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Case report

Perforated colon cancer complicated by necrotizing soft tissue infection: A case report and literature review

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ABSTRACT

Necrotizing soft tissue infections (NSTIs) are rare but life-threatening complications of colorectal cancer, often overlooked during patient diagnosis and treatment. NSTIs progress rapidly, leading to significant tissue damage and elevated mortality rates. This report presents the case of a 71-year-old male who presented with abdominal pain and distention, later diagnosed with perforated colon cancer and NSTI of the left abdominal wall. Following admission, the patient developed septic shock and acute kidney injury. Emergency surgery was performed, including radical resection of the colon cancer, proximal colostomy, and extensive debridement of necrotic tissue. Postoperatively, Continuous Renal Replacement Therapy (CRRT) was used alongside standard treatments, contributing to a relatively rapid recovery. At the 30-month follow-up, no evidence of tumor recurrence was observed.

1. Introduction

Necrotizing soft tissue infections (NSTIs) are rapidly progressing, life-threatening conditions characterized by extensive necrosis of the skin, subcutaneous tissues, fascia, and muscles, with mortality rates reaching 20 %–30 %. Accurate diagnosis of NSTIs is particularly challenging in patients without overt skin changes or a clear source of infection. Early recognition and timely treatment are essential to achieving favorable patient outcomes.

Perforation, a rare complication of colorectal cancer (CRC), can lead to the development of NSTIs. Colon perforation allows gastrointestinal microbes to invade soft tissues, often spreading along fascial planes. This typically results in extensive involvement of anatomical regions, including the abdominal wall, perineum, and extremities. Diagnosing and treating these patients is challenging due to the combined risks associated with tumor progression and uncontrolled infection.

This report describes a case of NSTI secondary to CRC perforation, complicated by septic shock and acute kidney injury. A favorable outcome was achieved through continuous renal replacement therapy (CRRT), tumor resection, necrotic tissue debridement, and broad-spectrum antibiotic therapy. This case highlights the clinical manifestations and treatment strategies for NSTI caused by CRC perforation and underscores the potential role of CRRT as an adjunctive therapeutic measure in managing severe infectious complications.

2. Case report

A 71-year-old male presented to the emergency department on February 15, 2021, with a 1-month history of recurrent abdominal pain and distension that had significantly worsened over the preceding 3 days. Initially, the patient experienced left-sided abdominal pain and bloating, accompanied by difficulty defecating but the ability to pass gas. Although treated with anti-inflammatory medications at a local hospital, his symptoms persisted without improvement. Three days before admission, his condition deteriorated further, with a complete cessation of gas and stool passage.

2.1. Initial examination and diagnosis

Upon hospital admission, the patient was in septic shock. Physical examination revealed septic parameters, including a temperature of 38.2°C, a pulse of 112 bpm, a respiratory rate of 24 breaths/min, and hypotension (88/54 mmHg). He appeared lethargic and in poor general condition, with pale, cold, and clammy extremities. The left abdominal wall was red, swollen, warm to touch, and showed palpable subcutaneous gas. Abdominal examination revealed generalized tenderness,

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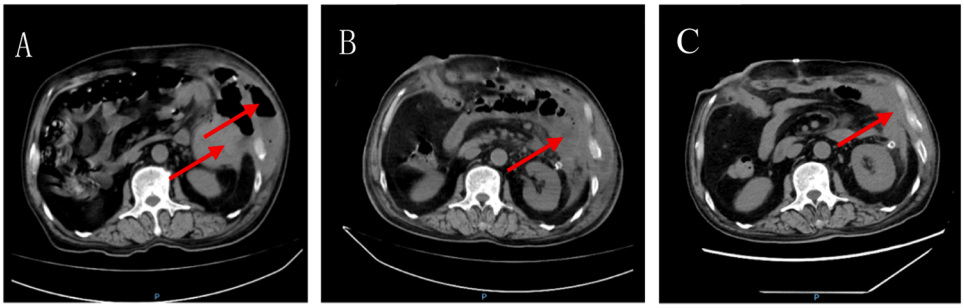

