A case study where memory disorder became obvious after disturbance of consciousness:

Treatment using a hierarchical model

Makoto Hirumuta (Department of Rehabilitation, Fujita Health University, Bantane Hospital, hirumako@fujita-hu.ac.jp)
Takaji Suzuki (Faculty of Rehabilitation, School of Health Sciences, Fujita Health University, takajis@fujita-hu.ac.jp)
Miho Ohashi (Department of Rehabilitation, Fujita Health University, Bantane Hospital, k-miho@fujita-hu.ac.jp)
Tomoko Kayukawa (Department of Rehabilitation, Fujita Health University, Bantane Hospital, ka-tomo@fujita-hu.ac.jp)
Yoichiro Aoyagi (Department of Rehabilitation Medicine I, School of Medicine, Fujita Health University, yyy@rc5.so-net.ne.jp)

意識障害改善後に記憶障害が顕在化した一例—階層モデルに沿った介入—

蛭牟田 誠（藤田医科大学 ばんたね病院 リハビリテーション部）
鈴木 孝治（藤田医科大学 医療科学部 リハビリテーション学科）
大橋 美穂（藤田医科大学 ばんたね病院 リハビリテーション部）
粥川 知子（藤田医科 大学ばんたね病院 リハビリテーション部）
青柳 陽一郎（藤田医科大学 医学部 リハビリテーション医学 I 講座）

要約

頭蓋咽頭腫に対する術後に意識障害を認め、意識障害改善後に注意障害、記憶障害を中心とした高次脳機能障害を呈した 40 代男性に対し、情報処理過程としての高次脳機能の過程に従いリハビリテーションアプローチを行った。記憶障害に対しては直接的アプローチに加え、外的補助手段としてメモリーノートを導入した。しかし、記憶障害に対する障害認識を十分持ち合わせておらず、効果的な導入は困難であった。そこでアウェアネスの概念に沿ったアプローチを実施した。その結果、WMS-R 等の評価で改善を認めた。また知的アウェアネスの獲得に至り、メモリーノートを自発的に確認することが可能となった。階層モデルに従い、アプローチをしていくことで症例の現状や段階を捉えやすくなりリハビリテーション介入がよりスムースとなった。

Key words
hierarchical model, awareness, amnesia, inattention, memory notebook

1. Introduction

Practical rehabilitation-methods for patients who suffer from amnesia are: 1. Direct and repeated training of memory ability; 2. External and internal compensation methods; 3. Cognitive training by improving learning methods, and; 4. Environmental adjustment (Kato, 2003). Direct intervention upon the nerve mechanism related to memory does not produce satisfactory effects in patients (Miyahara, 2008), and using a memory notebook is often selected as an external compensation method. However, variations in injuries and symptoms limit the use of a memory notebook and other external assistant-means today (Watanabe, 2002). Anosodiaphoria and the decay of self-motivation are known as obstructive factors when external assistant-means are introduced. (Nakagawa, 2011).

Suzuki (2016a) describes how intervention for patients with amnesia begins with the grasping of consciousness of which the focus is awakening, and the grasping of every aspect of attention functions and emotions, by following the process of cognitive function as a form of information-processing (Figure 1), Osaka

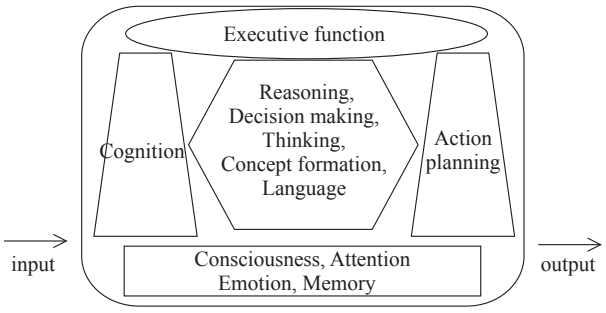

Figure 1: Process of cognitive function as a form of information-processing

Note: Extracted from Suzuki, T (2016b) in Reference after making some changes.

