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NEURODEVELOPMENTAL DISORDERS OF CHILDREN AS THE CHALLENGING CONTEXT OF CAREGIVING AND ATTACHMENT DEVELOPMENT: AN EXAMPLE OF CHILDREN WITH FAS/FASD

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Summary. The mutual mother – infant interaction activates simultaneously two systems: attachment system and caregiving system. It guarantees survival to a newborn and contributes to its optimal development – social, emotional and cognitive. According to the theory of John Bowlby (1969, 2007) a child has natural innate mechanisms such as crying, clinging, sucking, smiling, calling, and following. These mechanisms activates the caregiving system in the mother. In this theoretical paper, we aim to present how the neurodevelopmental disorder having its roots in brain damage can modify the original attachment behavior by causing difficulties in attuning to the caregiver and interfering with caregiving system activation.
The authors' clinical experience shows that FAS/FASD often correlates with attachment disorder. FAS can be both the cause of difficulties and reinforcement of the environmental factors which impair attachment.
In a clinical picture FAS and attachment disorder influence each other, resulting in behavioural and emotional disorder.
Key words: attachment, neurodevelopmental disorders, FAS – fetal alcohol syndrome, FASD – fetal alcohol spectrum disorders

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The contemporary psychotherapy strongly emphasizes the role of infant – mother communication, increasingly highlighting the role of their contact through body. Dinora Pines (2010, following Schier, 2013), a British psychoanalyst and one of the most prominent researchers in femininity wrote: "the early relation mother – infant is formed through the body; the attitude of the mother can be practically felt by the infant's skin (…) Through her handling of the child, the mother's skin may convey the whole range of feelings, from tenderness and warmth and love to disgust and hate" (as cited in: Schier 2013, p. 7).

However, as clinicians working with children with FASD (Fetal Alcohol Spectrum Disorder) on everyday basis, apart from the competence required from and difficulties faced by caregivers, we are also able to see particular difficulties experienced by children in the area of sensory processing and neuromotor maturity. Children are born with them and they have a considerable influence on regulatory functions and the development of attachment, making it difficult for the caregivers to attune to the specific needs of the child who manifests early predictors of neurodevelopmental disorders.

A particularly underestimated and minimized factor which interferes with child development and affects the sphere of attachment is alcohol (Adubato, Cohen, 2011). About 90% of the patients of Fastryga Foundation are children raised by foster or adoptive families or staying in educational care facilities. All of them have experienced a disrupted mother – infant interaction, which profoundly influences the development of cognitive and emotional disorders (Lyons-Ruth et al., 2009; Adubato, Cohen, 2011) .

Disorders specific to FAS/FASD children

Prenatal exposure to alcohol is linked with the risk of developing an insecure attachment style. However, the children whose mothers provided them with emotional support, were better at coping with frustration. In such children, a higher level of secure attachment was observed (O'Connor, 2001; O'Connor, Paley, 2006, 2009; O'Connor, 2011).

The brains of children exposed to alcohol during gestation shape chaotically. They are unable to regulate their emotions, form meaningful relationships or control impulses. The newborns of mothers who drink alcohol while pregnant (or depressed) are in the group of an increased risk of attachment disorders (O'Connor, 2011). As cited in Mary J. O'Connor "80% of children in the moderate-heavy alcohol exposed group displayed attachment styles classified as insecure. The rate of insecure attachments found among the more heavily prenatally alcohol exposed youngsters in the sample was significantly higher than rates reported in other samples of children of similar ages, socioeconomic status and ethnic backgrounds" (O'Connor, 2011, p. 3). On the other hand, alcohol abuse interferes with emotion regulation and organization in mothers (Adubato, Cohen, 2011). The research also showed that alcohol adversely affects the abilities of infants to develop attachment because of the excessive activation of the limbic system, which is responsible for adaptive functions and fight-or-flight defensive responses (Schore, 2002).

