Original article

A case of anomic aphasia with various paraphasic errors: Focusing on phonological anomia

Yuka Oishi[1], Tsutomu Sugai[2]

[1]Department of Speech, Language, and Hearing Sciences, Niigata University of Health and Welfare, Niigata, Japan
[2]Department of Brain surgery, Yamagata Prefectural Central Hospital, Yamagata, Japan

Key words: phonological anomia, oral naming, analysis of errors, phonological fragments, paraphasia

Received: 27 November 2015/Accepted: 8 January 2016

Abstract

This article reports a case of 70-year-old right-handed woman who made various naming errors because of anomic aphasia that developed after hemorrhage in the left temporal lobe. She was fluent in spontaneous speech with no signs of dysarthria, and despite occasional word-finding difficulties, she had almost no paraphasic errors. Auditory comprehension was preserved for short sentences. Comprehensive examination during the chronic phase revealed, in addition to semantic errors, many phonological errors such as formal paraphasia and phonological fragments which are normally absent in classical anomic aphasia. However, word-level repetition was excellent with no phonological paraphasia. A detailed cognitive neuropsychological investigation of the patient's ability to name objects to confrontation was carried out in an attempt to determine where her cognitive deficits might lie. Based on analysis of these oral naming errors, we suspected that she could not select appropriate lexical items from the lexicon and, moreover, that she had difficulty retrieving complete phonological forms of the items.

Introduction

Phonological anomia has been investigated periodically [1-3] since it was first reported by Kay and Ellis in 1987. In Japan, the concept of phonological anomia became well known after Mizuta et al. reported four cases in 2003. Patients with phonological anomia present with a diverse range of symptoms, making it difficult to define the pathological condition. However, in 2008, Mizuta divided anomic aphasia into word selection anomia and phonological anomia [4]. Compared with word selection aphasia, which involves difficulties with lexical item selection, Mizuta defined phonological anomia as a pathological condition characterized primarily by phonological fragments and phonological paraphasia with no signs of semantic errors in oral naming. Mizuta also emphasized that patients with phonological anomia have good repetition skills and no phonological paraphasia, unlike in conduction aphasia in which phonological errors are observed throughout expressive language [5].

This article reports here a case of a patient who made phonological errors in oral naming tasks due to anomic aphasia that developed after hemorrhage in the left temporal lobe. This article comprehensively evaluated her oral naming skills

Corresponding author: Yuka Oishi
Department of Speech, Language, and Hearing Sciences, Niigata University of Health and Welfare, 1398 Shimami-cho, Kita-ku, Niigata, Niigata 950-3198, Japan
TEL/FAX: +81-25-257-4329, E-mail: oishi@nuhw.ac.jp

and lexical comprehension to assess her lexical processing deficit.

I. Case

Case: A 70-year-old right-handed woman with 12 years of formal education and currently a teacher of Japanese tea ceremony.

Chief complaint: Unable to find intended words when speaking.

Previous medical history: Cerebral hemorrhage in the left temporal lobe 8 years earlier.

Present medical history: When cradling a grandchild, she fell on a stone and hit the back of the head. A few days later, she visited an outpatient brain surgery clinic because of irritability and inability to find words when speaking. Head computed tomography revealed hemorrhagic focus and she was admitted urgently for treatment of subcortical hemorrhage in the left temporal lobe. She was discharged 1 month later and continued to undergo speech therapy on an outpatient basis.

Neurological findings: Alert and oriented. Right homonymous hemianopsia. Preexisting sensorineural hearing loss, for which a hearing aid was used.

Neuropsychological findings: Alert, oriented, and cooperative in the beginning of speech therapy. Fluent aphasia was noted. No signs of orofacial apraxia, apraxia, or agnosia. Forward and backward digit span up to 5 and 4 digits, respectively. Scored 4 on visual tapping span and 29/36 on Raven's Coloured Progressive Matrices, and had a performance IQ of 106 (66 percentile) on the Wechsler Adult Intelligence Scale Third Edition.

Radiological findings: At 4 days and 6 months after onset, brain magnetic resonance imaging revealed new temporal subcortical hemorrhage (Figure 1a, b) caudal to the old hemorrhage that had caused cystic degeneration across the left temporal and parietal lobes.