(1996) advocated that the hierarchical model of the conscious (Figure 2) is constituted with awakening at the bottom, awareness in the middle as attention to externality, and self-consciousness as attention to the self at the very top. Crosson et al. (1989) defined awareness as “the ability to recognize the disorder occurring to him/herself,” and he formulated a hierarchical model with three levels consisting of intellectual awareness, emergent awareness, and anticipatory awareness (Figure 3). As shown above, it is necessary for interventions for patients with amnesia

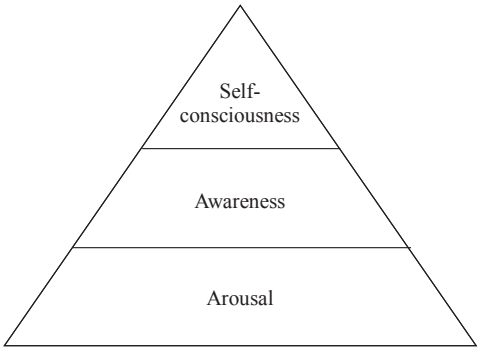

Figure 2: Hierarchical model of the conscious

Note: Extracted from Osaka, N. (1996) in Reference after making some changes.

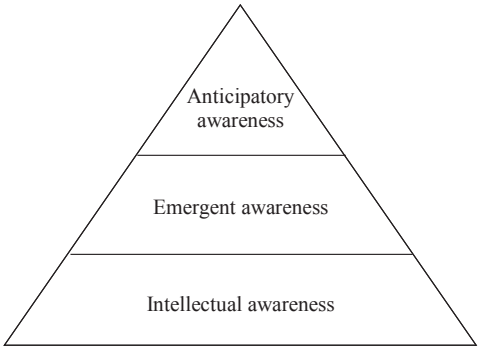

Figure 3: Hierarchy of self-awareness

Note: Extracted from Crosson, B. et al. (1989) in Reference after making some changes.

to be conducted gradually.

In this case history, a memory notebook was introduced as an outer assistant-means because high-order brain dysfunction, especially amnesia, became evident after some improvements were found for the patient's disturbance of consciousness. However, as the patient was not fully aware of his amnesia, it was judged that the patient would not respond to the introduction of a memory notebook effectively. As a result, the patient responded better and made some progress after other approaches were made following the concept of awareness. This paper will report on this process.

2. Case presentation

- Social history
  A male in his 40's. Right handed (though innate left handed and corrected to being right handed at some stage in his life). University graduate, and worked in the automobile manufacturing industry.
- Diagnosis
  Craniopharingioma, right frontal-lobe hemorrhage.
- History of present illness
  The patient was treated at an ophthalmology clinic for one and a half years, but as symptoms aggravated, he came to our hospital. Craniopharingioma was found in his suprasellar region after being given an MRI test. A month later this, he was admitted into our hospital for surgery. After an operation removing the craniopharingioma, he developed a right frontal-lobe hemorrhage and an operation to remove an intracranial hematoma was performed 2 days later. Physical and occupational therapies began on the 2nd day after the second operation. On the 16th day after the second operation, speech-hearing therapy began.
- Anamnesis
  Ureterolithiasis
- Neuroradiologic finding
  Before hospitalization, a growth was found in suprasellar region by an MRI test (Figure 4). On the 11th day after the operation to remove an intracranial hematoma, an new and old hematoma was found in the right frontal-lobe by another MRI test on the head (Figure 5).

