POST-STROKE APHASIA RECOVERY: ACTUAL UNDERSTANDING, FUTURE PERSPECTIVES

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ABSTRACT

Post-stroke aphasia is a frequent encounter, with 20 – 30% of ischemic stroke patients affected; despite classical recovery attempts, 10 – 15% of these will still have a severe form of aphasia at 6 months. Its presence greatly impedes both motor recovery and post-stroke quality of life. With stroke as one of the leading causes of disability worldwide, improved understanding of spontaneous recovery mechanisms and adequate, tailored intervention could represent important ways of limiting personal, social and economic costs in such patients.

Key words: stroke, aphasia, recovery

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The main determinant of the presence and magnitude of a post-stroke aphasia is the lesional neuroanatomical site. Classical clinical correlates of main cerebral arteries occlusion are presented in Table 1. Aphasia could also derive from lesions situated in "non-classical" locations, but as a general rule the classical ones results in greater severity on clinical scores. This clinical dependence allows us to use initial brain MRI not only as a diagnostic tool but also as a mean of prognosing recovery. The core of a patient's potential of recovery lies in the unaffected elements of a functional neural network, endorsed by the adaptive plasticity of its brain (1).

TABLE 1. *Clinical correlates of brain arteries occlusion*

OCCLUDED ARTERY	APHASIA TYPE
Dominant MCA superior division	Broca aphasia
Dominant MCA inferior division	Wernicke aphasia
Dominant MCA total	Global aphasia
Dominant ACA	Transcortical aphasia
Basal ganglia arteries	Capsulo-striatal aphasia

The already classical work of Pedersen and coworkers (2) of Copenhagen Aphasia Study showed that clinical post-stroke aphasia types evolves over time; the pattern of chronic aphasia differs from the acute one in a given patient. Adapting the recovery approach according to aphasia stage is mandatory. Using relatively easy-to-use tools as Western Aphasia Battery (WAB) and Scandinavian Stroke Scale, they identified the main predictors of outcome as being the initial severity of aphasia and the initial severity of stroke; recovery does not depend of age, sex or aphasia type.

Lazar and colleagues gave a new, quantified perspective of the matter in a recently published study (3): the main predictor of aphasia recovery at 3 months post onset is the degree of initial severity, appreciated by WAB. They considered the maximal recovery potential as the difference between maximal possible WAB score for a given patient and WAB at onset: max recov WAB = max WAB – onset WAB. The effective recovery is a percentage of these maximal recovery potential, a Δ WAB: WAB at 3 months – WAB at onset. For medium intensity aphasia (after exclusion of very mild and very

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severe forms), the effective recovery represents approximately 70% of the maximal recovery potential, if the patient receives at least one form of dedicated therapy.

TABLE 2. *Algorithm for evaluating neurological recovery at 3 months*

RECOVERY POTENTIAL
Max recovery potential = max WAB – onset WAB
Effective recovery = ΔWAB = 3 months WAB – onset WAB
ΔWAB at 3 months ≈ 70% Max recovery potential

Other studies have shown recovery percentage at 3 months being similar (approx. 70%) for motor deficits also (4); this brings up an interesting hypothesis of similitude between recovery mechanisms of deficits concerning different functional domains. Adressing a common basis for recovery of different types of deficit would represent an important therapy goal.

Aphasia approach changed itself over time: the neuropsychological perspective is in our days overwhelmed by insights from physiological methods, mainly functional imagery. The main gain obtained with this type of studies was recognition of adult brain's ability of reorganization after a morphological and functional impairment. The adaptative or maladaptative character of this reorganization, the involved cerebral areas and their potential multivalent roles were subjects of endless scientific debate. Technical difficulties in isolating activities in single cerebral areas or grouping them into coherent functional arrays contributed to confuse the subject.

Functional recovery is dependent of cortical structural integrity. Which cortical areas, activated, are promoting language recovery? The answer proves itself to have many nuances. A very recent study by Fridriksson and coworkers (5) considered anomia (a constant, easy to quantify presence in almost every aphasia type) as main parameter; it was found that anomia improvement correlated with increased activation of anterior and posterior left (dominant) hemisphere. On the basis of a paradoxical effect, existence of an "unfavorable-for-recovery" left frontal area could also be assumptioned: large left hemisphere lesions with greater destruction of frontal lobe can paradoxically have a greater improvement of aphasia over time, comparing with incomplete/smaller frontal lesions.

Persistent anomia despite treatment was a consequence of lesions in areas concerned with lexical recovery and phonological processing (37, 39 Brodmann – left posterior medium temporal lobe and temporo-occipital region). Identifying such lesions by initial MRI proved to have a negative predictive value for recovery (5).

Aphasia recovery is underlined by mechanisms located in both cerebral hemispheres. Mechanisms inside the same hemisphere govern recovery from small left sided lesions, in an adaptive fashion (6). As a result of decreased transcallosal inhibition, larger lesions recruit homologous contralateral structures (right hemisphere), whose activation is more or less beneficial, depending on many factors. An activating technique as rTMS can be combined with functional data from cerebral PET studies in order to evaluate the aphasia contribution of left and right inferior frontal gyrus (7). rTMS resulted in increased reaction time latency or error rate in the semantic task in 5 patients with right IFG activation, indicating essential language function. In a verbal fluency task, these patients had a lower performance than patients with effects of rTMS only over the left IFG, suggesting a less effective compensatory potential of right sided network areas (7).

After defining the areas of clinical benefit, the practical method of transcranial direct electrical stimulation is a relatively simple task. This is accomplished using an anodic electrode applied over the scalp, in the identified functional region of morphologically intact cortex (8). For the same dominant hemisphere, language parameters are improved in a degree dependent of the geographical closeness between lesion and stimulation area. The effects of the technique have the advantage of good time persistence, beyond the stimulation period. By extrapolation, this method can be used in promoting recovery of other types of neurological deficits.

Transcranial magnetic stimulation (TMS) of contralateral (non-dominant) cerebral hemisphere inhibates cortical activity with different effects: inhibition of pars triangularis improves naming and reduces verbal latency, while the same method gives opposite effects when applied on right-sided pars opercularis (9). From a therapeutical approach, such differences allow an individualized TMS treatment, proven that brain areas are correctly identified, both morphologically and functionally.

These data will be probably largely reviewed when studies feasible now in animals will be translated into humans. Axonal remodeling can be imaged by a new technique developed from DTI MRI (q-space diffusion tensor imaging); this allows further understanding of mechanisms that already govern white matter reorganization from the early stages of stroke (10). The revolutionary technique

of high resolution 2-photon technique imaging visualizes in vivo the cortical structures, going well deep until the dendritic level; animal cortical plasticity can be evaluated profoundly and repeatedly over time (11).

The new paradigm brought up by revolutionary imagery acquisitions is shortly followed by newly identified targets of treatment: blockers of axonal growth inhibition, blockers of astrocyte or extracellular matrix growth inhibition, RhoA pathway inhibition, axonal growth stimulators and cognitive enhancers (12). Future studies will define the real clinical benefit of each of them. Their design could benefit from the "70% recovery" paradigm: in order to be considered effective, at 3 months from onset every tested medication should determine a clinical improvement sensibly beyond 70% of the maximal recovery potential.

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