Intraarterial and Intravenous Videoangiography with ICG and Fluorescein: A Quantitative Comparative Investigation of Fluorescence Videoangiography Methods with Clinical Implications

Evgenii Belykh
Xiaochun Zhao
Michael T Lawton
Mark C Preul

The Loyal and Edith Davis Neurosurgical Research Laboratory
Department of Neurosurgery
Barrow Neurological Institute
St. Joseph’s Hospital and Medical Center
Phoenix, Arizona
Department of Neurosurgery, Irkutsk State Medical University
Irkutsk, Russia
Disclosure

• **DISCLOSURES:** None

• **FINANCIAL SUPPORT:** This study was supported by funds from the Newsome Chair in Neurosurgery Research held by Dr. Preul and from the Barrow Neurological Foundation.
Introduction

• Quantitative fluorescence videoangiography may provide valuable intraoperative information regarding dynamics of cerebral blood flow. The goal of this study was to quantitatively compare intraarterial (IA) and intravenous (IV) fluorescein videoangiographies of brain vasculature in a large animal model with a wide field operating microscope and confocal laser endomicroscope (CLE).
Methods

• Repeated intravenous and intracarotid injections of fluorescein sodium with dose escalation were visualized in swine brain (n=5). Escalating doses were 2, 5, 10 mg/kg for IV and 0.005, 0.05, 0.1% in 5 mL for IA fluorescein. IV ICG videangiographies (0.2, 0.5, 1 mg/kg) were used as controls. Fluorescence videoangiographies of exposed cerebral hemispheres were recorded in appropriate modes with the operating microscope and CLE. We assessed duration of intravascular fluorescence, maximum intensity, time-to-peak, delay, rise time, mean transient time and slope parameters in cortical arteries and veins. Microvascular flow alterations were visualized with CLE.
Results:

- IA injection required significantly lower fluorescein dose to achieve results similar to IV injection;
- Quantitative parameters were significantly shorter with IA injection (all P<.05).
- Time-to-peak, delay, rise time, mean transient time were not significantly different between IV fluorescein and ICG.
- 10 mg/kg fluorescein resulted in prolonged staining vessel wall and surrounding normal brain.
- Flow alterations were equally visualized with ICG and IA/IV fluorescein. CLE blood flow microimaging was possible beyond the timespan of visible macro fluorescence (>40 min).
Summary points

• Videoangiography with IA fluorescein results in significantly faster restoration of the intravascular fluorescence to the baseline compared to the IV injection allowing for repetitive angiographies with less contrast dose.

• Sensitivity of flow detection was similar among IA/IV fluorescein and IV ICG.

• Angiography with fluorescein produced higher resolution imaging compared with ICG.

• Confocal laser endomicroscopy blood flow microimaging allows for significantly longer flow imaging even after a small dose fluorescein. These findings may allow for significant improvement for microvascular surgical imaging in vivo.