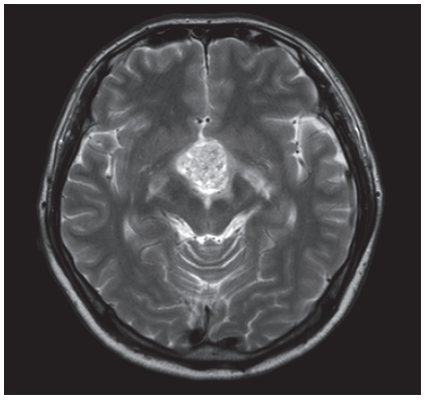

Figure 4: Brain MRI of prior to surgery

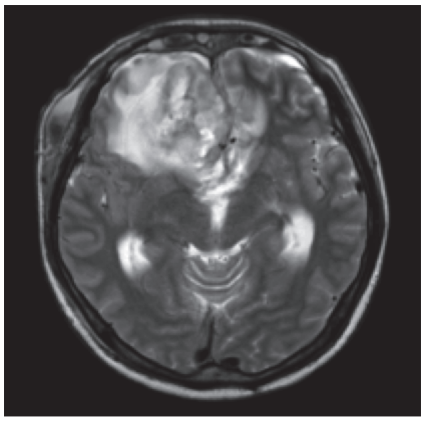

Figure 5: Brain MRI on 11th day after surgery

- Neurological finding
  At the first intervention of speech-language hearing therapy, the patient's consciousness level was recorded as II-10-20 on the Japan Coma Scale (JCS), and the results for Manual Muscle Testing were 4 for the right upper limb, 3 for the right lower limb, and 3 for both left upper and left lower limbs. Activities of Daily Living (ADL) were scored at 24/126

points by the Functional Independence Measure (FIM).

- Initial assessment

  Table 1 shows the results of neuropsychological findings recorded on between the 41th and 55th days after the second operation and test results of neuropsychological findings. The testing for attention function was suspended because the patient could not complete a Trail Making Test-A (TMT-A), even though plenty of time was spent on it. The patient scored 34/36 points for a Raven's Colored Progressive Matrices (RCPM) test. The results for a Wechsler Adult Intelligence Scale-Third (WAIS-III) were 89 for verbal IQ, 67 for performance IQ, and IQ79 for all tests, As the patient obtained 94 of the group index of working memory and scored 94 for attention/concentration on a WMS-R, it was judged that his working memory was intact. His abilities at thinking and analogy also were sustained since they were not affected by memory disturbance. The results of a Wechsler Memory Scale-Revised (WMS-R) were scale-out except for attention/concentration, and the results of a Rivermead Behavioral Memory Test (RBMT) were 2/24 points for the standard profile and 0/12 points for screening. As a result, although immediate memory was good, the prospective memory and the recent memory were severely reduced. Observation of his daily life indicated that the level of his remote memory had also dropped. The result of his Behavioral Assessment of the Dysexecutive Syndrome (BADS) was 95 points according to the standardized score and the overall section was at average. The patient's self-motivation level lowered and he was found to be confabulating. Based on the above, the patient was judged as having an overall disturbance of attention and severe amnesia.

- Awareness evaluation

  Though the condition of cognitive dysfunction, including amnesia and attention, were explained to the patient, he was saying that "he can go back to his job and drive a car." There was also an incident of him not being able to go back to his room by himself. These episodes indicated that he did not fully understand his disorder and how the disorder could affect his daily life. It appeared that he had not even reached the level of intellectual awareness.

3. Process of rehabilitation interventions

Interventions were made 5 or 6 times a week.

3.1 Direct approaches

3.1.1 Intervention to disturbance of consciousness (on between the 1st and 40th days)

Immediately after the initiation of physical and occupa-

Table 1: Test results of neuropsychological findings

Name of Test		Initial evaluation (on between the 41th and 55th days after second operation)	Re-evaluation (on between the 76th and 86th days after second operation)
WAIS-III	Verbal IQ	89	99
	Performance IQ	67	75
	All tests IQ	76	87
HDS-R		10/30	19/30
RCPM		34/36	32/36
WMS-R	Verbal memory	under 50	52
	Visual memory	under 50	75
	General memory	under 50	65
	Attention/concentration	94	94
	Delayed recall	under 50	under 50
Miyake's paired verbal associate learning test	Relevant dialogue	3-4-5	5-6-8
	Irrelevant dialogue	0-0-0	0-0-2
RBMT	Standard profile score	2/24	3/24
	Screening score	0/12	0/12
RAVLT	List-A play	2-3-3-6-3	3-5-2-5-6
	List-A delayed recognition	3/15	13/15
TMT	A	discontinuance	138 seconds
	B	–	197 seconds
BADS	Total profile score	17/24	–

Notes: HDS-R: Hasegawa dementia rating scale-revised. RAVLT: Rey's auditory-verbal learning test.

tion therapies, standing up by using a slope was instructed on and practiced. Oral care, swallow reflex facilitation, and other swallowing training were also conducted at eating scenes as interventions based on speech language hearing therapy. The awakening level was to be improved by stimulating the auditory, visual, pain, and temperature senses.

