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Short Communication

Usefulness of indocyanine green fluorescence angiography for the urgent decision of the level of limb amputation

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Dear Sir,

Major lower limb amputations are often performed by orthopedic surgeons and other surgeons in the clinical setting. In cases of chronic gangrene due to diabetes and/or arteriosclerosis obliterans, the amputation level is planned based on the preoperative angiography findings and the detection of necrosis on visual inspection. Amputation is performed above or below the knee. Fine adjustment of the amputation level is conducted intraoperatively upon checking the skin findings and evaluating for bleeding. This report shows the application of near-infrared (NIR) fluorescence imaging, using indocyanine green (ICG), to determine the amputation level in a patient with femoral artery occlusion. In the present case, the amputation level was difficult to determine based on visual examination and computed tomography angiography (CTA) findings.

The angiographic assessment of vascular blood flow does not always match that of soft tissues, such as the skin at the amputation stump.¹ This results in wound-healing disorders, which require additional surgical treatment. NIR-ICG imaging is a promising tool for visualizing regional tissue per-

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fusion.^{2,3} It has been used to measure retinal microcirculation since the 1970s and to confirm tissue perfusion in hepatic, cardiac, and plastic surgeries. However, it has been rarely applied in the orthopedic field.³

This is a case of an 80-year-old woman, who was successfully resuscitated from cardiac arrest caused by acute myocardial infarction. Percutaneous cardiopulmonary support was implanted postoperatively. After catheter removal, a pseudoaneurysm developed in the left femoral artery. The pseudoaneurysm was treated via an endovascular repair by embolization with thrombin (because surgical thrombectomy was not applicable). However, the endovascular treatment was complicated by complete occlusion of the left femoral artery.

Acute arterial occlusions of the extremities may result in severe and complex myoneuropathic metabolic syndrome, which leads to limb loss and death.⁴ In the present case, 48 h elapsed since femoral artery blood circulation disruption. Emergency amputation was performed because it was the preferred intervention for metabolic complications. Since there were no noted cutaneous findings, indicating gangrene, the amputation level was difficult to determine based on the CTA findings. ICG was used to determine the amputation site. The extent of subcutaneous blood flow was well-delineated (Figure), so the amputation level was easily determined. Two weeks postoperatively, the transection healed, and there was no noted necrosis. The treatment course was unremarkable.

This case showed three utility points for the application of NIR-ICG imaging in emergency extremity amputation. First, NIR-ICG imaging accurately assesses soft tissue blood flow. It assesses the peripheral small vessels proximal to the skin, rather than the large vessels.^{2,3} In this respect, ICG is superior to CTA. Second, NIR-ICG imaging is performed can be performed instantly at any location. It is easy to use and does not expose the patient to radiation.^{2,3} The tissue hemodynamics are evaluated repeatedly to confirm the planned amputation site, remove excessively tight sutures, and facilitate rapid surgery before necrosis development.

Thirdly, ICG is contraindicated for a few patients only, and it is safe for children and the elderly.⁵ Angiography cannot be used in patients with renal insufficiency, thyroid disease, asthma, or patients on diabetic medications. Both ICG and angiography are contraindicated for patients with a history of iodine hypersensitivity.

NIR-ICG is a useful imaging tool for accurately determining the amputation level, especially in patients with acute arterial occlusion.

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Ethical approval

Not required.

Declaration of Competing Interest

None.

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