OPEN

PRS GLOBAL OPEN

CASE REPORT
Breast

Microsurgery in the Sickle Cell Trait Population: Can it Be Safely and Successfully Performed?

Sara Eliseo, MS*
Levana Berlin, DO†
Ahmed M. Mansour, MD†
Susan Hansen, MA†
Bharat Ranganath, MD‡
Sean J. Wallace, MD, MS‡

Summary: Free-tissue transfer reconstruction in patients with sickle cell anemia risks failure due to polymerization of sickle hemoglobin within the flap microcirculation. However, outcomes vary, as the amount of polymerization is dependent on factors such as disease phenotype/diagnosis, degree of hypoxia, and intracellular dehydration. Most of the literature focuses on patients with sickle cell disease, which produces higher concentrations of sickle hemoglobin and, therefore, is a contraindication to microvascular reconstruction. Fewer reports describe microsurgery in patients with sickle cell trait (SCT) who carry the heterozygous phenotype. Here, we present a case in which a patient with SCT underwent microsurgical breast reconstruction with deep inferior epigastric perforator free-tissue transfer. The 52-year-old woman had previously experienced a failed alloplastic-based reconstruction after radiation therapy for breast cancer. In our case, clinical and Doppler examinations demonstrated that arterial and venous anastomoses had remained patent; so the patient was discharged on postoperative day 4. Blistering developed on postoperative day 8, and by day 15 there was partial necrosis of the inferior-lateral aspect of the deep inferior epigastric perforator flap. Debridement and closure resolved the issue, and at 5 months postprocedure, the flap remained well-perfused and well-incorporated. This case, presented here with patient consent, reports a successful outcome of microsurgical reconstruction in a patient with SCT. It expands the limited evidence to support the safety and feasibility of autologous surgical interventions for patients with the heterozygous phenotype of sickle cell anemia. *(Plast Reconstr Surg Glob Open 2023; 11:e5377; doi: 10.1097/GOX.0000000000005377; Published online 7 November 2023.)*

Sickle cell anemia is a spectrum of disease caused by a mutation in the β-globin gene, inducing formation of sickle-shaped hemoglobin (HbS). Patients with a homozygous phenotype have increased levels of HbS and are classified as having sickle cell disease (SCD), whereas those with a heterozygous phenotype have lower levels of HbS and are classified as having sickle cell trait (SCT). Patients affected by SCD have overall higher lifetime risk of morbidities and earlier mortalities than their heterozygous counterparts with SCT.[1,2] HbS polymerizes and damages the erythrocyte membrane under conditions of hypoxia and intracellular dehydration. Sickle-shaped erythrocytes increase blood viscosity within the microvasculature, which can lead to microcirculatory collapse and, in free-tissue transfer patients, partial flap necrosis.[3–5] Erythrocytes in heterozygous carriers contain 30%–40% HbS; so polymerization occurs less frequently, and the chance of microcirculatory collapse is reduced.

In microsurgery, prolonged ischemia times during free-tissue transfer can also lead to flap hypoxia and venous stasis. Sustained ischemia time in patients with SCD or SCT can cause intracellular polymerization of HbS and sickling within the flap microcirculation, significantly increasing the risk of perioperative flap necrosis.[1,4] Although the current literature supports SCD as a contraindication to microvascular reconstruction, limited evidence discusses the outcomes in SCT patients.

CASE PRESENTATION

A 52-year-old woman with undisclosed SCT and right breast cancer status postmastectomy with adjuvant chemoradiation presented for autologous breast reconstruction. Breast examination revealed contracted scar tissue compounded by radiation damage and a well-healed Wise-pattern scar (Fig. 1). Free autologous reconstruction was

*From *Philadelphia College of Osteopathic Medicine, Moultrie, Ga.; †Lehigh Valley Health Network, Allentown, Pa.; and ‡George Washington University Plastic Surgery, Washington, D.C.*

Received for publication May 18, 2023; accepted September 12, 2023.