II. Speech therapy findings and post-therapy course

In the beginning of speech therapy, spontaneous speech was fluent with no signs of neuromuscular dysarthria or impairment of articulation. Although the patient had occasional word-finding difficulties, no paraphasia was observed. With no euphoric behaviors or anosognosia, she underwent proactive rehabilitation. The Standard Language Test of Aphasia (SLTA) was conducted at 1 and 6 months after onset (Figure 2). Speech therapy findings during a period of 6 months following disease onset are shown below.

1. Output

i) Spontaneous Speech

Around the time speech therapy was initiated,

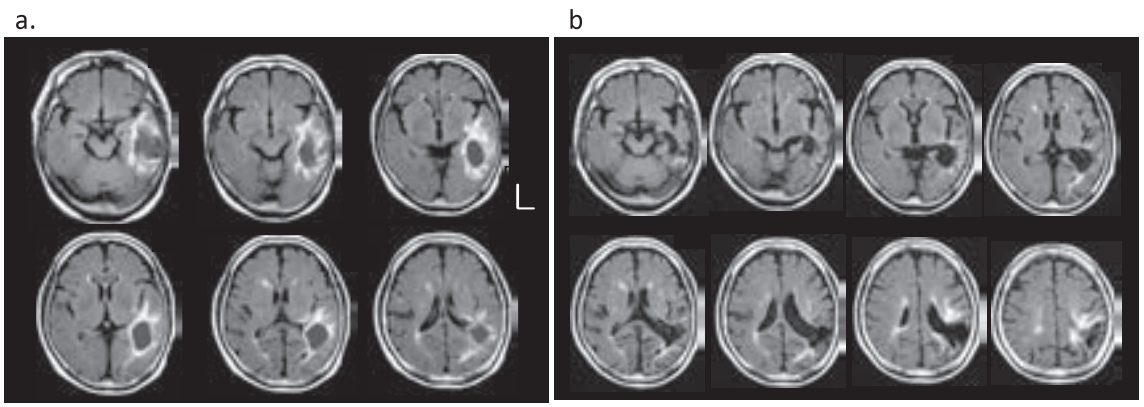

Figure 1. Head magnetic resonance image at 4 days and 6 months after subcortical hemorrhage in the left temporal lobe

