

Case Report

A Subarachnoid Hemorrhage-induced Traumatic Brain Injury Case who Restarted Regular Food Oral Ingestion after 6 Years of Dysphasia-associated Nasogastric Tube Feeding

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Abstract

Objective:. We report here a 71-year-old traumatic brain injury case who overcame dysphasia in June, 2013, after the female developed the difficulty in swallowing in December, 2006 – more than six years prior to her swallowing ability's revival -- following the second in two rounds of subarachnoid hemorrhage and the hemorrhage-induced car accident which pounded the patient right in the middle of her driving amidst the provisional unconsciousness induced by the subarachnoid hemorrhage. A vasospasm-associated ischemic stroke that broke out a week after the 2006 hemorrhage has since impaired her communication-related functions such as speech, reading and writing, while leaving the right side of the case's body paralyzed.

What is noteworthy in this case is that she restarted an oral ingestion of regular food in June, 2013, following a six-year-and-six-month dysphasia period thanks to a 13-month swallowing training she underwent under the guidance of a team of a speech-and-language therapist (SLT), nurses and a certified nutritionist at our nursing-care facility for the elderly, the Geriatric Nursing-Care and Medical Facility Roken Towada, in the prefecture's Towada City. The swallowing training was conferred chiefly by the SLT to the patient, a businesswoman from Kamikita County in the northern Japanese prefecture of Aomori.

The subarachnoid hemorrhage, the second of its kind, hammered out the patient on December 15, 2006, while the then 65-year-old patient was driving a car. The resultant loss of consciousness stripped her of the ability to maneuver her car all of a sudden, causing her to crash it into the rear of another automobile that was waiting for the traffic lights to change.

The traffic mishap, first of all, caused the patient to sustain a cerebral contusion against the hard surface of her car's steering wheel, with the vehement impact triggering the formation of edemas at the resultant left-hemisphere coup lesion and the right-hemisphere contrecoup lesion around the cerebral area sandwiched by the frontal and parietal lobes. The edemas appear to be responsible for dysphasia that tormented the case over the subsequent six-year period.

The strong mechanical force she underwent at the moment of the traffic mishap, which occurred in the immediate aftermath of the subarachnoid hemorrhage, displaced and compressed her cerebral hemispheres against the inner skull. Computed tomography scan images showed that the left-hemisphere contusion produced a coup lesion near the central sulcus adjoining the point of the harsh impact as well as a contrecoup lesion in the antipolar area as the brain swung back in the cerebrospinal fluid following the initial impact. (See Figure 4's CTS images No. 11~13 circled by a red dotted line)

In the subarachnoid hemorrhage, a rupture of her aneurysm was responsible for the sudden start of bleeding at her subarachnoid space at her left cerebral hemisphere. Neurosurgeons at the Towada City Hospital, to which she was transported by an ambulance, performed a craniotomy the following day, placing a metal clip across the neck of the ruptured aneurysm to prevent it from bursting again.

A color photograph of her face (Figure 1-a) clearly shows the lingering presence of a large collision-associated depression at the left upper side of her forehead near a hairline, indicating that she turned her face toward the right reflexively at the moment of the vehement collision and thus crashed the left side of her forehead against the hard steering wheel. The afore-mentioned CT scan images show that the subarachnoid hemorrhage induced a left-hemisphere vasospasm, which in turn triggered an ischemic stroke at a cerebral region almost beneath the left central sulcus a week after the Dec. 15, 2006 subarachnoid hemorrhage. (See Figure 4's CTS images 14~18 circled by a yellow dotted line for the lesion caused by the ischemic stroke)

The CT scan images, taken on June 12, 2007, for analysis by neurosurgeons at the Hirosaki Stroke and Rehabilitation Center, show the appearance of a large low-density area at the region around and almost beneath the left medial Rolandic artery that runs along the left central sulcus as a complication issuing from the hemorrhage-induced vasospasm. (See Figure 4's CTS images 14~18 circled by a yellow dotted line) These CTS low-density images, the consequences of the ischemic stroke-associated lesion, account for permanent residual serious damages to her brain cells issuing from the ischemic stroke that was induced by the second subarachnoid hemorrhage.

It is noteworthy that the coup- and contrecoup lesions-induced low-density images are observed symmetrically at both sides of the longitudinal cerebral fissure in the CTS images, while the ischemic stroke-induced low-density area is observed asymmetrically -- only in the left hemisphere -- indicating the whereabouts of a ruptured aneurysm.

The traumatic brain injury caused her to suffer right hemiplegia, aphasia, agnosia, motor ataxia, dysbasia and other serious cerebral dysfunctions during the subsequent nine-year period. But dysphasia, one of these higher cerebral dysfunction consequences, did not last through the end of the nine-year period. It did vanish in June 2013.

In other words, the female surmounted dysphagia in June, 2013, after the difficulty in swallowing tormented her for a total of six years as a result of the 13-month intensive swallowing training conferred to her following her initial five-year ingestion difficulty-related anguish.

The lengthy and painstaking 13-month swallowing training enabled her to regain a stable ability to swallow and ingest regular food, the development that freed her from the necessity of receiving nutrients through a nasogastric feeding tube.

The tube was removed from her by the rehabilitation team led by the SLT in June, 2013. Consequently, the case required no reinstalling of such tube until she was discharged from our facility three years later -- in June 3, 2016.

The patient was then transported to the Towada Daiichi Hospital for hospitalization and passed away there four months later -- on October 3 of that year. It is crucial to note that the female patient, whose cerebral functions were seriously undercut by both recurrent subarachnoid hemorrhages and the subsequent ischemic stroke issuing from the hemorrhage-induced vasospasm, restarted an oral ingestion of regular food following a long period of nasogastric tube feeding that lasted for more than six years.

Patient and Method: In 1999, the patient, then 57, volunteered to see neurosurgeons at a hospital, where the doctors detected the evidence of the initial breakout of subarachnoid hemorrhage through a comprehensive brain screening checkup. But the case rejected a craniotomy recommended by the doctors, only permitting them to advance a catheter to counteract the subarachnoid hemorrhage. Then, on December 15, 2006, the patient, now 65, underwent the second attack of subarachnoid hemorrhage, developing an ischemic stroke a week later and sustaining a traumatic brain injury over the subsequent 10-year period.

Following the second hemorrhage and the ischemic stroke it induced, the case suffered from dysphagia, agnosia, motor ataxia, hemiplegia and aphasia. Although she had been bedridden since 2006, the year of the second subarachnoid bleeding, a swallowing training was administered by the SLT and the rehabilitation effort was intensified with the participation of a greater number of rehabilitation staff, starting in May, 2012, after she sporadically showed subtle signs that she may be regaining an ability to swallow food.

During the subsequent 13-month training period, she showed increasingly clear signs that she is regaining a swallowing reflex. During the 13-month training for swallowing and ingestion, the rehabilitation team's staff carefully observed her reactions and searched for any signs of progress. After clear-cut signs of improvements were detected, the team finally decided in June, 2013, that she can now be freed from the nasogastric feeding tube. The tube was thus removed after the crucial removal decision was made.