We must also remember that those children have an inborn dysregulation of HPA axis (hypothalamic-pituitary-adrenal axis), called a stress axis, which is a biological substrate of reaction to the activating events with high stimulation in a form of greater reactivity or continuous reactions (Kobor, Weinberg, 2011; Mead, Sarkar, 2014). An identical activation was observed in children in an unfavourable care environment (van IJzendoorn et al., 2011) .

Healthy attachment is an organized, complex neurodevelopmental pattern, which provides foundations for the future experiences of the self (body states, emotions, self-regulation), as well as relationships with others (care, protection, safety). It requires "adequate parenting", which means constant care and consistent safety and structure. An insufficient amount of these factors underlies attachment disorders in children with FASD.

Therefore, in this paper we would like to focus on the neurobiological understanding of the bases of the attachment relationship.

Neurodevelopmental disorders

Neurodevelopmental disorder is a broad term encompassing a number of abnormalities in motor, intellectual and social development of a child. However, the literature lacks unambiguous definition explanation (in a broader context, they refer to brain growth disorders, and in a narrower context – to disorders of the brain function, including neuropsychiatric problems, motor function deficits, learning disabilities, and the disorders of language development and non-verbal communication).

According to the DSM-5 (see: DSM-5, 2013) neurodevelopmental disorders include:

- Intellectual disability,
- Communication disorders,
- Autism spectrum disorders,
- ADHD,
- Specific learning disorders,
- Motor disorders,
- Other specified and unspecified neurodevelopmental disorders (including FASD as a disorder resulting from pre-natal exposure to alcohol – without specifying whether it is a variant with clear facial dysmorphic features or a non-dysmorphic variant – subtype: ARND – Alcohol Related Neurodevelopmental Disorder).

The cause underlying the above disorders is a damaged or atypically developed central nervous system (abnormalities of subcortical areas, white matter disorders, mirror neurons functioning deficits, cortex abnormalities) (Owen et al., 2013; Bauer, 2015).

This may cause a lack of positive emotions at the caregiver while having a contact with the child (Krukow, 2008; Schier, 2013), which, in turn, causes limited or inadequate responses of a mother to a child's needs as well as reactions of her body (change in the body temperature, stiffening, change of smell) caused by secretion of the stress hormones in her body. At the neurochemical level, it contributes to

a distortion of the inner operating models in the child (Schaffer, 2006; Whitcomb et al., 2015), by developing abnormal responses from the right brain hemisphere, which primarily forms non-verbal mother – child communication (Schore, 2002). If a regulation is distorted, then features which are usually associated with the right hemisphere such as: emotional self-awareness and recognizing other people's expressions may be distorted as well (Galderisi, Mucci, 2000). Hence, it is so important to observe any non-verbal forms of communications between a child and a caregiver as the most primal patterns which shape the brain.

Proper development of sensorimotor skills affects the basic motor functions, motor coordination, concentration and the level of activity, which is necessary for a child to acquire new motor and cognitive skills, properly communicate with the environment and develop communication and social competence (Stock-Kranowitz, 2012; Jirikowic et al., 2013; Ayres, 2015; Goddard-Blythe, 2006, 2015).

Sensory processing deficits and neuromotor immaturity which accompany this disorder may seriously impair inborn attachment behaviours (such as crying, smiling, following, calling, clinging) (Bowlby, 2007; Wiśniewska, 2012; Whitcomb et al., 2015).

Neurodevelopmental disorders and attachment disorders in children with FAS/FASD

Prenatal alcohol exposure leads to serious problems, both medical and psychological. Alcohol is a well-known teratogen which adversely affects the neurobehavioural development, resulting in cognitive disorders, learning difficulties and emotional problems.

A vast body of scientific literature describes the link between the consumption of alcohol by pregnant women and neurodevelopmental problems occurring in their children (Astley, 2004; Jirikowic et al., 2013). The symptoms present in children with prenatal alcohol exposure include in particular cognitive disorders and attention deficits, hyperactivity, verbal expression disorders, motor problems, perseveration, impulse control disorder, etc. (Streissguth et al., 1996; Klecka, Janas-Kozik, 2009; Pawłowska-Jaroń, 2011).