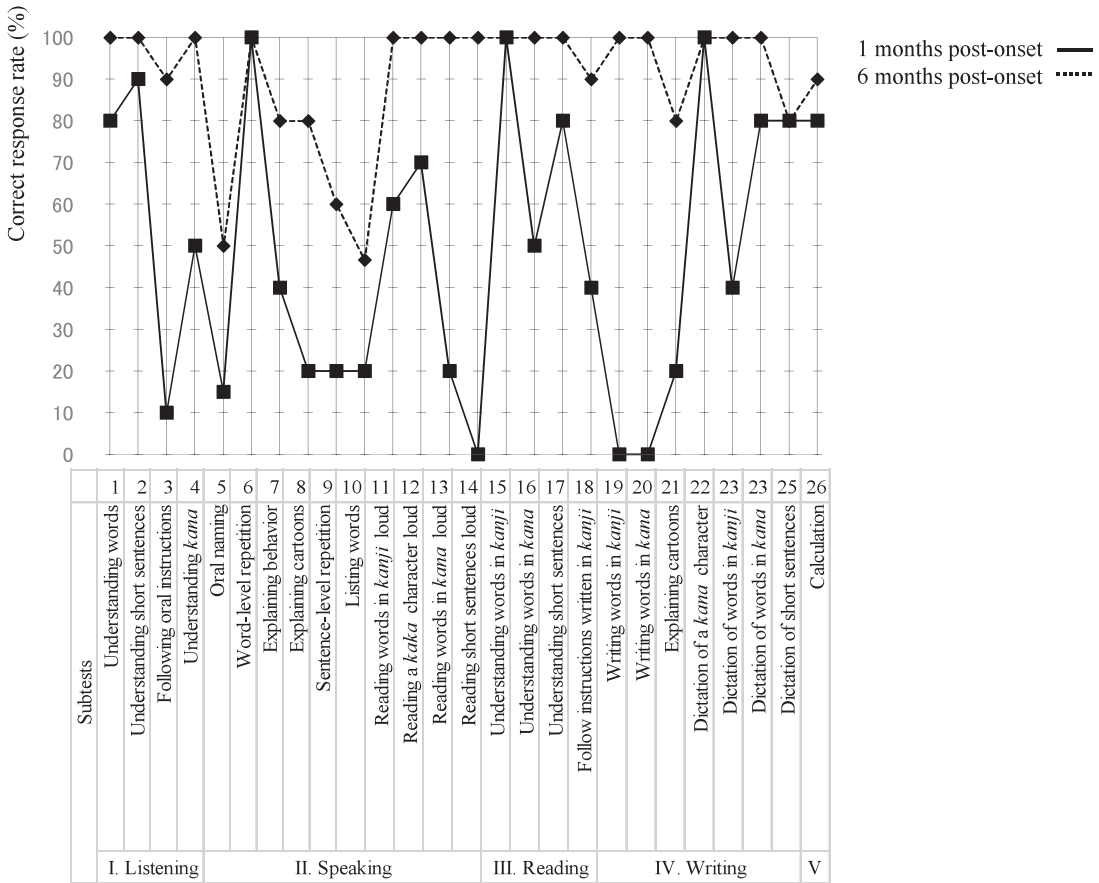

Figure 2. Results of the Standard Language Test of Aphasia at 1 and 6 months after onset

the patient had difficulties with word retrieval in spontaneous speech and often used demonstrative pronouns such as “this” and “that” and circumlocutions, but no phonological paraphasia or verbal paraphasia. In oral naming tasks, many phonological fragments and phonological errors were observed. Word-initial cues were generally ineffective; when she could retrieve a word with the correct initial sound, it was not the intended word. Word-retrieval skills in spontaneous speech and oral naming tasks improved over the clinical course, but word-retrieval difficulties continued. As for oral naming, at 6 months after onset, the patient correctly answered 50% of items in the SLTA oral naming tasks, but her oral-naming deficit persisted with low-frequency words, and she produced many phonological fragments as she had done in the acute phase. Word-level repetition improved, but sentence-level repetition was possible up to 4 sentences. For >5 sentences, it was difficult to maintain the sounds. In reading-aloud tasks, deep dyslexia and phonological errors were observed (e.g., 時計 ([tokei], clock) → 電気 ([denki], electricity), 鉛筆 ([enpitsu], pencil) → 英語 ([eigo], English), 時計 ([tokei], clock → コセ…イ([*kose…i*]), and 新聞 ([shinbun], newspaper → インソ…インセイ ([*inso…insei*]).

Examples of spontaneous speech (from a formal tea gathering before onset):
“That… well… there was a thing about tea, which…. I had to do that. That… Yama…. there

was a tea ceremony gathering at Yamadera. At 8 o'clock in the morning, first at 3:30, I went there around 3:30, and took care of that…, it…, and later, about 1 week, I became sick."

Explanation of cartoons in SLTA:
"Briefly,…. looked around, and, the wind blew, well… I mean…. This was removed, water…, water was taken. When inside the water was counted up…. my head….. came out, so by combining the water, that was removed by hand…."
ii) Writing
At initial examination, the patient had dysgraphia due primarily to an inability to recall *kanji* characters, and she sometimes added unnecessary *kana* characters. Her symptoms improved gradually, and she was able to perform sentence-level writing most of the time at 6 months post-onset. She had more difficulty reading than writing.

2. Comprehension
i) Auditory comprehension
Auditory comprehension was preserved at word level and short sentence level, but a functional decline was observed in oral instruction tasks. At 6 months post-onset, she understood short but complicated sentences involving the handling of objects.
ii) Reading comprehension
Reading comprehension was preserved at short sentence level, but a functional decline was observed in *kanji* instruction tasks involving the handling of objects, but this did gradually improve.

Our diagnosis was anomic aphasia based on the findings of preserved auditory comprehension, word retrieval difficulties and oral naming deficits as the core symptoms in speech, no paraphasia in spontaneous speech, and preserved repetition at word level. Because of the many phonological errors present in oral naming tasks even in the chronic phase, we analyzed the patient's lexical processing deficits in this study.

Methods
1. Analysis of errors in oral naming

The Test of Lexical Processing in Aphasia (TLPA) was administered at 6 months post-onset. Errors in the use of nouns in different semantic categories (200 words in total) were analyzed in three steps. First, according to the method reported by Tomita et al. [6], we classified her oral naming task errors into several categories as follows: correct answers, periparases, no response, and perseveration. Also, other responses (paraphasia, neologisms, and phonological fragments) were analyzed. Analysis included the initial errors and errors made in corrective processes, but not repeated errors. As for phonological fragments, responses at the single-syllable level were analyzed.

