CASE REPORT

# Necrotizing Fasciitis of Bilateral Breasts following Unilateral Modified Radical Mastectomy for Invasive Ductal Carcinoma: A Case Report and Review of Literature

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## ABSTRACT

Necrotizing fasciitis of the breast is a rare but potentially fatal soft tissue infection. It may occur primarily in patients without any direct cause, and less commonly after undergoing elective surgical procedures such as cosmetic mammoplasties and oncologic resections.

This is a case of a 46-year-old female with stage IIIA invasive ductal carcinoma of the left breast treated with modified radical mastectomy presenting with a necrotizing infection involving the bilateral breast regions and left lateral abdomen six days after operation. She was managed with broad-spectrum antibiotics and radical debridement with right mastectomy, followed by wound coverage with split-thickness skin grafting. This is the eight case of breast necrotizing fasciitis occurring after mastectomy for breast cancer reported in the literature.

*Keywords: breast, necrotizing fasciitis, invasive ductal carcinoma, modified radical mastectomy, case report*

## INTRODUCTION

Necrotizing fasciitis (NF) is a soft tissue infection characterized by rapidly progressive necrosis involving the skin, subcutaneous tissue, and musculature which spreads along the superficial fascial planes.[1-3] The term was first coined by Wilson in 1952.[4] NF carries a high burden of morbidity and mortality due to severe systemic effects and delays in diagnosis and management, with mortality rates ranging from 10 to 15%.[3] The incidence of NF is 4 to 15 cases per 100,000 population, and is commonly observed in the abdomen, groin, and extremities. The breast is a rare site of occurrence, and cases of breast NF can easily be misdiagnosed as other forms of non-necrotizing infections such as mastitis and breast abscess.[3]

Risk factors for the development of NF include advanced age, diabetes mellitus, obesity, vascular disease, renal failure, alcoholism, malnutrition, immunosuppressive conditions, and nonsteroidal anti-inflammatory drug (NSAID) use.[2,3] Many cases are associated with an inciting penetrating or non-penetrating traumatic event. Recent surgery is a risk factor for necrotizing soft tissue infections because of possible introduction of pathogenic organisms through the cutaneous barrier and contamination of sterile compartments. Even clean operations may lead to NF especially in patients with other risk factors which predispose to poor wound healing and an impaired immune response.

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Necrotizing fasciitis of the breast was first reported in 1997, and has been observed to occur during the lactation period, after various surgical procedures, and in the absence of any inciting events.[3,5] We report a case of NF of the breast developing after a modified radical mastectomy, with extension to the contralateral breast and ipsilateral lateral abdominal wall. We also review the current literature on available reports of NF of the breast and discuss the pathophysiology and management of these cases.

## CASE PRESENTATION

A 46-year-old female consulted for a 1-year history of an enlarging left breast mass. On examination, there was a 3 cm firm, movable, nontender mass at the inferior aspect of the areola of the left breast with overlying skin dimpling. There were no ulcerations or gross tumor extension to the skin, and no signs of cutaneous infection. There were no palpable lymph nodes at the ipsilateral axilla. The contralateral breast and axilla were unremarkable. She had a 22-pack-year smoking history and denied other co-morbid conditions. There was no identified history of breast cancer in the family. Core needle biopsy of the left breast mass showed invasive ductal carcinoma, and a mammogram did not reveal other synchronous lesions.

Various treatment options were offered but the patient opted for immediate surgery. She underwent left modified radical mastectomy (MRM), with an operative time of 180 minutes, no intraoperative blood transfusion required, and no intraoperative complications noted. Antibiotic prophylaxis with Cefazolin 2 g was given to the patient prior to skin incision. The surgery was performed by a junior surgical trainee (3rd year resident) assisted by a senior resident (subspecialty fellow). As per institutional practice, in the absence of any post-operative complications, the patient was discharged on the first day after surgery with a Jackson-Pratt (JP) drain, with instructions on daily wound care, JP drain output monitoring, and outpatient follow-up after one week.