We also know and observe it in our everyday work that children with prenatal alcohol exposure have more problems with developing attachment than children not exposed to this teratogen. They are disadvantaged in terms of their developmental starting point due to the negative influence of alcohol on the developing brain (Astley et al., 2006; Dyr, 2006). Post-mortem examinations of the brains of foetuses with FAS show numerous changes indicating underdevelopment of the central nervous system on its various levels and the disorders of neural migration and organization, which causes decreased plasticity of the brain/and therefore the ability to develop new neural connections (Nunez, Roussotte, Sowell, 2011). This, in turn, causes sensorimotor and reflex deficits influencing the quality of attachment (Purvis et al., 2013, Whitcomb et al., 2015). The relationship between prenatal alcohol exposure and the insecure attachment style manifests itself in the course of child development.

Infants with FASD manifest a number of reactions that are incomprehensible to their caregivers by the lack of typical attachment behaviours such as crying, eye contact, clinging or spontaneous following the caregiver. They also manifest atypical reactions, which is a result of specific damage of the brain caused by alcohol and high levels of stress hormones (cortisol and adrenaline), but frequently also by sensory deprivation in the first months of life (Cermak, Daunhauer, 1997; Cermak, Groza 1998; Zarnegar et al., 2016). Unaware caregivers encounter a lot of difficulties with attuning to specific reactions of their baby, and the intuitive ways of reacting fail them.

Medical imaging (with the use of fMRI) based on Bowlby's ethological attachment model revealed that the activation of the caregiving and attachment system causes the activation of the limbic system, the prefrontal cortex, the basal ganglion, as well as the hypothalamus and the pituitary gland, both mother and child. These areas of altered activity are believed to be the neural base of care and attachment systems (Lenzi et al., 2015).

In FASD, the prefrontal structures and the limbic area are damaged. The limbic area not only plays a crucial role in the formation of emotions (Astley et al., 2006), but it is also responsible for the realization of attachment behaviours (Lemche et al., 2006; Lenzi et al., 2015).

In children with FASD a decreased mass of the hippocampus and a smaller amygdala can be observed (Spadoni, McGee, 2007). The amygdala is believed to be the key structure of the limbic system; it takes part in the recognition of the emotional meanings of impulses, mainly by means of conditioning. Until recently it was believed that it participates mainly in the expression of fear and defence responses, however, research conducted in the early 2000s proved that it also plays a significant role in the system of rewards and positive emotions (Murray, 2007), as well as in the mediation of secure attachment (Lemche et al., 2006). The amygdala has also numerous connections with the centres of various modalities, it conducts sensory and motor impulses to the thalamus (treated as a 'relay station' for the sensorimotor stimuli, which orders, interprets, connects with each other and with the previous experiences and sends them out to particular areas of the cortex (Ayres, 2015). These rich connections made by the amygdala allow for combining information from various modalities, accessing the memory resources, as well as the modulation of attentional processes and quick activation of vegetative and hormonal reactions. Information about a stimulus relayed to the amygdala is simultaneously sent to the cortex, which, through analysis and evaluation, blocks or controls an emotional response (LeDoux, 2000).

Since the amygdala is a gate modifying a response to sensory stimuli, the problems occurring in this area are known as sensory processing deficits (or sensory integration disorders), particularly the subtype known as modulation disorders will have a major influence on the development of attachment disorders (Ayres, 2015; Whitcomb et al., 2015).

Attachment and caregiving context: Child characteristics related with sensory integration and modulation disorders

Children across the fetal alcohol spectrum demonstrate high rates of sensory processing differences (61-81%) (Jirikowic et al., 2013).

According to Ayers (the author of the concept and the method of diagnostics and therapy, 1971), sensory integration is a neurological process organizing sensations received from the body and the environment in such a way that they can be used to trigger adequate responses and deliberate actions. It also defines a way in which we use the received stimuli for deliberate actions.

