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Case Report

Hematologic malignancies combined with acute necrotizing fasciitis: a report of 3 cases and literature review

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Abstract: A retrospective analysis was conducted on the clinical data of 3 patients with hematologic malignancies complicated with necrotizing fasciitis (NF) admitted to the Hematology Department of Tianjin Union Medical Center in June 2021, March 2024, and November 2024. Also, according to search results for relevant literature on hematological malignancies combined with necrotizing fasciitis published before October 2025, 6 articles (6 cases) were included. Among them, 6 were male and 3 were female, with ages ranging from 4 days to 76 years. All 9 patients presented with fever accompanied by local swelling and pain. Comprehensive imaging examinations (e.g., CT, MRI) were conducted on all cases to confirm NF, with perianal infection, limb soft tissue infection, perineal infection, and external oblique muscle infection identified in 3, 4, 1, and 1 cases, respectively. Among the 9 patients, one infant patient died after not continuing treatment following anti-infective therapy. The remaining 8 patients all received treatment for this disease along with active anti-infection and surgical debridement therapy. One patient died of septic shock, and 7 showed improvements (leukemia remission, infection control, and wound recovery). For patients with hematologic malignancies and NF, surgical debridement should be performed as soon as possible after diagnosis. Early broad-spectrum antibiotics combined with anti-infection treatment should be administered, with the anti-infection treatment adjusted based on the drug sensitivity evidence of the pathogenic bacteria.

Keywords: Hematologic malignancies, necrotizing fasciitis, immunodeficiency, multidisciplinary collaboration, diagnosis and treatment strategy

Introduction

Chemotherapy or illness-induced agranulocytosis is an independent contributor to fatal infections in patients with hematologic malignancies. Necrotizing fasciitis (NF) is a rapidly developing soft tissue infection with a mortality rate reaching up to 25-35% [1]. In recent years, with the widespread application of new immunosuppressants, targeted drugs, and cell therapies, as well as the increasing infection of multidrug-resistant organisms (MDROs), the clinical characteristics, diagnosis, and treatment strategies of hematological diseases complicated with NF have presented new challenges and research progress. Cases of hematologic malignancies complicated with NF are rare and difficult to treat, requiring combined surgical intervention, anti-infection, and immune support. Through three successful treatment cases and a review of relevant literature over the past 10 years, this article summarizes the key points of diagnosis and treatment.

Materials and methods

The general information of the patients was collected from electronic medical record. This study was approved by the Institute Research Ethics Committee at the First Affiliated Hospital of Nankai University.

Case presentation

Case 1

A 61-year-old male patient complained of "fatigue and fever for more than half a month"

and was admitted to our hospital on June 17, 2021. In early June 2021, the patient experienced progressive worsening of fatigue, accompanied by shortness of breath after activities.

Routine blood tests in the local hospital showed WBC 1.5×10^9/L, HGB 88 g/L, and PLT 26×10^9/L. The patient had pancytopenia and thus visited the Tianjin Hematology Hospital. A complete blood count was performed, revealing a WBC of 0.84×10^9/L, an HGB of 77 g/L, and a PLT of 33×10^9/L. The bone marrow morphology suggested acute myeloid leukemia (AML; 93.5% blasts on the marrow smear and 32% blasts on the blood smear).

Bone marrow flow cytometry indicated an abnormal cell population accounting for 89% of nucleated cells, expressing CD34, CD117, CD-38, and CD33, partially expressing CD7, MPO, and CD64, weakly expressing HLA-DR, and no expressing CD13, cCD3, or other myeloid and lymphoid markers. This was consistent with an AML phenotype, but morphology and genetic testing should be correlated. The WT1 fusion gene was positive. The patient was diagnosed with AML. After rechecking the blood routine (WBC: 0.64×10^9/L, HGB: 73 g/L, PLT: 24×10^9/L), he was given one therapeutic dose of platelets via intravenous infusion. One the day before admission, the patient had a recurrence of fever with the highest temperature reaching 38°C. There were no chills or shivering discomfort. The patient came to our emergency department for further treatment and was given dexamethasone (5 mg) for fever reduction, moxifloxacin for anti-infection, and sugar and salt rehydration for symptomatic treatment. After these treatments, the body temperature returned to normal. On June 21, 2021, the patient was admitted to our department for further treatment. Examinations revealed the following findings: Complete blood count: WBC 0.41×10^9/L, NEUT 0.10×10^9/L, RBC 1.91×10^{12}/L, HGB 60 g/L, PLT 40×10^9/L; normal liver, kidney, and coagulation functions; chromosome karyotype analysis: +8 (trisomy 8, a clonal abnormality); gene mutations: IDH1 43%, BCORL1 2.5%, CEBPA 33.4%, PHF-6 84.8%. The patient was definitely diagnosed as acute monocytic leukemia (M5b; high-risk group).