The patient sought consult at the emergency department on the 6th post-operative day due to skin erythema over the post-operative site which progressively discolored and spread to involve the right breast accompanied by turbid foul-smelling discharge from the JP drain over the past two days. She did not report any fever or significant post-operative site pain. On admission, she had an initial blood pressure of 90/60 mmHg, heart rate of 118 beats per minute, and temperature of 36.8°C. Examination of the anterior chest area showed a necrotic superior skin flap on the left chest with extension of skin changes to the right breast and areolar area (Figure 1). Her initial blood count showed low hemoglobin and hematocrit at 89 g/L and 0.27, respectively, elevated white blood cell count at 19.56 x $10^9$/L with neutrophilic predominance of 0.92, and a low platelet count at 64 x $10^9$/L.

Intravenous hydration, empiric broad-spectrum antibiotic coverage with Piperacillin-Tazobactam, and monitoring of urine output and central venous pressure were initiated. Inotropic support was started due to decreasing blood pressure during the initial resuscitation phase. Upon emergent operation, there was note of nonviable skin flaps on the left chest and infected necrotic tissue on the right breast with loss of resistance on blunt dissection of the fascial plane. The bilateral pectoralis major muscles were viable. A total mastectomy on the right and wide debridement of all necrotic tissue on the left chest were performed (Figure 2).

She was admitted to an intensive care unit post-operatively and maintained on ventilatory and inotropic support. A second-look operation performed 12 hours after the initial surgery revealed progression of necrosis to the left lateral abdominal wall and flank area. Further debridement was performed, but intraoperative episodes of hypotension precluded complete excision of all necrotic tissue. Counter-incisions were placed on the left lateral abdominal wall for drainage and access for bedside dressing. Ventilatory and

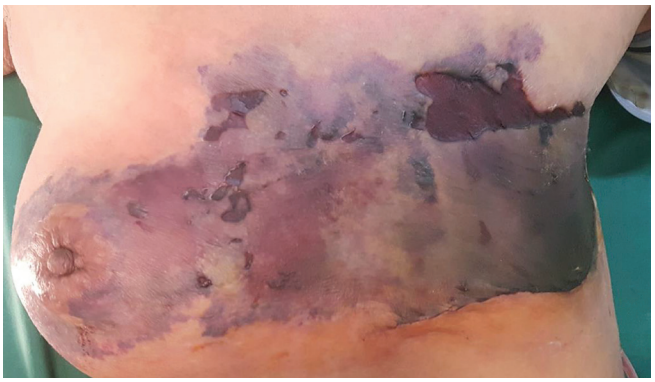

**Figure 1.** Ecchymosis, skin sloughing, and flap necrosis over the left chest with extension to the right breast.

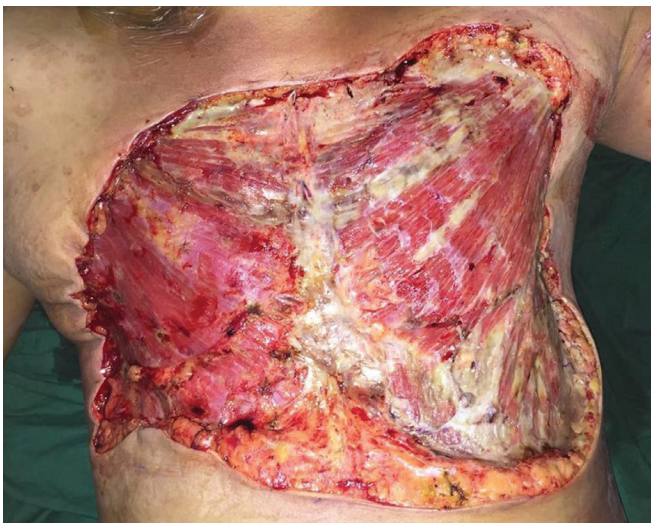

**Figure 2.** Post-operative photograph after initial debridement of the left chest and right mastectomy showing viable margins and pectoralis muscles.

