myorelaxant effects in children with increased muscular tonus [6].

**Anxiolytic drugs** (so-called small tranquilizers) – comprise anxiolytic, sedative, myorelaxant, antiepileptic and somnoleptic effects. They affect limbic system, which is very important for basic emotional life. They remove or alleviate psychological and physical feelings of weakness, anxiety symptoms, irritability, sleep disturbances, crying tendency and mostly situation-conditioned aggressive reactions [8].

In children suffering from cerebral palsy, benzodiazepins are most frequently used from among anxiolytic drugs. They intensify the effect of γ-aminobutyric acid (GABA) on GABA receptors and indirectly influence also cholinergic and adrenergic neurons; these mechanisms are thought to explain their anxiolytic, sedative, antiepileptic, myorelaxant and somnoleptic effects [8]. In the treatment of cerebral palsy the following benzodiazepins should be taken into consideration:

- **clonazepam** – apart from antiepileptic effect it causes relaxation of muscle tonus and is often prescribed in CP accompanied by epilepsy or spastic pareses of the limbs [6]. As antiepileptic drug it is usually used in primarily generalized, myokymic attacks with losses of consciousness, especially of petit-mal type – to stop grand mal seizures and status epilepticus. After administration of clonazepam a decrease is noted of intensity of involuntary movements in extrapyramidal origin. Clonazepam is a safe and relatively low toxic medication. Side effects include general weakness, fatigue, decrease of muscle strength, psychomotor slowness, disturbances of motor coordination, ataxia, more rarely skin rash, appetite disturbances and obstruction [8].

- **diazepam** – shows anxiolytic activity, sedative effect, decreases muscle tonus, reduces fear, improves sleep and decreases anxiety [8]. This drug is used mainly in CP with symptoms of spastic paralysis, or with extrapyramidal symptoms and epileptic seizures. It alleviates psychological symptoms accompanying epileptic seizures in children, e.g. dysphoric stages, psychomotor excitation, behavioral disturbances. Side effects are similar to those of clonazepam [6].

- **chlor Diazepoxide** – reduces fear and states of increased tension and anxiety, alleviates psychomotor excitation. Though it reduces muscle tonus to a lower extent, it is used in children with epileptic seizures as an supplementary drug that increases convulsant excitability threshold and removes psychological symptoms accompanying epilepsy, such as irritability and dysphoric states [6]. The use of chlordiazepoxide may cause the following side effects: general weakness, ataxia, dizziness, more rarely paradox psychomotor excitation [8].

- **oxazepam** – reduces anxiety, fear and emotional tension. It is particularly recommended in CP with neurotic traits, hysteroepileptic, and with vegetative and psychosomatic disturbances. Pharmacotherapy with oxazepam renders rehabilitation procedures and educational process much easier [6]. Apart from its sedative and anxiolytic effects, oxazepam is also used as an anticonvulsant and for reducing skeletal muscle tonus [8].

- **nitraze pam** – in children suffering from CP, it is used starting in early infancy and childhood. Nitrazepam shows anxiolytic and myorelaxant effects, acts as anxiolytic and myorelaxant, relaxes muscle tonus in spastic pareses and decreases intensity of involuntary movements in extrapyramidal forms of CP. It works well in children with excitement and anxiety, and most importantly, shows antiepileptic effects – it is recommended in epileptic seizures in infancy and childhood (nodding spasms’, akinetic, astatic, and myoclonus) [6, 8].

- **temazepam** – like other drugs from that group, it shows regulative activity towards limbic system, reticular system and polysynaptic reflexes integrated on the level of spinal cord. As a result, in children the following effects are observed: decrease of fear and anxiety, decrease of muscle tonus and affective tension, and sleep normalization. Temazepam is particularly useful in children with CP accompanied by psychosomatic symptoms of circulatory, digestive and respiratory systems. It also helps children with headaches, anxiety neurosis, appetite and digestive problems, as well as excessive perspiration and tachycardia of psychogenic origin [6, 8].

- **medazepam** – reduces fear and shows myorelaxant activity; it is used in CP with spastic pareses of the limbs and with symptoms of neurosis [6].

