TOWARDS QUANTITATIVE FUNCTIONAL BRAIN MAPPING:
THE SPATIAL ACCURACY OF ARTERIAL SPIN LABELLING

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BACKGROUND

• BOLD is widely used in research and clinic to map functional cortex. However, BOLD is an indirect measure of neuronal activity and its specificity can be biased by draining veins and especially in case of altered neurovascular coupling (i.e. in neuro-patients) [1].
• Arterial Spin Labelling (ASL) is an alternative non-invasive imaging technique that allows for a direct and quantitative measurement of the cerebral blood flow [2]. Although ASL may locate more directly and more precisely the neuronal activity, it is still only occasionally used in functional mapping.

AIM

• To validate the spatial specificity of ASL in functional modality (fASL) compared to BOLD in healthy subjects during the execution of tasks, before the application in the neurological population and application in the clinical routine.

METHODS

• 26 healthy subjects: [18-60] years old; 18 F.
• 1st session → MRt:
  o Structural T1 (4 echoes mprage)
  o Dual echo pseudocontinuous ASL (DE-pcASL) for simultaneous BOLD/ASL
    - Clenching hand task
    - Pneumatic stimulation of thumb
• 2nd session → neuronavigated TMS (Fig 1):
  o Stimulation of the motor area
    - Motor evoked potentials (MEP) measure (thumb and little finger)
    - Spatial assessment on the coordinates of the maximum of activation (MAX) and the center of gravity (CoG)
  o ASL versus BOLD
  o ASL/BOLD versus TMS

RESULTS

• In clenching hand task:
  o The Euclidean distance between fASL and BOLD ranged between 10.1 mm and 16.6 mm, as in literature [4].
  o In respect to BOLD, across subjects and along each brain direction (Fig 2), fASL localized significantly: i) more lateral (p<0.05); ii) more anterior (p<0.05); iii) more inferior (p<0.001)
• Similar results were observed at group-level under pneumatic stimulation (Fig 3).
• fASL resulted more adjacent than BOLD to TMS, with a significant shift (p<0.001) along the inferior-to-superior direction (Fig 4).

CONCLUSION

• Systematic shift between fASL and BOLD activation. • Better spatial specificity of fASL in respect to BOLD for targeting the regional neuronal excitability. • fASL might improve the special accuracy of presurgical localization of eloquent cortex.

References


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