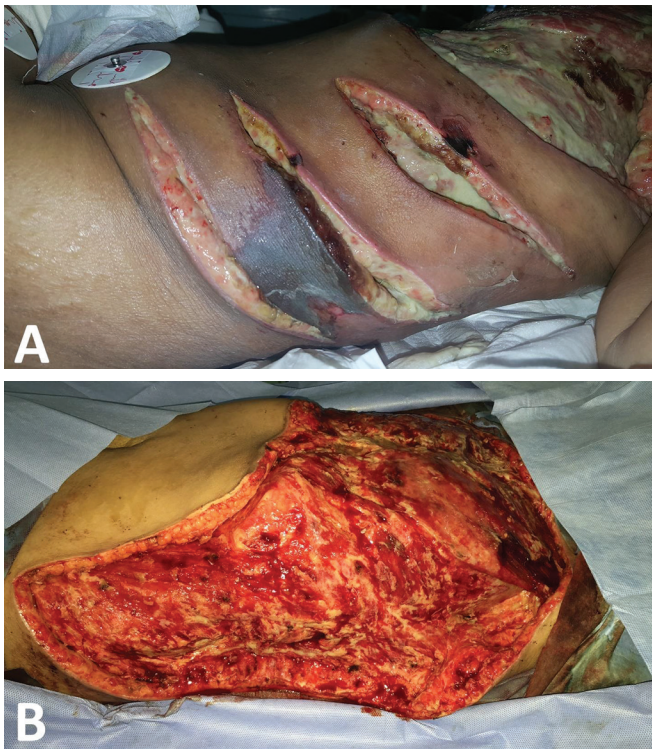


**Figure 3.** **(A)** Progression of infection over left lateral abdominal wall with ecchymosis, discoloration of subcutaneous tissue, and skin sloughing despite debridement over fascial layer and placement of incisions for drainage. **(B)** Post-operative photograph after final debridement of left lateral abdominal wall.

inotropic support were weaned and discontinued by the 5th day after the initial operation. Tissue culture studies yielded growths of *Staphylococcus pasteuri*, *Klebsiella pneumoniae*, and *Escherichia coli*. Antibiotics were shifted to meropenem, colistin, and vancomycin, and the wound was cleaned and dressed daily with sodium hypochlorite solution. The patient underwent another debridement on the 11th hospital day for complete removal of all necrotic tissue on the left lateral abdominal wall and flank regions (Figure 3).

By the 18th hospital day, there was significant granulation over the debridement sites and no signs of progressing infection. A negative pressure wound therapy (NPWT) appliance was applied to assist with further granulation and healing, which was replaced every three days. After 10 days with use of the NPWT appliance, the wound was almost completely covered with healthy granulation tissue. Split-thickness skin grafting was performed for wound coverage (Figure 4). Upon evaluation of adequate graft take and completion of intravenous antibiotic courses, the patient was discharged on the 37th hospital day.

The patient was seen on outpatient follow-up with good healing of the skin graft sites (Figure 5). Informed consent for inclusion in the case report was obtained at this time. Histopathologic examination of the initial mastectomy specimen showed a 2-centimeter invasive ductal carcinoma with metastasis to 10 out of 15 axillary lymph nodes, no lymphovascular space invasion, with a TNM pathologic staging of IIIA (T1N2M0). She started adjuvant chemotherapy on the 10th week after the initial mastectomy and has completed four cycles of doxorubicin and cyclophosphamide followed by four cycles of docetaxel with no untoward incidents. She is scheduled to undergo adjuvant radiotherapy for the advanced nodal disease.

