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Near Infrared Fluorescence Imaging to Assess Breast Flap Perfusion and Prevention of Ischemia: Case Report

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Introduction: Breast skin flap ischemia and necrosis is a serious consequence of breast reconstruction with reported incidence of 10% to 15%. Current clinical method of assessing breast skin flap perfusion includes combination of skin color, temperature, dermal edge bleeding, and capillary refill. Given the high incidence of ischemia and the presence of certain cohort of patient with greater risk, there is a need for an objective method of assessing the skin flap perfusion. Near infrared fluorescence imaging using indocyanine green is a new technique of assessing skin flap perfusion. We present a first reported case where breast skin flap ischemia was objectively identified intraoperatively by NIRF imaging, and this ischemia was reversed through active intra- and postoperative measures, which was objectively again identified by NIRF imaging.

Case presentation: A 36-year-old female patient underwent bilateral nipple sparing mastectomies with immediate reconstruction using tissue expanders. Clinical assessment of the breast skin flap was equivocal. NIRF imaging using SPY imaging system (Novadaq Technologies Inc, Toronto, ON, Canada) showed poor perfusion in the periareolar region. As a result, it was decided to completely deflate the expander, actively warm the skin flap and encourage cutaneous perfusion through use of topical glycerin trinitrate patch. A repeat NIRF imaging 48 hours showed 10-fold increase in perfusion in the skin flap.

Conclusion: NIRF imaging is a useful tool in assessing breast skin perfusion and to predict potential ischemia, which can aid in surgeon's management of patient.

Key words: Breast cancer – Reconstructive surgery – Flap perfusion

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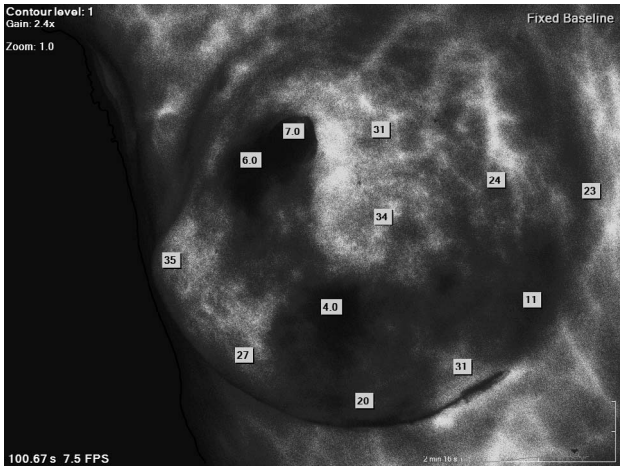

Fig. 1 NIRF using indocyanine green. The numeric values are an indicator of the perfusion of the tissue. Values less than 20 are associated with low perfusion.

Annually there are over 91,000 breast reconstructions performed worldwide. The success of the surgery is limited by its complications, including mastectomy skin flap necrosis, which occurs at a rate of 10% to 15% with estimates as high as 52% reported in some high risk patients.[1,2] Significant consequences can result from postoperative necrosis, including major morbidity, implant loss or revision procedures, postponement of further oncologic treatment, as well as poor aesthetic outcomes. Although mastectomy skin flap necrosis is a common complication after breast reconstruction, current methods for assessing the likelihood of necrosis rely almost exclusively on clinician judgment of various factors such as intraoperative skin color, dermal edge bleeding, skin temperature, and capillary refill time. However, as there are certain cohort of patients with high risk of breast skin flap ischemic complications (patients who are smokers, obese, hypertensive) there is a need to supplement clinical assessment with an objective method of assessing breast skin flap perfusion.[3] Additionally, if a patient undergoes immediate breast reconstruction with either prosthetic or autologous techniques, there is further added risk of flap ischemia and necrosis due to the tension on the flap. One objective method of assessing breast flap perfusion is by intraoperative near infra-red fluorescence imaging. Near-infrared fluorescence imaging (NIRF) is a novel technology that requires administration of a fluorescence-imaging agent (indocyanine green) that can be excited at near infrared wavelength of 760 nm. Upon illuminating tissue surfaces with penetrating near infra-red light to excite the indocyanine green within the tissue, the generated fluorescence is collected to form a 2-dimensional image demarking the tissue deposition of indocyanine green, and hence the perfusion of the tissue.[4] One study has noted that with the use of intraoperative NIRF, the complication rate from mastectomy and immediate breast reconstruction has decreased from 15.1% to 4%.[5] We present the first reported case where the breast skin flap ischemia was objectively identified by NIRF imaging, and this ischemia was reversed through active intra- and postoperative measures was objectively identified by NIRF imaging.