3.1.2 Intervention to cognitive dysfunction (on between the 56th and 75th days)

A visual cancellation task was conducted as an approach to the disturbance of attention, and the patient was asked to draw circles on all of one type among pictorial figures. Because the level of his continuous attention was found to be lowered, he was relocated to a quieter environment and asked to do simpler tasks. After this, he was given tasks of drawing a circle on all of two types among pictorial figures. Then the difficulty of tasks was increased gradually as he was asked, for example, to put circles on round figures and triangle figures at the same time. He was also asked to check over what he had just done.

An approach to memory function was made together with an approach to attention function after continuous attention improved. Memory tasks using picture cards were repeated and recall time was extended gradually. The number of picture cards was increased as well as decreased in order to adjust the difficulties.

The patient's faculty of orientation was also supported each time in addition to the approaches to disturbances of attention and memory. During these approaches, both positive and negative feedback were given with a view to encouraging the obtainment of intellectual awareness.

3.2 Indirect approaches (on between the 55th and 90th days) and environmental coordination, external compensation method

On the 55th day after the operation, a memory notebook was introduced as an external compensation method. The patient wrote about dates, his schedule, and other related matters with the nurse every day, and the content was checked during rehabilitation.

4. Results and process

4.1 Evaluation results

4.1.1 Consciousness level (the 40th day)

The patient was lucid, and ADL became 103/126 points by the FIM.

4.1.2 As neuropsychological findings (on between the 76th and 86th days)

The results of WAIS-III were IQ99 for verbal, IQ75 for performance, and IQ87 for all tests. The results of WMS-R were 52 for verbal memory, 75 for visual memory, 65 for general memory, 94 for attention/concentration, and delayed recall was under 50. The results of RBMT were 3/24 points for the standard profile and 0/12 points for screening. The times recorded for TMT were 138 seconds for TMT-A, and 197 seconds for TMT-B (Table 1). The results of the evaluations show some improvements to attention function and memory function, and especially to visual memory.

4.2 Process of using a memory notebook

Table 2 shows the process of using a memory notebook, and changes in contents of speech. On the 61th day after the operation, the patient forgot even the existence of the memory notebook. Reminding him of the notebook was required, but he did not understand the necessity of the memory notebook. We explained him about how and why he was hospitalized during rehabilitation. We also gave feedback about the symptoms and results of his cognitive dysfunction, and we gave the feedback by linking the symptoms to the failures he made during rehabilitation program. This was done in this way with a view to encouraging him to gain intellectual awareness. On the 68th postoperative day, a notice sheet about the memory notebook was put up on the wall of his room in the hospital as a reminder. The change in the words recorded on the 69th day indicates that he knew he needed to take something during rehabilitation program. On the 83th day the amount of content he wrote in the notebook increased and he could check over the content voluntarily.

4.3 Changes in contents of speech

On the 55th day after the operation, the patient was thinking that he could return to work and he could drive. He was denying his disorder completely, and thus an obtainment of intellectual awareness was prompted. On the 68th day, the patient confabulated about his hospitalization, saying he came to see his friend in the hospital and he felt ill. On the 69th day, questions about his condition began to appear in his writings. The patient was wondering if he was suffering from some kind of disorder. He said, "I was hospitalized due to amnesia but I don't know why I was admitted to the hospital." On the 83rd day he could explain how he was hospitalized. On the 84th day, he said, "I am not good at memorizing, so I want to have training to improve my memory." He was sensing the necessity of rehabilitation. He had reached the level of an obtainment of intellectual awareness. However, it was still difficult for him to recognize how the disorder could affect his life. The patient failed to obtain an emergent awareness while he was in our hospital.