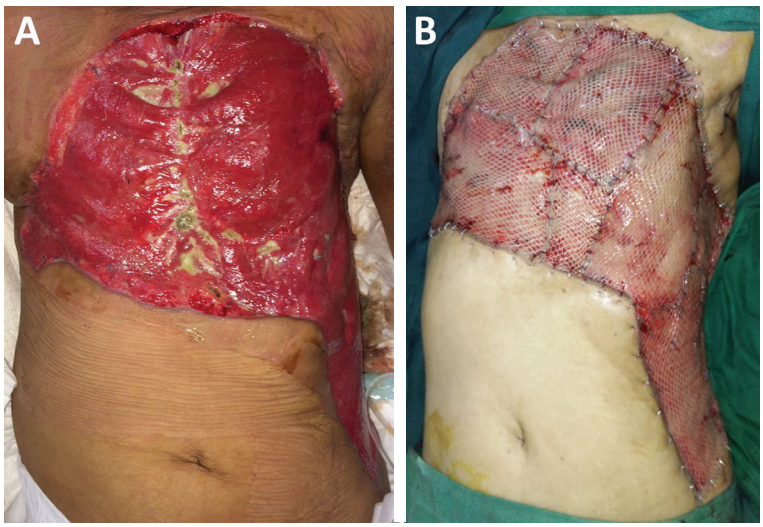


**Figure 4.** **(A)** Bed of healthy granulation tissue over wound after application of vacuum-assisted closure. **(B)** Post-operative photograph after split-thickness skin grafting over wound sites on chest and left lateral abdomen.

**Figure 5.** Healing of skin grafts with adequate graft take during outpatient follow-up.

## DISCUSSION

One hundred five reported cases of necrotizing fasciitis of the breast have been identified in the literature.[3,6-35] Primary breast fasciitis with no identified antecedent cause and fasciitis developing during the lactation period make up majority of the cases, with 44 cases (42%) of primary breast NF and 37 cases (35%) in lactating mothers. Only 18 cases of breast NF (17%) have been reported to occur after a surgical procedure. These consist of seven oncologic resections for invasive ductal carcinoma, five cosmetic procedures, three simple excisions, two core needle biopsies, and one cosmetic hydrogel injection. Two cases were associated with minor trauma, two cases occurred in association with herpes zoster flares, and one case each were associated with an insect bite and an arteriovenous fistula complication. This case is the eight report of necrotizing fasciitis of the breast occurring after an oncologic resection for breast cancer. The clinical data of these eight cases are summarized in Table 1.[5,31-35]

Mastectomies on non-inflamed or non-infected breasts are classified as clean surgical operations, and have an overall surgical infection rate of less than 2%. Aside from the site of operation, multiple intrinsic and extrinsic factors can affect the subsequent risk of developing surgical site infections even

**Table 1.** Clinical Characteristics of Breast Necrotizing Fasciitis Cases Occurring after Cancer Resection in the Literature

| Case | Author (Year) | Age | Sex | Procedure | Timing after operation | Symptoms | Areas of involvement |
|---|---|---|---|---|---|---|---|
| *1* | Eugster (1997) | 63 | F | Mastectomy | N/A | N/A | N/A |
| *2* | Velchuru (2006) | 61 | F | Right mastectomy with level 3 axillary dissection | Day 5 | Pain, fever, chills, purulent discharge, edema, skin necrosis | Right chest |
| *3* | Gehlen (2008) | 59 | F | Left sentinel node biopsy and axillary dissection, prior left mastectomy | Day 9 | Pain at drain site after removal, skin discoloration | Left anterior and posterior thorax, left axilla and proximal upper extremity |
| *4* | Subramanian (2010) | 59 | F | Right mastectomy with sentinel node biopsy and level 2 axillary dissection | Day 7 | Pain, cellulitis, flap necrosis, foul odor | Right chest |
| *5* | Angarita (2010) | 43 | F | Left quandrantectomy with sentinel node biopsy and level 2 axillary dissection | Day 35 | Wound dehiscence, pain, fever, edema, erythema, crepitus, purulent discharge | Left chest, right breast |
| *6* | Vieira (2012) | 55 | F | Left modified radical mastectomy, latissimus dorsi myocutaneous flap | Day 4 | Pain, fever, purulent discharge | Left chest |
| *7* | Vieira (2012) | 57 | F | Left modified radical mastectomy | Day 32 | Seroma formation, pain, fever, vomiting, cellulitis, skin necrosis | Left chest |
| *8* | Abon (2023) | 46 | F | Left modified radical mastectomy | Day 4 | Erythema, skin necrosis, purulent discharge | Left chest, right breast, left flank and abdominal wall |

