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Intraoperative Laser Speckle Contrast Imaging to Assess Vessel Flow in Neurosurgery: A Pilot Study

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Abstract

BACKGROUND AND OBJECTIVES:

Laser speckle contrast imaging (LSCI) has emerged as a promising tool for assessment of vessel flow during neurosurgery. We aimed to investigate the feasibility of visualizing vessel flow in the macrocirculation with a new fully microscope-integrated LSCI system and assess the validity and objectivity of findings compared with fluorescence angiography (FA).

METHODS:

This is a single-center prospective observational study enrolling adult patients requiring microsurgical treatment for brain vascular pathologies or brain tumors. Three independent raters, blinded toward findings of FA, reviewed regions of interest (ROIs) placed in exposed vessels and target structures. The primary end point was the validity of LSCI for assessment of vessel flow as measured by the agreement with FA. The secondary end point was objectivity, measured as the inter-rater agreement of LSCI findings.

RESULTS:

During 18 surgical procedures, 23 observations using FA and LSCI were captured simultaneously. Using LSCI, vessel flow was assessable in 62 (86.1%) and not assessable in 10 (13.9%) ROIs. The agreement between LSCI and FA was 86.1%, with an agreement coefficient of 0.85 (95% CI: 0.75-0.94). Disagreement between LSCI and FA was observed in the 10 ROIs that were not assessable. The agreement between ROIs that were assessable using LSCI and FA was 100%. The inter-rater agreement of LSCI findings was 87.9%, with an agreement coefficient of 0.86 (95% CI: 0.79-0.94).

CONCLUSION:

Fully microscope-integrated LSCI is feasible and has a high potential for clinical utility. Because of its characteristics, LSCI can be viewed as a full-field visual micro-Doppler that can be used as a complementary method to FA for assessing vessel flow during neurosurgery. Despite technical limitations related to the early development phase of the fully microscope-integrated system, we demonstrated reasonable validity and objectivity of findings compared with FA. Further research and refinement of the system may enhance its value in neurosurgical applications.

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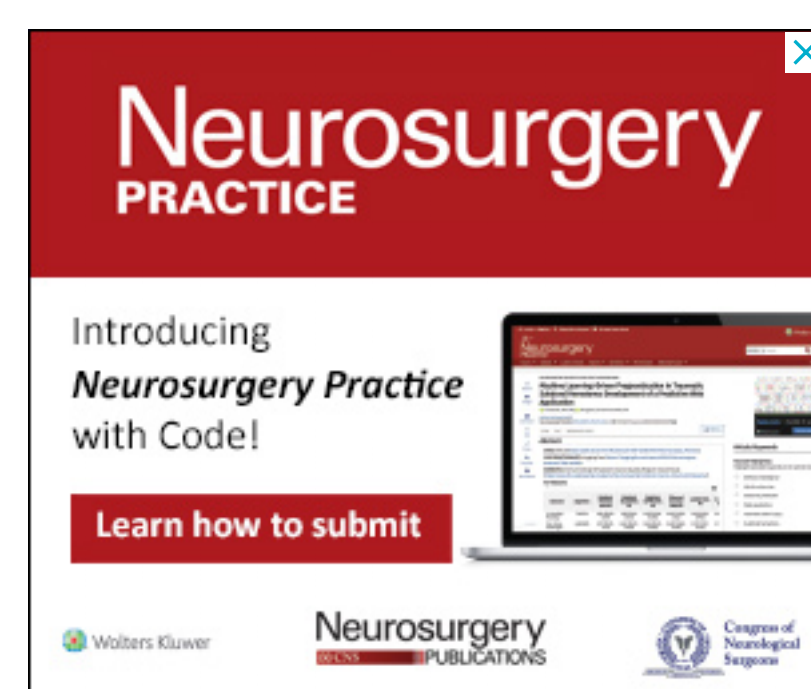
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