Less-invasive Treatment for Group A Streptococcal Fasciitis with Rapid Antigen Detection Test and Collagen/Gelatin Sponge

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CASE REPORT
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Less-invasive Treatment for Group A Streptococcal Fasciitis with Rapid Antigen Detection Test and Collagen/Gelatin Sponge

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Summary: Patients with severe group A *Streptococcus* (GAS) induced necrotizing soft tissue infection sometimes develop *Streptococcal* toxic shock syndrome, which is a life-threatening condition with an extremely high fatality rate. Obtaining survival is the most important goal; however, an early diagnosis for debridement surgery and quick granulation formation for skin grafting surgery can better preserve the extremity functions. The patient was a 47-year-old man with a history of atopic dermatitis who presented with GAS-induced necrotizing soft tissue infection in his left lower extremity. His vital signs indicated shock, and he was diagnosed with streptococcal toxic shock syndrome. Emergency surgery was performed with his body pressure maintained with noradrenaline. Intraoperatively, rapid antigen detection tests (RADTs) were negative in the medial thigh and positive in the lower leg, which helped in decision-making regarding the area of aggressive debridement surgery. The wound culture results matched the intraoperative rapid antigen detection test results. A collagen/gelatin sponge with the sustained release of basic fibroblast growth factor was used as an artificial dermis before skin grafting. Excellent granulation was obtained, and skin grafting surgery was performed on the 11th day after collagen/gelatin sponge placement. He was discharged home on the 42nd day with normal lower extremity functions. First, an intraoperative diagnosis using GAS-rapid antigen detection tests with an appropriate sampling method from small incisions avoided excessive surgical debridement. Second, collagen/gelatin sponge with the sustained release of basic fibroblast growth factor promoted quick granulation tissue formation for wound bed preparation. These efforts resulted in the successful less-invasive treatment of a patient with streptococcal toxic shock syndrome caused by GAS-induced necrotizing soft tissue infection. *(Plast Reconstr Surg Glob Open 2021;9:e3793; doi: 10.1097/GOX.0000000000003793; Published online 13 September 2021.)*

Severe necrotizing soft tissue infection (NSTI) caused by group A streptococcus (GAS) is associated with high mortality. In particular, streptococcal toxic shock syndrome (STSS), which occurs when bacterial toxins act as super-antigens, has fatality rate of 23%–44%.[1] An earlier diagnosis to indicate debridement surgery is a key to survival, and the use of a GAS-rapid antigen detection test (RADT) for pharyngitis has been reported to be useful for this purpose.[2,3] We previously reported the usefulness of GAS-RADT for avoiding excessive surgical debridement,[4] and an appropriate method for obtaining samples of the subcutaneous layer with a small incision.[5] Our newly developed collagen/gelatin sponge (CGS) can achieve the sustained release of basic fibroblast growth factor (bFGF) to improve wound healing.[6] We herein demonstrate the successful less-invasive treatment of a patient with STSS caused by GAS-NSTI based on an intraoperative diagnosis using GAS-RADTs with the promotion of quick granulation tissue formation using CGS with bFGF.

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CASE

A 47-year-old man with a history of atopic dermatitis visited another hospital with rapidly worsening tenderness and swelling of his left lower leg, the onset of which had occurred 1 day previously. Overnight he had a fever of 40°C. He was hospitalized with suspected cellulitis; however, after a few hours, his vital signs showed shock: systolic blood pressure, 66 mm Hg; pulse, 130 beats/min; body temperature, 39.4°C, 98% O_2 saturation on room air. While maintaining his body pressure with the administration of noradrenaline, a small incision was made on the medial side of his left lower leg to obtain samples from the subcutaneous layer for wound culture and a GAS-RADT; RapidTesta StrepA (Sekisui Medical Co., Ltd., Tokyo, Japan). The RADT was positive and he was transferred to our hospital for more intensive treatment. A blood test showed the following values: WBC, 15,290/μl; Hb, 11.4 g/dl; PLT, 8600/μl; CK, 60 IU/L; Cre, 0.81 mg/dL; CRP, 19.0 mg/dl; HbA1c, 5.1%; LRINEC score, 6. Erythema extended along the great saphenous vein to his left inguinal region. At 2 hours after transport, we started an emergency operation under general anesthesia.