After excluding contraindications, he received chemotherapy with the azacitidine + venetoclax regimen from June 18, 2021 to July 1, 2021. On the 4th day after chemotherapy, the patient developed fever (up to 39.2°C); there was pain in the right calf, with the local skin temperature elevated upon palpation and obvious tenderness. Empirical treatment with piperacillin-tazobactam, tigecycline, and posaconazole was administered for anti-infection therapy. The examination results are as follows: Blood routine re-examination: WBC 0.11×10^9/L, NEUT 0.04×10^9/L, HGB 64 g/L, PLT 24×10^9/L. Color Doppler ultrasound of the right lower limb: no venous thrombosis or arterial occlusion was found. MRI of the right lower leg: (1) soft tissue swelling in the posterior part of the right lower leg, exudative changes in the medial and lateral heads of the gastrocnemius muscle and the adjacent deep and superficial fascia, and some effusion in the muscle spaces; (2) a few exudative changes in the soleus, the medial head of the gastrocnemius muscle, and the adjacent deep fascia of the left lower leg (**Figure 1A**). Blood culture + susceptibility (aerobic + anaerobic) testing: pathogen identified: Stenotrophomonas maltophilia; susceptibility: susceptible to levofloxacin, co-trimoxazole, and minocycline. According to the susceptibility results, the antibiotics were adjusted to levofloxacin, compound sulfamethoxazole, and tigecycline. After 3 days of anti-infection treatment, the patient's body temperature returned to normal.

However, the redness and swelling of the right lower leg progressively worsened, with obvious tenderness, exudation and ulceration of the epidermis, and necrosis of the skin and subcutaneous soft tissues. Acute NF was considered (**Figure 1B**). An abscess incision and drainage procedure was performed, with a drainage tube placed (**Figure 1C**). Approximately 400 mL of pus was drained. Drainage fluid culture with antibiotic susceptibility testing (aerobic + anaerobic) revealed Stenotrophomonas maltophilia positivity. After the operation, the redness and swelling of the patient's right calf were ameliorated, the drainage was smooth, and the pain was relieved. Three days later, a further debridement and dressing change of the superficial tissues were performed, and the drainage tube in the right lower leg was removed. Five days later, a blood routine test

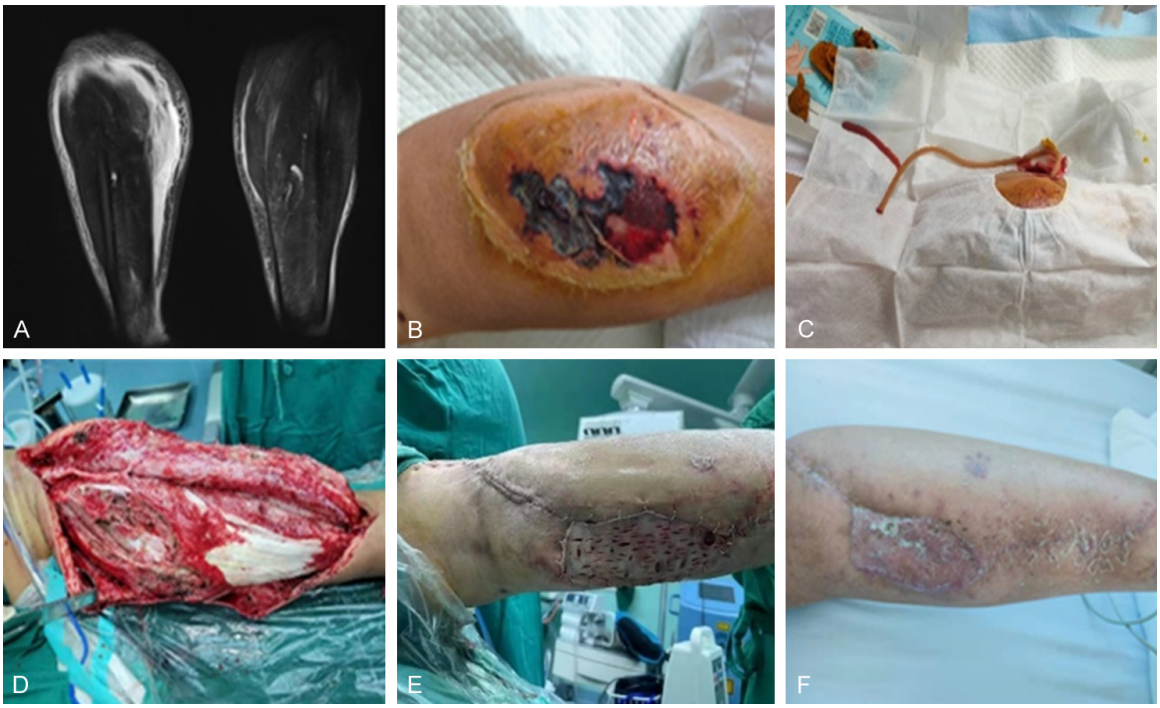

Figure 1. A 60-year-old male with acute myeloid leukemia type monoblastic (M5b). A. Initial T2-weighted MRI of the right lower leg shows ill-defined, patchy high signal intensity on fat-suppressed sequences within the medial and lateral heads of the gastrocnemius muscle and adjacent deep/superficial fascia, with fluid accumulation (long T1 and T2 signals) in the intermuscular spaces. B. The right lower leg is severely swollen and painful, with epidermal exudation, ulceration, and necrosis of the skin and subcutaneous soft tissues. C. Early incision and drainage for decompression. D. Surgical debridement of necrotic fascial tissue. E. Wound coverage with skin grafting. F. Successful graft survival at 3 months post-operation.