The stimuli delivered to the brain by the sense of balance (the vestibular system), and touch and proprioception, bring countless amounts of information. The brain processes the information (locates, recognizes, orders, interprets, connects with each other and previous experiences) and sends the results to the cortex, which is the basis for deliberate actions. We learn through our senses and without information entering our nervous system there would be neither learning nor development.

Sensory integration disorders (Ayres, 1971, 2015), nowadays called sensory processing disorder – SPD (Miller, 2000, as cited in: Stock-Kranowitz, 2012), is ineffective processing of stimuli by the nervous system. It is inadequate subjective reception of stimuli, which leads to an inadequate response to a stimulus and an inadequate motor or emotional response.

Sensory processing disorders can be associated with premature birth, brain injury, learning disorders and children with autism spectrum disorder and other developmental disabilities (Ayres, 1971, 2015; Stock-Kranowitz, 2012).

According to Lucy J. Miller, the statistics report a minimum of 1 in 20 children in the US have SPD. This is the only published statistic and is based on her research thus far. As awareness increases and more studies are done, we may very well find the statistics to be higher (Miller, 2014).

Particularly noteworthy are sensory modulation disorders. Sensory modulation is defined as a process in which neural activity is reinforced or blocked so that it remains in tune with other functions of the nervous system (Miller, Hanft, Lane, 2000; Miller et al., 2007), so it is a self-regulation of the nervous system activity. Children with modulation disorders usually have serious problems with everyday functioning. Their reactions are frequently inadequate to the occurring stimuli (they may be either forcefully expressed or non-existent for relatively strong stimuli) (Dąbrowska, 2007).

A correlation between attachment disorders and sensory modulation disorders is of interest to the scientists who deal with paediatric occupational therapy and sensory integration (Cermak, Daunhauer, 1997; Cermak, 2001; Koomar, 2009; Whitcomb et al., 2015).

There is an evidence that children who have a history trauma or being ill-treated often have sensory integration disorders (SPD, which may have a negative influence on their behaviour, social skills, motor skills and educational progress (Cermak, Daunhauer, 1997; Cermak, Groza 1998; Cermak, 2001; Purvis, Cross, 2007; Gourley et al., 2013; Purvis et al., 2013). The sensory stimuli may cause over-respon-

sivity or under-reponsivity to the touch, sound, smell etc. Such deficiencies may also cause problems with self-regulation and difficulties in experiencing relationships, as the social signals are interpreted in a wrong way and the reaction may be excessive or different from the average. An interaction with those children may lead to misunderstandings and conflicts (Parris et al., 2015).

As it has already been mentioned, a prenatal exposure to alcohol should be considered in categories of developmental trauma or ACE (adverse childhood experiences) which leads to permanent brain lesions (O'Connor, Kasari, 2000; Streissguth, O'Malley, 2000; O'Connor 2001; Clarke, Gibbard, 2003; Jacobson, Jacobson, 2003). Below, we describe various senses and possible modulation disorders (as cited in: Dunn, 2013; Klecka, 2007; Klecka, Palicka, 2009; Miller et al., 2007).

Vestibular system disorders

Vestibular system is located in the middle ear which includes the outer wall in the inner ear (the labyrinth) and its innervation (the vestibular nerve, vestibular nuclei in the brain stem, cerebellum and cortical centres). It reaches maturity as first of all the senses.

The organs of the sense of balance in the inner ear are mature in terms of shape, and partly in terms of innervation as early as in the 8th week of gestation, and in the 6th month, they have reached their ultimate size and they are fully innerved. These are the only parts of the organism which reach their full mature form in the prenatal period. From the beginning they are intensively exercised, because a foetus constantly moves and changes its position in the mother's womb.

Our balance organ consists of receptors responding to movement:

- linear – gravity receptors (utricle: forward – backward movement) and vibration (saccule: up – down movement),
- rotational – semicircular canal (superior, posterior and lateral).

Receptors provide us with the information about how the body is located and what is happening to it. The vestibular system also influences the regulation of posture and muscle tone, and due to numerous connections – it influences other senses as well.

