Wound Closure and Gradual Involution of an Infantile Hemangioma Using a Noncontact, Low-frequency Ultrasound Therapy

Thomas Serena, MD, FACS
Founder and Medical Director
Penn North Centers for Advanced Wound Care and NewBridge Medical Research
Warren, Pa

Facial hemangiomas are benign vascular neoplasms of infancy and childhood. Although most hemangiomas do not result in significant complications, some result in pain, ulceration, infection, and structural abnormalities and can interfere with respiration, vision, and hearing. A 5-month-old infant presented to the author's wound center with a necrotic wound within a large, segmental hemangioma of mixed superficial and deep morphology; her vision was obstructed. The patient's discomfort was indicated by poor feeding and irritability. The hemangioma had been treated with oral corticosteroids and laser therapy. The wound within had been treated with povidone-iodine, moist healing, and topical growth factors. Debridement of necrotic tissue was indicated at presentation; however, bleeding and discomfort were risks. Daily noncontact, low-frequency ultrasound (used for painless debridement of chronic wounds) was initiated to remove necrotic tissue and prepare the wound for grafting. By day 8 of this treatment, the wound bed was covered with healthy-appearing granulation tissue and epithelialization had begun. Additionally, the hemangioma began to involute. Laser treatments were discontinued and the patient was weaned from oral steroids. By week 7, the wound was completely closed and did not require skin grafting. The hemangioma continued to involute. Additional studies are warranted to elucidate the role of noncontact, low-frequency ultrasound in the management of ulcerated hemangioma.

KEYWORDS: hemangioma, wound, necrosis, noncontact ultrasound

Ostomy Wound Management 2008;54(2):68–71

Facial hemangiomas, the most benign vascular neoplasms of infancy and childhood, occur in up to 10% of infants and are more common in females and white infants. Although most hemangiomas do not result in significant complications, some may impinge on vital structures, ulcerate, or bleed. The life cycle of a hemangioma involves a phase of rapid proliferation in the neonatal period, followed by spontaneous involution, usually during childhood. The mechanisms that control involution of hemangiomas are still poorly understood but recent evidence seems to indicate that apoptosis (programmed cell death) plays a role.
death) may be partially responsible. Most infantile hemangiomas involute spontaneously and without sequelae but a sizeable minority will produce complications or need treatment. Complete involution occurs at an estimated rate of 10% per year; hence, approximately 50% of hemangiomas involute by age 5 years, 70% by age 7 years, and 90% by age 9 years.

Less than one half of hemangiomas are present at birth; the remainder become evident within the first few weeks of life. Early lesions may be so subtle they go unrecognized and are often mistaken for a scratch or bruise. Less commonly, a hemangioma may appear as a bright red, flat area resembling a port-wine stain. Most hemangiomas are solitary, range in size from a few millimeters to several centimeters in diameter, and may be superficial, deep, or a combination of superficial and deep. Superficial presentation is most common and consists of a bright red papule, nodule, or plaque raised above clinically normal skin. In contrast, a deep hemangioma is generally a raised, flesh-colored nodule that often has a bluish hue or an overlying telangiectatic patch. Hemangiomas most commonly occur in the head and neck but may present anywhere in the skin, mucous membranes, or underlying visera.

Ulceration is the most frequent complication of infantile hemangioma, occurring in approximately 5% to 13% of patients. Ulceration carries the risk of infection, hemorrhage, and scarring. Ulceration results from necrosis and typically occurs in deep, rapidly enlarging hemangiomas. Infants with ulcerated hemangiomas often are irritable, eat poorly, and may have sleep problems. Pain may precede ulceration and is thought to be the result of ischemia and necrosis within the hemangioma.

Case Report

The patient was born on December 11, 2006 after an uneventful pregnancy. Shortly after birth, her mother noted a faint pink hue on the left side of the face. Over the first month of life, the pink hue grew rapidly into a large, segmental hemangioma of mixed superficial and deep morphology. An extensive diagnostic work-up revealed no association with PHACE syndrome (ie, no additional related abnormalities). By 1 month of age, the hemangioma was causing significant discomfort and obstructing the patient’s vision. In January 2007, she was started on prednisolone sodium phosphate oral solution (Orapred 15 mg/mL, Ascent Pediatrics, Novato, Calif) at 3 mg/kg and increased to 5 mg/kg in February 2007; however, the lesion continued to enlarge and ulcerate. After approximately 1 month, she was weaned back down to the 3 mg/kg dose.

In February 2007, laser therapy was initiated on an every-fourth-week schedule with moist wound dressings, topical growth factors, and povidone-iodine administered between laser treatments. The laser therapy resulted in some involution of the lesion during 3 months of treatment. Based on the aggressive nature of the lesion, leading experts in vascular malformations planned to place tissue expanders and eventually resect the hemangioma. However, the tissue expanders could not be placed with open wounds present.