Another group of anxiolytic drugs consists of **glycerol derivatives**, showing strong myorelaxant effect with weaker anxiolytic, somnoleptic and anticonvulsive effects [8]. Methocarbamol, mephenesin and quasiphenesin found application in CP with paralysis and spastic, extrapyramidal or mixed pareses. Drugs from that group also reduce the intensity of involuntary movements, and their sedative and relaxing properties make contact with a child easier, reducing anxiety and negativistic reactions [6].

- **methocarbamol** – shows sedative activity, anxiolytic and relaxing effects, and mainly reduces the skeletal muscle tonus (inhibition of polysynaptic reflexes). Among rarely observed side effects are: headaches and dizziness, digestive problems, skin changes [6, 8].

- **quasiphenesin** – inhibits the conductivity system of the spinothalamic tract, reducing that way the tonus of skeletal muscles and sensitivity to external stimuli [8]. This drug is used in the treatment of CP with spastic pareses and psychosomatic symptoms [6].

**Neuroleptics** constitute another group of drugs used in children with CP. The therapy is based not on their antipsychotic activity, but rather on their influence on...
psychomotor drive and myorelaxant activity. Neuroleptics show sedative or stimulating effect in inhibitory states, they reduce psychomotor agitation, condition of excitation, aggression and autoagression and decrease the intensity of extrapyramidal movements. The most frequently used drugs from that group are [6]:

chlorpromazine – influences reticular and limbic systems, hypothalamus, shows inhibitory effect towards pituitary, has sedative, anxiolytic, spasmyloytic, anesthetic, antihistaminic and antiemetic effects [8]. Chlorpromazine is used in syndromes with intense psychomotor agitation to reduce drive and emotional tension (affective blockage). Due to slow intellectual processes, it may deteriorate conditions of educational therapy, ergotherapy and learning that are based on good contact with a child. The drug reduces muscle tonus and removes involuntary movements, e.g. in choreic or hyperkinetic syndromes caused by damage to the extrapyramidal system [6]. Among possible side effects, the post therapeutic akinetic-hypertonic Parkinson-like syndrome should be mentioned, sometimes with dyskinesia in a form of acathisia and toxokinesia, combined with anxiety states [8].

promethazine – used in children with various neurologic and psychic syndromes; in CP, it is most frequently used in cases of psychomotor excitation, increased drive and in syndromes of spastic pareses with coexisting extrapyramidal movements [6].

thioridazine – neuroleptic of gentle sedative and somnioleptic effects, alleviating or reducing intensity of involuntary movements of psychogenic and extrapyramidal origin, especially intense in some forms of CP. The drug also alleviates affective tension and negativism, as well as characterologic symptoms found in children suffering from CP [6].

haloperidol – has sedative effect, causes relaxation of muscle tonus and reduces or removes involuntary movements of extrapyramidal origin, especially persistent in extrapyramidal forms of CP [6].

sulpiride – is sometimes used in children suffering from CP with autistic overlay or with special psychomotor agitation. The drug shows antiautistic activity, as well as activating, anxiolytic and sedative effects [6, 8].

Antidepressants are less frequently used in treatment of CP. In children with coexisting enuresis, faecal incontinence and negativistic and depressive reactions – imipramine is used; it blocks mechanisms of biogenic amines’ return through cell membrane into the neural cell, influences serotonergic mechanisms and shows weak anticholinergic and antihistaminic effects. Second antidepressant most frequently used in CP is doxepine, which acts on limbic and reticular systems, and synaptic reflexes of medulla; it causes soothing of anxiety, sedation, mood improvement and skeletal muscle relaxation, as well as dilatation of peripheral blood vessels. Doxepine may be used in children with CP accompanied by motor symptoms, anxiety and psychosomatic syndromes [6, 8].