was rechecked, showing WBC 9.51×10^9/L, NEUT 9.03×10^9/L, HGB 89 g/L, and PLT 89×10^9/L. The patient's condition did not improve following more than 20 days of systemic anti-infection treatment. Therefore, a deep tissue debridement procedure on the right lower leg under local anesthesia was performed. During the operation, it was observed that the gastrocnemius fascia was infected and necrotic, with some muscle tissue also necrotic. The necrotic tissues were removed until the wound surface became fresh, and thorough hemostasis was achieved (**Figure 1D**). Vacuum sealing drainage (VSD) was performed after the operation. The VSD device was removed after 7 days of negative pressure drainage (200 mmHg) and suction, and skin graft harvesting from the right groin for the right lower leg wound was performed (**Figure 1E**). The patient was provided with regular dressing changes, nutritional support treatment, and sensitive antibiotics against infection. The stitches were removed 3 weeks after the operation. The skin graft survived and the wound healed well (**Figure 1F**).

A follow-up bone marrow examination six months after surgery indicated that the treatment for AML had achieved complete remission. The patient received a total of 5 cycles of consolidation treatment with azacitidine + venetoclax. The patient's right calf wound healed well, with no recurrence of infection, normal joint function, and resumed daily work and life. On March 20th, 2022, the bone marrow morphology re-examination results were indicative of relapsed AML, with 64.5% blasts on morphology, ~60.97% abnormal blasts by flow cytometry (MRD), and an elevated WT1 level of 1172.63. Considering disease recurrence, it was recommended that the patient be enrolled in a clinical trial for treatment. However, due to the patient's fever complicated with active infection of the gingival soft tissue, and with convulsion and good right lower limb, the patient and his family refused to be enrolled in the clinical trial and did not continue with chemotherapy after fever resolution via active anti-infection treatment. The patient requested to be discharged and was lost to follow-up.

Case 2

The patient is a 38-year-old male. On November 5, 2024, he visited Peking University School and Hospital of Stomatology for repeated gum swelling and underwent oral biopsy for pathological examination. It was considered to be a lymphoid tissue proliferative lesion and was recommended to undergo immunohistochemistry. On November 12, 2024, the sample was sent to Peking University People's Hospital for pathological review. It was considered to be a malignant tumor, and lymphoid hematopoietic system tumors were not excluded.

Combined with immunohistochemistry, a myeloid sarcoma was considered. On November 18, 2024, PET-CT was completed at Handan Hengang Hospital: the FDG metabolism in the left inferior alveolar gum tissue was increased, suggesting a malignant lesion; multiple lymph nodes were present in the left neck and left long head muscle, with elevated FDG metabolism, indicating metastasis; the lymph nodes noted in the superior mesenteric artery region on imaging and the FDG metabolism elevation suggested metastasis. A further examination on November 20, 2024, demonstrated the following: bone marrow morphology: hypocellular marrow with 3.5% blasts and 1.5% promyelocytes (requiring clinical correlation); bone marrow flow cytometric immunophenotyping (250,000 nucleated cells): normal level of CD34+CD117+ immature cells (0.14%), which expressed BCL2 without aberrant immunophenotype; genetic testing: positive NPM1 mutation and negative FLT3-ITD and TP53 mutations; fusion gene testing: no fusion genes, with significant overexpression of WT1 and PRAME and a WT1/ABL ratio of 7.2%); normal EVI1 expression and MLL-PTD mutation level; marrow biopsy: MF-0 with hypercellular hematopoiesis. Later, the patient visited the Chinese Academy of Medical Sciences, Institute of Hematology.

On December 5, 2024, a biopsy of the left lower gingival tissue was performed, and the pathological result indicated myeloid sarcoma. Subsequently, the following tests were completed: Bone marrow morphology: the bone marrow was markedly hypercellular, with hemocytoblasts observed in 37% of the bone marrow slices, suggesting AML (non-m3 subtype); Bone marrow biopsy: HE and PAS staining showed that the examined bone marrow was relatively fragmented, with a small amount of hyperactive bone marrow (about 70%), increased blasts that were scattered or in patchy distribution, and reticular fiber staining (MF-1 grade). The patient was definitely diagnosed with AML and was treated with drugs such as cytarabine (the specific drugs are unknown). Later, during the patient's remission period, a perianal abscess occurred and was treated by incision and drainage at a local hospital. The patient later reported that the wound had healed. On January 9, 2025, the patient re-visited the Chinese Academy of Medical Sciences, Institute of Hematology. A re-examination of the bone marrow morphology showed that after the treatment for AML, there was trilineage hyperplasia and relative erythroid hyperplasia.

