EVMS
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Fish Skin Xenografts in the Management of Gas Gangrene Foot Infections

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Statement of Purpose

The aim of this case series was to explore the usage of fish skin xenograft in the management of patients with wound deficits following gas gangrene infections.

Level of Study

Level IV, Case Study

Introduction

Gas gangrene infections of the lower extremity can be devastating given the destruction to the surrounding soft tissue and wide surgical excision that is required to achieve source control.

Often, gas gangrene foot infections are produced by polymicrobial bacteria, but they can also be caused by streptococcal bacteria alone and are rarely caused by clostridium perfringens[3]. A retrospective review completed by Martucci et al showed that over 50% of patients with gas gangrene infections presented septic, and after two operations, 64% of patients underwent some form of amputation. Those with comorbidities such as immunocompromised state and diabetes mellitus (DM) have a higher rate of mortality as compared to the general population[2].

Gas gangrene infections of the foot can lead to large soft tissue defects bringing in the question of whether limb salvage is an option. This case series explores the usage of fish skin xenografts after source control in patients with x-ray confirmed gas gangrene infections.

Images 1 and 2 demonstrate the extent of tissue damage encountered with gas gangrene infections and show the accompanying soft tissue emphysema identified on X-ray.

Methods

A retrospective case review of 8 patients with gas gangrene infections of the foot who underwent some form of source control and then had fish skin xenograft applications to the soft tissue deficit was performed. Data was collected on age, sex of patient, comorbidities, date of presentation with gas gangrene infection, location of gas gangrene infection, surgical procedures performed, number of graft applications, time between graft applications, weight-bearing protocol, antibiotics, size of initial wound, date healed, wound vacuum application, and Hemoglobin A1c.

Results

Six patients were included in the case series with a total of 8 (2 females, 4 males) gas gangrene infections. One patient had three separate instances of gas gangrene. Age ranged from 35 to 61 years of age. Prevalent comorbidities included diabetes mellitus, chronic kidney disease, peripheral arterial disease, and hypertension. Source control was initiated in all cases prior to graft application. All patients were placed on culture directed antibiotic regimen following discharge from initial hospitalization.

Application of fish xenografts ranged from 1-5 applications with 3-4 weeks between each application. All patients were non-weight-bearing. Seven of the eight cases of gas gangrene went on to heal with xenograft application. One patient did not follow up after the first post operative visit. Hemoglobin A1c ranged from 6.4% to 15.1%. Initial wound size ranged from 3.2 cm x 1.6 cm x 0.3 cm to 14.2 x 9.6 cm x 2 cm. Four patients had wound vacuum applied with graft. 3 patients had wound vacuum applied prior to graft application. One person did not have a wound vacuum. Complete wound healing ranged from 14 weeks to 32 weeks.

Image 3 above displays initial gas gangrene infection to the emergency department. Image 4 above displays the wound following fish skin xenograft application. Wound went on to heal with local wound care.

Image 5 below displays initial gas gangrene infection presentation to the emergency department.
Image 6 below displays the healed wound following fish skin xenograft application.

Discussion

With initial presentation of gas gangrene infections, large excisional debridement and open amputation are often performed in the foot and ankle to achieve source control. While source control is important in gas gangrene infections, there is a lack of research discussing the most appropriate option for coverage of a large soft tissue deficit following source control procedures.

The patient population who develop a gas gangrene infection of the foot and ankle often have significant comorbidities which can delay the healing process. A delay in healing means a wound will be open to the environment longer, predisposing this patient to another infection. This underscores the importance of attempting different types of soft tissue coverage which can lead to quicker healing.

Studies have shown that reoperation rates for diabetic foot infections are as high as one in four patients. Patient with a greater number of risk factors such as neuropathy, peripheral arterial disease, and more than one wound often have decreased success with healing amputations[1].

Fish skin xenografts are a form of regenerative medicine that provide a functional barrier and much like other grafts demonstrate antimicrobial properties. Fish skin xenografts do not undergo an extensive manufacturing process since there is less of a risk of transmitting viral disease. The collagen structure is better maintained due to this less extensive manufacturing process[3].

This study showed healing could be achieved in 14 to 32 weeks. Repeat fish skin xenograft application could be done in the office, saving a patient a trip to the operating room. Healing even occurred in patient's whose hemoglobin A1c was 15.1%. 7 out of 8 patients did go onto heal showing that fish skin xenografts appear to be a viable option for closing soft tissue deficits in gas gangrene infections following source control.

References

1. Anwander, H., Vonwyl, D., Hecht, V., Tannast, M., Kurze, C., & Krause, F. (2023). Risk Factors for Failure After Surgery in Patients With Diabetic Foot Syndrome. *Foot & ankle orthopaedics*, *8*(3), 24730114231182656. https://doi.org/10.1177/24730114231182656
2. Buboltz JB, Murphy-Lavoie HM. Gas Gangrene. [Updated 2023 Jan 30]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK537030/
3. Martucci, J. A., & Riemer, K. (2023). Gas-Producing Infections in the Foot at a Large Academic Medical Center: A 10-Year Retrospective Review. *The Journal of foot and ankle surgery : official publication of the American College of Foot and Ankle Surgeons*, *62*(2), 360–364. https://doi.org/10.1053/j.jfas.2022.09.004
4. Fiakos, Gabriella, et al. "Improved skin regeneration with acellular fish skin grafts." *Engineered Regeneration*, vol. 1, 2020, pp. 95–101, https://doi.org/10.1016/j.engreg.2020.09.002.