



Indocyanine green imaging in abdominal surgery

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Fluorescence guided surgery (FGS) represents one of the recent advances in surgery. It allows the surgeon to identify unseen structures or show perfusion of relevant organs and thus adds another dimension to the surgeon's understanding of anatomy, physiology and pathology (1, 2). Fluorescence imaging is performed after injecting a fluorophore which emits fluorescence that can be detected with special cameras (1). The most commonly used fluorophore is indocyanine green (ICG). ICG binds to albumin in the blood and is secreted with bile (2). FGS is most commonly performed as fluorescence angiography, fluorescence cholangiography and fluorescence lymphography. The most common uses of ICG are presented below.

INTRAOPERATIVE FLUORESCENCE ANGIOGRAPHY

Anastomotic leakage is a serious complication, associated with significant morbidity and mortality (3). One possible cause of anastomotic leakage is insufficient vascular supply. Markers of sufficient perfusion include pink color of the bowel wall, visible peristalsis, palpable pulsations and bleeding from the marginal arteries (4). These signs are subjective and may be misinterpreted even by experienced surgeons (4). The use of intraoperative fluorescence angiography can clearly show the margins of perfu-

sed tissue and can help choose the optimal site for bowel division and creation of the anastomosis. Fluorescence angiography can be used in patients with ischemic bowel or after dividing vascular supply to organs to see the ischemic margins (3, 4).

INTRAOPERATIVE FLUORESCENCE LYMPHOGRAPHY

The identification and analysis of the sentinel lymph nodes can be crucial in organ preserving operations where local endoscopic procedures can be oncologically adequate only if the draining lymph nodes are not infiltrated. ICG guided lymphography can not only aid with better visualisation of oncologically relevant lymph nodes but with determining the route of lymph drainage can help guide the extent of bowel resection (1). For example, cancers of splenic flexure of the colon can drain into the lymph nodes of the middle colic artery or left colic artery. This can guide the extent of colonic resection and the extent of lymphadenectomy. ICG needs to be injected around the tumor hours before the procedure to perform fluorescence lymphography (5).

FLUORESCENCE GUIDED IDENTIFICATION OF CRITICAL STRUCTURES

ICG secretes in bile and may help guide identify biliary tract anatomy and reduce the chances of hepatic duct injury (1). ICG needs to be given hours before the procedure for fluorescence cholangiography (6). Less commonly ICG is used to coat ureteric splints and aid with identification of ureters (6).

CONCLUSIONS

IFA is a safe and practical method to assist the surgeon during the operation. It may aid in reducing surgical complications such as anastomotic leaks and biliary duct injuries. The method can help differentiate liver tumors and may improve visualisation of relevant lymph nodes. In the future, we can expect new fluorophores that bind to different tissues, tumors, engage in different metabolic pathways and thus help with visualisation in surgery.

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