Fig. 1. (A) Preoperative CT scan showing a tumor of the descending colon with left abdominal wall swelling, gas and fluid collection, and visible air-fluid levels. (B) Abdominal CT scans performed on day 5 postoperatively revealing the alleviation of the infection and the less pronounced involvement of the abdominal wall and abdominal cavity. (C) Abdominal CT scans performed on day 10 postoperatively showing decreased fluid collection and the resolution of gas accumulation within the abdominal wall.

rebound tenderness, and muscular rigidity.

Laboratory test results were as follows:

- White blood cell count: 35.52 × 10⁹/L
- Neutrophil percentage: 90.8 %
- Procalcitonin: 7.74 ng/mL
- C-reactive protein: 207.78 mg/L
- Hemoglobin: 64 g/L
- Serum creatinine: 234.2 μmol/L

Abdominal computed tomography (CT) imaging results (Fig. 1 A) revealed:

- The thickening of the descending colon wall over an 11 cm length, with a maximum wall thickness of 3.1 cm and luminal narrowing.
- Stranding of the surrounding fat, with patchy areas of high density and visible lymph nodes.
- The collection of fluid and gas in the left paracolic gutter and subcutaneous tissues of the left abdominal wall, including localized air-fluid levels.
- Abdominal wall discontinuity and the loss of differentiation from the omentum.

In light of these findings, this patient was diagnosed with a perforated tumor of the descending colon, acute peritonitis, NSTI, acute intestinal obstruction, septic shock, acute kidney injury, and moderate anemia.

2.2. Emergency surgical treatment

Within 3 h of admission, the patient underwent an emergency laparotomy, revealing the following intraoperative findings:

- A large descending colon mass measuring approximately 10 cm in length and 6 cm in diameter.
- Tumor invasion into the left abdominal wall with poorly defined margins.
- Necrosis of the descending colon, including a 5 cm perforation and an 8 × 8 cm abdominal wall defect extending from the lower thoracic wall to the anterior superior iliac spine.

Extensive tissue necrosis and foul-smelling intestinal contents were observed. The surgical intervention included tumor resection, proximal colostomy, extensive abdominal wall debridement, and drainage. After the procedure, the patient was transferred to the intensive care unit (ICU) and placed on mechanical ventilation.

2.3. Postoperative course

On the first postoperative day, the patient remained sedated and intubated, with a pulse of 128 bpm and a blood pressure of 103/69 mmHg, supported by norepinephrine and phenylephrine. Laboratory findings were as follows:

- White blood cell count: 29.86 × 10⁹/L
- Neutrophil percentage: 87.2 %
- Hemoglobin: 59 g/L
- Serum creatinine: 239.0 μmol/L
- Serum albumin: 17.46 g/L

Approximately 800 mL of purulent drainage was collected from the left abdominal wall drainage tube. Microbial cultures identified *Pseudomonas aeruginosa* and *Candida albicans*. Initial empirical antibiotic therapy with meropenem and tigecycline to cover potential broad-spectrum pathogens, including Gram-positive bacteria, Gram-negative bacteria, and anaerobes, was adjusted based on culture results to piperacillin-tazobactam (targeting *Pseudomonas aeruginosa*) and fluconazole (targeting *Candida*), while tigecycline was continued for broad-spectrum coverage. These adjustments accounted for the polymicrobial context associated with intestinal perforation. To address metabolic acidosis and azotemia caused by acute kidney injury, CRRT was initiated, lasting for 76 h (mode: CVVHDF, citrate anticoagulation).