Usually every child with CP is given drugs from energizing group, also called psychostimulants or energizers. They improve mood, increase psychophysical strength, improve memory, concentration of attention and intellectual processes. Psychostimulating drugs are recommended for children with mental impairment, disturbances of specific analysers, memory problems, disturbances in concentration of attention, mental slowness, excessive fatigability and learning difficulties. Drugs from this group affect metabolism of the nerve cell by: 1) increasing norepinephrine excretion and stimulating noradrenergic system, and blocking and inhibiting monoaminoxidase; or 2) direct influence on the metabolism of the nerve cell and central cholinergic structures, increasing ATP concentration in the cell and blocking of phosphodiesterase. Nootropic drugs, like some thymoleptics, by improving children’s mood, increase their interest in school activities as well as play, and help to overcome everyday life difficulties. This group consists of:

meclofenoxate – regulates oxygen metabolism, excretion of pituitary and hypothalamic hormones, influences glucose consumption in nerve cells, accelerates electrolyte metabolism, stimulates oxidative processes in both central and peripheral nervous systems [6, 8].
deanol – increases mental activity, accelerates thinking, improves concentration of attention and mood [8]. The drug is recommended in rare clinical forms of CP with decreased muscle tonus (flaccid forms of CP), and in cases with mental impairment and disturbances of specific analysers. Difficulties in learning and adaptive disturbances are also recommendations for administration of deanol, provided the child does not experience epileptic seizures, as the drug may down-regulate the convulsion threshold [6].

piracetam – improves intellectual processes, memory, concentration of attention, increases ability to learn, facilitates memorizing, alleviates fatigue, significantly influences metabolism of the nerve cell, stimulates cortex, diencephalons and subcortical nuclei (especially amygdala) [6, 8].

aminosuccinic acid L-Aspartic Acid – C4H7NO4 – is an aminoacid involved in indirect metabolism of the nerve cell, stimulates brain function, improves concentration of attention and intellectual processes, removes psychomotor anxiety and excitation states. The drug is administered in various forms of CP with coexisting epileptic seizures [6, 8].

Piracetam – improves integrative function of the brain and influences bioenergetic metabolism of the nerve cell, improves energetic balance of the brain tissue, maintains proper polarization of the cell membrane, neutralizes toxic substances and increases concentration of ATP [6,8]. In children with CP, it improves mental fitness and effectiveness of learning, enhances perception and improves contact and cooperation during therapy. Piracetam works particularly well in treatment of children with mental retardation and lowered drive or psychomotor slowness – they become more active during school hours and play time, and exhibit increased
interest in the environment and social activities. Children’s tolerance for the drug is very good and side effects are observed extremely rarely [6].

In children with CP, along with substances improving the metabolism of the nerve cell, some drugs improving blood flow in the brain are also recommended:

- toperisone – inhibits polysynaptic reflexes, influences limbic system and hypothalamus, reduces muscle tonus and facilitates proper saturation of the nerve cells with nootropics [6, 8].
- vinpocetine – improves blood flow in the brain, oxygen metabolism, influences metabolism of the cell and shows weak anticonvulsive activity. The drug is used in CP cases with spastic or extrapyramidal pareses, epilepsy and mental impairment, as well with disturbances of specific analysers [6, 8].
- cinnarizine – acts on blood vessels, removes vascular spasms, increases blood flow in the brain, improves central and peripheral perfusion, influences metabolism of the nerve cell and reduces trophic and termoregulatory symptoms [6].

Anticonvulsive drugs constitute the next group of drugs administered to almost half of the children with CP:

