Favorable Outcome of Fournier Gangrene in Two Patients with Diabetes Mellitus on Continuous Peritoneal Dialysis

Fournier gangrene (FG), a form of necrotizing fasciitis of the perineum and genitals, with high morbidity and mortality in the general population, carries the additional risk of involvement of the peritoneal catheter tunnel and peritoneal cavity in patients on chronic peritoneal dialysis (PD). We describe two men with diabetes who developed FG in the course of PD. Computed tomography showed no extension of FG to the abdominal wall, and spent peritoneal dialysate was clear in both patients. Broad-spectrum antibiotic therapy with anaerobic coverage and early aggressive debridement followed by negative-pressure wound therapy and repeated debridement led to improvements in clinical status in both cases. Surgical closure and healing of the wound was achieved in one patient; the wound of the second patient is healing, but remains open. Both patients experienced prolonged hospitalization, with a serious decline in nutrition status. In patients on PD, FG can be treated successfully. However, additional measures are required to evaluate for potential involvement of the PD apparatus and the peritoneal cavity in the infectious process; and prolonged hospitalization, worsening nutrition, and multiple surgical interventions can result.

Key words
Fournier gangrene, diabetes mellitus, malnutrition, negative-pressure vacuum dressings

Introduction
Fournier gangrene (FG) is a synergistic polymicrobial necrotizing fasciitis of the perineum and external genital organs primarily affecting men (1–3). Its histologic picture is characterized by obliterator endarteritis of the subcutaneous arteries and gangrene of the subcutaneous tissue and the overlying skin (1–3). An acute surgical emergency, FG has a mortality rate of 24% – 45% (4). Extension of FG to the abdominal wall, chest, axillae, and thighs has been reported (3). Gangrene of the abdominal wall in patients on chronic peritoneal dialysis (PD) carries the added risk of extension of the necrotizing infectious process into the tunnel of the PD catheter and the peritoneal cavity.

Only 1 case of FG in a patient on PD (5)—with a fatal outcome—was found in a bibliographic search. We report 2 men with diabetes who developed FG in the course of PD and survived. Their cases illustrate the diagnostic interventions, management, and follow-up of FG in PD patients.

Case descriptions
Both patients reported here were receiving PD for end-stage renal disease secondary to diabetic nephropathy. The PD schedule, which was exactly the same in the 2 patients, consisted of automated nocturnal 9-hour PD with 4 exchanges (3.0-L fill volume), plus two 2.5-L daytime exchanges, one with 7.5% icodextrin and one with dextrose. Peritoneal transport was of the high-average type in both patients.
**Patient 1**

A 68-year-old man on PD for 41 months presented with excruciating pain and swelling of the left groin and scrotum of 5 days’ duration. He had experienced no episodes of peritonitis or exit-site or tunnel infection in the past, but had experienced an episode of urinary tract infection 1 year before the development of scrotal swelling and pain. Weekly Kt/V urea varied between 1.82 and 2.43.

At presentation, the patient’s temperature was 38°C, his heart rate was 113 bpm, and his respiratory rate was 23/min. His body mass index was 29.0 kg/m². The left side of the scrotum was swollen and indurated, with extreme tenderness along the course of the left epididymis, and crepitus in the perineum and left hemiscrotum. Pertinent laboratory values (6) included serum sodium 133 mmol/L (glucose 286 mg/dL); potassium 4.5 mmol/L; creatinine 11.86 mg/dL; total CO₂ 20 mmol/L; hematocrit 33.5%; and white cell count 15.2×10³/mm³, with 87% neutrophils.

Computed tomography (CT) showed scrotal wall thickening, prominent soft-tissue thickening, and subcutaneous gas posterior to the left inguinal canal, consistent with necrotizing fasciitis involving the left inguinal and intertriginous regions. The process did not involve the abdominal wall.

The patient was treated with aggressive hydration, parenteral vancomycin and piperacillin–tazobactam, and urgent wound debridement. Histologic examination of the excised tissue revealed subcutaneous tissue necrosis and inflammation. Tissue cultures revealed mixed urogenital flora. Anaerobic and fungal cultures of the excised tissue were negative. A urinary tract infection was also present. Spent peritoneal dialysate contained 56 cells per cubic milliliter, with negative cultures.

The patient’s hospital course was complicated by severe hypotension that lasted 6 days, and atrial fibrillation with a rapid ventricular rate requiring cardioversion. Three surgical explorations with debridement were performed, and the wound was treated with negative-pressure wound therapy. During this patient’s hospitalization, PD was continued using the established schedule, and spent PD fluid was monitored. Repeated effluent cell counts and cultures were negative.

The patient was discharged after 17 days of hospitalization. During hospitalization, he lost 6.2 kg of body weight. By 6 weeks after presentation, his wound was healed, and he had regained his lost weight. His serum albumin was 4.2 g/dL before hospitalization, declined to 3.3 g/dL during hospitalization, and increased to 4.4 g/dL at 6 months after discharge.