Case Presentation

A 36-year-old female with a strong family history of breast cancer presented with a screen-detected

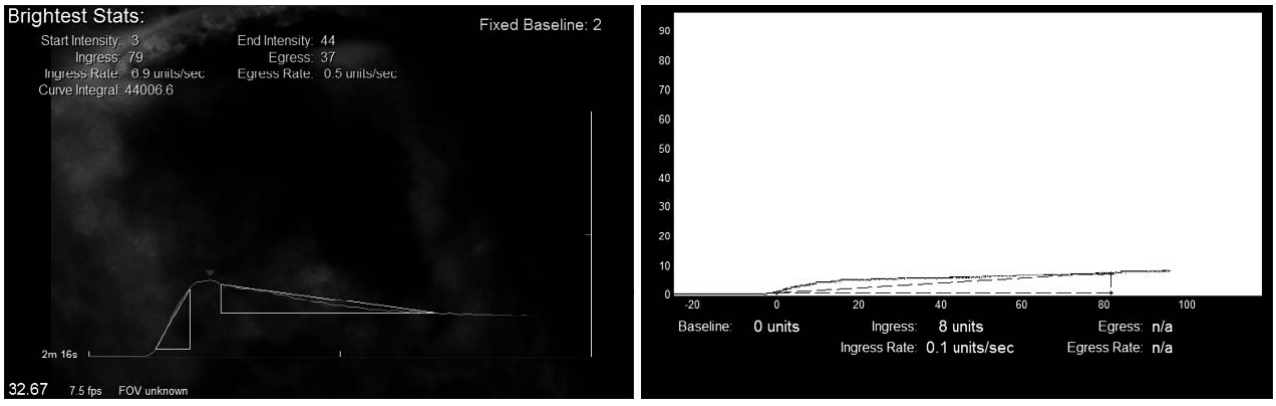

Fig. 2 NIRF using indocyanine green. This graph shows the low perfusion in the periareolar region at the time of the operation after the expander has been inserted.