Following the alleviation of dysphasia, the case started to eat normal meals three times a day and she became capable of using a wheelchair more freely and for longer hours a day than before. This higher level of mobility and her swallowing reflex's strong recovery are attested to by a color photograph of the patient taken on October 18, 2013 – four months after her swallowing function's revival. In the photo, the case, now freed from a nasal nasogastric tube, is seen munching a Japanese "watagashi" cotton candy while sitting in a wheelchair and clutching hold of the candy stick with her left hand.

But the right hemiplegia still hounded the patient, a right-hander, even after the recovery of the swallowing function due to the presence of the residual permanent damages to the left hemisphere of her brain, the damages resulting from the December 2006 ischemic stroke. The October 18, 2013, photograph also makes evidence of the lingering right hemiplegia.

Conclusion: Buttressed by the patient's strong desire to restart eating food in a normal manner without relying on a nasogastric tube with her efforts being backed by the rehabilitation team's strenuous efforts to revive her swallowing functions, she regained her oral swallowing and ingestion ability, while starting to use a wheelchair more freely and for longer hours each day during the subsequent three-year period.

Introduction

Dysphagia affects about half of people who develop various types of acute strokes. Dysphagia increases the risk of its sufferers contracting aspiration pneumonia. As a result of a high rate of mortality dysphasia causes by inducing aspiration pneumonia, dysphagia has been in second place as an independent predictor of mortality after the stroke category that is in first place. The percentage of Japanese people who develop aphasia after undergoing various types of cerebral strokes for the first time stands at approximately 35%.

Some post-stroke patients have developed both dysphagia and aphasia. (Figure 1) These patients receive some kinds of rehabilitation training to improve speaking functions to attain higher levels of activity of daily life (ADL). Functions related with communications at most right-handed persons are controlled by a certain cerebral field at the left hemisphere of their brain. Since one side of a brain controls the movements of the opposite side of the body, many of right-handers who have developed communication difficulties after suffering a left-hemisphere stroke also tend to develop a paralysis at the right side of their body.

Daily rehabilitation training is important to enable a resumption in a patient's normal activity. We are reporting here the female case of serious post-stroke aphasia and dysphagia who later came to show subtle signs that she may be comprehending the meaning of what a speech-and-language therapist is trying

to communicate to her. After the SLT patiently performed a speech-and-language therapy combined with a swallowing-reflex reactivation training for almost five years, she began to show subtle and fractional signs that she may be regaining her swallowing reflex. At the closing phase of the long therapeutic period, the SLT discerned subtle signs that the swallowing training may be on the verge of producing some good results.

During the subsequent 13 months, the swallowing training was intensified with the participation of other rehabilitation staff, albeit in a cautious, multi-stage manner accompanied by careful observations of the patient's reactions and body language. The case finally restarted a normal swallowing activity and was then released from the nasogastric feeding tube in June, 2013. This enabled her to enjoy a better quality of life during the subsequent three-year period.

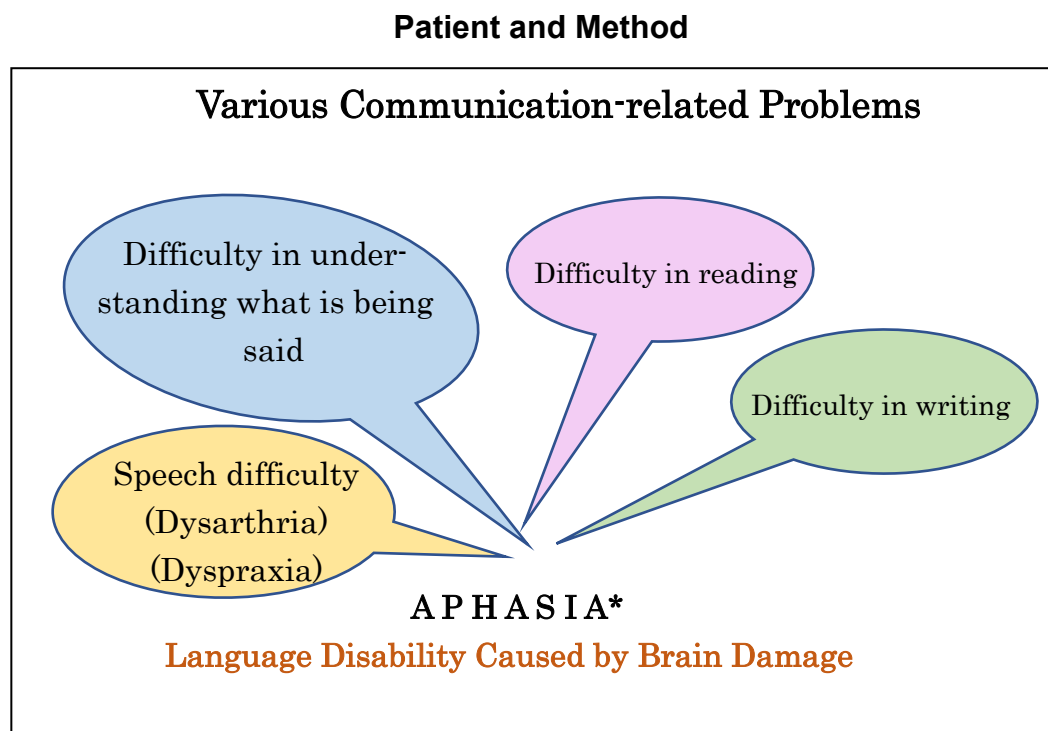


Figure 1. Symptoms of Aphasia

*Aphasia does not affect intelligence

Patient

A 66-year-old female with the initials E. M. (The age is as of her 2007 admission to our nursing-care and medical facility for the elderly, Roken Towada)

Month and Year of Birth: December 1941

Dates of admission to Roken Towada: firstly; June 18, 2007 (6 months after ischemic stroke), secondly; September 10, 2007 after being briefly discharged and transfer to other medical facility (9 months after the stroke)

Degree of nursing-care necessity appraised under the Japanese government-stipulated care necessity-level assessment standards: 5 (Highest, or the most serious degree), namely being bedridden almost around the clock.

Level of patient's daily-life independency assessed in accordance with the government-stipulated appraisal standards: C2 (Highest) (See Table 1)

Table 1 Government-stipulated Definitions in Assessing Patients' Daily Life Independency level (Degree of Necessity of Being Bedridden)

Independent	Rank J	Has some impairment of activity, but almost independent daily life is possible 1. Can go elsewhere by the use of public transportation means 2. Can get out of the house to visit a near-by house or shop
Close to bedridden	Rank A	Enjoying almost independent life at home, but need help when going outside of house 1. Can go outside with help, go to bed only for night sleep 2. Rarely go outside of house, often have to stay in bed during daytime
Bedridden	Rank B	Need help even while at home, have to stay in bed mostly during daytime, but can sit down 1. Have to use a wheel chair during meals and when going to bathroom

		2. Need help to move the body and sit on wheel chair
	Rank C	Have to stay in bed all the time. Need full help for eating, urination, bowel movement and in changing clothes 1. Can roll over in bed by himself 2. Cannot roll over

This case's Diagnosis

1. Subarachnoid hemorrhage (Clipping was performed to close up a hole at the ruptured aneurysm)
2. Cerebral infarction following subarachnoid bleeding-induced ischemic stroke, Post-stroke syndrome, higher brain dysfunctions including aphasia
3. Traumatic brain injury (brain contusion) stemming from automobile collision

Main Complaints

Higher brain dysfunctions, Right hemiplegia, Paresthesia at right side of the body, Aphasia, Dysphagia, Communication problems

Past History

1997 (55 years old) Cholelithiasis for which extracorporeal shock wave lithotripsy was performed.