- vigabatrin – an analogue of γ-aminobutyric acid, irreversible inhibitor of GABA-T (γ-aminobutyric acid aminotransferase). Anticonvulsive effect of this drug comes from its irreversible inhibition of GABA aminotransferase, which causes an increase of GABA concentration, responsible for inhibition of epileptic seizures [8]. Vigabatrin is used as a supportive drug in the treatment of epilepsy resistant to other anticonvulsant drugs, especially in seizures with secondary generalization [9].
- lamotrigine – stabilizes neuronal membrane via inhibition of potential controlled sodium canals and – in that way – blocks the release of stimulating aminoacids (e.g. glutamonic acid). The drug is used in partial seizures with tonic-clonic seizures with secondary generalization [9]. When used in monotherapy, it may cause headaches and dizziness, somnolescence or insomnia, fatigue, nausea, erythema multiforme and leukopenia [8].
- felbamate – the mechanism of its action is not well understood; the substance does not show any important effect on benzodiazepine nor GABA-receptors; it probably up-regulates the convulsive threshold and inhibits spreading of excitations responsible for the epileptic seizures. Felbamat is used in mono- or combined therapy in patients with partial seizures, in whom no improvement was observed after administration of other drugs [9].
- topiramate – a drug with a wide spectrum of anticonvulsive effects and a very complex pharmacologic mechanism. Topiramate blocks dependent on membrane potential sodium canals, increases activity of GABA, shows antagonism towards glutaminic acid receptors and regulates the acid-alkaline balance [9]. It is used in mono- or combined therapy in partial seizures with or without seizures with secondary generalization, and in combined therapy in primarily generalized tonic-clonic seizures [8].
- gabapentina – similar in structure to γ-aminobutyric acid molecule, but the mechanism of its action is completely different from GABA-ergic preparations. Gabapentina is used in monotherapy or as auxiliary drug in the treatment of partial simple or combined seizures that may be with secondary generalization [8, 9].
- tiagabine – shows strong and selective inhibition of the reuptake of γ-aminobutyric acid (main inhibitory neurotransmitter in the CNS) by neural and glial cells. The drug is administered in the combined therapy of partial or partial seizures with secondary generalization that do not respond to treatment with other anticonvulsive drugs [9].
- phenobarbital – due to its severe side effects, use of this drug decreased in the treatment of epileptic syndromes. Luminal, apart from anticonvulsive activity, shows sedative and somnoleptic properties. Its pharmacological mechanism is based on inhibition of neurons of limbic system, reticular system and hypothalamus, through increase of inhibitory action of GABA on the neurotransmission; it impairs in that way transmission of stimuli to cerebral cortex [9].
- clonazepam – administered parenterally, is the most potent drug in breaking an epileptic seizure. In long-term therapy, it brings good results in treatment of majority of clinical forms of epilepsy in infants and children, especially typical and non-typical unconsciousness and in primarily or clonic-tonic seizures with secondary generalization. Clonazepam, by influencing GABA-ergic system, causes direct inhibition to cortical or subcortical foci that evoke epileptic seizures and prevents generalization of an epileptic seizure [9].
- nitrazepam – described above
- diazepam – described above
- valproic acid – the mechanism of action has not been described yet; it is known that the drug selectively increases GABA concentration in CNS synapses and decreases the usage of GABA by glial cells and nerve endings by inhibiting GABA aminotransferase and semialdehyde dehydrogenase. In addition, it stabilizes cell membranes and strongly influences postsynaptic membrane causing sensitization of GABA receptors, and interferes with chloride transport increasing membrane transmission for potassium [9]. Valproic acid is a drug of choice in treatment of generalized idiopathic epilepsy, and also in treatment of all other forms of epilepsy: with primary or secondary generalization, tonic-clonic, tonic, clonic, myoclonic-astatic, myoclonic, atonic, with loss of consciousness and other [8, 9].

To alleviate or remove increased muscle tonus in children suffering from CP, some other drugs are also used:
- baclofen – acts especially on monosynaptic reflexes, inhibits medullary automatisms, visceral reflexes, reduces muscular rigidity and tonus. Baclofen – via reduction of gamma neurons’ excitation in medulla – shows very strong toning up effect on striated muscles [8]. The drug is used in CP with spastic pareses and involuntary movements. Among intolerance effects are balance disturbances, nausea,
vomiting and sometimes psychic disturbances, like excitation or hallucinations [6, 8].

pridinol – acts selectively on extrapyramidal system, alleviating involuntary movements; it also has anticholinergic properties [6,8].

phenoprobamat – tones up skeletal muscles, has sedative and anticonvulsive effects (used rather in older children and adults) [6].

biperiden – acts spasmytotically and parasympathetically, removes stiffness and akinness, tremor and involuntary movements, decreases increased tonus of spastic kind and extrapyramidal spasticity [6].