First, we made an incision on the medial thigh and obtained samples for wound culture and RADT. The RADT was negative (Fig. 1A). Next, we inserted a finger into the subcutaneous layer of his lower leg as the "finger test." The subcutaneous layer was dissected with minimal resistance and "dishwater" colored fluid seeped without bleeding; the fluid was examined using a GAS-RADT and was strongly positive. (**See Video 1** [online], which displays the fingers test.) The skin and subcutaneous tissue of lower leg were extensively opened to obtain sufficient drainage (Fig. 1B).

We diagnosed the symptoms as STSS and treated him in an intensive care unit with the administration of noradrenaline and antibiotics [Penicillin G (4,000,000 units, 6 times/day); Clindamycin (600 mg, 3 times/day)]. O_2 saturation declined to 85%, even with 6 L/min of oxygen by mask, and a chest x-ray showed glass shadows in both lungs, suggesting acute respiratory distress syndrome. Blood cultures were negative. The wound culture of the left lower leg was GAS (*Streptococcus pyogenes*) without any other bacteria. The left thigh wound culture was negative, which matched the intraoperative RADT results. The patient's breathing gradually stabilized and he was discharged from the intensive care unit on the 4th day after the first surgery.

The second surgery was performed on the 10th day under local anesthesia. The opened left thigh wound was sutured and the left lower leg was covered with a Pelnac Gplus [size, L (120×82 mm) Gunze Co., Ltd., Ayabe, Japan] impregnated 10 ml of human recombinant bFGF spray [Fiblast Spray (1000 μg); Kaken pharmaceutical Co., Ltd., Tokyo, Japan] to obtain quick granulation tissue formation (Fig. 2). The calculated concentration of trafermin was 10.2 μg/cm^2. (**See Video 2 [online]**, which displays the addition of human recombinant bFGF.) Excellent granulation was obtained and the third surgery for mesh skin grafting was performed on the 11th day after the second surgery (**See figure, Supplemental Digital Content 1**, which shows the intraoperative findings of the third surgery [a, b], and postoperative findings at three months [c]. **http://links.lww.com/PRSGO/B769**.). He was discharged home on the 42nd day with normal lower extremity functions.

Fig. 1. The intraoperative use of RADTs for GAS to avoid excessive surgical debridement. Preoperative (A) and postoperative (B) findings of debridement surgery. RADTs for GAS: a sample from the left lower leg was positive (black arrow), while a sample from the left thigh was negative (black arrowhead).

DISCUSSION

In 2008, a large-scale epidemiological study in Europe (Strep-EURO) showed the fatality rate of GAS-NSTI within 7 days of the diagnosis was 32%. Notably, STSS in GAS-NSTI showed a fatality rate of 50%.[7] Obtaining survival is the most important goal; however, a precise diagnosis of the invaded area and the promotion of wound healing is

Fig. 2. Quick wound bed preparation using collagen/gelatin sponge with bFGF (A). The left lower leg was covered with a Pelnac Gplus impregnated 10ml of human recombinant bFGF on the 10th day of hospitalization (B).

beneficial for activities of daily living. Because GAS-NSTI can occur in both compromised hosts and the healthy younger population, early healing and rehabilitation to maintain activities of daily living are essential. To achieve this purpose, we used the following approach.

First, GAS-RADT for the pharynx was used during the first surgery to determine where aggressive debridement should be performed. A recent meta-analysis on GAS pharyngitis indicated the high diagnostic accuracy of the GAS-RADT (sensitivity, 86%; specificity, 96%).[8] In 2021, we reported a case in which this test method was useful for avoiding excessive surgical debridement.[4] To assess the possibility of false negative in RADTs, we are currently conducting a clinical study of its accuracy in wounds. In this case, the medial thigh was found to be RADT-negative with a test incision, which facilitated minimally invasive surgery.

Second, quick wound bed preparation for skin grafting surgery using CGS sustained bFGF was performed. Pelnac Gplus is a novel artificial dermis that can sustain the gradual release of impregnated bFGF, which accelerates wound healing. Recently, the ability of Pelnac Gplus, which protects and sustains the efficient release of bFGF for more than 7 days, was demonstrated in vitro.[9] Moreover, an in vivo study showed that Pelnac Gplus impregnated with bFGF accelerates capillary formation, granulation tissue formation, and epithelialization.[10] We hypothesize that combination with negative pressure wound therapy could obtain even faster tissue granulation.

CONCLUSION

An intraoperative diagnosis using GAS-RADTs and the promotion of quick tissue granulation using CGS with bFGF facilitated successful less-invasive treatment.

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