DOI: 10.1097/GOX.0000000000005377

Disclosure statements are at the end of this article, following the correspondence information.

Fig. 1. Preoperative photograph at evaluation for reconstruction.

recommended due to a previously failed tissue expander-based reconstruction attempt. The patient consented and was cleared by primary care and cardiology as low risk for surgical complications. The patient's BMI at admission was 23.2.

A two-perforator DIEP flap was elevated from the left hemi-abdomen and was well perfused via evaluation with indocyanine green. The superficial inferior epigastric vein was preserved for use as an additional source of venous outflow secondary to the flap size of her underlying SCT. The pedicle had one deep inferior epigastric artery and one deep inferior epigastric vein. Total flap weight was 871 g.

The internal mammary artery and internal mammary vein (IMV) were accessed and prepared in a standard fashion. Anterograde end-to-end arterial anastomosis with 8-0 nylon suture was performed between the flap pedicle artery (deep inferior epigastric artery) and the intramammary artery. Anterograde end-to-end venous anastomosis was performed between the deep inferior epigastric vein and the IMV, using a 3.5-mm coupler. Due to the large size of the flap and skin paddle, a second end-to-end venous anastomosis was performed between the superficial inferior epigastric vein and the retrograde IMV to augment venous outflow. No congestion was noted at either venous anastomosis site. Indocyanine green confirmed good flap perfusion following anastamoses. No anastomotic revisions were necessary. Total operative time was 9 hours; ischemia time was less than 60 minutes. Daily deep venous thrombosis prophylaxis was provided

Fig. 2. Partial flap necrosis at postoperative day 23.

with twice daily 5000 IUs of subcutaneous heparin administered in either thigh along with daily 325 mg oral aspirin. The flap remained warm, well perfused, and without signs of vascular compromise. The patient was discharged on postoperative day 4 on daily 325 mg aspirin and followed up closely as an outpatient.

On postoperative day 8, the inferior-lateral breast developed blistering. Local wound care was provided, and by postoperative day 15, a 5×4 cm eschar developed, indicating partial flap necrosis involving full skin thickness and subcutaneous fat at the distal extent of the flap (Fig. 2). The devitalized tissue was removed until all wound edges showed evidence of healthy bleeding (Fig. 2). No anastomotic revisions were necessary. The resulting defect measured 10×5 cm and was closed primarily under general anesthesia in the operating room. At 5 months postdebridement, the patient maintained a well-perfused and well-incorporated flap. She subsequently underwent a symmetry procedure (Fig. 4).

DISCUSSION

Sickle cell anemia presents with varying amounts of HbS depending on phenotype. Individuals with SCT show variability in microsurgical risk profile due to varying percentages of HbS. Due to the patient's unknown SCT status on initial evaluation, no perioperative precautions were made. However, there are few case reports describing uncomplicated flap incorporation when such precautions were followed.[4,5]

One case of successful flap incorporation was described in a patient with 23.3% HbS who underwent oral cavity composite resection and reconstruction with a fibular free flap. Nitrous oxide was avoided intraoperatively to prevent sickling crisis, and hemodynamics were controlled with esmolol and dexmedetomidine infusion.[5] Han et al described an SCT patient who underwent an anterior lateral thigh free-flap reconstruction without complication, possibly due to preoperative red blood cell exchange transfusion to dilute HbS level to below 30% (level recommended to improve microcirculatory hemodynamics)[4,6] while maintaining adequate hematocrit level. Intravenous

Fig. 3. DIEP flap reconstruction immediately postoperative from debridement of devitalized areas.