Then, according to the classification developed by Hirano et al. [7], the analyzed errors were classified using three indexes—lexicality, semantic relevancy, and phonological relevancy. Phonological relevancy was determined according to the method used by Hirano et al. [7] to calculate similarity between phonological units. In this method, the degree of similarity between the error and intended word is measured based on the type, position, and number of phonemes and the number of moras, with similarity expressed in the range between 0.00 (no common phonemes) and 1.00 (exact match). In accordance with the criteria used by Hirano et al. [7] defined responses are with ≥ 0.40 similarity to be phonologically relevant and the threshold was set at 0.40.

Words with semantic relevance were defined as follows: words in the same semantic category (e.g., cherry and plum); superordinate terms in which one of the words has a superordinate concept (e.g., flower and plum); subordinate terms where one of the words is attached to the other (e.g., school and ground); words with common attributes such as

function and shape (e.g., sun and light); situation-related words (e.g., cup and water); and synonymous words (e.g., glove and *tebukuro* [‘glove’ in Japanese]). Any other words were considered semantically irrelevant. According to the classification by Hirano et al. [7], phonological fragments having many moras are classified as “neologism and so forth” with no phonological relevance, even when some of the moras are reproduced. In this study, we therefore established a category named “Phonological fragments” for instances of non-words with no lexicon, which were then divided based on the presence/absence of phonological relevance.

In the third step, we calculated correct response rates based on the attribute and category and analyzed the effect of word-initial sounds. To investigate attributes, oral naming I (familiarity) tasks in the Sophia Analysis of Language in Aphasia (SALA) test were administered. In addition, nouns in different categories in the TLPA test were used to calculate the number of correct responses based on familiarity and number of moras. Auditory comprehension and number of correct oral namings were compared using the nouns in different categories in the TLPA test. The oral naming tasks in the SALA and TLPA were used to evaluate the rate of word-initial cues used and the outcomes.

2. Analysis of lexical comprehension

Passive vocabulary was assessed using the auditory comprehension tasks in the TLPA section for nouns in different semantic categories, reading comprehension tasks on nouns and verbs, understanding similarity between nouns or verbs (visual presentation), and lexical decision tasks (visual/auditory presentation). In addition, a categorization task was repeated 5 times, in which the patient categorized 12 line drawings presented randomly into 3 groups. The line drawings were selected from the TLPA.

3. Analysis of phonological processing

Mora detection tasks [8] were administered to evaluate if and where /ka/ is present in a word and mora disassembly tasks were administered to evaluate phonological processing. In addition, the patient completed word repetition tasks I (imageability × frequency) and II (number of moras) and the nonsense-word repetition tasks in the SALA test.

Results

1. Analysis of errors in oral naming

The number of correct answers was 61 of 200 target words (30.5%). The total number of errors was 170, 98 of which were analyzed in this study. Table 1 shows the categories of the oral naming errors and examples. Among words with lexicon (+), the proportion of semantic paraphasias with related meanings was 36.7% (36/98), the highest of all. In addition, there were 11 (11.2%) formal paraphasias with phonological relevance, but none with semantic relevance. On the other hand, non-words without lexicon (-) included many phonological fragments. Only 6 (6.1%) phonological fragments that were phonologically relevant, revealing some moras in the target words were recalled correctly (e.g.,ねぎ([negi], green onion) → [ne]; 便所 ([benjo], toilet) → [be]). There were 19 (19.4%) phonological fragments with phonological relevance (e.g., かご ([kago], basket or cage) → [te]; バター ([bata:], butter) → [mi]).

According to the SALA test 48 correct answers divided into 36 high familiarity words (75.5%) and 3 low-familiarity words (6.3%), while according to the TLPA test 100 correct answers divided into 46 high familiarity words (46%) and 15 low familiarity words (15%), demonstrating the effect of familiarity. The number of correct answers by mora was 26/57 (45.6%) for 1–2 moras, 18/55 (32.7%) for 3 moras, 12/52 (23.1%) for 4 moras, and 4/27 (14.8%) for 5–7 moras, showing the effect of length.

