Hemispheric Dominance

The hemispheric dominance theory, or left brain versus right brain theory, proposes that each side (hemisphere) of the brain controls certain cognitive processes. The separation of functions between the sides of the brain is called lateralization or laterality.

Traditionally, the dominant hemisphere (usually left) cerebral hemisphere is regarded as the more important one, and everyday clinical decisions are influenced by this view.

Surgery on patients with lesions in the dominant hemisphere for language is best done with awake language mapping. Intraoperative MRI (iMRI) has also been proposed as an ideal method for tumor resection control in patients with primary brain tumors.

The lack of a substantial number of recent, robust follow-up studies investigating the QoL in patients at different stages of disease and treatment indicates that more research is needed. Relevance to clinical practice. Understanding the QoL in patients with brain neoplasm and the differences between right and left hemisphere sites of the neoplasm can help nurses develop different interventions and offer more guidance for effective clinical intervention [1)].

In an overall patient-reported QOL perspective, tumor laterality does not appear to be of significant importance for generic HRQOL in patients with intracranial tumors. This may imply that right-sided cerebral functions are underestimated by clinicians [2)].

Broca's area and Wernicke's area are linked by a white matter fiber tract, the arcuate fasciculus.

This axonal tract allows the neurons in the two areas to work together in creating vocal language. In more than 95% of right-handed men, and more than 90% of right-handed women, the left hemisphere is dominant in certain aspects of language and speech processing. In left-handed people, the incidence of left-hemisphere language dominance has been reported as 73% and 61%, suggesting left handed people tend to be less lateralized than right-handed people. In general, however, neuroimaging methods such as functional magnetic resonance imaging and magnetoencephalography show involvement of both hemispheres in many aspects of language processing, and the “dominance” of one hemisphere just refers to more brain activation relative to the other hemisphere (or better performance by that hemisphere on psycholinguistic tasks such as dichotic listening); it is not the case that language is “localized” in any one hemisphere.

Language mapping by navigated transcranial magnetic stimulation (TMS) is commonly applied over the left language-dominant hemisphere to indicate the language-related cortex. Detailed language mapping of Broca's region including stimulation targets in the immediate vicinity to the premotor cortex may raise concern about confounding unspecific motor effects. Sakreida et al. performed interhemispheric comparisons to delineate such possible unspecific effects from true TMS-induced language inhibition.

Fifteen healthy German speakers named object pictures during navigated TMS over a left- and right-

hemispheric target array covering the left inferior frontal junction area. Six mapping repetitions were conducted per hemisphere. Order of stimulation side was randomized between participants. Self-rating of discomfort was assessed after each stimulation; language errors and motor side effects were evaluated offline.

Naming errors were observed significantly more frequently during left- than right-hemispheric stimulation. The same pattern was found for the most frequent error category of performance errors. Hierarchical cluster analyses of normalized ratings of error severity revealed a clear focus of TMS susceptibility for language inhibition in object naming at the dorsoposterior target sites only in the left hemisphere. We found no statistical difference in discomfort ratings between both hemispheres and also no interhemispheric difference in motor side effects, but we observed significantly stronger muscle contractions of the eyes as compared with the mouth.

The results of (1) unspecific pre-/motor effects similarly induced in both hemispheres, and (2) a specific focus of TMS susceptibility in the language-dominant hemisphere render any substantial contribution of nonlanguage-specific effects in TMS language mapping of the inferior frontal junction area highly unlikely [3].

1)
Palese A, Lamanna F, Di Monte C, Calligaris S, Doretto M, Criveller M. Quality of life in patients with right- or left-sided brain tumours: literature review. J Clin Nurs. 2008 Jun;17(11):1403-10. doi: 10.1111/j.1365-2702.2007.02182.x. Review. PubMed PMID: 18482138.
2)
Drewes C, Sagberg LM, Jakola AS, Solheim O. Quality of life in patients with intracranial tumors: does tumor laterality matter? J Neurosurg. 2016 Dec;125(6):1400-1407. PubMed PMID: 27015402.
3)
Sakreida K, Blume-Schnitzler J, Frankemölle G, Drews V, Heim S, Willmes K, Clusmann H, Neuloh G. Hemispheric Dominance for Language and Side Effects in Mapping the Inferior Frontal Junction Area with Transcranial Magnetic Stimulation. J Neurol Surg A Cent Eur Neurosurg. 2020 Feb 11. doi: 10.1055/s-0040-1701236. [Epub ahead of print] PubMed PMID: 32045945.