

Video Article

Microsurgical Clip Obliteration of Middle Cerebral Aneurysm Using Intraoperative Flow Assessment

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Abstract

Cerebral aneurysms are abnormal widening or ballooning of a localized segment of an intracranial blood vessel. Surgical clipping is an important treatment for aneurysms which attempts to exclude blood from flowing into the aneurysmal segment of the vessel while preserving blood flow in a normal fashion. Improper clip placement may result in residual aneurysm with the potential for subsequent aneurysm rupture or partial or full occlusion of distal arteries resulting in cerebral infarction. Here we describe the use of an ultrasonic flow probe to provide quantitative evaluation of arterial flow before and after microsurgical clip placement at the base of a middle cerebral artery aneurysm. This information helps ensure adequate aneurysm reconstruction with preservation of normal distal blood flow.

Video Link

The video component of this article can be found at <https://www.jove.com/video/1294/>

Protocol

Cerebral aneurysms are abnormal widening or ballooning of a localized segment of an intracranial blood vessel. These lesions typically occur at branch points of the parent vessel as a result of progressive weakening of the arterial wall. Cerebral aneurysms are most commonly detected after the aneurysm ruptures causing subarachnoid hemorrhage. This form of intracranial hemorrhage carries a 45% risk of mortality within the first month after rupture and survivors often experience severe permanent neurologic injury¹. Recently, due to the increased use of advanced imaging modalities such as MRI and CT scan, cerebral aneurysms are frequently identified prior to rupture and options for the treatment of cerebral aneurysms include surgical clipping and coil embolization. In this video report, we describe the microsurgical clipping of a middle cerebral artery aneurysm utilizing an ultrasonic perivascular probe for blood vessel flow assessment.

The goal of surgical clipping of a cerebral aneurysm is to definitively remove the aneurysm from the circulation while preserving blood flow through the parent and distal arteries. Typically, the operating microscope is used to provide improved visualization of the aneurysm and enable successful dissection of the aneurysm and placement of a titanium clip at its base. Improper clip placement may result in residual aneurysm or partial or full occlusion of distal arteries, potentially causing cerebral infarction. Several studies using intraoperative angiography during aneurysm surgery have demonstrated the inadequacy of direct visual inspection at predicting the maintenance of adequate blood flow in the parent and distal arteries^{2,3}. Despite its utility, intraoperative angiography carries the risk of arterial injury or stroke and its widespread availability is limited⁴. In this report, we describe the use of an ultrasonic flow probe to provide quantitative intraoperative assessment of blood flow following the surgical clipping of an aneurysm.

The Transonic flow probe uses transit-time technology to measure blood flow. The probe uses two transducers to alternatively transmit and receive ultrasonic signal in both the upstream and downstream directions with respect to blood flow⁵. The flow-meter then measures the transit time for a wave of ultrasound to travel the fixed distance between the transducers. The difference between the upstream and downstream integrated transit times is a measure of blood flow. Quantitative flow measurements are performed in the parent and distal vessels prior to aneurysm clipping and then reassessed after the clip has been applied to ensure preservation of blood flow⁶⁻⁸. If blood flow is decreased, the clip may then be readjusted as necessary. As seen in this video, surgical obliteration a middle cerebral artery aneurysm is performed and quantitative assessment of blood flow using the ultrasonic probe enables confirmation of preserved flow through the distal arteries supplying the brain, thus enabling the avoidance of neurologic complication from improper surgical clip placement.

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