Vestibular oversensitivity is over-responsivity, with a low excitation threshold, and vestibular undersensitivity is under-responsivity, with a high excitation threshold.Under-sensitive children constantly seek tactile sensations which stimulate the balance organ. They rock, spin around, run, jump, hang upside down, climb, and have difficulty sitting still. Over-sensitive children tend to avoid activities which require keeping balance, they have a fear of heights, dislike car travel, tend to get dizzy, avoid physical activity and prefer to remain in one place.

Auditory perception disorders

Auditory system develops from the vestibular system (the balance organ). They are both innerved by the same nerve – eighth cranial nerve (vestibulocochlear nerve). According to neurobiological theories, each system which is developmental-

ly 'newer', is still dependent on the 'older' system or on the nervous structures from which it evolved, therefore the auditory system is still dependent on the proper functioning of the vestibular system (responsible for the sense of movement and for balance).

When a child is born, his/her ears are fully mature to perform their work: the conductive part of the auditory organ is functional, the 8th nerve is myelinated enough, auditory centres in the cortex are electrically active, but the developing systems – vestibular and auditory are particularly sensitive to the influence of ototoxic substances (drugs, alcohol), therefore a child may be born with impaired hearing. And although, objectively, he/she will be able to hear, the reception of the information through the ear and the brain will not be correct. What can develop, is auditory over-sensitivity (over-responsivity, with a low excitation threshold) or auditory under-sensitivity (under-responsivity, with a high excitation threshold).

The following features are characteristic of a child with a low excitation threshold:

- defends oneself against certain sounds, covers ears,
- easily distracted, particularly in the situations where more sounds occur,
- makes a constant noise to dominate other sounds (from the background or from the inside of own body.

The following features are characteristic of a child with a high excitation threshold:

- seems to be not hearing when called,
- is fascinated by certain sounds and repeats them frequently.

Children with auditory reception deficits often behave in a chaotic way (they seek or avoid stimuli), they do not follow instructions given at school or kindergarten to the whole group, they are very noisy, they often have delays in speech development. If additionally their brain and speech centres develop in an incorrect way in both hemispheres, they can also experience problems with understanding the emotional meaning of the communication directed to them, jokes and metaphors, as well as complex interpersonal communication.

Visual perception disorders

The beginning of the eye development can be observed as early as in the third week of gestation. The development of the lens is complete about the 7th week, and reaches the peak of its maturity in the 8th month of womb life, and then a slow degeneration of this organ begins. From the 16th week of gestation a foetus reacts to sunlight, and in the 24th week of gestation it starts making complex movements with the eyeballs, looking up, down, and to the sides.

The correct use of the visual organ, i.e. seeing, provides a lot of information about people and objects, it helps establish the boundaries between ourselves and other objects when we move. In the case of the reception of visual sensations, again we can deal with oversensitivity or undersensitivity.

A child with visual oversensitivity may lose orientation on a sunny day, have difficulty watching his/her surroundings or experience problems with the selec-

tion of visual stimuli (for example, get tired looking at contrasting colours, such as black letters against white background). A child with visual undersensitivity may encounter difficulties with finding objects; he/she may pay attention to details but fail to see the whole picture, he/she will also have problems with following a parent with his/her eyes.

Tactile sensation disorders

The receptor responding to tactile stimuli, i.e. the skin, is our biggest sense. It develops and becomes mature very early – the first tactile responses occur between the 6th and 7th week of gestation. The first contact with the outside world is made by means of the sense of touch. A healthy baby should calm down immediately after being held.

How does touch affect functioning? Its primary function is protection (it informs, on the very basic level, if a tactile stimulus is a threatening one or not); it allows for tactile perception, it provides information about the body and helps develop body scheme, it plays a role in motor planning, helps shape visual perception, (provides information about what we see, information about the features of an object and its relation to the surroundings). It also influences the development of fine motor skills by means of discriminative touch; if there is tactile defensiveness in any part of the body, then discriminative touch cannot develop, neither can fine motor skills. Touch also influences emotional security and social functioning (seeking or avoiding tactile contact).