5. Discussion

This case history is about a patient being found to suffer from attention disturbance, memory disturbance, and other cognitive dysfunction after the disturbance of consciousness had improved. Using approaches based on a hierarchical model made understanding of the actual status and stages of the patient

Table 2: Process of using a memory notebook, and changes of contents of speech

Days after the operation	Memory notebook	Contents of speech
55th	Starts using a memory notebook.	Thinking that it is possible to return to work and drive a car.
61th	Requires encouragement to use it. No full understanding of necessity of the notebook.	
63th		Encouraged to be conscious of disease. "I know I forget easily, but I am ok."
64th	Possible to check over writings after encouragement.	
67th		Encouraged to obtain awareness by using a scar on forehead. "This is a cut caused for removing a clot from nose bleeding."
68th	Put up a notice-paper as reminder about the notebook.	"The reason why I was hospitalized is because I came to see my friend in hospital and I also felt ill."
69th	Understands to carry something with him, but no understanding of what to carry.	"I was hospitalized for amnesia. I don't know why I was hospitalized."
76th	Possible to open the notebook without being led to it.	
83th	Increase in writing. Possible to check over writing voluntarily.	"I went to the ophthalmology clinic for my eyes but I was hospitalized for problems in my brain."
84th		"I am not good at memorizing and want to have training to improve my memory."
87th		"I came in for a drop in vision, but I was told about having a tumor and had an operation."

easier and made rehabilitation interventions smoother.

5.1 Direct approaches

5.1.1 Intervention to disturbance of consciousness

An initial approach was made to the disturbance of consciousness. The disturbance of consciousness is positioned at the bottom in the processes of cognitive dysfunction as a form of information process and in the hierarchical model of consciousness. From early stage the patient was given multiple stimuli and given training that including taking a seated position, standing up, and swallow reflex facilitation. As a result of natural recovery and approach to disturbance of consciousness, significant JCS improvement was recognized.

It was judged that when the awakening level was at a low level, attention would not function, but the consciousness level improved even from the point when immediate recall became possible.

5.1.2 Intervention to cognitive dysfunction

Cognitive dysfunction became obvious as the level of consciousness increased. We then focused on caution function and memory function according to the process of cognitive function as a form of information-processing (Suzuki, 2016b). As a result, disturbances of attention function and of memory function were improved. Direct intervention upon the nerve mechanism related to memory does not produce satisfactory effects in patients (Miyahara, 2008). Improvement of disturbance of the attention function might have influenced the improvement of the disturbance of the memory function.

5.2 Indirect approaches and awareness

A memory notebook was introduced at an early stage as an outer assistant-means together with some direct approaches to cognitive dysfunction. However, the patient was not sensing the necessity of the memory notebook, and thus the usage of a memory notebook was not practical.

Watanabe et al. (2002) suggested that contributing factors towards the practical usage of outer assistant means are: 1. The patient's consciousness of the disease; 2. The fact of whether the patient had a habit of taking notes pre-clinically and; 3. The necessity for taking notes (as a daily habit) felt by the patient. The patient in this case history was found to have a poor consciousness of his disorder and to be failing to obtain intellectual awareness. The process of hospitalization was explained repeatedly and, as a result, it became possible for him to answer the question of why he was hospitalized. He could understand the situation he was put under. He was also given feedback about the results and symptoms of his high-order brain dysfunction, and the feedback was given by linking it to the failures he made during rehabilitation. Ohigashi (2009) described how it is difficult to make patients with severe amnesia realize their condition. He suggests that it would be more effective if the patients were prompted to know the outcomes of their actions by him/herself, and if compensation methods were used for the purpose of prompting the patient to realize his/her condition. The patient in this paper was given feedback repeatedly by making