| Case | Comorbidities | Pathogens | Antibiotic treatment | Intervention | Wound closure | Outcome |
|---|---|---|---|---|---|---|
| *1* | Obesity | *Streptococcus pyogenes* | Amoxicillin-clavulanic acid, gentamicin | Hyperbaric oxygen | N/A | Died |
| *2* | Obesity | Methicillin-sensitive *Staphylococcus* sp, *Enterococcus* sp, mixed anaerobes | Empiric broad-spectrum antibiotics | Debridement | Unspecified wound closure | Recovered |
| *3* | None | *Streptococcus pyogenes* | Empiric amoxicillin-clavulanic acid, gentamicin → intravenous penicillin | Debridement | None | Recovered |
| *4* | Obesity | Coagulase-negative *Staphylococcus* sp, mixed coliforms, skin flora | Empiric broad-spectrum antibiotics | Debridement | Negative pressure assisted closure, split-thickness skin grafting | Recovered |
| *5* | Overweight, AV nodal reentry tachycardia | Oxacillin-resistant *Micrococcus* sp, multi-drug sensitive *Streptococcus milleri* | Empiric oxacillin → piperacillin-tazobactam, vancomycin | Bilateral mastectomy | Negative pressure assisted closure, reverse abdominoplasty | Recovered |
| *6* | Overweight, hypertension | ***Pseudomonas aeruginosa*** | Empiric ceftriaxone, ampicillin, gentamicin | Debridement | Primary closure | Recovered |
| *7* | Overweight, hypertension, type 2 diabetes mellitus | ***Streptococcus pyogenes*** | Empiric vancomycin, metronidazole, cefepime | Debridement | None | Died |
| *8* | Smoking history | *Staphylococcus pasteuri*, *Klebsiella pneumoniae*, *Escherichia coli* | Empiric piperacillin-tazobactam → meropenem, colistin, vancomycin | Right mastectomy, debridement of left chest and flank | Negative pressure assisted closure, split-thickness skin grafting | Recovered |

in clean operations. Factors intrinsic to the patient that can increase infection risk include advancing age, malnutrition, ongoing infection, and presence of co-morbidities such as diabetes and immunosuppressive conditions including malignancy. Extrinsic risk factors include surgeon skill and experience level, operative duration, skin asepsis and antibiotic prophylaxis, implant insertion, instrument sterility, and operating theater quality.[36] Less experienced surgeons can incur more surgical site infections due to prolonged operating times and less awareness of potential breaks in sterility during the procedure. Lack of surgical experience also play a role in the technical aspects of surgeries like mastectomies, where incorrect dissection and development of the skin flaps can lead to devascularization and eventual infection.

