Recent insights into neurogenic stuttering following stroke

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Overview

• Introduction
• Incidence/prevalence
• Comorbidity with other acquired speech-language disorders
• Lesion localization
• Summary
Neurogenic Stuttering (NS):

- Acquired speech disorder
- Stuttering dysfluencies
  - repetitions of sounds, syllables or monosyllabic words
  - prolongations
  - blocks
- Following neurological disease
  - stroke
  - traumatic brain injury
  - neurodegenerative disease
  - other etiologies (encephalitis, epilepsy, …)

Introduction

Shortage of systematic prospective research on large group of patients following a specific etiology

- **Incidence/prevalence?**
  rare disorder ⇔ not uncommon for SLP’s in medical settings to work with patients with NS

- **Stuttering characteristics?**
  secondary characteristics, adaptation effect, consistency over various speech tasks…

- **Comorbidity & differential diagnosis?**
  other speech-language disorders

- **Lesion localization?**
  associated with lesions in the 4 lobes in both hemispheres

Incidence/prevalence

• 319 patients screened at stroke unit
• Follow-up screenings at 1 month, 3 months & 1 year
• 33 referred for further testing
  • neurogenic stuttering
  • aphasia
  • apraxia of speech
  • dysarthria
  • cognitive problems
  • hearing problems
• Tests: acute phase, 6 months & 1 year
Incidence/prevalence

Incidence

- 17/319 patients met criteria for neurogenic stuttering
  - 5.3% incidence

Prevalence

- long-term follow-up possible for 14/17 patients
- 6 recovered
- 8/319 patients persistent neurogenic stuttering
  - at least 2.5% prevalence

→ NS following stroke is not rare
→ Spontaneous recovery in half of the patients
Incidence/prevalence

Characteristics 17 patients with NS

- Ischemic stroke
- 51-87 years, med. 72 years
- 10 males, 7 females
- Persistent NS in 6/10 males and 2/7 females
- Stuttering frequency
  - conversation: mean 6.0%SS (0.6-19.4 %SS) **
  - monologue: mean 4.1%SS (1.0-10.9 %SS)
  - reading: mean 2.6% SS (0.0-10.3 %SS)

NS not consistent over different speech tasks
Comorbidity

15/17 patients comorbid speech-language disorders
- 11 aphasia (10 specific word finding problems)
- 9 dysarthria
- 5 cognitive problems
- 2 apraxia of speech

- high comorbidity NS & aphasia
- low comorbidity NS & AOS

- higher stuttering frequency with comorbid aphasia or AOS
- more comorbid disorders can lead to higher frequency of stuttering
- number of comorbid disorders does not predict recovery of NS
Lesion localization

- 37 stroke patients: 20 NS ↔ 17 no NS
- Only significant difference = stuttering frequency
- No differences in age, co-occurring disorders, …
- MRI or CT scan
- Lesion analysis with voxel-based Bayesian lesion symptom mapping (vBLSM)

\[ d(\delta) = Pr((\eta_A - \eta_B) \geq \delta) \]

with \( \delta = 0 \) and \( d(0) \geq 0.95 \)

Chen & Herskovits, 2010
Lesion localization

- **red-black**: probability map with $d(0) \geq 0.90$
- **pink**: striatum
- **blue**: inferior frontal gyrus
- **green**: superior temporal gyrus
- **yellow**: superior longitudinal fasciculus
Lesion localization

- NS following stroke is not associated with one specific brain area

- 9 identified areas largely overlap with cortico-basal ganglia-cortical network consisting of inferior frontal cortex, superior temporal cortex, intraparietal cortex, basal ganglia, superior longitudinal fasciculus and internal capsule

- NS probably has its onset following a disintegration of neural processes necessary for speech production, such as articulatory planning, perceptual processing and internal timing
Lesion localization

• Consistent with most of the case studies of NS following stroke

• Many of the areas associated with NS have also been implicated in developmental stuttering
  – similar neural characteristics?

• Interindividual differences in localization may be associated with the occurrence of co-occurring disorders?

De Nil et al, 2009;
Neumann & Euler, 2010
Summary

- Stroke is the most common etiology of NS
- Because of inconsistencies concerning secondary stuttering characteristics and emotions and attitudes: 3% SLD
- Incidence of NS following stroke is 5.3%
- NS persists in half of the patients
- NS frequently co-occurs with other speech-language disorders following stroke
Summary

dysfunction in network consisting of inferior frontal cortex, superior temporal cortex, intraparietal cortex, basal ganglia & their interconnections

disintegration of neural functions necessary for speech production

neurogenic stuttering dysfluencies following stroke
Thank you for your attention!

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Further reading

- Theys et al (submitted). The cortico-basal ganglia-cortical loop is crucial for neurogenic stuttering following stroke: evidence from voxel based lesion symptom mapping.