History of Present Illness

1999 (57 years old) Subarachnoid bleeding was detected when the case volunteered to get her brain to be examined at a comprehensive screening check. Patient refused to let doctors perform a craniotomy, letting them advance a catheter to plug a bleeding lesion at her subarachnoid space.

December 15, 2006 (65 years and 0 month) The patient relapsed into a subarachnoid hemorrhage and became unconscious right in the middle of driving a car, rear-ending an automobile that was waiting for the lights to change. She was taken to the Towada City Hospital by an ambulance. Doctors diagnosed her unconsciousness as the consequence of subarachnoid hemorrhage that issued from the rupture of an aneurysm. The following day, neurosurgeons opened into her skull, placing a metal clip across the neck of her aneurysm. A week after the craniotomy, a cerebral infarction pounded the case, and doctors administered an

anticoagulant via an intravenous drip.

February 8, 2007 (66 years and 2 months) As yet another complication that pounded the case, she developed a hydrocephalus for which the surgeons performed a ventriculoperitoneal shunting.

March 7, 2007 (66 years and 3 months) Patient was transferred to the Hirosaki Stroke and Rehabilitation Center to receive rehabilitation training. There, surgeons sought to perform a percutaneous endoscopic gastrostomy in vain. Since they found her stomach to be located at too high a location inside the abdominal cavity, they found it unfitting to perform a PEG operation. Then, they decided to feed her via a nasogastric tube. She stayed there until June 17, 2007.

June 18, 2007 (66 years and 6 months) ~September 5, 2007 (66 years and 9 months) She was admitted to Roken Towada for the first time.

September, 2007 (66 years and 9 months) She was transferred to the Hachinohe JRC Hospital supervised by the Japan Red Cross Society in yet another attempt to get a PEG installed. After an examination, JRC doctors decided that her conditions are not fitting for such an operation, returning her to the Roken Towada after a hospitalization of only six days.

Sept. 10, 2007 The patient was readmitted to the Roken Towada.

Patient's Status (at the point of her second admission to the Roken Towada)

The patient was bedridden, with a nasogastric tube attached to her. Her face was expressionless, while she showed a poor response. She was careless. She was aphasiac, but on rare occasions she changed her facial expressions in response to what a staff said to her, i.e., she smiled, grimaced, or nodded.

She had sputum on her airway and her oral cavity was filled with sputum. Aspiration and secretion at her airway were observed quite often. Even when her oral cavity cleaning was performed, or when an ointment was applied or when nurses put water into her mouth, she did not show a swallowing reflex. When water was put in the oral cavity, a change in the respiratory sound was detected.

She had lost a cough reflex. Her pulse and blood pressure were within normal ranges.

She was aphasiac almost completely. She had communication problems resulting from her degraded psychological activity, while demonstrating a speech difficulty. She had a attention deficit disorder.

Results of physical examination

Body weight 47.8 Kg

Height 157 cm

At the left upper side of her forehead, which anatomically corresponds with the left side of her skull's frontal bone adjacent to the surface of her temporal lobe, a depression was easily observed. (Figure 1-a)

Ethical aspect

Both verbal and written informed consents were obtained from the patient's family to publishing this case report.

Radiography Examination

The CT scan images used in this case report were taken 6 months after the second of her subarachnoid hemorrhage on Dec. 15, 2006, which triggered a vasospasm-induced ischemic stroke (cerebral infarction) a week later. (Figure 2, Figure 3a-3c)



Figure 1-a A depression is clearly visible at the left upper side of her forehead (This picture was taken on Christmas day, 2012)

Figure 2. Brain CT scan images (taken on June 12, 2007 for analysis by neurosurgeons at the Hirosaki Stroke and Rehabilitation Center)

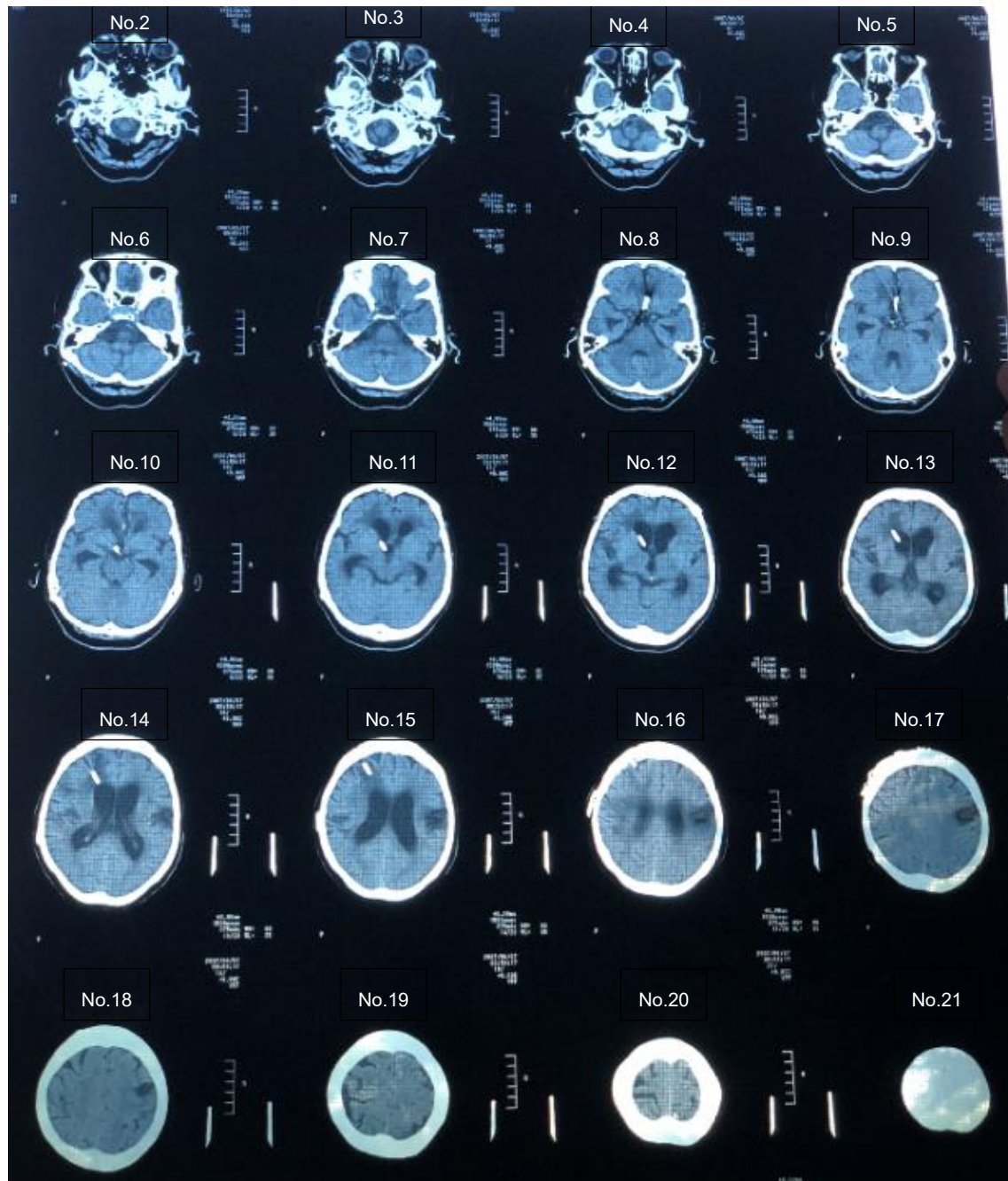


Figure 3a. Left View of Skull and Upper Orbit Occipital Lower Surface Plane for Brain CT Scan (5mm slice)

