Successful Treatment of Necrotizing Fasciitis and Toxic Shock Syndrome by Hip Amputation and Endotoxin Hemoadsorption

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Abstract

Background: Necrotizing fasciitis is a rare but severe condition associated with high mortality. We encountered a patient with severe and rapidly progressing necrotizing fasciitis.

Patient: A 40-year-old male was hit by a tractor and received a wide laceration wound spanning the length of his posterior thigh. Soon after the accident, the wound was washed and debridement was performed. Two days postoperatively, we observed septic changes in the wound and diagnosed this condition as necrotizing fasciitis. Consequently, the patient’s leg was amputated at the thigh. The patient, however, developed toxic shock syndrome after the amputation. Endotoxin adsorption using a polymyxin B-immobilized fiber column was performed for 2 days. Finally, a hip joint amputation was performed after 11 days, following which the patient’s general condition gradually improved.

Discussion: Treatment for necrotizing fasciitis should be initiated promptly. Early debridement is associated with a significant decrease in mortality. In severe conditions, endotoxin and cytokine removal by blood purification is one of the most effective treatments. Although group A streptococci are widely known as “flesh-eating bacteria,” we should also consider a wide variety of pathogenic organisms to be the probable cause of severe necrotizing fasciitis.

Conclusion: Management of necrotizing fasciitis requires careful investigation as well as an aggressive therapeutic approach, which may include urgent surgical intervention. In addition to surgery, endotoxin adsorption therapy should be considered.

Key words: necrotizing fasciitis, endotoxin, polymyxin B-immobilized fiber column (PMX), flesh-eating bacteria, debridement

Introduction

Necrotizing fasciitis is an uncommon but severe condition associated with high mortality1-4). This infection spreads rapidly throughout the fascia and may result in muscle necrosis. It is treated with antibiotics, surgical debridement, etc. We encountered a patient with a severe case of rapidly progressing necrotizing fasciitis, but our patient survived after aggressive treatment with hip amputation and endotoxin adsorption by using a polymyxin B-immobilized fiber column (PMX).

Patient

A 40-year-old man was hit by a tractor while doing farm work on September 11, 2004. Soon after the accident, the patient was brought to the emergency room in an ambulance. The patient had no illnesses at the time of admission and no history of complications before the accident.

On admission, the laceration was wide and spanned the length of the posterior thigh (Figure 1). The deep flexor muscle and tendon behind the knee joint were severely damaged and had been contaminated with soil. Fortunately, the neurovascular structures, bones and joints were not damaged. Emergency surgery, muscle repair and skin closure, including washing and debridement of the wound, were performed in an operating room using a lumbar anesthetic block. The wound area lacking skin was covered with artificial skin (Figure 2). Because of blood loss, his systolic blood pressure at admission was between 60 and 80 mmHg, and mass blood transfusion was performed with intravenous administration of norepinephrine. After the surgery, the patient was moved to the intensive care unit, and his blood pressure and condition were well controlled.
At 2 days after the operation, the patient developed a high fever of over 40°C with general fatigue, pain and copious, malodorous discharge from the wound. His breathing was rapid, and laboratory data revealed high levels of C-reactive protein. On the basis of these symptoms, we diagnosed septic changes caused by necrotizing fasciitis. Therefore, amputation of the thigh was immediately performed on September 14, 2004. The deep fascia and muscle surrounding the thigh were found to be heavily contaminated and became necrotic within a few days despite administration of high dosages of antibiotics. We performed not only mid-thigh amputation but also wide resection of the necrotic tissue. Even after this operation, the patient’s condition was critical. The patient subsequently developed toxic shock syndrome, requiring blood pressure support, and multiple organ system failure, requiring hemodialysis and artificial respiration. To treat the toxic shock syndrome, endotoxin adsorption was performed with a PMX for 2 days. Bacterial culture typing and sensitivity tests revealed the presence of *Enterococcus faecalis*, *Proteus vulgaris* and *Streptococcus* species. On the basis of these results, case-specific antibiotic therapy was initiated.

Because the necrotizing fasciitis persisted despite the antibiotic therapy, we felt that wide debridement was necessary. Finally, disarticulation of the hip joint (third operation) was performed 11 days after the initial operation. The wound was heavily contaminated through the fascia, and the color of the muscle surrounding the thigh had changed (Figure 3). After this operation, the wound was not covered completely in order to allow drainage.

Thereafter, the patient’s general condition gradually improved. Figure 4 summarizes the treatment and condition of the patient. At 37 days after the third operation, a final operation for skin closure was performed using a free skin graft from the opposite side. Finally, after 69 days of hospitalization, the patient was transferred to a rehabilitation facility for fitting with an artificial leg.

**Discussion**

Necrotizing fasciitis is a severe condition associated with high mortality. The reported mortality rate for necrotizing fasciitis varies from 6% to 29%[^1-4] (Table 1). Once a patient is diagnosed as having necrotizing fasciitis, treatment should be initiated promptly. The operation should be planned...
immediately without unnecessary delay. Early debridement of necrotizing fasciitis is associated with a significant decrease in mortality.

Medical practitioners should pay attention to the condition of patients with necrotizing fasciitis as it is associated with high mortality. Carter et al.\textsuperscript{5}) lined up this group. The most important considerations in regard to a patient’s initial condition and complications include malignancy, cardiac disease, pulmonary disease, intravenous drug abuse and malnutrition. The following patients with necrotizing fasciitis should be considered to be at a high risk: patients with no complications before initiation of the therapy but in whom the first debridement of the wound is delayed, patients who are older than 60 years of age, female patients, hypotensive patients, patients with bacteremia, patients with a total body surface area involvement of more than 250 cm\textsuperscript{2}, patients with renal failure and those with elevated blood lactate levels\textsuperscript{5}).