After excluding contraindications, high-dose cytarabine was administered for consolidation chemotherapy (2 g/m^2 day 1-3). After chemotherapy, the patient suffered from perianal ulceration during the bone marrow suppression period. The ulceration area gradually expanded, accompanied by scrotum enlargement (**Figure 2A**), fever, and dysuria. On January 24, 2025, the patient visited our department with the following test results: blood routine: WBC 4.49×10^9/L, NEUT 4.28×10^9/L, HGB 72.00 g/L, PLT 28.00×10^9/L; blood coagulation test at admission: plasma prothrombin time (coagulation method): 15.3 seconds, PT-INR: 1.32↑, plasma fibrinogen (coagulation method): 11.46 g/L, D-dimer quantification (immunoturbidimetric method): 0.69 mg/L↑. After a consultation with the colorectal surgery department, it was considered that the patient had AML complicated with NF.

On January 24, 2025, the patient underwent a general anesthesia-assisted resection and debridement of the necrotic tissue in the anal skin and subcutaneous area. During the operation, the scrotum, right hip, and left perianal skin were found to be red and swollen, accompanied by large areas of necrosis, purpura, local blisters, and severe scrotal edema. The skin on the right buttock, the left perianal area and the scrotal region was incised until the superficial fascia layer was reached. The necrotic fascia was removed and the pathological samples were collected until normal tissue was

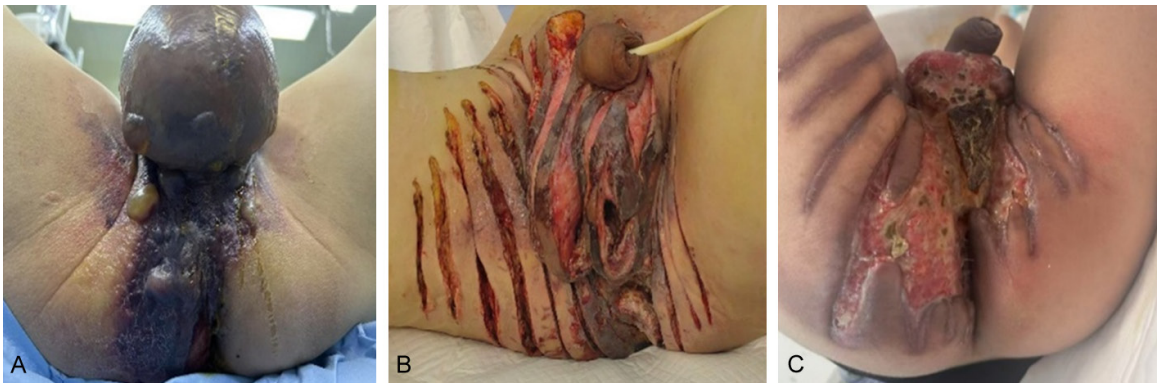

Figure 2. A 38-year-old male patient with acute myeloid leukemia. A. Perianal and scrotal tissue necrosis at initial disease onset before operation; B. Clinical status on day 1 after debridement of the necrotic perianal skin and subcutaneous tissue; C. Favorable healing of the perianal and scrotal wounds approximately two months after the procedure.

reached. The skin of the affected area was incised section by section for end-to-end drainage, and precise hemostasis was achieved. After being repeatedly washed with hydrogen peroxide, the wound was rinsed with normal saline, packed with hemostatic gauze, and finally treated with a pressure dressing. The patient was safely returned to the ward after the operation (**Figure 2B**). The patient suffered from anemia and low platelet count. Oral ibrutinib was administered to increase platelet count, and intravenous infusion of red blood cells and platelets was provided for supportive treatment. For perianal NF, imipenem, vancomycin, and posaconazole tablets were used in combination for anti-infection. Subsequently, the culture of posterior perianal secretions showed multidrug-resistant Acinetobacter baumannii and Escherichia coli; hence, the antibiotics were adjusted to imipenem, linezolid, levofloxacin, isavuconazole, and oral compound sulfamethoxazole for anti-infection.

On February 23, 2025, a follow-up bone marrow aspiration was conducted. The bone marrow morphology was consistent with complete remission after treatment for AML; the bone marrow flow cytometry showed no residual disease; NPM1 gene mutation quantification indicated 0%. The therapeutic efficacy was evaluated as CR. Starting from February 24, 2025, the Azacitidine + Venetoclax regimen was used for consolidation chemotherapy. On March 24, 2025, a repeated bone marrow examination was carried out: bone marrow findings indicated complete remission. Bone marrow flow cytometric analysis showed negative residual disease. NPM1 gene mutations were not detected (0%). Confirming no contraindications, the patient was given a consolidation chemotherapy (Azacitidine + Venetoclax) March 24, 2025. The perianal wound recovered well (**Figure 2C**). After chemotherapy, the patient was discharged on March 30, 2025. He received subsequent treatment at the local hospital and did not return to the hospital. And he was lost to follow-up.

Case 3

A 48-year-old female patient was admitted to our hospital on March 29, 2024, because of "intermittent nausea and acid reflux for more than 2 years, and a follicular lymphoma diagnosis more than 1 month ago".