The skin has a few kinds of receptors for receiving the sensations of touch, pressure, texture, heat, cold, pain and movement of hairs on the skin, therefore there can be various deficits of tactile sensory processing (oversensitivity and undersensitivity) in one child. Under-responsivity means a very high excitation threshold of the receptors needed to feel a tactile stimulus. A child has a lowered sensitivity to touch, does not notice a cut or a bruise, does not know where he/she has been touched, does not feel a burn or cold on his/her skin, has a poor body scheme and is unable to recognize the features of an object held in his/her hand. He/she also does not feel hunger or fullness. In the case of over-responsivity to touch (as if it was threatening or unpleasant) we talk about tactile over-responsivity (or tactile defensiveness). A child may not tolerate playing with hands, not accept some kinds of clothing, he/she may be bothered by tags, threads or seams in clothing, combing or washing hair, cutting nails, hugging and sudden unexpected touch. He/she may also not tolerate some foods because of its texture, etc. An infant with tactile defensiveness does not activate the natural clinging reaction.

Taste disorders

Taste buds start to develop from the 55th day of gestation. In the 3rd month, the basic tastes start to diversify. In the 14th week, a foetus starts to swallow about one litre of amniotic fluid a day and develops sensitivity to its taste. In the 5th month of gestation, the number of taste buds and salivary glands rises and the taste organ is

functional. A baby has a larger surface of the reception of taste sensations than an adult. Taste buds are located on the whole blade, lower surface and tip of tongue, on the hard palate and mucosa of lips and jaws. Research conducted on mammals clearly documents the fact that even before being born, it is possible to develop habits which direct taste preferences after birth.

Taste-oversensitive children may not tolerate many tastes and refuse to eat certain kinds of food. Taste under-sensitive children need strong stimuli in the oral cavity, therefore they seek distinctive tastes (spicy condiments, dishes containing monosodium glutamate, sour dishes, etc. They tend to eat inedible substances).

Smell disorders

The smell organ is 10000 times more sensitive to the concentration of chemical particles than the taste organ! Babies are born with the ability to differentiate smells and react positively to, for example vanilla, strawberries or bananas, and negatively to the smell of ammonia, rotten eggs or fish. After birth, a newborn is directed by smell when searching for a nipple. The smell receptors are sensitive to the toxic influence of alcohol and the shortages of microelements (particularly of zinc, which is depleted by alcohol), therefore the disorder of the perception of olfactory sensations is so common in children with FASD. Such children more often manifest olfactory under-sensitivity than over-sensitivity. They seek strong olfactory sensations and in order to feel the smell of something, they smell smeared faeces, urinate in their rooms, enjoy rubbish bins, or are unwilling to change dirty underwear.

Neuromotor immaturity

Another type of disfunction resulting from prenatal brain damage is neuromotor immaturity – one of the "neurological soft signs" (NSS). This term describes the retention of immature patterns of motor control, on the basis of too weakly or too strongly expressed primitive or postural reflexes. It may be a result of classical neurological symptoms, or it may reflect functional or developmental dysfunctions of particular areas of the brain (Goddard-Blythe, 2006, 2015).

The presence or absence of primitive or postural reflexes at the key moments of development is a credible indicator of the maturity of the central nervous system.

Primitive reflexes are the reactions which develop during gestation. They are present in full-term newborns at the moment of birth and they should be inhibited (integrated) by the upper regions of the developing brain in the first 6-12 months after birth.

The risk factors which may influence the immaturity include: experiencing long-term or strong stress, the influence of teratogenic substances (alcohol and drugs), which interfere with the process of neurogenesis. Other factors may include: the necessity to stay in a lying position for a long period of time, antibiotic therapy, caesarean section or other difficult childbirth, induced labour, pre-term or post-term labour (by more than 2 weeks), perinatal asphyxia, low birth weight, bacterial or viral infections with a high temperature in infancy, frequent infections

of the middle ear, head injuries. Reflexes are the first source of basic motor skills, they provide an innate response to the basic sensory stimuli and they facilitate the appearance of specific motor responses to a particular situation (Goddard-Blythe, 2006).