Table 1. Classification of paraphasic errors (n=98)

	Lexicon (+) = word		Lexicon (-) = nonword	
	Semantic relevance (+)	Semantic relevance (-)		
Phonological relevance (+) *Phoneme similarity score ≧0.40*	Mixed paraphasia 5 (5.1%) 白　菜([hakusai], chinese cabbage)→ 葉っぱ([happa], leaf), れんこん([renkon], lotus root)→ ダイコン([daikon], radish)	Formal paraphasia 11 (11.2%) ネギ([negi], leek) → ミギ[migi], right) , 廊下([ro:ka], corridor)→ ソウコ([so:ko], warehouse)	Phonological paraphasia 5 (5.1%) 傘([kasa], umblela)→ アマ[ama], ネギ([negi], leek)→ レギ[regi]	Phonological fragments 6(6.1%) くるみ→ク 背中→ネ 便所→ベ
Phonological relevance (-) *Phoneme similarity score ＜0.40*	Semantic paraphasia 36 (36.7%) 桜[sakura], cherry tree)→ ウメ([ume], plum tree), コップ([koppu], glass)→ ミズ([mizu], water)	Irrelevant paraphasia 9 (9.2%) ハム([ham], ham)→ パン([pan], bread), レモン([lemon], lemon) →シカ([shika], deer)	neologism, etc. 7 (7.2%) 朝顔([asagao], morning glory) →アジラ[azira], まぶた([mabuta], eyelid) →カミノ[kamino]	Phonological fragments 19 (19.4%) 歯([ha], teeth)→ツ[tsu], バター ([bata:], butter) →ミ[mi]

*Responses are presented in the order of target and expressed words.

The number of correct answers by category in auditory comprehension tasks was 12/20 (60%) for indoors, 15/20 (75%) for buildings, 16/20 (80%) for vehicles, 20/20 (100%) for tools, 16/20 (80%) for processed foods, 18/20 (90%) for vegetables and fruits, 17/20 (85%) for plants, 19/20 (95%) for animals, 16/20 (80%) for body parts, and 15/20 (75%) for colors. In oral naming tasks, the number of correct answers was 5/20 (25%) for indoors, 3/20 (15%) for buildings, 5/20 (25%) for vehicles, 5/20 (25%) for tools, 8/20 (40%) for processed foods, 5/20 (25%) for vegetables and fruits, 6/20 (30%) for plants, 6/20 (30%) for animals, 6/20 (30%) for body parts, and 12/20 (60%) for colors, with no significant difference between categories despite the relatively higher number of correct color-related answers in oral naming tasks.

When word-initial voicing cues were provided, 5 of 57 (8.8%) incorrect words in the oral naming tasks of the SALA test and 19 (13.7%) of 139 incorrect words in the TLPA were converted to the correct answer, indicating that the effect of word-initial voicing cues was poor. Most responses to cues were either “no recollection” or “recollection of other words, not target words, containing the initial sound (e.g., はたき ([hataki], duster) → はさみ ([hasami], scissors) and ペリカン([pelican], pelican → ペンギン ([penguin], penguin). The recall rate for non-target words or the creation of neologisms in response to word-initial voicing cues was 19.3% (22/57) in the SALA test and 20.1% (28/139) in the TLPA. In all cases, the incorrect answer was accompanied by a negative expression such as “well, not…,” indicating that the patient was searching for a correct word but could not retrieve it.

2. Analysis of lexical comprehension

As shown in Figure 3, the patient scored 164 of

200 (82%) in the TLPA task on the auditory comprehension of nouns in different semantic categories (mean ± SD in healthy individuals, 199.00 ± 1.00). Reading comprehension and familiarity decision tasks (visual presentation) revealed that the patient understood 61 of 96 written nouns (63.5%; 94–96 nouns in healthy individuals), 43 of 48 written verbs (89.6%; 45–48 verbs in healthy individuals), and had a similarity of 18 of 48 nouns (37.5%; 43–48 nouns in healthy individuals) and of 24 of 48 verbs (50%; 43–48 verbs in healthy individuals), showing a functional decline in tasks requiring reading comprehension. In lexical decision tasks (visual presentation) on *hiragana* and *katakana* (the Japanese syllabic scripts called *kana*) as well as on *kanji*, the number of correct words was 47/96 (49.0%; 95–96 words in healthy individuals), whereas in the tasks on *kanji* alone, the number of correct words was 95/120 (79.2%; 109–120 words in healthy individuals), showing a decline in the tasks on *kanji* alone. However, in auditory presentation, the correct words were 99/104 (95.2%; 91–104 words in healthy