Necrotizing fasciitis may be subdivided into two general types based on the etiologic organisms of the infection. Type I NF is a polymicrobial infection and may involve Gram-positive, Gram-negative, and anaerobic microorganisms in combination. This type is more commonly seen, and is usually associated with immunocompromised conditions and cases with injury to the normal mucocutaneous barrier, such as with surgical procedures.[1,3] Type II NF is monomicrobial in origin, and the most common organisms involved are *Streptococcus pyogenes* and *Staphylococcus aureus*. Other possible pathogens include *Klebsiella, Clostridium*, *Pseudomonas*, and other bacterial and fungal species.[1,3] Among all 106 cases of breast NF, there is a near-equal distribution of polymicrobial (48 cases, 45.3%) and monomicrobial (46 cases, 43.4%) infections. Among reports with specific bacterial species isolated, the most prevalent pathogen is *S. pyogenes*, which was identified as a solitary organism in 18 cases and was seen in three cases with polymicrobial infections. Nine cases (8.5%) had no bacterial growths on culture, and three cases (2.8%) did not report any microbiologic findings. Among the eight cases associated with a cancer surgery, three cases had monomicrobial *S. pyogenes* infection, one had a solitary *P. aeruginosa* growth, two had polymicrobial infections with multiple Gram-positive species, and two cases including the present one had mixed Gram-positive and Gram-negative bacterial cultures.[5,31-35]

Early recognition of the clinical signs and symptoms of breast NF is crucial for timely management and for optimizing breast preservation, particularly in cases which have not previously undergone mastectomy. The breast anatomy presents a distinct challenge in the diagnosis of NF, as the thickness of the subcutaneous and mammary tissue intervening between the skin and the fascial layer may delay the appearance of cutaneous signs until advanced stages of infection, at which point sepsis and systemic organ dysfunction may already be present.[2,3] Initial symptoms include fever, erythema, edema, and pain or tenderness which may be disproportionate to the extent of visible disease. More overt symptoms such as skin ecchymosis, blister and bullae formation, crepitus, purulent discharge, and frank tissue necrosis present later in the course of the disease, at which time extensive and potentially disfiguring surgery will be needed for source control.[1-3]

Among the NF cases preceded by an oncologic excision or mastectomy, the most common symptoms identified were severe pain at the post-operative site, fever, skin necrosis, and purulent discharge from the wounds or surgical drains. Severe symptoms may present earlier in these cases because of the removal of intervening subcutaneous breast tissue allowing more rapid spread of infection, as well as a tenuous blood supply to the developed skin flaps and dissected tissue regions. Appearance of any of these symptoms in the post-mastectomy patient should alert the surgeon to the risk of a necrotizing infection rather than just a simple surgical site infection.

The timing of infection relative to the surgery is also variable. Six out of the eight breast NF cases with an antecedent procedure developed within a week after surgery, while two cases developed NF more than a month after operation. Both late cases presented with other local wound complications prior to the onset of NF. One patient reported by Angarita et al. had wound dehiscence and fever by the 28$^{th}$ post-operative day, and the second case reported by Vieira et al. had seroma formation at the axillary region on the 7$^{th}$ post-operative day and underwent multiple aspirations prior to developing NF.[34,35] The possibility of developing breast NF up to the late post-operative period must be emphasized, and the presence of other wound complications should be considered as possible causative events or risk factors for progression to fasciitis.

Due to the difficulty in diagnosing NF solely based on clinical signs and symptoms, several adjunctive tests and diagnostic indicators have been proposed. The finger test is a simple bedside procedure where a small incision is made on the suspected area of involvement under local anesthesia and carried down to the fascial layer. The absence of bleeding, drainage of turbid foul-smelling purulent fluid, or loss of resistance of the fascial interface to blunt finger dissection constitute a positive test supporting the diagnosis of NF.[37] Plain radiographs may show soft tissue swelling or subcutaneous air pockets, while sonography, computed tomography, and magnetic resonance imaging may visualize tissue edema, fascial thickening and irregularity, abnormal fluid or gas collections along the fascial planes, and enhancement of inflamed tissues on contrast administration or T2-weighted imaging.[1,3,38] However, imaging tests are not considered the gold standard of diagnosis, as confirmation is usually obtained through operative and pathologic findings.

