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An Egyptian patient story: multilingual role in post-stroke aphasia recovery

Iman Muhammad Ahmad Jomaa[1,2], Wafaa Batran Wahba[3], Ramez Reda Moustafa[4] and Tamer Roushdy[4*]

Abstract

Background: Ischemic strokes are common neurological disease and unless being managed fast enough within hours of onset a permanent deficit usually results. Such deficit impairs the patient independency to a great extent. Aphasia affects more than a quarter of acute stroke cases. Initially it is more prominent and with time its severity may subside, yet to which degree and what factors play a role in this severity reduction still needs further studies and is under postulations.

Case presentation: Multilingual role in post-stroke aphasia recovery is presented in this case report where a trilingual female who acquired a foreign accent and who involuntarily uses code switching between Arabic, French and English in order to linguistically communicate; thus overcoming post-stroke language communication problems. The neurolinguistics data are taken from the results of the application of the Western Aphasia Battery-Revised scale in Cairene Dialect, in addition to extra language exercises including repetition, picture description and conversation with the patient. Linguistic analysis includes the investigation of morph syntactic constructions, phonetic deviations and semantic paraphasia. Linguistic analysis also revealed that the patient's aphasia disorder is of the conduction type and that she resorts to her second language (L_2) namely French or her third language (L_3) namely English if she finds it difficult to produce the Arabic word.

Conclusion: Cognitive reserve and multilingualism may have a role in post-stroke aphasia recovery.

Keywords: Stroke, Aphasia, Recovery, Multilingual aphasia, Neurolinguistics analysis, Western Aphasia Battery-Revised

Background

Conduction aphasia is an infrequent fluent type of aphasia where the aphasic preserves expression and comprehension abilities. It has been interpreted as a disconnection between the superior temporal gyrus where Wernicke's area is found and the inferior frontal gyrus where Broca's area is found. Lesion in the arcuate fasciculus is the main reason for this kind of language impairment, as it disconnects receptive language areas from expressive ones [1, 2]. That is why conduction aphasia is known as associative aphasia. It was first interpreted by Wernicke's in 1874 then supported by Geschwind during 1960 by Wernicke–Geschwind model of language [3]. Because of the significant difficulty of verbal production and the impairment in articulation this type of aphasia has many other interpretations such as motor or kinesthetic afferent aphasia and efferent conduction aphasia [4].

A patient with conduction aphasia has severe difficulty in repetition, word finding and speech production paraphasia, in addition to difficulty in the comprehension of some lexical words in isolation. According to Benson and his colleagues, conduction aphasia has three fundamental features: namely, fluent conversation, comprehension intact, and severe impairment in repetition ability. Additionally, it has five other secondary ones: namely, impairment in naming, impairment in reading, apraxic agraphia

*Correspondence: Tamer.roushdy@med.asu.edu.eg
[4] Neurology Department, Faculty of Medicine, Ain Shams University, 38 Abbasia, PO 11591, Cairo, Egypt
Full list of author information is available at the end of the article

which is the inability to write words with their proper letters as used in standard language and is referred to as orthographic production deterioration that is of variable degrees in conduction aphasia, ideomotor apraxia which is inability to pantomime gestures and tool-use in addition to other various neurological impairments that differ from one case to another. One additional significant feature in conduction aphasia is self-correction [5].

In the current case, neurolinguistic analysis for a multilingual patient with conduction aphasia is presented with a highlight on Chomsky theory of language acquisition and language organ as well as role of multilingualism in aphasia recovery.

Case presentation

A 44-year-old right-handed female patient, multilingual (Arabic, French, English) with no modifiable vascular risk factors, had a motor car accident in August 2015 that caused her a compound fracture along her left upper fibula and tibia. The patient underwent an orthopedic operation. Unfortunately, this patient suffered from deep venous thrombosis along the operated leg with embolism that migrated to her right cardiac chambers and through a patent foramen ovale the embolism through her arterial tree reached the left middle cerebral artery causing her stroke (Fig. 1).

At baseline neurological assessment, the patient was conscious, yet alertness, attention, orientation could not be assessed secondary to her global aphasia with score of 19.4 on Western Aphasia Battery-Revised (WAB-R), this patient had dense right-sided weakness and hemi-hypoesthesia. The patient scored 15 on National Institutes of Health Stroke Scale (NIHSS) and modified Rankin scale of 3.

The patient underwent intensive physiotherapy, and speech therapy. Within 6 months the patient achieved recovery with NIHSS reduction to 2 (mild-to-moderate sensory loss, mild-to-moderate aphasia) and her modified Rankin scale became zero.