links to the failures he had made. This worked as a hint for him to realize his condition and he eventually obtained intellectual awareness. Watanabe (2002) suggested that important factors for judging whether patients with amnesia could use compensation means or not are: 1. With or without any disturbance to immediate memory, and 2. Intellectual ability indicated by WAIS-R. The patient's, immediate memory was relatively kept at the beginning of the intervention, but the intellectual ability of WAIS-III showed a decrease. However, on the 78th day after the operation he was possible for him to obtain a score beyond IQ75 on the WAIS-III test. This is the level Watanabe indicated as a line for deciding the possibility of using a memory notebook. The patient obtained intellectual awareness and his status got closer to the conditions given above. These may have worked as factors in increasing the frequency of his usage of the memory notebook, though this has not been established. The reason for this is because the patient has not reached the point of obtaining an emergent awareness. However, the frequency of his using the memory notebook is increasing, and this suggests that the patient is in transition towards obtaining an emergent awareness.

The patient was given feedback by linking it to the failures he made with a view to obtaining intellectual awareness, but it was possible that this could be causing him psychological stress, since his weaknesses and faults were being pointed out. The patient in this case history was transferred to another hospital after he obtained intellectual awareness. But it is possible to make the suggestion that suitable support and interventions are necessary in the period after the obtainment of intellectual awareness. Nagano (2012) indicated that in order to make patients understand their disorder precisely, it is necessary to provide proper support depending on how much the they grasp about their condition. Knowing what stage a patient is at leads to the precise supply of support.

6. Future tasks

Interventions in this case history were given by following the process of cognitive dysfunction as a form of information-processing and Hierarchy of self-awareness. This made it possible to conduct some approaches suited to the patient.

This study is based on one case history, and thus the effectiveness of the interventions following the models is limited to this case. Studies should be conducted on more cases in the future.

References

Crosson, B, Barco, P. P., Velozo, C. A., Bolesta, M. M., Cooper, P. V., Werts, D., & Brobeck, T. C. (1989). Awareness and compensation in postacute head injury rehabilitation. *Journal of Head Trauma Rehabilitation*, 4, 46-54.

Kato, M. (2003). Ninchi Rehabiliation. In. Kashima, H. & Tanemura, J. (eds.), *Yokuwakaru, shitugosho to Koji nokino shogai*, 436-445. 1st edition. Osaka: Nagai Shoten.

Miyahara, T. & Kadowaki, Y. (2008). The effectiveness of a memory notebook on self-awareness in a patient with memory disorder. *The Journal of Japanese Occupational Therapy Association*, 27, 254-264.

Nagano, Y. (2012). Koji nokino shogai no awareness. *Higher Brain Function Research*, 32(3), 433-437.

Nakagawa, Y., Sano, Y., Funayama, M., Kato, M., & Kato, M. (2011). The long-term course of a case with amnesia: About improvement of the awareness. *Cognitive Rehabilitation*, 16, 35-44.

Nishimura, T. (2003). A training use of compensatory memory books in a person with severe disorders of higher brain functions. *Japanese Journal of Vocational Rehabilitation*, 16, 52-59.

Ohigashi, Y. (2009). Understanding of anosognosias. *Higher Brain Function Research*, 29(3), 295-303.

Osaka, N. (1996). *Ishiki toha nanika: Kagaku no aratana chousen*. Tokyo: Iwanami shoten.

Suzuki, T. (2016a). Kiokushogai ni taisuru rehabilitation-daishoho ya kankyochosei wo fukumete. *Rehabilitation Nurse*, 09, 24-32.

Suzuki, T. (2016b). *Procedure of assessment. Gold Master Textbook: Cognitive Dysfunction, 2nd edition* (Suzuki, T. ed.). pp. 20-28, Tokyo, Medical View.

Watanabe, S., Hashimoto, K., Ohashi, M., Sakamoto, H., Ohashi, Y., Sasaki, K., & Miyano, S. (2002). Kiokushogai ni taisuru rihaapproach: Gaiteki hojyoshudan no yukosei ni tsuite. *Cognitive Neuroscience*, 3, 184-187.

(Received May 15, 2018; accepted November 20, 2018)