The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score was developed by Wong et al. as an adjunct in differentiating NF from non-necrotizing soft tissue infections. The laboratory parameters included in the LRINEC score and their corresponding points are listed in Table 2. A LRINEC score ≥6 was shown by the original authors to have a positive predictive value (PPV) of 92% and negative predictive value (NPV) of 96%.[37] External validation of the LRINEC score has unfortunately produced lower accuracy scores, with 43-59% sensitivity, 83% specificity, PPV

**Table 2.** The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) Score[37]

| Variables (Units) | Score |
|---|---|
| ***C-Reactive Protein (mg/L)*** | |
| <150 | 0 |
| ≥150 | 4 |
| ***Total white cell count (per mm³)*** | |
| <15 | 0 |
| 15-25 | 1 |
| >25 | 2 |
| ***Hemoglobin (g/dL)*** | |
| >13.5 | 0 |
| 11-13.5 | 1 |
| <11 | 2 |
| ***Sodium (mmol/L)*** | |
| ≥135 | 0 |
| <135 | 2 |
| ***Creatinine (µmol/L)*** | |
| ≤141 | 0 |
| >141 | 2 |
| ***Glucose (mmol/L)*** | |
| ≤10 | 0 |
| >10 | 1 |

ranging from 18-38%, and NPV at 92-94% at a cut-off score of 6. Other authors have concluded that a positive LRINEC score may not be accurate in differentiating NF from other forms of severe soft tissue infections while a negative score may be used as an adjunct in avoiding extensive procedures in lower risk patients. However, clinical assessment should still be emphasized in the diagnosis and stratification of severe soft tissue infections, particularly in the early diagnosis of NF.[39-41]

Source control and supportive therapies for end-organ involvement remain the cornerstones of management for necrotizing fasciitis. Broad-spectrum antimicrobial therapy must target all possible etiologic organisms, with coverage for Gram-positive, Gram-negative, and anaerobic pathogens. Empiric antibiotic therapy is started during the initial resuscitation phase, while blood and surgical specimens are sent for both aerobic and anaerobic culture studies to determine definitive antibiotic coverage. Empiric agents include combination beta-lactam and beta-lactamase inhibitors, carbapenems, and vancomycin for patients with risk factors for methicillin-resistant *Staphylococcus aureus* (MRSA) infection such as prior colonization or diabetes mellitus.[1,3]

Radical debridement must be performed early in the management phase, and serial intraoperative investigations are warranted due to the rapid progression of NF. In cases of primary breast NF, a total mastectomy may be necessary for the removal of the involved breast, while radical debridement of all necrotic tissues and explantation of artificial implants may be required for patients with previous breast operations. A second-look procedure is recommended within 24 hours of the initial operation to identify further necrosis and determine the need for additional debridement.

Several adjunctive therapies have been suggested for cases of NF, but their use must not interfere with the initiation of appropriate antibiotic therapy and surgical debridement. One report demonstrated successful breast tissue preservation with limited debridement and use of hyperbaric oxygen (HBO) therapy, however the overall utility of HBO in the management of NF has shown mixed results in other studies and remains controversial at this time.[1,3,42] Intravenous immune globulin may be administered in cases of *S. pyogenes* infection to theoretically neutralize circulating exotoxins causing organ failure, but its actual benefits are still under investigation.[1,3] Negative pressure wound therapy is a valuable tool in the arsenal of wound management, where continuous low-pressure suction applied over the wound area aids in infection clearance and promotes growth of healthy granulation tissue. Various wound coverage and reconstructive options may be performed once the infection has been eradicated, patient condition has improved, and adequate healing is observed in the affected areas.

## CONCLUSION

Necrotizing fasciitis of the breast may occur in patients who have undergone mastectomies or cosmetic breast procedures but is still more commonly reported in patients without any direct antecedent cause. Necrotizing fasciitis in the post-mastectomy patient may be caused by monomicrobial or polymicrobial infection and may present either early or late in the post-operative period. Broad-spectrum antibiotic coverage and source control via radical debridement of necrotic tissue remain the mainstays of treatment.

### Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

### Author Disclosure

All authors declared no conflicts of interest.

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