Approximately 2 years before admission, the patient experienced intermittent nausea (with no obvious cause) accompanied by acid regurgitation, occasionally with vomiting. The vomitus was gastric contents. There was no abdominal pain, diarrhea, fever, chills, hematuria, or black stool. She was diagnosed with gastric polyps by gastroscopy in a local hospital a year ago, and then underwent an endoscopic polypectomy. However, the symptoms did not show significant relief. About one month ago, the patient felt worsening of the aforementioned symptoms. She then underwent a re-examination of the stomach through gastroscopy at Langfang People's Hospital. The results indicated gastric antral xanthoma, gastric angle erythema (awaiting pathology), chronic atrophic gastritis (C1) with erosion, and possible

duodenitis. Pathological report: Duodenum - The mucosa exhibits chronic inflammation with only a few mucosal glands present and a large number of lymphocytes presenting diffuse and monotonous hyperplasia in the submucosa; the possibility of neoplastic lesions cannot be excluded, recommending external consultation. Antrum - The gastric mucosa shows chronic inflammation, with mild intestinal metaplasia and local glandular hyperplasia; clinical follow-up is advised.

Gastric angle - The gastric mucosa shows chronic inflammation. The sample was submitted to the Peking University Cancer Hospital for pathological consultation: Duodenum - non-Hodgkin lymphoma, duodenal follicular lymphoma; immunohistochemistry: Bcl-2(+), Bcl-6(+), CD10(+), CD20(+), CD21(-), CD23(+), CD3(-), CMYC(-), CD5(-), CYCLIND1(-), Ki67%(+5%), MUM-1(-), PAX-5(+); Antrum - Chronic inflammation of mucosal tissue with intestinal metaplasia; Gastric angle - chronic mucosal tissue inflammation. Later, the patient visited our general surgery department on March 14, 2024. The results of the blood routine test were: WBC 10.19×10^9/L, RBC 3.9×10^{12}/L, HGB 106 g/L, and PLT 324×10^9/L.

PET-CT: A duodenoscopic biopsy returned a pathology diagnosis of follicular lymphoma. The pretreatment assessments included: (1) multiple hypermetabolic lymph nodes in mesentery and its roots, retroperitoneum, and bilateral common iliac vessels, suggesting lymphoma invasion; (2) heterogeneous radiotracer uptake in the 1-3 segments of the duodenum, with coarse mucosa and small nodules on CT scans of the same anatomical level, indicating residual lymphoma. Based on the above findings, follicular lymphoma (Deauville score: 4 points, Ann Arbor stage: IIE or IV) was considered. The patient visited our department on March 29, 2024. The bone marrow morphology and flow cytometry showed no obvious abnormalities. The diagnosis was follicular lymphoma, with an Ann Arbor stage VI, an A FLIPI score of 2 points, and an FLIPI score of 1 point. After excluding the contraindications, the patient started 4 cycles of the G-CHOP chemotherapy regimen (The conventional dosage was calculated based on body surface area) on March 31, 2024: Obinutuzumab 1000 mg, ivd, d0, cyclophosphamide (1200 mg, ivd, d1), epirubicin (110 mg, ivd, d1), vindesine (4 mg, ivd, d1), and prednisone [100 mg, per os (po), d1-5]. On July 2, 2024, the patient was admitted to the hospital urgently due to fever and thigh pain. Based on the MRI of both hip joints from another hospital (multiple masses in the right hip joint and the upper segment of the femur's muscle tissue, suggesting infectious lesions and recommending further contrast-enhanced examination; traumatic arthritis of the right hip joint, muscle atrophy of the right buttock and upper femur, requiring correlating with clinical history; bone marrow edema and cystic changes in the greater trochanter of the left femur; swelling of subcutaneous tissues in both hips), as well as the blood test results (WBC 1.01×10^9/L, NEUT 0.68×10^9/L, HGB 53 g/L, PLT 152×10^9/L), the diagnosis was chemotherapy-induced bone marrow suppression, severe granulocytopenia, and NF of the thigh soft tissues. The patient was treated with G-CSF (5 μg/kg) to increase white blood cells, intravenous infusion of red blood cells, and empiric treatment with biapenem and linezolid for infection control.

The MRI of the right thigh (**Figure 3A**) showed: 1. abnormal signal shadows within the bone marrow of the proximal part of the right femur, along with cystic lesions in the surrounding soft tissues and surrounding exudative changes, suggesting an infectious lesion and pus formation; 2. right hip arthritis and right femoral head necrosis. A consultation with the chief of trauma orthopedics was carried out. Local pus aspiration and decompression were performed bedside (**Figure 3B**), and the antibiotics were changed to imipenem/cilastatin combined with linezolid. The patient experienced intermittent high fever, and it was not ruled out that it was caused by a resistant bacterial infection. Therefore, the treatment was adjusted to cefoperazone/sulbactam, ciprofloxacin, and linezolid for anti-infection. Given the persistent intermittent high fever and progressively worsening localized pain in the right thigh, infection control was deemed unsatisfactory.