By postoperative day 5, CT imaging revealed reduced soft tissue involvement and lower gas levels in the left abdominal wall (Fig. 1B). On day 6, the patient was extubated and resumed enteral nutrition. Laboratory testing on day 6 demonstrated improvement:

- White blood cell count: 16.99 × 10⁹/L
- Neutrophil percentage: 81.3 %
- Hemoglobin: 66 g/L
- Serum creatinine: 102.1 μmol/L

2.4. Pathology findings

The resected tumor measured 6 × 6 × 1 cm and was identified as a moderately differentiated adenocarcinoma that had invaded the subserosal connective tissue. No neural or vascular invasion was observed, but extensive tumor necrosis and stromal fibrosis were evident. Both the surgical margins and omentum were free of tumor involvement. Metastatic carcinoma was present in 2 of 14 analyzed lymph nodes, with the largest metastatic focus measuring 0.5 cm. Pathological staging was classified as pT3N1bM0. Immunohistochemical analyses revealed:

- HER-2: Negative
- P53: 60 % positive
- Ki-67: 50 % positive
- MLH1, MSH2, MSH6, PMS2: 90 % positive

2.5. Outcome and follow-up

By postoperative day 8, the patient's white blood cell count had normalized, and hemoglobin levels improved to 89 g/L. He was subsequently transferred to the general ward. CT imaging on postoperative day 10 revealed a clear resolution of intra-abdominal exudates and gas, along with reductions in subcutaneous fluid within the left abdominal wall (Fig. 1 C).

The patient was discharged on postoperative day 15. Despite declining chemotherapy, he remained in good health during a 30-month follow-up, with normal stoma function and no evidence of tumor recurrence.

3. Discussion

NSTIs are severe infections characterized by extensive necrosis of the skin, subcutaneous tissue, fascia, and muscles [1–3]. These infections progress rapidly, often causing widespread tissue damage and the potential for organ failure within 24 h of onset [4]. Septic shock occurs in 25 %–50 % of NSTI cases [5–8], and acute kidney injury is present in approximately one-third of patients [4,7,9]. The overall mortality rate for NSTI ranges from 20 % to 30 % [10]. CRC perforation disrupts the continuity of the intestinal tract, leading to the leakage of intestinal flora such as *Escherichia coli*, *Enterococcus*, and anaerobic bacteria. This results in dual infections affecting the abdominal cavity and soft tissues, differing slightly from typical NSTIs in terms of bacterial origin. Literature reviews indicate that over half of NSTI cases associated with CRC perforation involve septic shock and acute kidney injury, resulting in a higher mortality rate compared to other NSTIs. The risk factors for NSTIs include diabetes, malnutrition, immunosuppression, alcohol abuse, chronic liver and kidney diseases, trauma, and malignancies. When the cause of NSTI is unclear, and no obvious skin entry point is identified, gastrointestinal origins should be considered. Patients with a history of altered bowel habits, gastrointestinal bleeding, or weight loss should be evaluated for intestinal malignancies. NSTIs caused by CRC perforation have distinct anatomical patterns of spread. The infection can propagate along anatomical pathways, including the retroperitoneum, femoral canal, inguinal canal, obturator foramen, and sciatic foramen. This can result in necrotizing infections involving the abdominal wall, limbs, and perineum. Rare cases have described retroperitoneal tumor perforation leading to the spread of infection through fascial planes and subcutaneous tissue into the thoracic cavity, causing diffuse pulmonary infection [11].

Clinically, NSTI symptoms commonly include fever, tachycardia, hypotension, shock, swelling, erythema, pain disproportionate to physical findings, skin discoloration, subcutaneous crepitus, and subcutaneous gas. However, early NSTI stages may not involve visible skin changes. As these infections typically spread along poorly vascularized fascial planes, overlying tissues may initially remain unaffected, potentially delaying diagnosis and treatment. A systematic review of 1463 NSTI cases found that 71 % were initially misdiagnosed [1]. The polymicrobial nature of infections caused by colorectal tumor perforation increases the complexity of the infection, and the LRINEC tool may lack sufficient sensitivity for these cases. Diagnosing NSTIs requires a comprehensive evaluation of symptoms, laboratory findings, and imaging studies. The presence of gas within soft tissues is a hallmark of these infections [12]. CT is the primary diagnostic tool for NSTIs, providing a detailed assessment of infection extent and the distribution of gas in soft tissues, outperforming plain radiographs in accuracy. Ultrasonography can assist in detecting superficial structures and fluid accumulation. Magnetic resonance imaging (MRI) offers excellent tissue contrast and can identify soft tissue edema, but its higher cost and prolonged examination time limit its use in specific clinical scenarios.