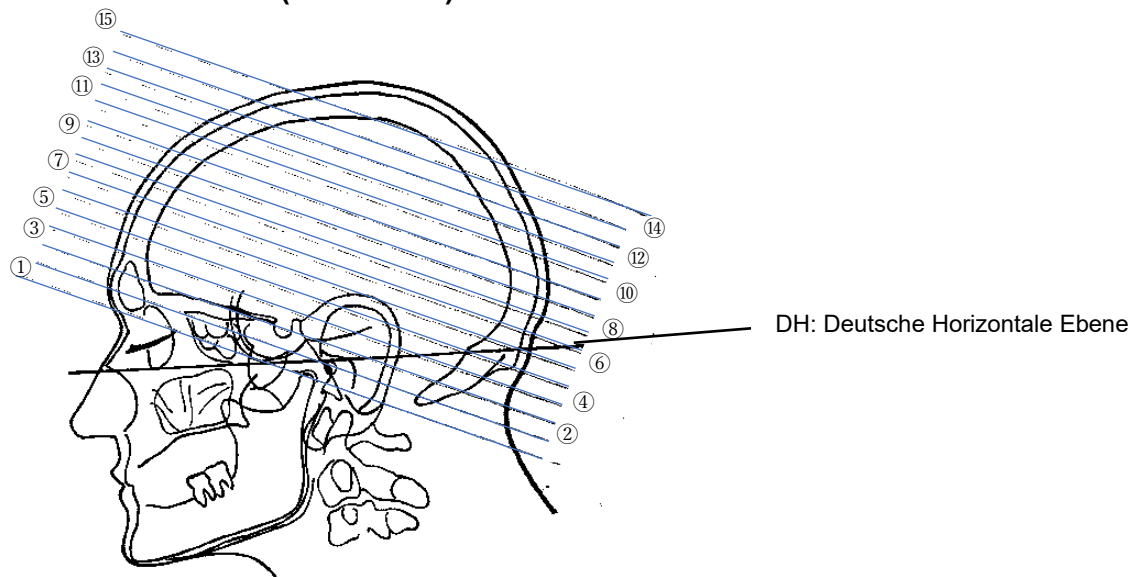


Figure 3b. Left Cerebral Hemisphere—Supro-Lateral Surface

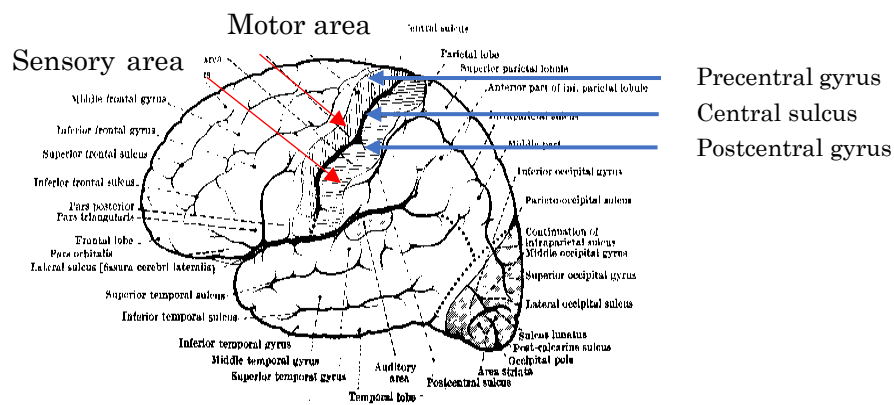


Figure 3c. Left Cerebral Hemisphere—Medial Aspect

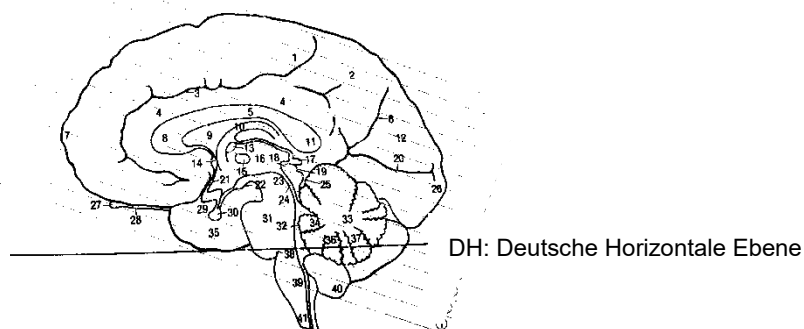
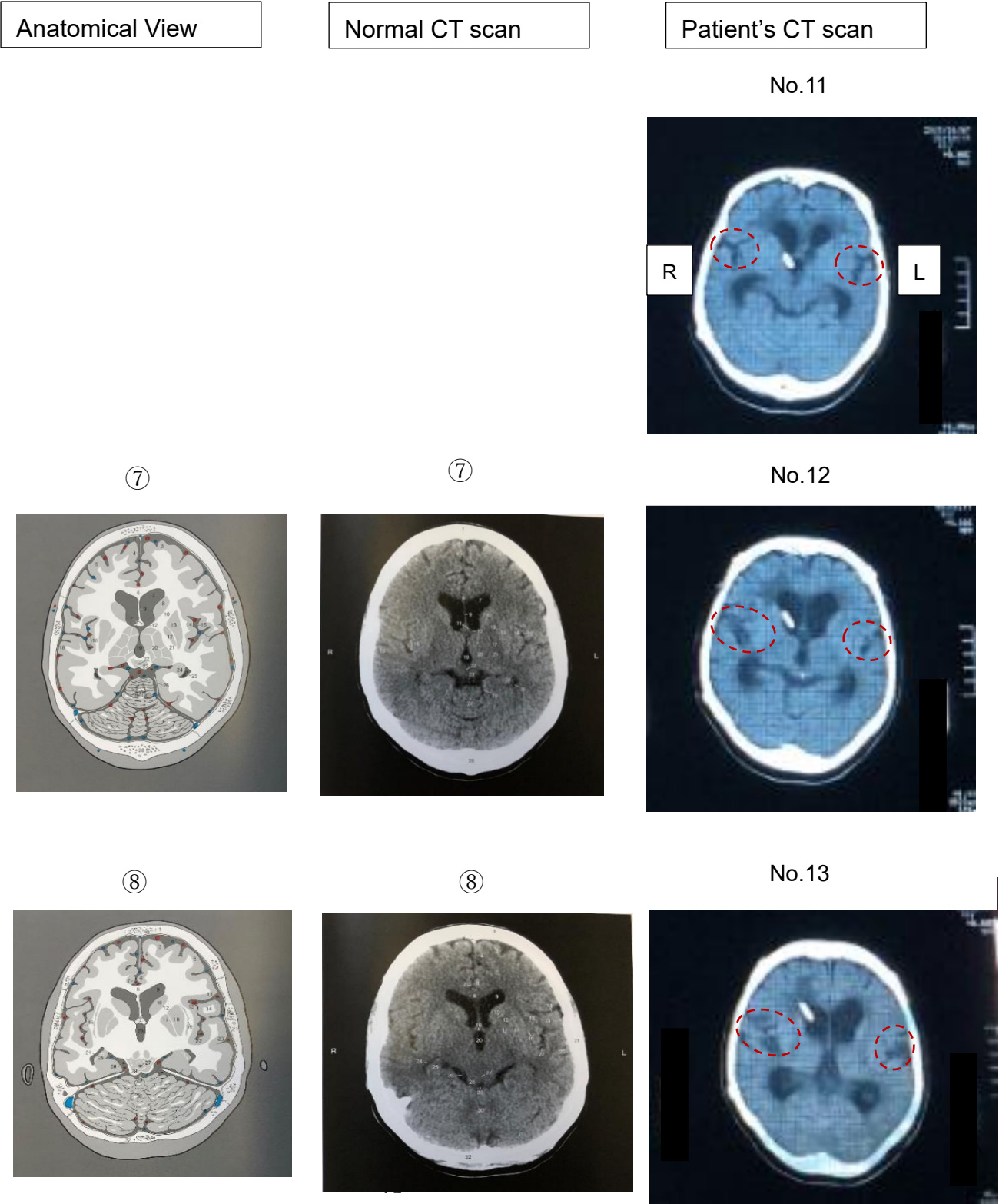
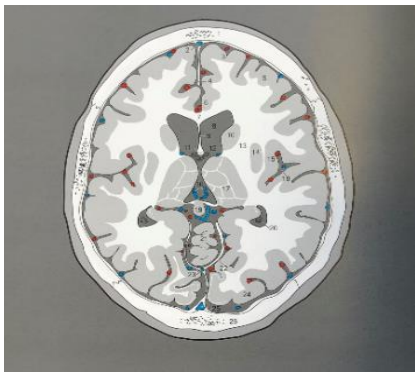


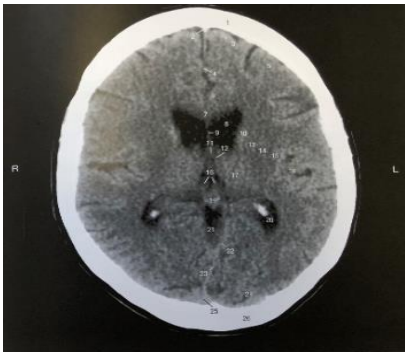
Figure 4 Comparisons between the case's CTS images and those of