Disorders of primitive (innate) reflexes

In the next paragraphs we will describe selected primitive reflexes and their abnormalities which may influence the development of attachment behaviours (as cited in: Klecka, Palicka, 2010).

Moro reflex appears between 9th and 12th week of gestation, and it is present after birth, letting an infant breathe in the air and activate a spontaneous breath with the upper and the lower part of the lungs. As a survival mechanism, Moro reflex is an instinctive response to threatening stimuli activated in the first months after birth. It is activated by vestibular stimuli (movement and the loss of head support), as well as tactile, visual and auditory ones. An infant's movements must be free (arms and legs unconstrained) in order to practice both stages of the reflex (abduction and adduction). If the reflex persists beyond the 3-4 month of age, an infant may overreact to sudden stimuli, which may cause constant oversensitivity of one of the senses, and therefore overreaction to certain stimuli, for example noise, touch, light, etc. The Moro reflex should develop into startle (Strauss) reflex, which is a more aware reaction and it is connected with the perception of a stimulus. If there is no danger, an infant ignores the stimulus and resumes an interrupted activity. The Moro reflex causes an instant response to a stimulus, before the conscious part of the brain manages to assess the situation and respond accordingly. The children who experience a retained Moro reflex, tend to overreact to minor stimuli, they exhibit immature behaviour, and have difficulty ignoring irrelevant stimuli. It may lead to sensory system "overload" and affect behaviour and attention. The constant release of cortisol and adrenaline exhausts the adrenal cortex, which leads to increased susceptibility to infections and allergies, and fatigue.

If an infant is born without or with too weak Moro reflex, he/she cannot shape adequate responses to outer stimuli, or they may be slower or distorted, for example a baby instead of crying (calling) – freezes, which may lead to dissociation. In a situation when abduction and adduction of limbs, characteristic for the Moro reflex, are blocked (for example by excessive swaddling of an infant) – the primitive reflex of clinging may become distorted.

Tonic labyrinthine reflex. It appears in the 12 week of gestation in flexion and before labour – in extension. They play an important role in the labour – when the head is tilted to fit in the birth canal, and the arms straighten, which lets infants assume the right position. The reflex becomes gradually inhibited from the 6th week to 3.5 years of age. It is caused by the change in the location of the head in space. TLR in flexion is caused by the forward head movement, and TLR in extension with tilting the head back. If TLR retains in an older child, it affects muscle tone and the development of the reflexes of extension and balance, which are the basis of integration of proprioception, as well as eye movement coordination and control.

After birth, retained flexion TLR prevails, which enables an infant to automatically flex and relax the muscles of the limbs, facilitates lying in the supine position and clinging to a caregiver, as well as doing the cradle hold. In children who have a prevalence of the extension TLR caused by difficulties in the self-regulation of muscle tone, excessive bending backwards can be observed, which makes it difficult to cling to a caregiver, latch and suck.

Root and suck reflexes. They appear in the 24-28 week of gestation and they are active immediately after birth. They initiate: rooting, sucking, swallowing and they are the reaction to touch, which gradually becomes a visual response (to the sight of a breast or bottle). Their role is to support the development of the articulation muscles. Some researchers have noticed a relationship between the suck reflex and the eye movement (blinking), which suggests that in the early stage of development there is a relationship between the movement of the mouth and the eye (a functional relationship between sucking and blinking may undermine the autonomy of eye movements such as sight direction). The retention of the root reflex may adversely affect the mouth area muscle control, the positioning of the tongue and the process of swallowing, which sometimes results in speech and articulation impairment. It is also connected with the oversensitivity of the mouth area. If these reflexes are not active right after birth, one of the important attachment mechanisms will not appear – touch in search of a stimulus and sucking.