The effect of intravenous anti-infection treatment was not satisfactory. The platelet count was 102, and the blood coagulation was normal, which met surgical indications. The patient underwent a right thigh soft tissue incision and drainage surgery under general anesthesia on

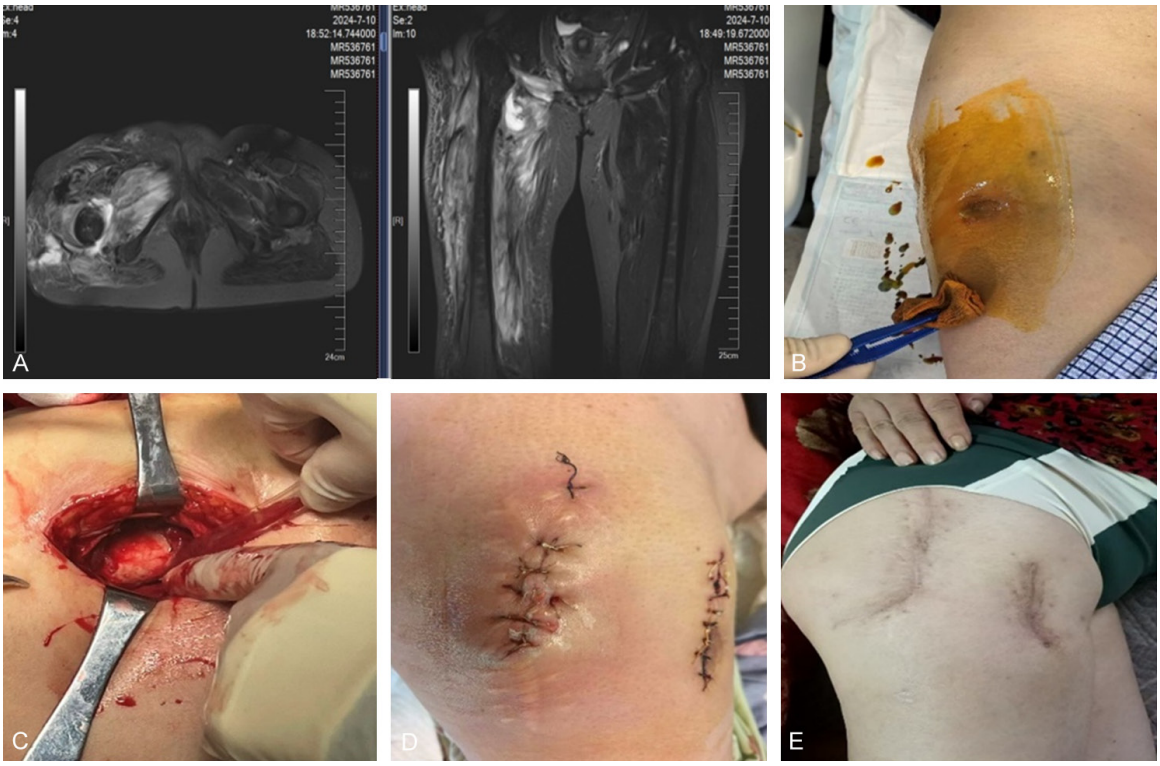

Figure 3. A 48-year-old female patient with follicular lymphoma. A. In the early stage of the disease, MRI of the right thigh showed signal abnormality within the bone marrow of the proximal part of the right femur, along with cystic lesions in the surrounding soft tissue and exudative changes around; B. Local pus aspiration and decompression at the bedside; C. Right thigh soft tissue incision and drainage under general anesthesia; D. Resolution of local redness and swelling with subsequent drain removal; E. Well-healed wound of the right thigh.

July 5, 2024 (**Figure 3C**). During the operation, a sinus tract was seen in each of the anterolateral and posterolateral parts of the proximal right thigh, accompanied by purulent secretions. The tracts were incised, with one being approximately 5 cm long and the other 3 cm long. The skin at the edges of the tracts was removed, and the deep fascia was incised. A large amount of purulent discharge was seen to flow out. Within the abscess cavity, there were many septations extending to the femur, with the femur surface exhibiting a moth-eaten appearance. The necrotic tissue in the abscess cavity was cleared, and the cyst wall was repeatedly scraped off with a curette. After that, the wound was repeatedly rinsed with hydrogen peroxide, iodophor, and normal saline (9 L of saline). After hemostasis, a negative pressure drainage tube was placed, and the wound was closed. The operation went smoothly, the anesthesia was satisfactory, and 400 ml of blood was transfused during the procedure. The patient was safely returned to the ward after the surgery. The NGS test result of the pus sample showed highly virulent and drug-resistant Staphylococcus aureus. The anti-infection treatment was adjusted to a regimen combining Tazocin with daptomycin. The patient's hemogram recovered, and she was discharged for personal reasons (**Figure 3D**). After discharge, the patient's right thigh pain gradually worsened, and the abscess recurred. She underwent surgical treatment at another hospital (details unknown) and received continuous VSD treatment after surgery. Following the operation, she returned to our hospital regularly for targeted therapy with 1000 mg of Obinutuzumab, and was added to Lenalidomide chemotherapy intermittently. After 8 cycles of treatment, a PET-CT re-examination was conducted: (1) The multiple enlarged lymph nodes in the original abdominal cavity, retroperitoneum, and bilateral common iliac vessels reduced and shrank significantly, and most of the lesions almost completely resolved, with no abnormal increase in metabolism; (2) The metabolism of

Table 1. Literature summary of 6 patients with hematologic malignancies complicated by acute necrotizing fasciitis