NSTIs caused by CRC perforation require a dual-faceted approach targeting both the infection and the underlying perforation. The primary treatment for NSTIs involves prompt surgical debridement, broad-spectrum antibiotic therapy, and hemodynamic support. Adjunctive therapies may also be employed, such as hyperbaric oxygen therapy and intravenous immunoglobulin administration. Successful outcomes are highly dependent on early recognition and intervention. Delays in diagnosis or surgical intervention are strongly associated with increased mortality and poorer outcomes. Studies have demonstrated that patients undergoing surgery within 6–12 h of hospital admission show significantly lower mortality rates compared to those receiving delayed surgical treatment [13–15]. Key predictors of mortality include advanced age and failure to perform debridement within 24 h of admission [14,16]. Early debridement and drainage are thus essential for survival. Without surgical treatment, mortality rates can approach 100 %, even when antibiotics are administered [17]. Antibiotic therapy is a vital component of NSTI management, with empirical regimens initially providing broad-spectrum coverage against Gram-positive bacteria, Gram-negative bacteria, anaerobes, and possibly Candida. Based on microbiological results, adjustments are made to ensure precision in targeting specific pathogens [18,19]. For treating NSTIs caused by CRC perforation, the choice of antibiotics must be dynamically adjusted based on empirical protocols and microbiological findings. In the present case, initial treatment with meropenem and tigecycline provided effective broad-spectrum coverage for early polymicrobial infection risks. Subsequent adjustments based on culture and susceptibility results included piperacillin-tazobactam for *Pseudomonas aeruginosa*, fluconazole for *Candida albicans*, and the continued use of tigecycline to address potential multidrug-resistant pathogens. This strategy aligns with the principle of initiating broad-spectrum coverage and transitioning to pathogen-specific therapy as additional diagnostic information becomes available.

Management of CRC perforation involves prompt proximal

colostomy to eliminate the source of infection and reduce the risk of further spread. Colostomy also minimizes the likelihood of anastomotic leakage, preventing recurrent infections and allowing for faster restoration of enteral nutrition, which contributes to improved postoperative nutritional status and recovery. The decision to perform complete tumor resection depends on the patient's physical condition and surgical tolerance. Comprehensive postoperative anti-tumor therapy should be tailored to the tumor stage. While colostomy is almost universally performed in such cases, it provides a stable platform for addressing NSTIs and supports further treatment of the underlying malignancy. In this case, the patient declined chemotherapy after surgery. While chemotherapy is critical for reducing local recurrence and metastasis, it can impede granulation tissue growth and wound healing. Initiating chemotherapy is thus recommended only after wound healing is complete. In the present case, the patient presented with septic shock and acute kidney injury and underwent emergency radical colectomy, proximal colostomy, and extensive necrotic tissue debridement. Postoperatively, CRRT was administered for 76 h in conjunction with conventional treatments. CRRT, a blood purification technique, facilitates the extracorporeal filtration of excess fluid, inflammatory mediators, and metabolic byproducts, aiding patients with impaired renal function. This approach helps restore inflammatory homeostasis, correct acid-base and electrolyte imbalances, and promote recovery from septic shock and acute kidney injury [20].

