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Understanding Children with Severe and Multiple Disabilities based on Physiological Knowledge with a Focus on drinking behavior

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(Keywords: Profound and Multiple Learning Difficulties/Disabilities, drinking behavior, subfornical organ)

1. Introduction

Recently, the number of children with severe and multiple disabilities attending special needs schools (MEXT, 2015)[1] has increased. Teachers working at such schools need to attend to the issue of Severe and Multiple disabilities in Japan, and specifically to those students with Profound and Multiple Learning Difficulties/Disabilities (PMLD), or Profound Intellectual and Multiple Disabilities (PIMD). PIMD is defined as those who have significant motor, sensory, impairments and they need complex health care needs (Ware, 2004)[2]. PMLD is defined as those who have extremely delayed intellectual and social functioning, may have limited ability to engage verbally, require to interpret their communication intent by familiar people and frequently have an associated medical condition which may include neurological problems, and physical or sensory impairments (Bellamy, Croot, Bush, Berry & Smith, 2010)[3].

To understand these children some researchers use an index inspired by physiology.

Okazawa (2012)[4] reviewed studies of people with profound and multiple disabilities who need intensive medical care, from the perspective of how people around them should understand them. He pointed out that physiological studies have suggested that people with profound and multiple disabilities interact with their environment. And to contribute to their education, physiological indices should be included in an educational approach and planning.

Nozaki and Kawasumi (2012)[5] observed the child with profound brain and respiratory disabilities by using bodily movements and heart rate. They suggested that heart rate might be linked to involuntary movements observed in the child's face or passive movements of one of the child's hands, researchers and teachers should note in order to make good use of the heart rate index. Moraes and Chau (2012)[6] explored four autonomic nervous system (ANS) signals: electrodermal activity, skin temperature, cardiac patterns and respiratory patterns, for the purposes of communicative interaction with a PIMD student. As the result, ANS signal patterns revealed issues unique to people with PIMD. Cock, Munde, Petrt, Noortgate and Maes (2012)[7] found a lower heart rate when participants were presented with negative stimuli than when they were presented with positive stimuli. Their skin temperature was higher for the expression of low intensity negative emotions compared to the expression of low intensity positive emotions. The results suggested that, as with people without disability, heart rate and skin temperature can give information about the emotions of persons with severe and profound disabilities. Vos, Cock, Petry, Noortgate and Maes (2013)[8] tried to validate the behavioral observations of emotions using respiration and heart rate variability. They formed the hypothesis regarding higher percentage rib cage contribution, that a marginally lower mean inspiratory flow and lower heart rate variability is found when the expressed emotions became more positive.

Lima, Silva, Amaral , Magalhães and Sousa (2013)[9] assessed the behavioral and physiological responsiveness of three children with profound intellectual and multiple disabilities to a set of sensory stimuli. Responsiveness was assessed in terms of consistent behavioral and electrodermal. The data presented hav-

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ing implications for the development and the emotional well-being of individuals with profound intellectual and multiple disabilities. Memarian, Moraes and Chau (2014)[10] tried to find physiologically arousing stimuli and labile physiological channels in a non-verbal adolescent with severe and multiple congenital disabilities who did not have a reliable means of communication. The results of this case study suggest that physiological data may complement caregiver acumen in deciphering the reactions of non-verbal clients with severe and multiple disabilities. Putten, Stewart, Steenbergen, Wijck, Schans(2013)[11] thought that physical fitness and health are related to physical activity, and that to gain an insight into the physical activity levels of PIMD was important. They examine heart rate patterns to measure the activity levels of persons with PIMD and to analyze these heart rate patterns according to participant characteristics. The heart rate patterns suggested that other, more personal and psychosocial factors had significant influences on heart rate patterns. When the former study is enlarged, bodily movements and heart rate, autonomic nervous system (ANS) are used as a measure of physiological rate for PMLD and PIMD. As Bellamy, Croot, Bush, Berry & Smith (2010)[3] suggested Children with PMLD and PIMD have neurological problems, and physical or sensory impairments, we should consider children's well-being or quality of life.

The purpose of this study to suggest that physiological knowledge is key for any educational approach focusing on drinking behavior because eating and drinking are very important educational activities in special needs education school.

2. Method

Several investigations have demonstrated that the subfornical organ (SFO, Fig.1) sends angiotensinergic projections to the median preoptic nucleus (MnPO), and suggested that the SFO projections play important roles in elicitation of drinking and cardiovasucular responses.

We examined the mechanism of the subfornical organ in our former studies. From these studies, we make key map of drinking behavior.