a person with a healthy brain. The case's CTS images are presented at the right edge of each row



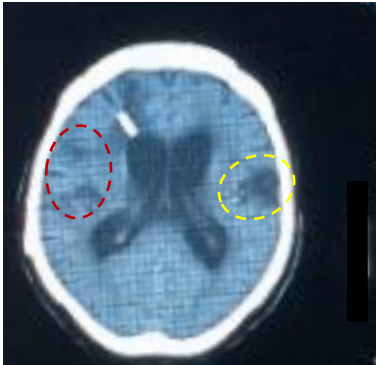
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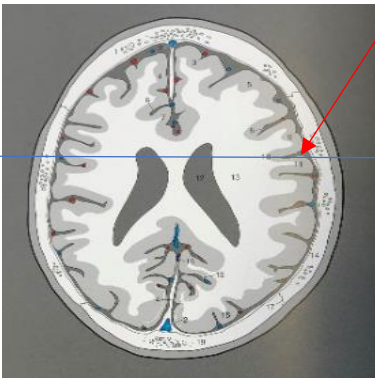
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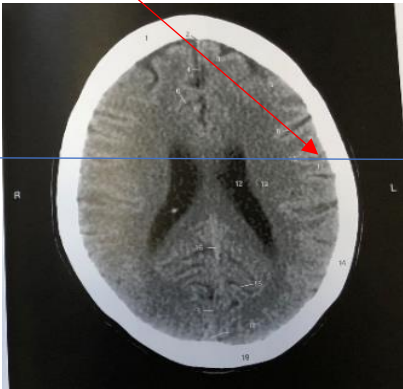


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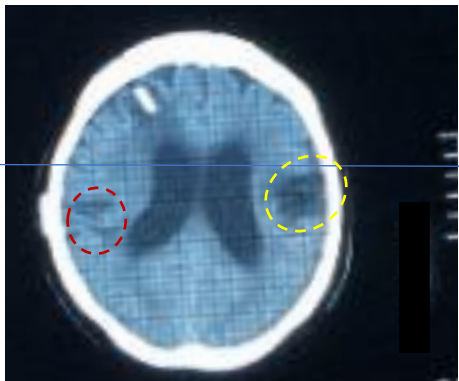


