Utilization of Near-infrared Indocyanine Green Angiography for Immediate and Delayed Venous Outflow Assessment in Breast Reconstruction: A Case Report

Sir:

CG angiography, a technique recently used to assess blood supply in free flaps, has been used in breast reconstruction to assist in evaluation of arterial perfusion and ischemic debridement. We present a technique to extend the use of this technology to assess venous outflow, the predominant form of flap failure, taking advantage of the 2 properties of ICG dye: its short 2- to 3-minute half-life and tight binding to plasma proteins which keeps it intravascular.

The patient was a 56-year-old woman who presented with a history of invasive ductal carcinoma of the right breast and subsequently underwent modified radical mastectomy and reconstruction with free flap. ICG angiography (SPY Intraoperative Imaging Systems; Novadaq Technologies Inc., Mississauga, ON, Canada) was used to assess both immediate and delayed venous outflow of the free flap before division from the external iliac vein and after re-anastomosis with the internal mammary vein. For immediate assessment, image acquisition occurred from the time of injection of the 2.5 mg/ml ICG dye solution until 5 minutes post injection with the artery and vein in clear view. For delayed assessment, the laser-assisted fluorescence imaging was used to analyze the flap fluorescence 25 minutes after injection of the dye.

Venous outflow of the skin flap imaged before division and after anastomosis of vessels revealed similar patterns in both immediate and delayed venous assessment. Evaluation of the free flap after elevation but before division from the external iliac vein using the delayed technique revealed that the deep venous system was sufficient to drain the entire flap. After anastomosis of vessels with the recipient site, imaging using the immediate technique revealed visualization of the arterial inflow followed by illumination of the tissue flap indicating arterial sufficiency.

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Fig. 1. Visualization of venous drainage including beyond the venous anastomosis. A, Immediately after injection of the dye the artery fluoresces. B, A few seconds later the flap fluoresces and the vein is illuminated.

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Areas of well-perfused tissue quickly began to fluoresce, whereas areas with poor perfusion remained dark. Finally, the venous vasculature began to fluoresce and flow beyond the venous anastomosis could be verified, [http://links.lww.com/PRSGO/A22](http://links.lww.com/PRSGO/A22). Intraoperative delayed assessment of the flap’s fluorescence pattern after inset demonstrated complete extrication of the dye, thereby indicating appropriate venous drainage (Fig. 2). Quantitative analysis revealed that numeric values were significantly lower than the values obtained immediately following injection (Fig. 2). Inspection of the reconstructed breast at 3 weeks postoperative showed a completely healthy skin paddle with well-healing scars.

In this report, we describe the first use of ICG angiography to address appropriate venous outflow in free-flap breast reconstruction. ICG angiography is useful in this setting because it binds rapidly to plasma proteins, confining the dye to the intravascular space and allowing visualization of flow through vessels. Additionally, the short, 2- to 3-minute half-life of the ICG dye allows for the assessment of venous drainage at various intraoperative stages. Initially after injection, sufficient vessel coupling and appropriate flow through the internal mammary vein can be visualized as the plasma proteins make their first pass through the tissue. By waiting 25 minutes, dye bound to circulating plasma is metabolized; thus, when the laser is used without reinjection of the dye,

![Video Available Online](image)

**Video 1.** See Video 1, Supplemental Digital Content 1, which displays the immediate assessment technique. Injection of indocyanine green dye followed by illumination of the arterial inflow and tissue flap indicating arterial sufficiency. Finally, the venous vasculature begins to fluoresce and flow beyond the venous anastomosis can be verified, [http://links.lww.com/PRSGO/A22](http://links.lww.com/PRSGO/A22).

![Fig. 2. Visualization of right reconstructed breast demonstrating appropriate perfusion (A) and quantitative analysis of fluorescence values (B). Visualization of right reconstructed breast 25 min later demonstrating complete venous outflow (C) and quantitative analysis of fluorescence values (D).](image)
the only fluorescing areas are those in which plasma is trapped and the bound dye is incapable of being metabolized.

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DISCLOSURE

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