Upon the informal written consent by the patient, neurolinguistic analyses along frequent sessions were taken from the verbal production of the patient mainly using her (L_1) Arabic by a native speaker of Cairene Arabic under the supervision of two neurologists. Sessions included linguistic testing and therapy adopting WAB-R that was translated from English into the dialect of Egyptian Cairene Natives [6].

Regarding her aphasia, the patient had intact comprehension, moderate difficulty in expressing herself in spoken language with paraphasia and paragraphia. WAB-R score reached 84 and was classified as conduction aphasia.

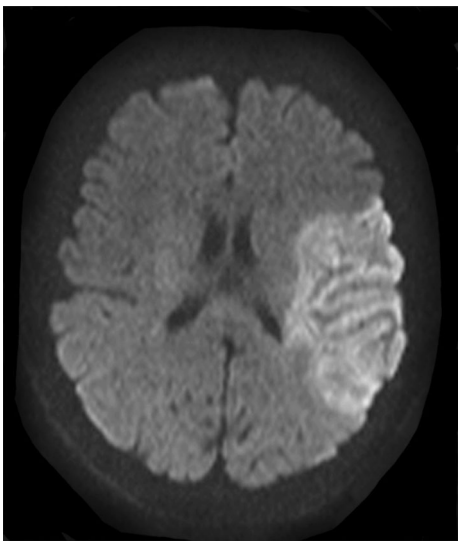

Fig. 1 Magnetic resonance imaging with restricted diffusion representing acute ischemic infarction along dominant language hemisphere

Linguistic testing and therapy was conducted targeting morphosyntactic constructions, phonological paraphasia, and semantic paraphasia.

The syntactic data are presented according to the following paradigm:

Line 1: Patient's output.
Line 2: Morphosyntactic features.
Line 3: Idiomatic translation of patient's output.

As for Arabic letters, its transliteration is presented in Tables 1 and 2.

Morphosyntactic structures

a. Line[1] Bossi addressing a male person.

   Line[2] Look + fem. 2nd pers. Pro.

   Line[3] Look.
b. Line[1] Ana elna Dðar mesh ħelwa.
   Line[2] I the eyesight not good + fem. Sing.
   Line[3] I have poor eyesight.
c. Line[1] ʔolek addressing a male person.
   Line[2] I present aspect + tell you + fem 2nd pers. Pro.
   Line[3] I will tell you.
d. Line[1] Enti ʕaref addressing a male person.
   Line[2] You + fem 2nd pers. Pro. Know + mas pers.
   Line[3] You know.
e. Line[1] EnaharDa ana ʃo ɣl awy ba ʕdein ru: ħ hena.

Table 1 Arabic transliteration alphabet

Arabic script	IPA symbol
أ - ء	ʔ
ب	b
ت	t
ث	ɵ
ج	ʒ
ح	ħ
خ	x
د	d
ذ	ð
ر	r
ز	z
س	s
ش	ʃ
ش	tʃ
ص	S
ض	D
ط	T
ظ	D ð
ع	ʕ
غ	ɣ
ف	f
ق	q
ك	k
ج	g
ل	l
م	m
ن	n
ه	h
و	w
ى	j

Table 2 Phonetic description of distinctive Arabic sounds

Symbol	Phonetic description	Arabic script
ħ	Voiceless uvular fricative	ح
x	Voiceless pharyngeal fricative	خ
S	Voiceless alveolar fricative emphatic	ص
D	Voiced dental fricative emphatic	ض
T	Voiceless dental stop emphatic	ط
D ð	Voiced interdental fricative emphatic	ظ
ʕ	Voiced pharyngeal fricative emphatic	ع
ɣ	Voiced velar fricative	غ
q	Voiceless uvular stop emphatic	ق

Line[2] Today I work + n. Very then go + mas sing here.
Line[3] I had a lot of work today then I came here.

f. Line[1] Ana xala S etnein sana we morte xalas.
Line[2] I just 2 year and dead (fr.) + fem. Finally.
Line[3] I will be dead in 2 years.
g. Line[1] El scene dah … rock kebeera left, right dah rock bas gr…green.
Line[2] the scene this + mas sing … rock big + fem sing left, right this + mas sing. Rock green.
Line[3] In this scene, there is a big rock on the left and a green one on the right.

Phonological paraphasia

The following data are taken from the patient's repetition task where she has this ability damaged in an obvious way. However, she resorted to code switching in some words in order to avoid phonological mistakes which corroborates with the fact that conduction aphasics are aware of their linguistic mistakes. The phonological data are presented in the following paradigm:

Line[1] Patient's actual speech.
Line[2] Phonological features.
Line[3] Translation.

