Opinion

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Indocyanine Green Videoangiography in Neurosurgical Procedures

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About the Study

ICG-VAG (Indocyanine Green Videoangiography) is a new technique for neurosurgery treatments. ICG-VAG revealed blood flow in the vessels as a hemodynamic shift in the intensity of ICG fluorescence. The preservation of blood flow in the parent and perforating arteries, as well as blockage of the aneurysm, were recognised after clipping cerebral aneurysms. The patency of blood flow from the transplant was checked during bypass surgery. The precise stenosis area or residual stenosis was observed before and after carotid endarterectomy. The feeding arteries, draining veins, and nidus were all plainly visible after the arteriovenous malformation was removed. Tumor-related arteries, normal brain parenchyma vasculature, bridging veins, and tumor margin infiltration were all seen during tumor surgery. These findings obtained using ICG-VAG was useful to achieve these surgeries safely and completely without complications associated with the use of ICG-VAG.

Indocyanine Green (ICG) is a dark green-blue-colored, water-soluble compound with a molecular weight of 774.96. In the body, ICG is carried to the liver in combination with lipoprotein in the blood, where it is absorbed into liver cells and discharged into the bile without being metabolized. ICG has been used to test the function of liver cells. Since ICG is a fluorescent material emitting fluorescence, it has been used for angiography of the retina and choroid in the field of ophthalmology. The advancement of ICG monitoring systems has led to its use in a variety of medical sectors. It has been used intraoperatively for cerebral angiography in neurosurgery, coronary angiography in heart surgery, neck angiography in neck surgery, and visualization of lymph nodes in cancer surgery. Despite the fact that traditional intraoperative angiography has some risks, such as embolic events, ICG-Videoangiography (ICG-VAG) can be performed quickly and easily with intravenous injection of ICG without leaving the operating room. This method may further develop and its use will be expanded. This method is used for neurosurgical procedures such as cerebrovascular surgeries and tumor surgeries.

ICG-VAG is used in the purpose of clipping cerebral aneurysm, the purpose of clipping the neck of a cerebral aneurysm is to occlude the aneurysm neck without stenosis or occlusion of the parent arteries and perforating arteries. After clipping surgery, in some cases a neck remnant and occlusion of parent arteries and/or perforating arteries in some other cases were observed. As a result, improving surgical technique and monitoring these findings throughout surgery may be important. Although cerebral angiography is the most exact test for this purpose, it takes time and has a number of side effects, including embolic occurrences. Recently, Doppler ultrasound imaging and endoscopy have been used for intraoperative monitoring, but it is difficult to detect a neck remnant and flow disturbances of fine arteries such as perforating arteries with Doppler ultrasound, and endoscopy has difficulties in that there is a blind area, and intravascular blood flow is hard to recognize. As a result, instead of cerebral angiography, ICG-VAG was determined to be a beneficial examination. ICG-VAG is superior to standard cerebral angiography for preserving perforating arteries in particular.

Individuals with hemodynamic atherosclerotic vascular lesions or moyamoya disease, as well as patients with big or complex cerebral aneurysms that require proximal artery blockage or trapping aneurysm, undergo Extracranial (EC)-Intracranial (IC) bypass surgery. The ability to assess graft patency intraoperatively is critical for successful EC-IC bypass surgery. The usefulness of ICG-VAG for flow evaluation in bypass surgery has been reported that this examination was useful for recognition of patency of anastomosis by comparing the findings of ICG-VAG with those of postoperative computed tomography angiography. ICG –VAG is performed for Carotid Endarterectomy (CEA), it is a safe and durable treatment that has been shown to prevent ipsilateral stroke. There should be no cerebral embolism throughout this surgery.

The feeding arteries, nidus, and draining veins must all be identified during surgery for Arteriovenous Malformations (AVMs). The difference in the timing of improvement of these structures provides information regarding vessel architecture and patency to ICG-VAG. The usefulness of ICG-VAG for removing Cavernous Malformations (CMs) has been reported that ICG-VAG could directly visualize cerebral CMs and orbital cavernous angiomas, and it demonstrated slow and low perfusion within the lesions.

Identification and full interruption of fistulae are critical in the surgical treatment of spinal AVF, however they are not usually visible during surgery. The detection of the fistulous location and confirmation of its obliteration during surgery are noted advantages of ICG-VAG for this surgery. The increased operating time and limited visibility to the working field, as well as the requirement to fully expose the fistula, have been cited as drawbacks. Intra-arterial ICG-VAG can help identify the exact location of a fistula by reducing the influence of normal arterial vasculature, which is enhanced by traditional peripheral venous ICG injection.

Conclusion

By understanding the characteristic features of flow dynamics, the intraoperative ICG-VAG provides useful information for microsurgical resection of cerebral CMs and examined the potential utility of ICG-VAG for the surgical treatment of intramedullary CMs By displaying intramedullary CMs as avascular regions, ICG-VAG offered useful information for detecting lesion boundaries. By visualising the venous structure in instances with venous anomalies, ICG-VAG contributed to the safe and full excision of the lesions. ICG-VAG indicated the characteristics of poor blood flow within cavernous malformations in extramedullary CMs.

Endoscopic ICG-VAG was applied in aneurysm clipping and pituitary adenoma surgery. Despite several disadvantages, such as the presence of blind areas and the difficulty of doing real quantitative blood flow analysis, ICG-VAG is a helpful intraoperative study due to its safety and ease.