Fig. 4. DIEP flap reconstruction at 13 months after index surgery.

heparin (5000 units) was administered before pedicle ligation, followed by the initiation of a subtherapeutic heparin drip. Postoperatively, the patient was continued on heparin for 3 days along with daily oral 325 mg of aspirin.[4]

Alternatively, there are reported cases of SCT patients with signs of vaso-occlusion and/or flap necrosis after free-flap reconstruction. Abraham et al described an SCT patient who underwent DIEP flap reconstruction and developed venous congestion on postoperative day 2 despite being administered an intra- and postoperative heparin drip; preoperative hemoglobin electrophoresis revealed 47% HbS.[3] Another case describing an SCT patient after free latissimus dorsi flap noted flap congestion at 2 hours postprocedure.[1] Spear et al reported a case where an SCT patient experienced skin flap necrosis following bilateral reduction mammaplasty.[7] Despite extra precautions and absence of known intraoperative complications, these authors collectively suggest failure resulted from SCT with higher percentages of circulating HbS.[1,3,7]

Although preoperative HbS levels were not obtained for our patient, the partial flap necrosis was likely resultant from increased circulating HbS levels due to her SCT status as opposed to increased polymerization during intraoperative ischemia time. Identifying the risk of vaso-occlusion and flap necrosis via evaluation of HbS levels through hemoglobin electrophoresis may be prudent in determining candidacy for microsurgical reconstruction.[4,5] The Preoperative Transfusion in Sickle Cell Disease Study Group recommended perioperative HbS levels below 30% to minimize complications.[8] Though this percentage is consistent with the few cases described above, a paucity of data limits us from establishing any definitive conclusions.

Despite unknown HbS level in our SCT patient, the majority of her flap remained viable throughout the postoperative period, without further complications following surgical debridement. The presented case supplements the current literature that microsurgical reconstruction can be considered and performed, with added precautions when indicated, while understanding the inherently higher complication risk.

CONCLUSIONS

We report a case of a 52-year-old woman with an undisclosed history of SCT following DIEP flap reconstruction complicated by partial flap necrosis that was ultimately debrided and salvaged. This complication could likely be attributed to increased circulating HbS levels and polymerization/sickling within the microvasculature due to the patient's SCT status, as indocyanine green confirmed good perfusion of the flap following reperfusion. As another supporting example in the literature, a case series would be the next step to further understand this clinical scenario.

Levana Berlin, DO
1200 S. Cedar Crest Boulevard
Allentown, PA 18103
E-mail: levana.berlin@lvhn.org

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Platt AJ, Robertson A, Batchelor AG. Successful free flap transfer and salvage in sickle cell trait. *Br J Plast Surg.* 2000;53:707–708.
2. Steinberg MH. Sickle cell anemia, the first molecular disease: overview of molecular etiology, pathophysiology, and therapeutic approaches. *ScientificWorldJ.* 2008;8:1295–1324.

3. Abraham PF, Allam O, Park KE, et al. Microsurgery in the sickle cell trait population: is it actually safe? *BMJ Case Rep.* 2020;13:e234924.
4. Han KD, DeFazio MV, Lakhiani C, et al. Free tissue transfer in patients with sickle cell trait: not just a trait. *Plast Reconstr Surg.* 2015;136:723e–725e.
5. Mehta R, Rao KN, Nagarkar NM, et al. Free flap reconstruction and its management in sickle cell trait: lessons learned from a case. *Indian J Surg Oncol.* 2021;12:816–821.
6. Weinzweig N, Schuler J, Marschall M, et al. Lower limb salvage by microvascular free-tissue transfer in patients with homozygous sickle cell disease. *Plast Reconstr Surg.* 1995;96:1154–1161.
7. Spear SL, Carter ME, Low M, et al. Sickle cell trait: a risk factor for flap necrosis. *Plast Reconstr Surg.* 2003;112:697–698.
8. Vichinsky EP, Haberkern CM, Neumayr L, et al. A comparison of conservative and aggressive transfusion regimens in the perioperative management of sickle cell disease. The Preoperative Transfusion in Sickle Cell Disease Study Group. *N Engl J Med.* 1995;333:206–213.