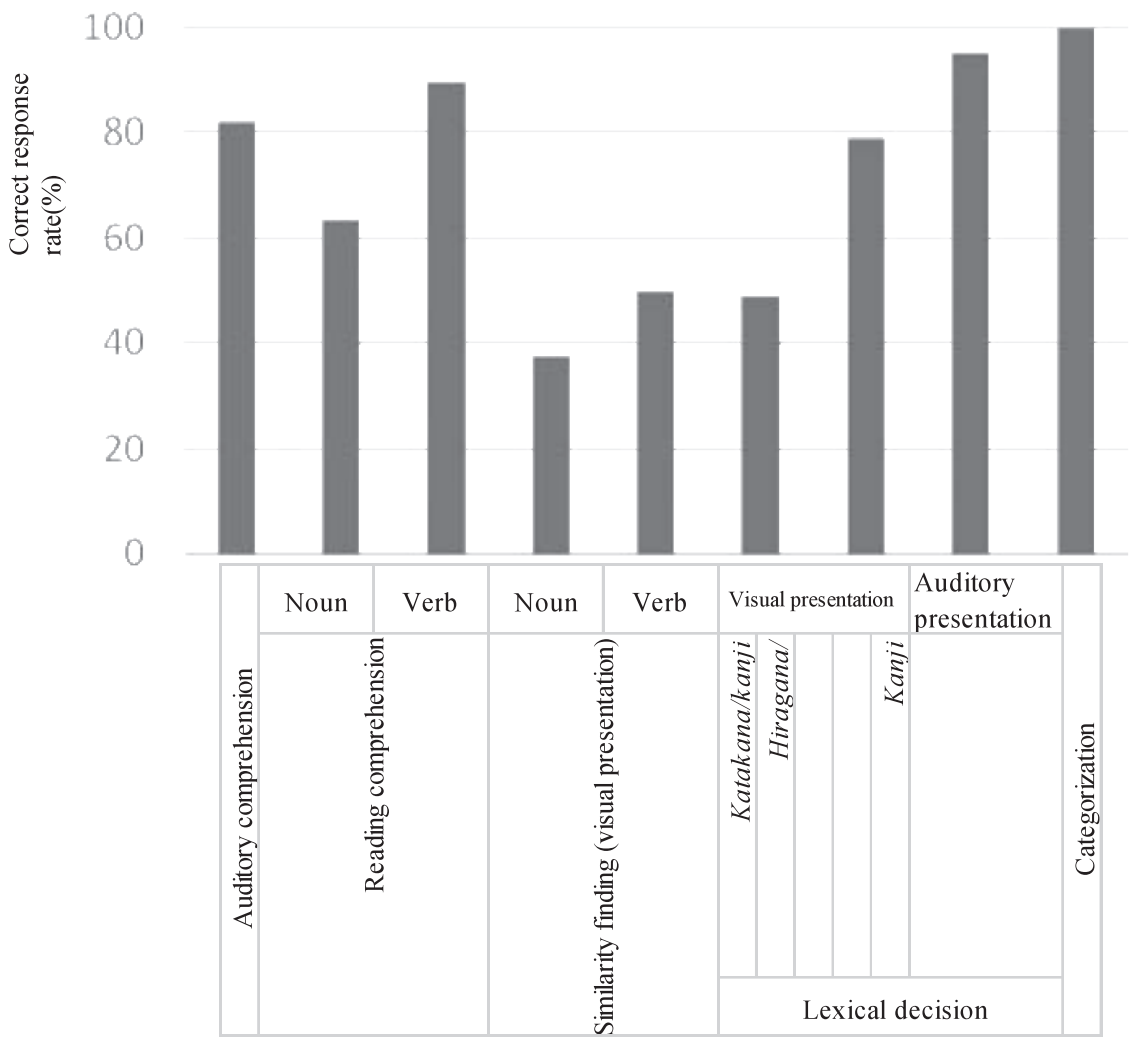

Figure 3. Results of lexical comprehension tasks

Table 2. Results of phonological processing tasks

Tasks	Results
Is there any /ka/?	48/48
Where is /ka/?	24/24
Mora disassembly	29/29
Word repetition I(imageability × frequency)	51/52
Word repetition II(number of moras)	89/90
Non-word repetition	49/56
Backword word repetition	≦3moras

individuals), indicating auditory lexical decision was intact. The score on the categorization tasks was excellent (60/60, 100%).