In May 2007, the patient presented to the author’s clinic with a necrotic wound in the central portion of the lesion measuring 6.0 x 7.0 cm. With no signs of infection present, culture was not indicated. The wound was painful and bled easily (see Figure 1). The patient was irritable. Her parents reported that she had been eating poorly.

In an effort to heal the ulcer, daily treatments with noncontact, low-frequency ultrasound (MIST Therapy System, Celleration, Inc., Eden Prairie, Minn) were initiated on May 17, 2007. This particular therapeutic ultrasound device is indicated to promote healing.
wound healing through wound cleansing and maintenance debridement through the removal of yellow slough, fibrin, tissue exudates, and bacteria. Although this therapy has been shown to promote healing of chronic ulcers, particularly of the lower extremities in adult patients, it has not been studied in ulcers within hemangioma or in children.

Duration of each noncontact ultrasound treatment was based on wound area per the manufacturer’s treatment algorithm, which ranged from 7 minutes per day for the initial wound area of 42 cm² (6.0 cm x 7.0 cm) to 3 minutes per day when the wound area measured <10 cm². After each treatment, bacitracin and moist, nonadherent dressing (Adaptic®, Johnson & Johnson, Somerville, NJ) were applied. The wound immediately improved — nonviable tissue decreased and granulation increased. By May 31, 2007, the wound had begun to epithelialize and measured 3.0 cm x 5.0 cm. The treatments did not appear to cause discomfort. On May 31, 2007, it was noted that the hemangioma had begun to involute (see Figure 2). On June 7, 2007, the open area measured 2.0 cm x 4.5 cm. Laser treatments were discontinued.

One month into noncontact ultrasound therapy (mid-June), the wound divided into two areas measuring 1.0 cm² and 1.4 cm². Frequency of noncontact ultrasound treatments was reduced to three times per week. In late June, the patient developed hypertension and was weaned from oral prednisolone at a rate of 0.5 cc per week until ultimate discontinuation in October 2007. On July 2, 2007 (week 7), the wound was completely closed, eliminating the need for a skin graft.

The patient’s vision was no longer affected, her appetite had improved, and she appeared to be in less pain. The hemangioma has continued to involute; the patient continues to be monitored (see Figure 3).

**Discussion**

Most hemangiomas occurring in infancy require no treatment. For complicated hemangiomas, the first-line therapy is systemic corticosteroids, which often arrests hemangioma growth and induces regression when administered during the proliferative phase. However, additional medical intervention often is required for large, ulcerative hemangiomas or for those impinging on vital structures. Meticulous local wound care (ie, topical and oral antimicrobials, barrier creams, bio-occlusive dressings, and debridement as indicated) and pain control (ie, oral analgesics and sparingly used topical lidocaine) are the mainstays of ulcer therapy.

The initial plan for this patient was to remove the necrotic tissue to prepare the wound for grafting with bioengineered skin or other advanced wound care techniques. The risk of bleeding precluded sharp debridement. Moreover, a general anesthetic would have been required for even minor debridement. Likewise, topical enzymatic debriding agents might have exacerbated her discomfort.

Noncontact, low-frequency ultrasound is one of the newest technologies used to debride chronic wounds without causing the pain typically associated with traditional debridement techniques. The potential biophysical effects of ultrasound relevant to wound healing (summarized in a prior publication) are nonthermal and include alterations in cellular...
protein synthesis and release, blood flow and vascular permeability, angiogenesis, and collagen content and alignment.

More aggressive therapies have been utilized to heal ulceration of infantile hemangioma with some success. Published reports have described treatment with becaplermin (a recombinant platelet-derived growth factor) for ulcerated hemangioma refractory to standard care. In these cases, application of 0.01% becaplermin gel resulted in ulcer healing in a mean 10.25 days (range 3 to 21 days) for eight cases of perineal ulcerated hemangioma and 6 weeks in one case of ulcerated infantile hemangioma. Pulsed dye laser therapy has been reported to be effective for healing ulcerated superficial hemangiomas (50% of cases in one study and 100% in another).

In the case reported herein, a large, necrotic ulcer within a hemangioma of mixed superficial and deep morphology closed within 6.5 weeks when daily noncontact ultrasound treatment was added to the existing regimen of oral corticosteroids, laser treatments, topical antibiotics, and moist nonadherent dressing. Given the necrosis in this particular wound, the debridement effects of this ultrasound therapy likely contributed to healing the ulcer.

Conclusion
To the author’s knowledge, this is the first published report of noncontact ultrasound therapy for healing of ulceration within an infantile hemangioma. The course and outcomes of this case suggest that adjuvant use of this novel therapy may promote healing of such ulcers, which reduces the opportunity for infection to complicate or delay involution and may well provide pain relief for the patient. Further study of this ultrasound therapy for healing ulcerations within infantile hemangioma is warranted. - OWM

Acknowledgment
The author thanks Jill Shuman, MS, ELS, for her writing and editing contributions to this manuscript.

References