4. Conclusion

Case reports and literature reviews have highlighted the elevated mortality associated with NSTIs secondary to CRC perforation. These infections show anatomical specificity, often spreading along the retroperitoneum, femoral canal, inguinal canal, obturator foramen, and greater sciatic foramen. The most commonly affected regions include the abdominal wall, extremities, and perineum. Early identification of such infections is essential for effective patient management. In clinical scenarios involving CRC perforation complicated by NSTI, the presence of necrotizing infections in the abdominal wall, perineum, perianal region, or extremities with unclear etiology should prompt suspicion of CRC perforation. Early laparoscopic or open abdominal exploration is recommended to confirm the diagnosis. In cases where colorectal perforation is identified and symptoms such as limb pain, erythema, subcutaneous crepitus, or imaging evidence of gas within the soft tissues are present, the risk of NSTI must be considered. Immediate and thorough debridement of necrotic tissue is critical, with repeated debridement required in certain cases to achieve infection control. Effective treatment of NSTI caused by CRC perforation requires addressing both the NSTI and the underlying perforation. Key interventions include stoma diversion surgery and necrotic tissue debridement to alleviate symptoms and manage infection. The decision to perform primary tumor resection should be individualized, taking into account the patient's physical condition and surgical tolerance. Antibiotic therapy should adhere to the principle of "broad-spectrum coverage early, precise adjustment later." Initial broad-spectrum antibiotics effectively mitigate early risks of polymicrobial infections, while subsequent targeted treatment should be guided by culture and susceptibility testing. In critically ill patients with complications such as septic shock or acute kidney injury, CRRT offers clear advantages.

Table 1 (continued).

ID	Author	Sex	Age	Tumor	stages	position of Nsti	Shadow diagnosis	bacteria	Antibiotics	Surgery	Outcome
7	DOUGLAS M [27]	Male	77	Sigmoid	-	Scrotum, the lower anterior abdominal wall	-	*Escherichia coli, Bacteroides fragilis,* and *enterococci*	Ampicillinsulbactam and gentamicin	Debridement of necrotic tissue, sigmoid colon resection, colostomy	Discharged from the hospital 6 weeks after the initial presentation
8	R. A. Gamagami, M.D [28]	Male	45	rectal	T3N0M0	the perineum, scrotum, penis, and suprapubic regions	-	*Escherichia coli* and Enterococci	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, colostomy, hyperbaric oxygen therapy (for 1 week), abdominal perineal resection (4 weeks later)	1 year of follow-up, normal
9	S. W. T. Gould [29]	Male	70	rectal	-	the perineal and scrotal areas	-	Group F beta-haemolytic Streptococci and mixed anaerobes	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, Hartmann	Death
10	Cyrus C [30]	Male	78	rectal	-	the perineal and scrotal areas	CT	*Escherichia coli*	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, colostomy	-
11	H. Khalil [31]	Male	71	rectal	T4N2M1	the buttock and right thigh	CT	-	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, Hartmann	Death occurred 6 years after the initial episode
12	Hsiao-Wen Ku [32]	Female	77	transverse colon	-	the left middle and lower quadrants of the abdomen	CT	*Klebsiella pneumonia*	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, Hartmann	Discharged 1 month later

Table 1
Summary of reported cases.