Phoneme omission/deletion + insertion

a. Mokken instead of /momken/

/m/ deletion, /k/ insertion

Please
b. ħere ʔ instead of /ħarra ʔ/
/a/ deletion, /e/ insertion
Spicy
c. /ħadi: qah/ instead of /el ħadi: qah/
Definite article /el/ deletion
The garden
d. /ħeda ʔ/ instead of /eħtijag/
Initial /e/ deletion, /t/ deletion changed to /d/, /j/ deletion, final sound /g/ deletion, /ʔ/
Need
e. /Saleħ/ instead of /Saleħah/
/ah/ deletion which is a fem. feature.
A good female person
f. /ʃaħat/ instead of /ʃaħatah/
/ah/ deletion which is a fem. feature.
A female beggar

Phoneme substitution

a. /Elmawgu:d/ instead of /elmawDu: ʕ/

/g/ deletion, /D/ insertion /d/ deletion, /ʕ/ insertion

The topic

b. Sams instead of /ʃams/
/s/ substituted by /ʃ/
Sun
c. /Nu: x/ instead of /nu: ħ/ But she self-corrected it
/x/ substituted by /ħ/
Noah
d. /nu:r/ instead of /ro ħ/ But she self-corrected it
/u:/ substituted by /o/
Soul

Morpheme substitution

In this section the patient resorts to code switching in order to produce the easiest word from an articulation point of view.

a. Wall instead of /ħe Tah/
b. Test instead of /emteħan/
c. Laugh instead of /yedħak/
d. Apple instead of /tofaħah/
e. Fear instead of /xof/
f. Car instead of /ʕarabejah/

Semantic paraphasia

Avoiding negation element

a. / ħelw awy/ instead of /mafehu: ʃ mo ʃkelah/

(Very good) instead of (no problem at all)

Alright/okay
b. /ana ʕajza ʕarabi: / instead of /ana mesh ʕajza ʕarabi:
/I want + fem 1st Pro Arabic instead of I not want + fem 1st Pro Arabic
I do not want to speak in Arabic.

Morphosyntactic structures

a. Line[1] Ana xala s^{ʕ} etnein sana we morte xalas

Line[2] I just 2 year and dead (fr.) + fem. Finally

Line[3] I will be dead in 2 years.

Irrelevant speech

Answering a question about getting tan at the sea, the patient replied by telling a story about her glasses that fell into the sea.

Discussion

Along the current case report a multilingual female who suffered from post-stroke aphasia later on she recovered from global to conduction fluent aphasia within 6 months. It is hypothesized that being multilingual may have aided recovery like the cognitive reserve concept that guards against dementia. Linguistic analysis are conducted by the investigation of grammaticality of the morphosyntactic structures, and by the investigation of phonological production as well as investigating the semantic context. The data are analyzed according to the application of Chomsky's principles and parameters of universal grammar [7–9]; as well as the generative phonology [7–10] and semantic analysis in order to investigate all the linguistic levels in the given context and the processing of syntactic structures of the aphasic's verbal production [11].

The case presented in the current paper as previously mentioned is multilingual. Multilingualism has a great positive effect on the human brain. Before suffering from stroke, the patient spoke three languages fluently; namely, Arabic, French and English. She maintained some linguistic features of each language. Therefore, the patient was able to overcome her communicative problems through spontaneously using code switching from one language to the other; aiming at conveying all her ideas and thoughts 'gist' [12, 13].

Unique as it may seem; however, it is not the only case to be detected. Dr. T is a 77-year-old right-handed female who speaks Cantonese L1, English L2, and Mandarin L3. She showed an involuntary and uncontrolled code switching. Results of post-stroke testing showed normal cognitive ability [14].

EC is a 49-year-old right-handed male who speaks Hebrew as his L1, English L2, and French L3 with chronic mild non-fluent aphasia. The patient had a cross-linguistic recovery in his morphosyntactic verbal production; although treatment was conducted in his second language (English) [15].

The current case verbal production showed a feature of a foreign accent syndrome though she is Egyptian. Her multilingual abilities helped her recovery with overcoming on her phonological paraphasia by choosing an alternative verbal production from any of the languages she speaks, therefore her linguistic brain abilities developed after the stroke.

Linguistic analysis revealed that the patient resorts to her second language L_2; namely French or her third language L_3 namely English if she finds it difficult to utter the Arabic word. She has always preferred to answer the Arabic questions in English or in French.