Source of case	Sex	Age	Disease type	Infection site	Pathogenic bacteria	Treatment	Outcome
Ziba et al. [2]	Female	4 d	Acute myelocytic leukemia (AML)	Perineum	Pseudomonas aeruginosa	Anti-infection	Death
Al-FarsiF et al. [3]	Female	17 y	Acute lymphocytic leukemia (ALL)	Foot	Fusarium	Leukemia treatment+ anti-infection+surgery	Improved
Pérez et al. [4]	Male	53 y	Hairy cell leukemia (HCL)	Perianal	Escherichia coli	Anti-infection+surgery+ leukemia treatment	Death (septic shock)
Miller et al. [5]	Male	16 y	Acute lymphocytic leukemia (ALL)	Abdominal external oblique muscle	Clostridium perfringens	Leukemia treatment+ anti-infection+ECMO+surgery	Improved
Ozturk et al. [6]	Male	76 y	Chronic lymphocytic leukemia (CLL)	Shoulder joint and forearm	Staphylococcus aureus	Anti-infection+surgery	Improved
Liu Huanjun et al. [7]	Male	31 y	Acute myelocytic leukemia (AML)	Perianal	Escherichia coli	Leukemia treatment+ anti-infection+surgery	Improved

the duodenal bulb and descending segment increased, but was still lower than the previous level. The metabolic increase of the original duodenal horizontal and ascending segments was basically relieved. Based on the above points, partial residual activity of lymphoma was considered (PR, Deauville score: 4 points). The gastroscopy results indicated chronic superficial gastritis of grade II. The mucosa of the duodenal bulb was rough, and a biopsy was taken for pathological examination. No abnormalities were found in the posterior part of the bulb and the descending segment. The gastroscopy pathology report showed: Antrum - moderate atrophic gastritis, mild activity, moderate intestinal metaplasia in some glands, and low-grade intraepithelial neoplasia in some glands; Duodenal bulb - chronic inflammation of the mucosa. Immunohistochemistry of SMA indicated the presence of muscularis mucosa. The efficacy evaluation of the 8-week treatment was CR.

From January 17, 2025, targeted maintenance therapy with 1000 mg of Obinutuzumab (once every 2 months) was initiated. Currently, the patient remains in a remission state with the wound on the right thigh healed well (**Figure 3E**). The treatment is still ongoing and the follow-up results are good.

Literature retrieval

The China National Knowledge Infrastructure (CNKI), Wanfang Data, VIP Database, and Chinese Medical Journal Full-Text Database, relevant literature published in the past decade before October 2025, were searched. The search was conducted using both Chinese and English search keywords, including “hematologic malignancies”, “hematology”, “leukemia”, “lymphoma”, “myeloma”, and “necrotizing fasciitis”. Six studies (6 cases) were included (**Table 1**).

There are 3 cases in this paper and 6 cases reported in literature, totaling 9 patients with hematologic malignancies complicated with NF (male:female = 6:3, age: 4 days-76 years old). AML, ALL, CLL, HCL, and lymphoma were confirmed in 4, 2, 1, 1, and 1 cases, respectively. All 9 patients presented with fever accompanied by local swelling and pain. NF was diagnosed in all cases by comprehensive CT/MRI examinations, with perianal, limb soft tissue, perineal, and external oblique muscle infections identified in 3, 4, 1, and 1 cases, respectively. Gram-negative bacilli (e.g., Pseudomonas aeruginosa, Escherichia coli, Acinetobacter baumannii), Gram-positive cocci (Staphylococcus aureus, Clostridium perfringens, etc.), as well as Fusarium (1 case) and Stenotrophomonas maltophilia (1 case) were the pathogens identified. Among the 9 patients, one infant patient died after not continuing treatment following anti-infective therapy. The remaining 8 patients all received treatment for this disease along with active anti-infection and surgical debridement therapy. One died of septic shock, and 7 showed improvements (leukemia remission, infection control, and wound recovery).

Discussion

Epidemiology and pathogenesis

Although there is no exact statistical data on NF prevalence in patients with hematologic

malignancies, many studies have pointed to a statistically higher NF risk in such patients than that in the general population. Acute leukemia, lymphoma, and multiple myeloma are the most common types of hematological diseases. These diseases themselves or their treatment often induce neutropenia and impaired cellular immune function. Long-term neutropenia (>7 days), high-intensity chemotherapy, hematopoietic stem cell transplantation, long-term use of glucocorticoids, and spleen dysfunction are known risk factors of NF in hematologic malignancies. A neutrophil count of $<0.5\times10^9$/L is associated with a ten-fold risk of bacterial/fungal invasion [8]. When managing hematologic malignancies, the invasive procedures, chemotherapy drugs, and radiotherapy rays can all damage the body's mucosal barrier, facilitating the translocation of pathogens [9].

Pathogen profile characteristics

In hematologic malignancies with concurrent NF, Streptococcus pyogenes and Staphylococcus aureus are the most commonly detected pathogens. The proportion of intestinal Gram-negative bacilli (Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Enterobacter cloacae) is also on the rise. When hematologic malignancies are combined, patients are vulnerable with extremely low immunity, predisposing them to NF caused by Listeria, Mycobacterium, Vibrio vulnificus, Clostridium (e.g., Clostridium perfringens), and fungi (Mucor, Fusarium, etc.). Fungal NF is more insidious and progresses rapidly. Imaging features, histopathology, and microbiological culture are particularly important for diagnosis.