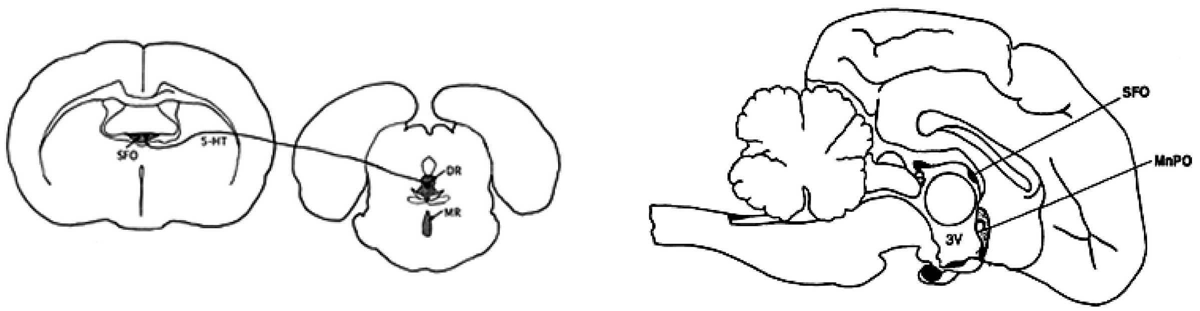

Fig.1 SFO

(1) Serotonergic systems in the SFO

Serotonergic axons within the SFO are derived from the dorsal raphe nucleus (DR). Hypovolemia or hemorrhage increases the release or turnover of serotonin (5-hydroxytryptamine, 5-HT) in the SFO. Local administration of 5-HT into the SFO causes enhanced thirst and elevated pressure. Interactions between the serotonergic and angiotensinergic systems in the SFO are important for the generation of drinking. So serotonergic projections may be involved in the control of body fluid balance and cardiovascular functions (Tanaka, Kariya, Nomura, 2003)[12].

(2) GABAergic systems in the subfornical organ (SFO)

The SFO contains γ-aminobutyric acid (GABA) neurons and terminals. GABA and its analogs influence the ANG II-induced drinking and pressor responses through SFO neurons. GABA modulates the transmission of acetylcholine in the SFO. (Tanaka, Nomura, Kawakami, Ushigome, Nomura, 2002)[13].

3. Results

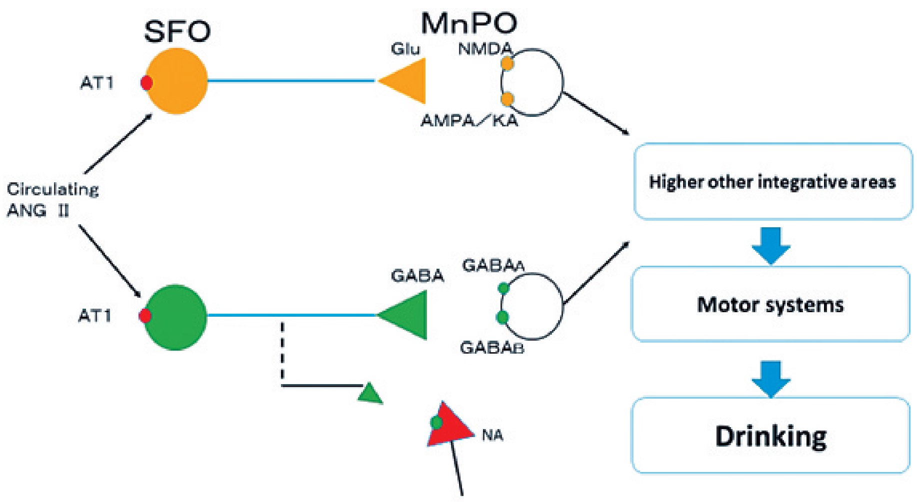

Fig.2 key map of drinking behavior

From our former studies[(14)(15)(16)(17)] we suggest the 'key map of drinking behavior' (Fig.2). Interactions between the serotonergic and angiotensinergic systems in the SFO are important for the generation of drinking.

4. Discussion

To clarify the precise physiological functional roles of water intake system mechanisms, further studies are in progress, however we can speculate that children with severe and multiple disabilities have any different systems compared with other children. The central nervous system of children with severe and multiple disabilities should be examined in order prevent dehydration and aspiration. Generally, GABAergic systems act to inhibit act the activity of neuronal excite activity in the central nervous system. For example, it has been established that dopaminergic projections to the several brain regions, serves to help create comfortable feelings, such as when children with severe and multiple disabilities are praised in the class. We think it is important that the teachers who are engaged in education of children with severe and multiple disabilities to be conscious of children's expression because it might mediate the their bodily situations (Takahashi, 2011)[(17)]. When a teacher guides children with severe and multiple disabilities in eating and drinking activities, the teacher should recognize the importance of water intake system mechanisms for their well-being. (Takahashi, 2013; 2015)[(18)(19)].

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