In the clinical pattern of CP, the main symptom is the increased muscle tonus of spastic type. Administration of drugs lowering striated muscle tonus increases the range of passive and active movements, improves muscle strength and prevents contractures [6]. Regarding their chemical structure, the drugs lowering muscle tonus are quite diversified, which directly influences their mechanism of action. These drugs may be divided into the following groups: 1) decreasing psychic tension and emotional states, acting anxiolytically via influence on limbic system; 2) pharmacologically active substances, blocking transmission, influencing directly myoneural junction through reversed release of calcium to intracellular space and endoplasmic reticulum; 3) inhibiting polysynaptic reflexes; 4) acting directly on reticular system and hypothalamus; 5) inhibiting transmission in intraneurons conducting impulses from sensory cells to motor cells of the anterior cerebral horns; 6) acting depressively on extrapyramidal system; they are characterized by spasmytotic and parasympathomimetic activity; 7) preparations, the myorelaxant activity of which is dependent on presynaptic inhibition via alpha motor system, decreasing excitability and impulsion of mono- and polysynaptic reflexes [7]. It is worth pointing out that myorelaxant drugs should be used prior to motor rehabilitation – in order to alleviate pain and fear of entering and continuing of treatment. The most frequently used drugs are:

derivatives of benzodiazepine – belong to anxiolytic drugs that, apart from myorelaxation, also show anxiety-relieving, sedative, anticonvulsive and somnoleptic activity. In children with CP, the following drugs are used: chlordiazepoxidum, clonazepam, medazepam, nitrazepam, diazepam, oxazepam, tetrazepam, lorazepam and estazolam [6].

benzotamina – influences limbic, reticular and gamma fibres system, acts calming, anxiety-relieving and toning up on muscle system [6]

baclofen – described above

dantrium – acts on myoneural junction and on peripheral nerve conduction, may cause skin rash and hepatotoxicity [6]

phenoprobamat – inhibits intraneurons of the medulla, combines properties of decreasing skeletal muscle tonus with sedative and anticonvulsive effects. Side effects are observed rarely, and among the more severe ones are intolerance by digestive tract, balance disturbances and somnolecence [6, 8].

metocarbamol – decreases muscle tonus via central action, blocks interneurons in medulla and inhibits polysynaptic reflexes, without influencing muneural junction. The drug is well tolerated by children with CP and other neurological syndromes characterized by increased muscular tonus. Among side effects are headaches and dizziness, nausea and vomiting [6,8].

tolperzone – described above

pridinol – shows strong parasympathomimetic and spasmytotic activity, acts depressively on extrapyramidal system, which explains very good results in removal of involuntary movements. The drug is often administered in extrapyramidal forms of cerebral palsy [6].

mephenoxaline – inhibits impulse transmission in polysynaptic spinal and supraspinal reflexes, suppresses activity of intraneurons transmitting excitation from sensory neural cells to the motor cells of anterior cerebral horns [8]. The drug decreases muscle tonus, pain, alleviates emotional tone and fear [6].

tizanidine – decreases muscle tonus, relieves pain, acts sedatively, inhibits tonic activity of motor neurons and increases presynaptic inhibition in medulla, acting at Ia nerve endings. Probably also activates alpha receptors of the brain stem [8].

toloxypromiodanol – decreases muscle tonus through inhibition of intraneurons in transmission of impulses from sensory cells to motor cells of anterior cerebral horns. The drug strengthens activity of barbiturates [8].

botulin toxin A (BTX-A) combines antipsychotic activity with sedative myorelaxant properties, decreases intensity of involuntary movements. BTX-A is one of the seven types (A-G) of toxin produced by Gram+(+) Clostridium botulinum. The substance is very important in the treatment of cerebral palsy due to good effects in relieving spasticity of lower limbs, which, if untreated, in severe cases leads to irreversible changes, requiring surgical procedures.

Conclusions

Sensible use of relatively wide spectrum of psychoenergetic, relaxant, sedative, anxiolytic, toning up, improving cerebral perfusion, anticonvulsory and reducing muscle tonus drugs greatly facilitates diagnosis, functional psychotherapy, kinesitherapy, ergotherapy, manual therapy, physical therapy, as well as social and occupational rehabilitation [6].

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