3. Analysis of phonological processing

As shown in Table 2, the number of correct answers was 48/48 in the find /ka/ task, 24/24 in the locate /ka/ task, and 29/29 in mora disassembly task. In the SALA test, word repetition I (imageability × frequency) was 51/52 (50–52 in healthy individuals), word repetition II (number of moras) was 89/90 (89–90 in healthy individuals), and repetition of nonsense words was 49/56 (49–56 in healthy individuals), showing that repetition of both words and non-words was excellent and that phonological operation not requiring word retrieval was good.

Discussion

We made a diagnosis of anomic aphasia in this case because the patient retained auditory comprehension and repetition at word level and her main difficulties were with word retrieval and oral naming during speech, but with no paraphasias in spontaneous speech. However, unlike classical anomic aphasia, the specific feature of this case was the presentation of various paraphasic errors in oral naming. Careful observation of naming errors in the chronic phase revealed many phonological errors such as formal paraphasia and phonological fragments, which are seldom observed in typical anomic aphasia.

1. Anomic aphasia

Classical anomic aphasia is defined as aphasia with fundamentally fluent utterances, normal articulation and syntax, but markedly impaired word retrieval [9,10,2]. The patients are essentially unable to perform proper lexical selection, and strictly speaking only gaps, but no paraphasic errors, are observed in speech because of difficulties in word retrieval. However, unlike phonological paraphasia, mild semantic paraphasia is often considered acceptable [4]. Comprehensive studies of anomic aphasia have shown a decline in semantic understanding at word level [2] and mild phonologic deficits in repetition or reading tasks [11], showing various clinical manifestations.

Two levels of lexical access have been proposed for speech production [12]. In response to this, Mizuta reported the subclassification of anomic aphasia into lexical selection anomia and phonological anomia [4]. In the former, patients have difficulties selecting words and often use roundabout periphrastic expressions. Because proper words are not selected and the intended words are not retrieved, the patients have no tacit

knowledge about the phonological format [13]. As for phonological anomia, frequent appearances of phonological fragments similar to those present in the intended words indicates that lexical selection is preserved, but the patients have difficulty developing phonemes, and thus cannot reproduce proper words [4], suggesting dysfunction of the phonological output lexicon [14] and inadequate activation of phonological representations [5].

2. Phonological anomia and phonological fragments

Phonological fragments are a form of error that patients with aphasia make in tasks of oral naming, repetition, and reading aloud. Unlike semantic paraphasias or neologisms, phonological fragments are not united as a word and generally contain a fragmented sound in one or two syllables. It should be noted here that phonological fragments with an error in a single syllable were analyzed in this study. In general, patients with anomic aphasia seldom make phonological errors; in particular, phonological fragments containing information about phonemes in the intended words are relatively rare compared with other types of aphasia [13, 2].

Phonological fragments are similar to the tip-of-the-tongue (TOT) phenomenon in healthy individuals [15]. TOT occurrences are accompanied by the information of phonemes in the intended words and reflect an activation of the target word in the absence of retrieval [16]. In previous studies, patients with phonological anomia who had good comprehension and preserved repetition and who produced phonological fragments containing a part of the intended target words were reported as clinical cases of aphasia accompanied by TOT-like phenomena [11,5]. According to Kay et al. [11], a patient made phonemic errors that sounded similar to the intended words, but was able to provide the initial sound and the number of syllables. Mizuta et al. [5] also frequently observed phonological paraphasias, where phonemes are partly substituted with others. Other frequently observed symptoms were phonological fragments containing a part of the intended words, phonological paraphasias, and omission of a phoneme in the intended words, suggesting that the patients were able to reproduce a phonological format similar to that of the intended words even though the phonological information about the intended words was insufficient. Based on these specific naming-related symptoms, the production of phonological fragments seems to suggest that patients with phonological anomia are able to perform lexical selection at word level but unable to acquire sufficient information on the phonemes.

