Chronic wounds are complex and often do not heal according to the phases of wound healing. When a chronic wound is large or fails to heal with assistance from a wound VAC, a tissue transfer may be considered. Perfusion is the top priority for a surgeon when assessing flap viability. Although clinical exams may provide some information, accurate assessment of blood flow is critical to determining the status of the flap. The SPY Elite laser angiographic system (Stryker Corp/Novadaq Technologies, Kalamazoo, Mich.) allows for the assessment of blood flow to a flap in real time. Chronic wounds are often inflamed; thus, determining adequate blood flow of a flap via a clinical exam may be limited. Indocyanine green is a safe tracer which remains in the circulatory system allowing for the accurate assessment of perfusion.1 The SPY system has been used for several different procedures.2–5 This report describes successful use of the SPY laser angiographic system to assess the perfusion of a tissue transfer flap for a chronic wound. To our knowledge, this is the first report describing the use of the SPY system for assistance with sternal wound closure.

Application of SPY Angiography in the Management of a Chronic Sternal Wound

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Summary: The SPY angiography system has several surgical uses. Often, surgeons may experience difficult cases in which the viability and perfusion of tissue is questioned. By using the SPY angiography system intraoperatively, this system may provide additional information allowing the surgeon to make calculated real-time decisions which may lead to improved patient outcomes. This study describes a case of a chronic sternal wound treated with reconstruction using intraoperative SPY angiography. Adequate perfusion of the flap was determined via SPY angiography intraoperatively. The flap was thereafter successfully utilized to cover the chronic wound. The patient was followed postoperatively with progression of wound closure. Sternal wounds often pose a complex problem for patients and physicians. The use of intraoperative SPY angiography provided critical information to the operating team allowing for the successful identification of a viable flap. The use of SPY angiography provided the patient an opportunity to achieve a successful outcome and reduced the risk of skin necrosis or reoperation. (Plast Reconstr Surg Glob Open 2019;7:e2245; doi: 10.1097/GOX.0000000000002245; Published online 25 June 2019.)

CLINICAL REPORT

A 79-year-old nonsmoking female with a history of right breast mastectomy and radiation, coronary artery disease (CAD), diabetes mellitus type 2, and hypertension presented to our university hospital with a chronic infection of a sternal incision site 5½ weeks postoperative from a coronary artery bypass. Patient was on insulin, sitagliptin, amiodarone, apixaban, aspirin, atorvastatin, colchicine, diltiazem, furosemide, levothyroxine, nitroglycerin, omeprazole, potassium chloride, prednisone, and pregabalin at home. Cultures obtained at a local wound care clinic demonstrated the presence of Enterobacter aerogenes. The patient was started on vancomycin and piperacillin/tazobactam IV antibiotics. Cardiothoracic surgery performed 2 separate wound washouts with antibiotic solution followed by sternal wire removal, distal sternal bone debridement and removal, and wound vacuum assisted closure (VAC) placement. A large wound remained, and plastic surgery service was consulted for reconstruction.

Seventeen days after admission, the patient was taken to the operating room jointly by plastic surgery and cardiothoracic surgery for debridement and flap reconstruction.

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The right side of the sternum was debrided. In the right midportion of the sternum, the ventricle was noted to be attached the underside of the bone. During debridement, SPY technology was used to confirm maximal debridement without causing damage to underlying structures. A breast flap was elevated from the pectoralis muscle to the lateral chest wall. The pectoralis was isolated, taking as much muscle as possible laterally to the humerus and superiorly to the clavicle. Given the patient’s history of CAD, the SPY laser angiography system was utilized to determine adequate pectoralis muscle perfusion. The inferior portion of the muscle was noted to have decreased perfusion (Fig. 2 and SDC1; see video, Supplemental Digital Content 1, which displays SPY imaging of the muscle flap, http://links.lww.com/PRSGO/B111). This portion of the flap was debrided (Fig. 3). The pectoralis muscle flap was then advanced providing full coverage of the exposed wound and sutured to deep structures. A fasciocutaneous breast flap was elevated and tacked down laterally and medially to anchor the breast flap (see Supplemental Digital Content 2, which displays muscle flap before closure, http://links.lww.com/PRSGO/B112). Retention sutures were placed to secure the flap in place without significant tension. Three 19-French drains were also placed in various positions above and below the muscle. The skin was closed. A negative pressure wound dressing was then applied. Patient was admitted back to the intensive care unit.

After hospital discharge, the patient was seen in the plastic surgery clinic on postoperative day (POD) 11. Two drains were removed at this visit. The flap was healing with minimal marginal necrosis. The patient was then seen on POD 20 for removal of her last drain and noted improvement in wound healing. On POD 26, the patient was noted to have 1–2 cm of superficial marginal necrosis present in the middle of the breast flap. On POD 40, the patient had improvements in healing and had minimal marginal necrosis (Fig. 4). The patient’s wound continued to improve and showed no signs of infection or flap compromise. Consent was obtained for all photos in this report.

**DISCUSSION**

Sternal wound infections often lead to long postoperative recoveries. Given this patient’s history of CAD, hypertension, and diabetes, possible vascular perfusion abnormalities may have compromised her body’s ability to
effectively heal and prevent postoperative infections. Furthermore, her age made her susceptible to the development of a chronic wound infection. Due to the high risk of wound healing complications, the use of laser angiography to assess the patient’s perfusion status was advisable. Additionally, the patient’s history of CAD made predicting the viability of the flap unreliable. SPY angiography was necessary in this case since the risk of complications, such as flap necrosis and possible wound exposure, outweighed the cost of utilizing SPY.

The report describes the effective use of the SPY laser angiography system to intraoperatively identify the vascular supply of a flap. Given the close proximity of the flap to the wound infection, the use of the SPY system provided the surgeon with critical feedback regarding the vascular perfusion. Additionally, given the recurrence of the wound infection, the viability of the tissue flap was vital to preventing another recurrence allowing for the best possible opportunity for wound closure. Other options of assessing tissue perfusion such as with fluorescein, dynamic infrared thermography, and other types of perfusion imaging utilizing indocyanine green dye or methylene blue dye required extended periods of time for evaluation, increasing the OR time and may also be extremely cost prohibitive, such as fluorescence-assisted imaging which may cost over $100,000 per use.

Using SPY in this case did not significantly alter our procedure; however, it did allow the surgeon to assess the viability of the tissue and debride area of decreased perfusion and preserve areas of healthy tissue. The use of SPY here assisted the physician in determining area of adequate debridement, which may have prevented future complications such as necrosis and possibly another surgery. The use of the SPY system provided assurance of tissue perfusion intraoperatively. By using this system for patients with a complex medical history, surgeons may provide each patient with the best opportunity for a successful outcome.

**SUMMARY**

This report describes the effective and successful use of the SPY angiography system for determining flap perfusion on a patient with a chronic sternal wound. Through the use of the SPY angiography system, successful identification of adequate perfusion of tissue may increase the chance of positive outcomes in complex sternal wound reconstructions. This report provides an example of the successful use of SPY angiography system during the reconstruction of a chronic sternal wound.

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