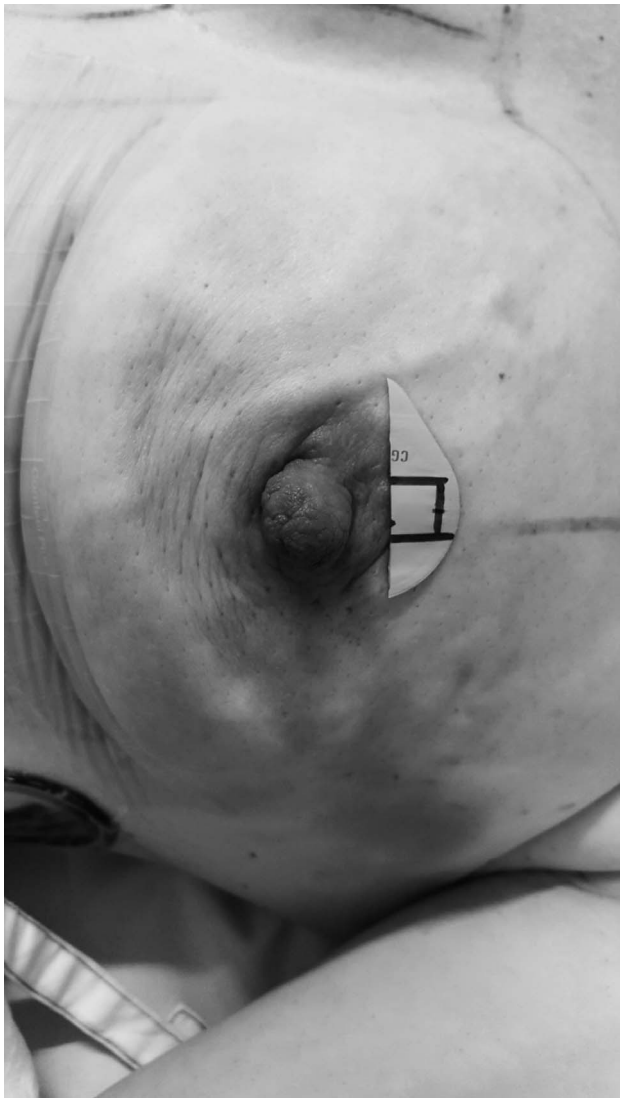

Fig. 3 Postoperative day 1 image showing topic glycerin trinitrate patches attached to areas of breast skin flap with low perfusion to facilitate increased blood flow.

right-sided cancer. She underwent bilateral nipple sparing mastectomies with immediate reconstruction using tissue expanders. On clinical assessment of the skin flap, the skin flap was cool, pink with capillary refill of less than 3 seconds. NIRF imaging using the SPY imaging system (Novadaq Technologies Inc, Toronto, ON, Canada) with indocyanine green showed poor perfusion in the peri-areolar region bilaterally (Figs. 1 and 2). Based on this finding, intraoperatively the expander was deflated and breast was warmed with warm-saline soaked sponges. Postoperatively, the breast was actively warmed with warm blankets and cutaneous vasodilatation was encouraged by use of topical glycerin trinitrate patches (Fig. 2). Glycerin trinitrate patches were removed when the patient developed headache. A repeat NIRF imaging performed 48 hours later showed 10-fold increase in skin flap perfusion (Fig. 4). Patient made successful recovery.

Conclusion

In this case, NIRF imaging was a useful tool in assessing breast skin perfusion and to predict potential ischemia. Through use of active intervention intra-operatively and postoperatively, we were able to demonstrate objectively improvement in perfusion using NIRF.

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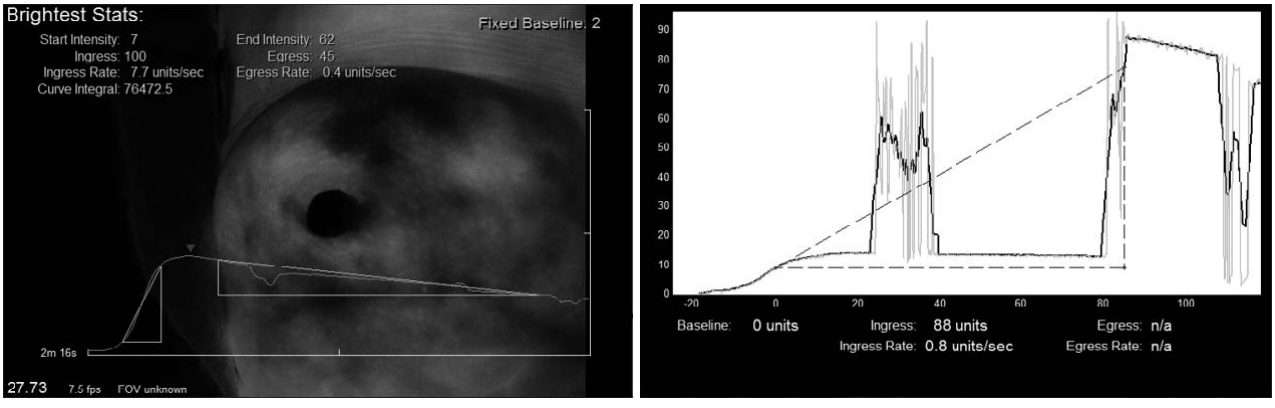

Fig. 4 NIRF using indocyanine green. This graph shows a 10-fold increase in blood flow in periareolar region 48 hours after the operation.

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