Central Sulcus

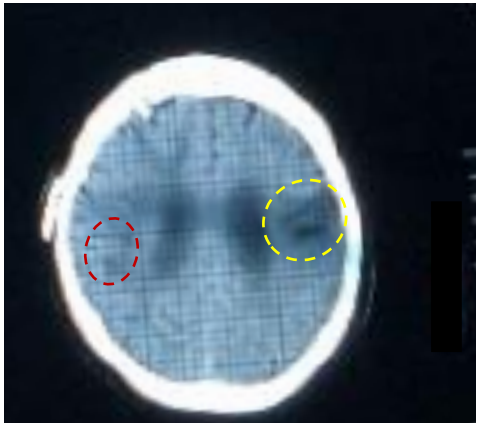
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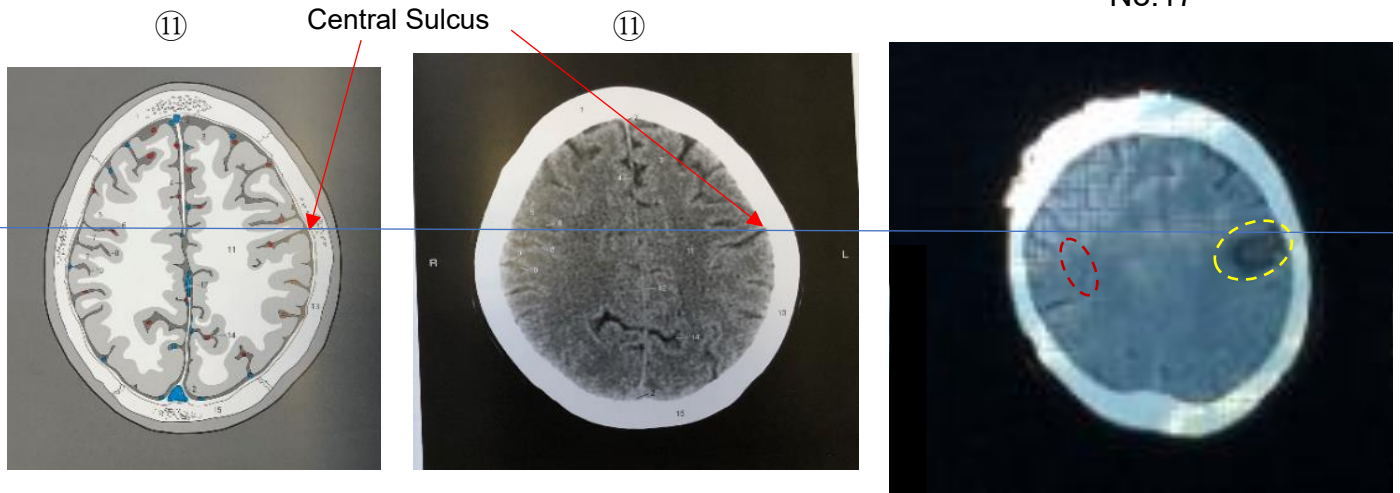
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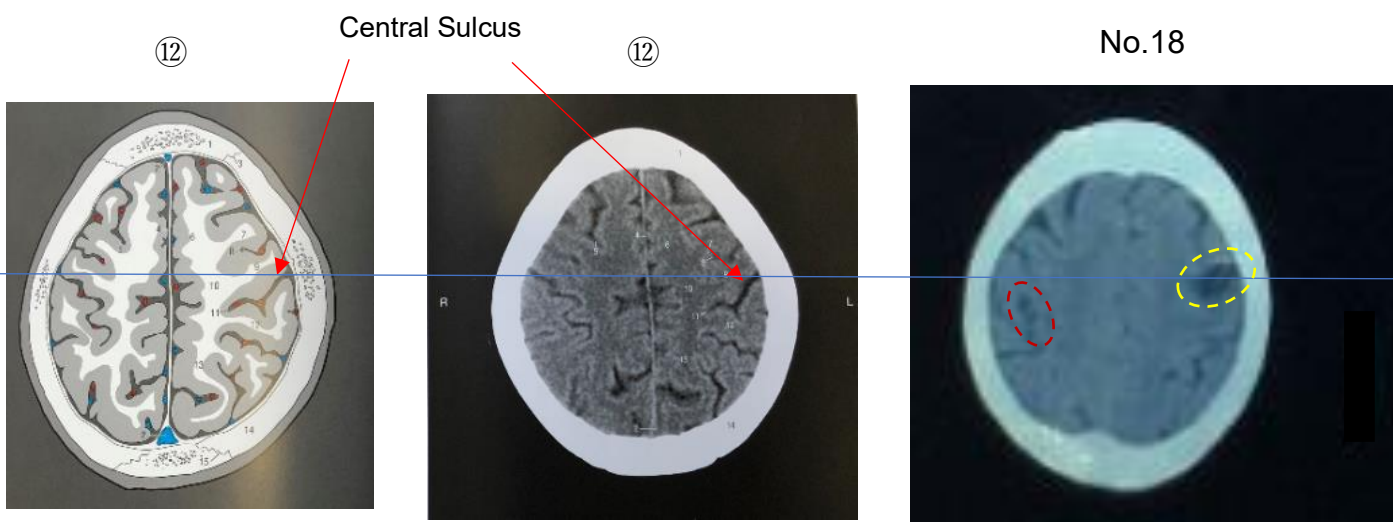
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No.18



The **No.11~No.13 low-density areas circled by a red dotted line** show the lesions caused by the 2006 December 15, 2006, contusion. The contusion-induced lesions resulted from the mechanical forces that displaced and compressed the hemispheres forcefully. The lesions stemming from the impact between her forehead and her car's steering wheel are observed on the lateral convexity of the both hemispheres. Hence, lesions were formed by deceleration of the left temporal lobe against the inner skull under a point of impact (coup lesion), and that of the right temporal lobe against the inner skull of the antipolar area (contrecoup lesion) that was caused by the swing-back of the brain in the cerebrospinal fluid. Meanwhile, the **No. 14~18 low-density areas circled by a yellow dotted line** show the lesion induced by a vasospasm-associated ischemic stroke that broke out a week after the 2006 subarachnoid hemorrhage.

Clinical Course

Clinical course followed by the case through the end of 5th year after 2006 admission to Roken Towada

Table 2 depicts patient's physical and psychological conditions after she was admitted to Roken Towada.

Table 2. Patient's physical and psychological conditions through the end of 5th year after admission

Time	Finding
September 2007 (at the second admission)	Attention deficit, Right hemiplegia, Paresthesia of right half of the body, lost facial expression, lower responsiveness, Clear depression at a point at her left upper forehead (which was formed at the time of traffic accident on December 15, 2006) was observed.
September 2008: 1 year later (67 year old)	Facial expression resumed. She expresses Yes-No by body language. There was no improvement in swallowing activity. She often pulled out nasogastric tube intentionally and elevated body temperatures were occasionally recorded on the days following such evulsions. One day, she suddenly nodded, rotated neck, pointed a target by finger.
September 2009: 2 years later (68 year old)	When someone talked to her, she came to respond much more clearly than before. Judging from her facial expressions, she appeared to be comprehending the meaning of some words. She came to respond by nodding to express a Yes and shaking head to express a No. When a staff showed he understood what she tried to mean, she smiled. Still, she could not speak. She could not cough. She could not swallow.
September 2010: 3 years later (69 year old)	Simple communication became possible by observing her Yes-No expressions. Very subtle swallowing movement was observed when she received a stimulus with a staff pouring a small amount of cold water into her oral cavity.

	Coughing reflex remained ambiguous. Changes in respiration sound were noted when fluid was poured in the oral cavity. Marked orofacial apraxia was noted. She did not show interest in receiving training using written words.
September 2011: 4 years later (70 year old)	Facial expressions became apparent. Yes-No expressions increased. She seemed to understand what staff said. Sometimes she succeeded in making vocal sounds. Apparent swallowing reflex started to be noted and amount of sputum in the airway decreased.
September 2012: 5 years later (71 year old)	Facial expressions increased. Yes-No expression became successful. It appeared that she regained a very limited ability to memorize and remember a few Chinese characters. Clear swallowing reflex started to be noted after small amount of water was injected, although no change was observed in respiratory sound. Making vocal sound was possible. Definite cough reflex started to be noted.

Clinical course after spending almost 5 years at Roken Towada

After receiving almost five years of rehabilitation training, the patient started to show a subtle swallowing reflex after ingesting a small amount of water. This encouraged rehabilitation staff to intensify training of her swallowing functions on a more full-fledged manner, although she had to continue relying on a nasogastric tube.