When the patient was asked a question requiring an answer to be in numbers, she started by counting from 1

then go on until she reached the number in target, then she uttered it in French or English. When she was asked to read numbers, the same case applies. When she saw four-digit numbers or more, she tries to avoid reading.

As for reading texts, the patient ignores reading function words, though not always. When asked if she understood what she read, she said yes but she could not explain. The tests were meant to be conducted with the usage of Arabic language, Egyptian dialect; however, the linguist, tested the patient in English and in French. The patient showed interest in reading English and French tests; however, she did not understand the texts either and same observations were detected.

In this case report, it is assumed that aphasics maintain the instinct faculty of language because they simply have human brains, the nature of their brains allow the aphasics to try to re-communicate. According to Steven Pinker, "language is not a cultural artifact that we learn the same way we learn to tell time, or tie our shoe. Instead it is a distinct piece of the biological makeup of our brains. Cognitive Scientists have described language as 'psychological faculty', a 'mental organ', a 'neural system' and a 'computational module' [12, 13].

The patient showed a very good but gradual response to treatment. The case was somehow similar to a child learning a language. As no one can predict what words would spontaneously be uttered in a given situation, because human are not prepared with a list of sentences or phrases; therefore, a language cannot be considered as a mere mental lexicon inventory. The brain must contain a 'recipe' or a 'program' that can build an unlimited set of sentences out of a finite list of words. 'This program is the mental grammar not the pedagogical one'. The case with children is that they develop these complex grammars rapidly and without formal instruction to produce novel sentences proving that language is innate and that their brains must be equipped with a 'Universal Grammar', that may be in the form of a bodily organ. Parallel to this, the patient in our case was able to restore her language again; most probably because of the hypothetical grammar organ [7, 9].

An aphasic can use his mouth to eat, to drink and to blow candles, can use his teeth and tongue to chew and swallow food but not to articulate language. This indicates that the neurological link between the mouth and the brain is only impaired in the language organ [7, 9].

The patient shows similar aspects of phonological mistakes as well as syntactic ones in all three languages. She also has an obvious problem in understanding the meanings of long and short sentences when reading them.

The patient cannot always express the ideas in her mind, but the ideas seem to be there somewhere in her brain. She seems to know the 'gist' of what she wants to say, despite the fact that she seems not to know the 'gist' of what she reads. For a normal person the surrounding environment forces the speaker to create a bunch of words reflecting the variety of things that the speaker sees or feels (perception). The case is different with aphasics, they seem to know but it is difficult to express. The patient keeps saying /mish keda ya3ny/ /mish awy ya3ny/ When she feels that words are trapped in her brain, she asks the one she speaks with to say them on behalf of her. She keeps trying to deliver them by mimic. Albert Einstein sums it up, before the words are connected to any logical construction they seem to be clear images.

The patient seems to our surprise is maintaining the parameter setting of the three languages, though seemingly lost a big part of the Arabic one. Arabic is her mother language and at the same time one of the scrambling languages because of the case markers /enta/ …. /enty/. Experimental studies of baby cognition showed that infants have the concepts of an object before they learn any words for any objects. It could be concluded that an aphasic in a progress stage of treatment restores these concepts. According to Chomsky, the unordered super rules (principles) are universal and innate. Children are born with these principles and they only have to know the parameter value; head-first, and head-last [7–9].

Conclusion

Multilingualism may have a role in post-stroke aphasia recovery.

Abbreviations

NIHSS: National Institute of Health Stroke Scale.; WAB-R: Western Aphasia Battery Revised.

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IJ, TR: conceptualization, formal analysis and investigation, writing—original draft preparation, writing and editing. WW, RM: conceptualization, supervision. All authors read and approved the manuscript.

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Availability of data and materials

The corresponding author takes full responsibility for the data, has full access to all of the data, and has the right to publish any and all data separate and apart from any sponsor.

Declarations

Ethics approval and consent to participate

All procedures performed in the study were in accordance with the ethical standards of the Faculty of Medicine, Ain Shams University Research and Ethical Committee, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The study was approved by Ain Shams University—Faculty of medicine ethical committee in 8 September 2021.

Consent for publication
Written informed consent was obtained from participant for publication of this case report and accompanying images.

Competing interests
The authors declare that they have no competing interests.

Author details
[1]Azhar University, Cairo, Egypt. [2]Women College, Ain Shams University, Cairo, Egypt. [3]English Department, Faculty of Women, Ain Shams University, Cairo, Egypt. [4]Neurology Department, Faculty of Medicine, Ain Shams University, 38 Abbasia, PO 11591, Cairo, Egypt.

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