ID	Author	Sex	Age	Tumor	stages	position of Nsti	Shadow diagnosis	bacteria	Antibiotics	Surgery	Outcome
1	Charbel Karam [21]	Male	66	mid-rectal	-	inguinal canal, scrotum	CT	*Klebsiella pneumoniae,* anaerobes, *Candida albicans*	Empirical broad-spectrum antibiotics	Colostomy, debridement of necrotic tissue	Discharge 3-weeks later
2	Nicholas S. Cairl [22]	Male	80	Sigmoid	-	scrotal edema and erythema	CT	*Klebsiella pneumoniae, Enterococcus faecalis,* and *Streptococcus lutetiensis.*	Cefepime, vancomycin, and metronidazole	Colostomy, debridement of necrotic tissue	Discharged on post-operation day 10
3	Nicholas Bahl [23]	Female	54	Colon	pT2N0M0	left hemi abdomen and left flank	CT	*Streptococcus anginosus*	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, left hemicolectomy, colostomy	Discharged
4	Lorraine Ash [24]	Male	33	rectosigmoid junction	-	Scrotum, perineum, and anterior abdominal wall	CT	-	-	Debridement of necrotic tissue, colostomy	-
5	K Haemers [25]	Male	66	rectal	-	right buttock, lower right leg	CT	*E coli*, Group G hemolytic Streptococcus, and *Candida albicans*	Piperacillin/ tazobactam and metronidazole	Debridement of necrotic tissue	Death 2 days postoperatively
6	John Alfred Carr [26]	Male	54	rectal	T3N1aM1	scrotum, perineum, and buttocks	CT	-	-	Debridement of necrotic tissue, abdominoperineal resection, colostomy	Discharged on hospital day 23 to receive adjuvant therapy

Table 1 (continued).

ID	Author	Sex	Age	Tumor	stages	position of Nsti	Shadow diagnosis	bacteria	Antibiotics	Surgery	Outcome
13	Mohamed Mehdi Trabelsi [33]	Male	76	sigmoid	-	the inner side of the left thigh, the left inguinal region	CT	*Escherichia coli*	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, colostomy	Death one day after surgery
14	SEN HOU [34]	Male	57	the rectal	T4N0M0	perianal region, perineum and scrotum, inguinal area	CT, MRI	-	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, colostomy, radical resection of rectal carcinoma (stage 2)	Discharged on day 15
15	Suleyman Utku Celik [35]	Female	68	rectosigmoid	-	the left inguinal region and thigh	CT	*Escherichia coli* and anaerobes	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, Hartmann	-
16	Pierlesky Elion Ossibi [36]	Male	60	Rectal	-	the perineum and scrotum	CT	-	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, sigmoid colectomy	-
17	Laura S. Heidelberg [37]	Male	84	cecal malignancy.	-	right hip	CT	-	Empirical broad-spectrum antibiotics	Refusal of operation	Death
18	Chad E. Cragle [38]	Male	68	Rectal	pT4N1M0	the perineum and buttocks	CT	-	-	Debridement of necrotic tissue, colostomy, resection of rectal carcinoma (stage 2)	Remains cancer-free 18 months later

Table 1 (continued).

ID	Author	Sex	Age	Tumor	stages	position of Nsti	Shadow diagnosis	bacteria	Antibiotics	Surgery	Outcome
19	Elias E. Lahham [39]	Female	82	sigmoid colon	-	Lower extremity	CT	-	Empirical broad-spectrum antibiotics	Debridement of necrotic tissue, left hemicolectomy, colostomy	The patient died from septic shock 4 days later
20	Shirley Yuk Wah Liu [40]	Male	56	rectal	-	both lower limbs and upper limbs	-	group G streptococcal septicemia	Augmentin (amoxicillin and clavulanate), clindamycin and metronidazole	Debridement of necrotic tissue, bilateral above-knee amputation	Death 6 days after the onset of sepsis

Ethics approval and consent

I would like to declare on behalf of my co-author that the work described was original research that has not been published previously and is not under consideration for publication elsewhere. All the authors listed have approved the manuscript that is enclosed. The China-Japan Union Hospital Ethics Board approved this research.

Author statement

On behalf of my co-author, I would like to declare that the work described was original research that has not been published previously and is not under consideration for publication elsewhere, in whole or in part. All the authors listed have approved the manuscript that is enclosed.

CRediT authorship contribution statement

Li Qing-Chun: Writing – review & editing. **Zheng Jian:** Data curation. **Xiang Xin:** Writing – original draft. **Zhuang Jing-Zheng:** Supervision. **Ruan Lei:** Investigation. **Ma Cheng-Wei:** Resources.

Declaration of Competing Interest

We have no competing interests to report.

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