Patients suspected of having necrotizing fasciitis should be started empirically on broad-spectrum antibiotics covering the most commonly encountered pathogens. Group A streptococci are widely known as “flesh-eating bacteria”\textsuperscript{6}). Streptococcal necrotizing fasciitis may cause rapid onset of shock and multiple organ failure. Invasive group A streptococci have been isolated in 62\% to 97\% of necrotizing fasciitis cases. However, we should consider the wide variety of pathogenic organisms and polymicrobial infections involved in necrotizing fasciitis\textsuperscript{6}) (Table 2). Giuliano et al.\textsuperscript{7}) classified necrotizing fasciitis into 2 commonly encountered and distinct subtypes. In our case, culture typing revealed that the main causative species were the \textit{E. faecalis} and \textit{Streptococcus} species. \textit{P. vulgaris} was ruled out. In addition to the well-known group A streptococci, a variety of pathogens can act as superantigens leading to the rapidly progressive toxic shock syndrome associated with this condition.

Table 1  Mortality of necrotizing fasciitis

<table>
<thead>
<tr>
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<th>Mortality (%)</th>
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<tbody>
<tr>
<td>McHenry \textit{et al.} 1995</td>
<td>29</td>
</tr>
<tr>
<td>Bosshardt \textit{et al.} 1996</td>
<td>27</td>
</tr>
<tr>
<td>Rubinstein \textit{et al.} 1995</td>
<td>18</td>
</tr>
<tr>
<td>Lille \textit{et al.} 1996</td>
<td>6–25</td>
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</tbody>
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The reported mortality rate for necrotizing fasciitis varies from 6\% to 29\%.

Table 2  Microbiology of necrotizing fasciitis\textsuperscript{6})

<table>
<thead>
<tr>
<th>Gram-positive organisms</th>
<th>(%)</th>
<th>Gram-negative organisms</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A streptococci</td>
<td>18–46</td>
<td>\textit{E. coli}</td>
<td>8–28</td>
</tr>
<tr>
<td>Enterococci</td>
<td>16–34</td>
<td>Enterobacter</td>
<td>2–12</td>
</tr>
<tr>
<td>Coagulase (–) Staph</td>
<td>15–37</td>
<td>Pseudomonas species</td>
<td>9–20</td>
</tr>
<tr>
<td>\textit{Staph. aureus}</td>
<td>9–37</td>
<td>Proteus species</td>
<td>6–12</td>
</tr>
<tr>
<td>\textit{Staph. epidermidis}</td>
<td>18</td>
<td>Serratia species</td>
<td>2–6</td>
</tr>
<tr>
<td>Clostridial species</td>
<td>5–21</td>
<td>Bacteroides</td>
<td>18–48</td>
</tr>
<tr>
<td>Mixed Gram-positive</td>
<td>10</td>
<td>Mixed Gram-negative</td>
<td>16</td>
</tr>
</tbody>
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We should pay attention to the wide variety of pathogenic organisms and polymicrobial infections involved in necrotizing fasciitis.
With the wide spread of bacteria and the rapid progress of necrotizing fasciitis, bacterial exotoxins may directly damage the host tissues and act as superantigens to stimulate T cells and macrophages to release proinflammatory cytokines such as tumor necrosis factor-α (TNF-α), interleukin-1β (IL-1β), and IL-6, which mediate septic shock.

Endotoxin and cytokine removal by blood purification is one of the most effective treatments in such severe conditions. PMX removes circulating endotoxins and corrects the cytokine imbalance, theoretically preventing progression of the biological cascade of sepsis. The levels of inflammatory mediators such as TNF, IL-6, IL-10 and plasminogen activator inhibitor-1 (PAI-1) are therefore significantly decreased. An immediate mediator that activates monocytes is decreased. An immediate mediator that activates monocytes and macrophages is also reduced.

We treated this patient by endotoxin adsorption with PMX twice after diagnosing septic shock. Nemoto et al. suggested that 1 or 2 courses of adsorption for 4 hours each improved the survival of patients with sepsis. Furthermore, a recent paper has suggested that frequent applications of PMX would be effective against severe sepsis. The appropriate duration and frequency of PMX administration for treatment remain unknown. Therefore, further investigation is necessary to determine and confirm the appropriate cycles and frequencies of PMX treatment.

In many reports in the literature, it has been suggested that wide and extensive debridement of the necrotic tissue is a life-saving treatment. However, it is difficult to predict the level of amputation. In this case, thigh amputation was performed as the second operation. Slight contamination spread to the amputated end, and wide debridement was performed. We think that this debridement was enough to alleviate the condition; however, the condition remained unchanged. It is unclear whether improvement depends on the width of the debridement, but medical practitioners should consider that normal-appearing tissues may show extensive early vascular thrombosis as well as vasculitis on microscopic examination. If time permits, MRI should be performed; this may aid in determination of the extent of the infection or necrosis in the muscle and soft tissue.

Finally another consideration before performing an amputation is the patient’s whole body condition. In this case, the septic shock was severe and progressed rapidly. Intensive surgery such as amputation at the hip may damage the whole body condition. Hence, medical practitioners need to take into consideration not only the extent of infection but also the body condition. The level of amputation should be considered carefully.

Conclusion

Necrotizing fasciitis is a relatively uncommon condition and presents with diagnostic difficulties. We encountered a patient with a severe case of necrotizing fasciitis. Management of this infection requires careful investigation as well as an aggressive therapeutic approach, which may include urgent surgical intervention.

In addition to aggressive intervention through operation, endotoxin adsorption therapy with PMX should be considered for increasing the survival rate, and this is one of the most useful treatments for improving the survival of patients with necrotizing fasciitis.

References