Table 3. The main points of swallowing training at first stage of intensified training

Goal	Oral ingestion of jelly-based food
Type of training	Direct repetitive swallowing training
Method	Massaging of oral cavity by the use of cotton swabs wetted with cool water for the sake of inducing swallowing reflex. Starting from injecting a very small amount of water as described above, staff proceeded to injecting gradually thicker fluid. We then gradually raised the viscosity and solidness grades of what is given orally.
Frequency and time spent	2~3 times/ week 5~20 minutes each time

Table 4. Physical and psychological conditions and types of foods and drinks given through the 3rd month from start of intensified swallowing training (Figure 4a, Figure 4b)

Time	Physical status and foods
September 2012: at beginning of intensified training (71 year old)	Swallowing reflex was induced by injection of cool water, but there was some interval between water injection and reflex. Change of voice as well as coughing were observed
November 2012: 2 months later (71 year old)	Took half portion of jelly tea available on the market mixed with a thickener Swallowing movement became smoother with the process being freed from swallowing difficulties Swallowing no longer accompanied by choking reflex
December 2012: 3 months later (72 year old)	Took sweet jelly 5 days a week and tea added with a thickener. Sometimes ice cream and soft rice cracker were successfully fed with no problematic reactions (Figure 4a, Figure 4b)



**Figure 4a She is pleased to see cake
(This picture was taken on Christmas
day, 2012)**



**Figure 4b Taking liquid food
(This picture was taken on Christmas
day, 2012)**

First stage of intensified swallowing training completed in 3 months. Then, second stage was started.

Table 5. The main points of 2nd stage of intensified swallowing training

Goal	Oral ingestion of food other than jelly
Type of training	Direct repetitive swallowing training similar to stage 1's
Method	Feeding soft rice cracker (small portion each time)
Frequency and time spent	2~3 times/ week 20 minutes each time

Table 6. Type of foods given from 3rd to 6th month after start of intensified swallowing training

Time	Physical status and foods
January 2013: 4 months later (72 year old)	Became capable of taking soft rice cracker, jelly, tea added with thickener
March 2013: 6 months later (72 year old)	Took harder rice cracker, sponge cake, coffee without thickener

Until this stage, the patient did not have her own teeth at all. At this occasion, Rehabilitation team put in a full denture to her.

Table 7. The main points of third (final) stage of swallowing training

Goal	Ingestion of normal diet
Type of training	Try to serve whatever food the patient indicates she likes (She indicated with body language that she is not fond of food processed by mixer)
Method	Gradual raising solidness grades of food
Frequency	Start from lunch only, then lunch and dinner, finally 3 times a day

Table 8. Physical status and diet given from 7th to 13th month after start of intensified swallowing training

Time	Physical status and diet
April~May 2013: 7~8 months later (72 year old)	Full denture was put in Snack was given
June 2013: 9 months later (72 year old)	At first, rice cooked with 5 times the usual amount of water, a mixer-processed food, and a thickened soup were served uneventfully, although patient coughed out once in a while By the end of this period, however, a set of rice cooked with 5 times the ordinary quantity of water, coarsely-chopped food, thickened liquid food was served -- all in same volumes as those for healthy persons.
July 2013: 10 months later (72 year old)	Lunch of above-mentioned set was served every day. Diet was given twice a day three times a week. She became febrile after the third day of this trial and oral feeding was suspended.
August 2013: 11 months later (72 year old)	She became afebrile soon. But oral injection of diet remained suspended for 2 weeks. Then team restarted training all over again, beginning with the snack stage.
September 2013: 12 months later (72 year old)	Serving a set of rice cooked with 5 times volume of water, coarsely chopped food, thickened liquid food, all in normal quantities, was resumed for lunch. At first, at frequency of three days a week and then every day. Then diet was served twice a day, at first three days a week then every day. At the same time, the solidness of rice was changed from rice cooked with water 5 times the ordinary quantity of water to rice cooked with 1.1 times the ordinary quantity of water (normal rice).
October 2013: 13 months later (72 year old)	The swallowing training project reached the final stage. A set of normally cooked rice, coarsely chopped food, thickened liquid food, all in normal amounts, were served three times a day. Nasogastric tube was removed.

How she lived after she restarted oral injection of normal meals three times a day

After she became capable of eating meals with normally cooked rice, along with coarsely chopped food, she became capable of eating the types of food which healthy persons eat by crushing with the teeth. However, she preferred chopped foods. She became capable of drinking plain water to which a thickener was not added. She took every types of sweets which are served at our nursing-care and medical facility for the elderly. During a certain duration of period after she recovered her swallowing function, she remained satisfied with foods which our facility served. After this period, however, she turned out to be a kind of gourmet with strong preferences for certain types of foods. After her family became aware that she became capable of eating normal meals, her family members started to take foods from their home to our facility so that she and her family members may eat such meals together during the occasions of such visits. Once in a while, she enjoyed drinking glasses of wine and Japanese rice wine. Since she was staying at her private room, no other patients could not know what she ate during such family visits. After rehabilitation staff became aware that she was given foods by her family during such visits, they gently asked the family to limit the amounts of foods they might provide during such occasions of family-get-togethers. One day, she got such food given by her family stuck in her throat while she was enjoying the food with her family. She was taken to the hospital by ambulance. It was lucky that the food was safely removed from her throat. We told her family not to give her the types of food which are harder than what she was usually served at our nursing-care facility Roken Towada.

The patient's appearances were cute and she was loved by other patients and rehabilitation and medical staff at our nursing-care facility. Sometimes our institution organizes a "Sushi" party and a cake party. She enjoyed herself at such occasions, expressing her gratitude with abundant gestures and body language. She lived a happy life during the subsequent full three-year period after she became capable of eating normal types of meals three times a day. (Figure 5)



Figure 5 Patient in a Wheelchair on Oct. 18, 2013

The photo shows the case in a wheelchair after she was freed from the necessity of relying on a nasogastric tube. She used to stay in the wheelchair for several hours during daytime.

After the recovery of her swallowing reflex, she generally remained quite well during the subsequent three-year period during which time she stayed at our nursing-care and medical facility. But she later began to show some febrile conditions, which were diagnosed as a consequence of an infection at her upper respiratory organs in most cases. At such occasions, she used to recover without developing serious problems within several days.

In April 2016, she was taken to the out-patient department of a nearby hospital after our facility's staff found that her general physical conditions deteriorated. By this time, eight years and nine months had elapsed since she was admitted to our nursing-care facility for the first time in 2007.

Chest X-ray images, taken at the hospital, detected the presence of a pneumonia at her lung. Meanwhile, X-ray images of her abdominal region

revealed the presence of urinary tract stones. A laboratory examination of the specimen collected from her body produced findings of CRP4+, an elevated peripheral blood white blood cells number, as well as abnormal liver functions. Then, she was admitted to the hospital due to the diagnosis of pneumonia and a urinary tract infection.

In May 2016, after staying at the hospital for about a month, she was discharged from the hospital and readmitted to our institution. When she came back to our facility, we found that her physical conditions were not good. She had lost appetite. She became unable to eat meals by herself and needed help to eat. Two weeks after the re-admission to Roken Towada, her body temperatures shot up to as high as 38.6 C. Then on May 28 her body temperatures elevated up to 39.5 °C. Since then, remittent feverish episodes continued until June 3, when she had the elevated body temperature of 39.1°C, and developed shaking chills, losing consciousness. Then she was taken to the out-patient department of the same hospital to which she had been taken in April. She was readmitted after being diagnosed as having a fever of an unknown origin.