Clinical manifestations and diagnostic challenges

NP is usually atypical in patients with hematologic malignancies, increasing the difficulty of early diagnosis. This is especially true in the state of severe immunosuppression, where local inflammatory reactions are often suppressed. Pain is one of the most valuable early signs of NF. Even if the local skin erythema and blisters are not yet obvious, patients often complain of severe, unbearable pain that does not match the findings from physical examination. There may be only local pain, swelling, numbness, or paresthesia in the early stage of the disease, in contrast to cyanosis, ecchymosis, bullae (hemorrhagic and pustular), necrosis, or ulceration with filth and exudation that will only appear in the later stage. The onset is often insidious and its progression comes rapidly. Once it breaks through the local limitation, the release of toxins can rapidly lead to systemic poisoning symptoms (high fever, consciousness disorders, shock) and multiple organ failure within a short period of time, which is life-threatening. In laboratory examinations, though increased inflammatory markers like C-reactive protein (CRP) and procalcitonin (PCT) are suggestive, they lack specificity. MRI is the most sensitive method among imaging modalities, which can show fascia thickening and effusion. CT scanning is instrumental in evaluating the involvement of deep tissues. For highly suspicious cases, early surgical biopsy and microbial culture are essential. During the operation, the deep fascia appears dark, with a dull, 'wet towel'-like appearance, lacking hemorrhage, and easily detachable (positive finding on digital rectal examination). Rapid frozen sectioning and routine histopathology of necrotic tissues (revealing fascia and muscle necrosis accompanied by inflammatory cell infiltration, microvascular embolism, and bacteria/hyphae) and various microbiological examinations (routine culture, anaerobic culture, fungal culture, molecular tests such as PCR and mNGS) are the key to diagnosis. The rapid diagnosis accuracy of intraoperative frozen section can reach over 90% [10]. Molecular biology techniques such as 16S rRNA gene sequencing can improve the detection rate of pathogens [11], especially for patients who have used antibiotics.

Treatment strategies and prognostic factors

The treatment of hematologic malignancies complicated with NF emphasizes the "early, rapid, and aggressive" principle, integrating multidisciplinary collaboration from hematology, infection, critical care medicine, surgery, and imaging departments, as well as the microbiology laboratory. The treatment principles include early broad-spectrum antibiotic therapy, timely surgical debridement, active support treatment, and primary disease management. After early identification, empirical broad-spectrum antibiotics should be administered immediately, which should cover Gram-positive/negative bacteria and anaerobic bacteria, prioritizing the carbapenems+linezolid scheme [12]. Those who are suspected of having high-risk

factors should add antifungal drugs as soon as possible to cover Mucor and Aspergillus [13]. Antibiotic treatment usually lasts 4-6 weeks. To manage neutropenia, granulocyte colony-stimulating factor (G-CSF) can be considered to shorten the agranulocytosis period, supplemented with human immunoglobulin to neutralize toxins and regulate immunity [14, 15]. Surgical intervention is the cornerstone of treatment and the key measure to save lives, which should be carried out within 24 hours after diagnosis. Debridement within 6 hours after an NF diagnosis can reduce mortality (OR=0.32) [9]. Adequate debridement should be ensured, with repeated procedures until healthy bleeding tissue is observed. Intraoperative sampling for microbiological testing is also critical, based on which empirical treatment can be transformed into target treatment as soon as possible, enabling drug selection optimization and anti-infection strategy adjustment. For those with extensive limb involvement, early amputation may save their lives. Negative pressure wound therapy and skin flap transplantation are beneficial for later-stage wound repair. Support treatments (fluid resuscitation, blood transfusion, organ function support, and nutritional support) should be supplemented as appropriate. The treatment of primary disease requires individualized evaluation. Under the premise of controlling the infection, continued efforts should be devoted to anti-tumor treatment as much as possible.

Despite the continuous improvement of the medical treatment level, hematologic malignancies with concurrent NF are associated with a mortality rate reaching 60%, which could be reduced to 20% after timely treatment. Factors correlated with an adverse prognosis include a delayed diagnosis beyond 24 hours, a huge wound that is difficult to cover and repair, continuous neutrophil decrease, shock, multiple organ dysfunction, and uncontrolled primary disease. Chemotherapy discontinuation may affect the remission of hematological diseases. Hence, it is necessary to weigh infection control and tumor treatment timing [16].

Conclusion

To sum up, NF in hematologic malignancies is a fatal infection complication, with complicated pathogen composition, hidden symptoms, delayed signs, low specificity of auxiliary examinations, challenging early diagnosis, and great treatment difficulty. Future research needs to focus on improving early identification capabilities, optimizing the multidisciplinary team (MDT) process (with particular emphasis on early surgical intervention), developing new drugs and adjuvant therapies to overcome drug resistance, exploring individualized treatment schemes based on precise immune status, and improving preventive measures. Hematologists should enhance their understanding of this disease. For suspected cases, a multidisciplinary assessment and treatment should be promptly initiated. By improving the level of diagnosis and treatment, it is expected to reduce the mortality and disability rates of these high-risk patients.

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Disclosure of conflict of interest

None.

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