Disorders at the level of physical realisation of primary attachment mechanisms (clinging, sucking, crying) resulting from the neuromotor immaturity may cause disorientation or irritation to the caregiver. These cause disorders in releasing in the mother's brain endogenous opioids, which play an important role in regulating the attachment behaviours and in the separation reaction (Panksepp, 1998) and, in turn, cause an inadequate reaction at the level of their whole body (Krukow, 2008; Schier, 2013; Lenzi et al., 2015; Whitcomb et al., 2015) which usually directly translates into realisation of the care model and into regulating the child's condition.

Discussion

As stated before, healthy attachment is an organized, complex neurodevelopmental pattern which provides foundations for the future experiences of the self (body states, emotions, self-regulation), as well as relationships with others (care, protection, safety). In children with FASD, an insecure attachment style occurs very frequently (almost 80% population of FASD children), which in this case is conditioned by a number of factors (both biological and psychosocial).

FASD is a neurodevelopmental disorder, which develops as a result of damage of the central nervous system or its or atypical development. The brains of children exposed to alcohol in the prenatal period develop chaotically (the prefrontal area and areas of the lymbic system are evidently damaged, inter alia the mass of the hippocampus is decreased and the amygdala, responsible for the mediation of secure attachment, is smaller). Because of damaged or atypically developed central nervous system (abnormalities of subcortical areas, white matter disorders, mirror neurons functioning deficits, cortex abnormalities) children with FASD are

also unable to regulate their emotional states, form meaningful relationships, or to control their impulses. They experience problems with sensory processing (modulation disorders are particularly severe) and neuromotor immaturity (weakened or increased primitive reflexes). These deficits and neuromotor immaturity which accompany this disorder may seriously impair the attachment behaviours (such as crying, smiling, following, calling, clinging), which confuses the caregivers, who expect typical biologically conditioned infant behaviours. In such cases caregivers do not respond with attunement which is adequate for the needs of the child, which is a risk factor leading to the development of an insecure attachment style, based on based on development disorders of internal working models, that is self-reflection, the quantity of relationships and emotions of the caregiver to whom the child is attached.

We would like to emphasize that we understand how difficult it is to be a competent parent of a child with neurodevelopmental disorders. That is why our aim as clinicians working with children with FASD and their families (biological, adoptive and foster) is not only to provide therapy with the use of neurodevelopmental methods, but also to educate the parents and modify their caregiving and educational approach. By the consistency and repetitiveness of their actions and their emotional availability and attunement, they have a chance to become another "primary" caregiver and fix the brain whose ability to form an attachment relationship has been damaged. Recent studies show the right direction of our actions (Zarnegar et al., 2016).

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ZABURZENIA NEUROROZWOJOWE I ICH WPŁYW NA KSZTAŁTOWANIE SIĘ PRZYWIĄZANIA NA PRZYKŁADZIE DZIECI Z FAS/FASD Z FUNDACJI FASTRYGA

Streszczenie. Wzajemna interakcja niemowlęcia i matki aktywuje jednocześnie dwa systemy: przywiązania i opieki, to gwarantuje noworodkowi przeżycie i wpływa na optymalny rozwój społeczny, emocjonalny i poznawczy. Według założeń teorii Johna Bowlby'ego (2007) dziecko posiada naturalne wrodzone mechanizmy, takie jak płacz, przywieranie, ssanie, uśmiech, nawoływanie, podążanie, które uruchamiają program u matki (opiekuna) zajmującej się dzieckiem. W niniejszej pracy chcielibyśmy pokazać, w jaki sposób zaburzenia neurorozwojowe,

mające swoje podłoże mózgowe mogą modyfikować pierwotne zachowania przywiązaniowe, powodując trudności z dostrojeniem opiekuna i zaburzając u niego aktywację systemu opieki. Doświadczenie kliniczne autorów pokazuje, iż FAS/FASD często koreluje z zaburzeniami więzi. FAS może być zarówno przyczyną, jak i wzmocnieniem czynników środowiskowych zaburzających kształtującą się więź. W obrazie klinicznym objawy FAS i zaburzeń więzi przeplatają się, dając się poznać jako zaburzenia zachowania i emocji.
Słowa kluczowe: zaburzenia neurorozwojowe, FAS/FASD, zaburzenia przywiązania

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