She passed away on October 3, 2016, after being hospitalized there for four months.

Table 9. Medical Records of the patient after she was admitted to our institution: June 18, 2007~October 3, 2016 (6 months after attack of subarachnoid bleeding)

*highest temperature during the course of the disease

Year	Day	Symptoms & Signs	Treatment/Diagnosis	Admission to a hospital
2007	October 2 days	Fever 39.4°C*	DIV, Acetaminophen/Upper Respiratory Infection(URI)	no
	October 2 days	Fever 38.0°C	Minocycline/URI	no
2008	January 2 days	Fever 37.9°C	Minocycline/URI	no
	January 3 days	Fever 38.4°C	Cephmetazole/URI	no
	February one day	Fever 38.4°C	Cephmetazole/URI	no
	July one day	Fever 37.5°C	None/URI	no
	October one day	Fever 37.8°C	None/URL	no
	December 2 days	Fever 37.8°C	DIV, Cephmetazole/URI	no
	December one day	Fever 38.2°C	DIV, Cephmetazole/URI	no
2009	January one day	Fever 38.2°C	DIV/URI	no
	January one day	Fever 38.2°C	(Influenza kit negative)/URI	no
	April 3 days	Fever 37.8°C	Acetaminophen/URI	no
	July one day	Fever 37.8°C	None/URI	no
	October one day	Fever 37.6°C	None/URI	no
	November 2 days	Fever 38.6°C	None/URI	no
2010	January one day	Fever 38.3°C	None/URI	no
	February	Fever 39.2 °C	DIV, Cephmetazole,	no

	5 days	SpO ₂ down to 88~89%	Minomycin (Influenza kit A,B negative)/Pneumonia	
	February 2 days	Fever 39.9°C	DIV, Cephmetazole/Pneumonia	no
	May one day	Fever 38.6°C	DIV, Cephmetazole/URI	no
2011	March one day	Fever 37.6°C	None/URI	no
	May one day	Fever 37.6°C	None/URI	no
	May one day	Fever 38.4°C	Tarivit	no
	August one day	Fever 38.0°C	None/URI	no
	September one day	Fever 37.8°C	None/URI	no
2013	March One day	Fever 37.9°C	Ofloxacin/URI	no
	September 2 days	Fever 40.2°C	DIV, Celecoxib, acetaminophen/URI	no
2014	January 4 days	Fever 38.4°C	DIV, Cephmetazole (Influenza kit A,B negative)/Pneumonia	no
	February 4 days	Fever 38.9°C	DIV, Cephmetazole (Influenza kit A,B negative) /Pneumonia	no
	July 2 days	Fever 38.5°C	PL granules/URI	no
2016	Feb 3 days	Fever 38.7°C	SpO ₂ 92%/URI	no
	March 2 days	Fever 38.7°C	SpO ₂ 95%/URI	no
	March~April 5 days	Fever 39.2°C	DIV/Pneumonia and UTI	Admitted to Daiichi Hosp (April 1~ 8) Diagnosed as suffering pneumonia and Urinary tract infection

	April ~May 34 days	Fever 38.8°C	DIV, Ampicillin/UTI	Admitted to Daiichi Hosp (May 13~May 24) Diagnosed as having UTI
	May ~June 9 days	Fever 39.3°C SpO ₂ 88~90% Loss of consciousness, shaking chills	DIV, Ampicillin /UTI	Admitted to Daiichi Hosp (June 2~Oct 3*) Diagnosed as having UTI

* expiration date

Discussion

This is a case report of a female who suffered from the following:

1. Subarachnoid hemorrhage (Neurosurgeons placed a metal clip at the neck of a ruptured aneurysm to prevent it from bursting again)
2. Vasospasm-induced ischemic stroke that followed a subarachnoid hemorrhage, Post-stroke syndrome, higher brain dysfunctions like aphasia
3. Traumatic brain injury (bilateral brain contusion) that followed a traffic mishap

In a sense, everything started from a subarachnoid hemorrhage, which then triggered a vasospasm-induced ischemic stroke (cerebral infarction) a week after the 2006 subarachnoid hemorrhage. Pounded by the subarachnoid bleeding, the patient lost consciousness all of a sudden right in the middle of her driving. Then, the female businesswoman, then 65, crashed her car into the rear of an automobile that was waiting for the traffic lights to change at an intersection. She developed a traumatic brain injury, i.e., bilateral brain contusion. Following these complex series of events, she developed various residual brain damages, including aphasia, right hemiplegia, motor ataxia, dysbasia, agnosia and other higher brain dysfunctions.

When she was transferred to Roken Towada, she was brought to us with a diagnostic document stating that there is no hope of recovery. When the patient

was admitted to our institution, she was subsisting on the nasogastric tube-feeding. She carried a letter from the doctor of the hospital where she had been treated with the letter declaring that the doctor concluded that there was no hope of her restarting an oral injection of food.

However, while she was receiving a speech-language-hearing therapy she showed subtle signs that she started recovering a swallowing activity. It took five years of preparatory swallowing training before we finally started to give her a fresh series of intensified direct swallowing training. She had a severe motor ataxia and was also suffering from orofacial apraxia. Hence, applying training of coordination of orofacial muscles was not possible.

When she approached the closing phase of the fifth year of her stay at our nursing-care facility, she was still bedridden, while fully depending on a nasogastric tube to receive nutrition. Therefore, the intensified swallowing training was performed while she was still in the state of fully relying on an indwelling nasogastric tube. When she started receiving this fresh series of intensified swallowing training, she also received the training designed to enable her to sit on the wheelchair because a swallowing reflex may be revived more easily at feeble people like her when they are at a sitting position. It took another 13 months before she became capable of eating three meals a day and she was freed from the nasogastric tube feeding.

Following the subsequent three-year period, she enjoyed a happier life as she recovered to the point of being able to eat meals with her family often -- sometimes along with some alcoholic beverages like wine. But she finally entered the closing phase of her life. In 2016, she developed an intractable urinary tract infection, which appears to have triggered a sepsis as a complication. She was admitted to the Towada Daiichi Hospital in June 4, 2016, passing away on October 3, 2016.

Conclusion

This case showed that reviving a swallowing function is possible even at certain patients that were previously fully dependent on nasogastric tube feeding. She also recovered the ability to sit in the wheelchair. She was lucky to have resumed a swallowing function to the point of being able to eating normal types

of meals for as long as three years after the recovery of her swallowing and ingestion function.

The residual brain damages stemming from the 2006 ischemic stroke were persistent, serious and wide-ranging. Serious higher brain dysfunctions like aphasia hounded her ever since she had suffered in 2006 the second in two rounds of subarachnoid hemorrhage, which then triggered the vasospasm-induced ischemic stroke.

The most plausible explanation for the recovery of her swallowing function is that edemas in the coup lesion and contrecoup lesion she developed as a result of the impact from the 2006 traffic mishap went into remission as years go by, while the intensified rehabilitation training at our nursing-care facility exerted positive effects in reviving her swallowing function.