In a study of anomic aphasia accompanied by various types of paraphasia in oral naming, Mizuta (2006) frequently observed phonological fragments and formal paraphasia, as we did in our patient [15]. However, while our patient had some phonological fragments that shared phonemes with the intended words, the majority of phonological fragments observed by Mizuta did not show phonological relevance. Compared with phonological anomia, it appears that reproducing proper phonological formats is difficult in anomic aphasia.

With regard to lexical comprehension, categorization was possible, but a functional decline in auditory and reading comprehension of nouns was observed. The many incidences of semantic paraphasia (the selection of lexically relevant words) also suggest a functional decline in lexical comprehension at word level. On the other hand, unlike in conduction aphasia, our patient could perform phonological manipulation that did not involve word search because of excellent repetition of words/non-words and the absence of phonological paraphasia. Therefore, anomic symptoms observed in our patient suggest that she had lexical selection deficit accompanied by an element of phonological anomia, in addition to impaired retrieval of phonological

formats.

This article reported the case of a neurological patient with anomic aphasia who had various paraphasia errors in oral naming tasks. It is rare to encounter patients with pure anomic aphasia in the everyday clinical setting, and only a few Japanese groups have investigated phonological anomia in detail. Because most of the studies were conducted during the acute phase, the clinical manifestations vary widely, including the presence and absence of semantic paraphasia, different degrees of lexical comprehension, and various causal diseases, demonstrating the diverse pathology of anomic aphasia and various background factors. Nevertheless, because oral naming disorder is a core symptom of aphasia that we frequently encounter in clinical practice, from the perspective of clinical speech therapy, it is of great importance and practical value to accurately analyze individual cases of oral naming deficit to reveal the underlying mechanism. Clinicians should try not to miss any errors patients make in the future in efforts to accumulate more detailed data on anomic aphasia.

References

1. Raumer AM, Foundas AL, Maher LM et al. Cognitive neuropsychological analysis and neuroanatomic correlates in an acute anomia. Brain Lang. 1997; 58: 137-156.
2. Lambon R, Matthew A, Sage K et al. Classical anomia: a neuropsychological perspective on speech production. Neuropsychologia. 2000; 38: 186-202.
3. Bachoud-Levi AC, Dupoux E. An influence of syntactic and semantic variables on word form retrieval. Cogn Neuropsychol. 2003; 20: 163-188.
4. Mizuta H. Amnesic aphasia (anomia aphasia). Japanese Journal of Neurology. 2008; 68: 201-207.
5. Mizuta H, Fujimoto Y, Matsuda M. Four cases of phonological anomia. Japanese Journal of Neuropsychology. 2005; 21: 207-214.
6. Tomita H, Maegawa K, Yamauchi R et al. A clinical presentation of phonological anomia during recovery from Wernicke's aphasia. Japanese Journal of Speech, Language, and Hearing Research. 2015; 12: 78-86.
7. Hirano A, Okudaira N, Kanai H et al. A case of fluent aphasia with various paraphasias: Focusing on analysis of errors in oral naming tasks. Higher Brain Function Research. 2010; 30: 418-427.
8. Watamori Y: Aphasia. Manual for Speech-Language Therapy. Ishiyaku Publishers; 1984: 49-80.
9. Goodglass H, Kaplan S, Weintraub S et al. The "tip-of-tongue" phenomenon in aphasia. Cortex.1976; 12: 145-153.
10. Benson D, Ardila A. Aphasia: A clinical perspective. Oxford University Press; 1996: 46-60.
11. Kay J, Ellis A. A cognitive neuropsychological case study of anomia. Brain. 1987; 110: 612-629.
12. Levelt WJM. Accessing words in speech production: Stages, processes and representations. Cognition. 1992: 42; 1-22.
13. Kremin H. Naming and its disorders. In: Boller F, Grafman J, editors. Handbook of neuropsychology. Amsterdam: Elsevier Science Publishers; 1988: vol1.307-327.
14. Ellis AW, Kay J, Franklin S. Anomia. Differentiating between semantic and phonological deficits. In: Margolin DI, editor. Cognitive neuropsychology in clinical practice. New York: Oxford Univ Press; 1992: 207-228.
15. Mizuta H. Various naming errors in an anomic patient: Focusing on formal paraphasia. Higher Brain Function Research. 2006; 26: 8-15.
16. Brown AS. A review of the tip-of-tongue experience. Psychol. Bull. 1991; 109: 204-223.