**Patient 2**

A 54-year-old man on PD for 30 months was admitted with generalized weakness, fever, and scrotal swelling and pain for 1 day. In the preceding months, his weekly Kt/V urea had fluctuated between 1.66 and 1.92. He had experienced 1 episode of peritonitis with coagulase-negative *Staphylococcus* 14 months before the current admission, but no exit-site or tunnel infection. A perineal abscess had been drained 5 months before admission, and 2 months before admission, he had experienced the onset of persistent diarrhea which, after admission, proved to be secondary to *Clostridium difficile* infection.

On admission, the patient’s temperature was 38.6°C, his heart rate was 93 bpm, and his respiratory rate was 21/min. His body mass index was 34.3 kg/m². Examination of the scrotum revealed erythema, exquisite tenderness, and crepitus, particularly of the left hemiscrotum. Pertinent laboratory studies (6) included serum sodium 136 mmol/L (glucose 268 mg/dL); potassium 4.0 mmol/L; creatinine 15.78 mg/dL; total CO₂ 24 mmol/L; hematocrit 26.9%; and white cell count 20.7×10³/mm³, with 92% neutrophils. Blood cultures were negative, and spent dialysate was clear. Imaging with CT revealed diffuse edema and subcutaneous emphysema in the left scrotum, extending into the perineum and the penis (Figure 1), but not involving the abdominal wall.

On the day of admission, the patient underwent excision of the dead skin and debridement of the scrotum and was placed on a combination of vancomycin, piperacillin–tazobactam, and metronidazole. Histologic examination of the excised scrotal tissue revealed extensive inflammation and necrosis involving the soft tissue under the skin and the adipose tissue (Figure 2).

After the surgical intervention, the patient’s clinical status improved, but he required two more sessions of debridement of the surgical wound, which was treated with negative-pressure wound therapy. During his hospitalization, PD was continued on the established schedule. Physical debility and a need for systematic physical therapy delayed the patient’s discharge, which occurred after 38 days.
of hospitalization. His wound was granulating, but remained partially open on discharge.

During hospitalization, the patient lost 6.5 kg of body weight. His serum albumin, which was 4.1 g/dL before hospitalization, declined to a nadir of 2.8 g/dL, but had improved to 3.4 g/dL after 1 month.

Summary
The histologic features and pathogenesis of FG and of necrotizing fasciitis are indistinguishable (7). The patients presented in this report illustrate several of the cardinal features of FG. The disease more frequently affects men than women, but it has been encountered in all age groups. Diabetes mellitus and alcoholism are the two conditions most commonly associated with FG (2–4). Immunosuppression for malignancy or organ transplantation (2), leukemia (3), intravenous drug use, malnutrition (4), and HIV infection (8) are less frequently associated with FG. Calciphylaxis, which could be relevant in PD patients, was associated with 1 case of FG (9).

The disease evolves from a combination of tissue ischemia (diabetic small-vessel disease being a major predisposing factor) and overgrowth of bacteria (anaerobes often having a major role) (2,3). A portal of entry through the colorectal region, the genitourinary tract, or the skin is usually identified (3,4). Multiple microbial organisms are usually recovered from the infected tissue. In one series of 236 patients, the most common organisms recovered were, in descending frequency, various species of *Escherichia coli*, *Bacteroides*, *Staphylococcus*, *Proteus*, *Streptococcus*, *Pseudomonas*, *Enterococcus*, and *Klebsiella* (4).

In addition to identification of the portal of entry, which could require endoscopic procedures such as proctoscopy or retrograde pyelography, evaluation of the FG margins is critical to management and, as noted earlier, acquires even greater importance in PD.
patients. Imaging, which also assists in making the
diagnosis in difficult cases, is used to determine the
extent of FG (10). Plain radiography, ultrasonography,
CT, and magnetic resonance imaging have all been
applied for this purpose (10). Imaging by CT was
reported to be superior to that by plain radiography
or ultrasonography (11). Magnetic resonance imag-
ing is accurate in identifying the extent of disease
and the point of origin (12). Given those reports, CT
or magnetic resonance imaging, whichever is readily
available, should be considered the imaging procedure
of choice in FG.

The high mortality in FG has led to efforts to
develop prognostic indicators that might be used
to evaluate various therapeutic modalities. The FG
severity index is calculated using stratified (high and
low) values of body temperature; heart and respira-
tory rates; serum sodium, potassium, creatinine, and
bicarbonate; and hematocrit and white cell count (6).
High index values were found in several studies to
predict mortality with reasonable accuracy (13–15).
Other clinical factors that were found to be associated
with mortality were hepatic dysfunction, older age,
colorectal origin (3), extent of the disease (2), and
delays in surgical intervention (16).

Early recognition of FG is imperative (17). Man-
agement has two prongs that should both be applied
as soon as the diagnosis is made. First, parenteral
antibiotics with broad coverage, including anaerobic
agents, should be initiated, and hemodynamic stabili-
ization should be pursued. At the same time, aggressive
surgical debridement should also be performed (17).
The wound should initially be treated with topical
antiseptics and frequent dressing changes, and the
edges of the wound should be carefully monitored for
signs that the FG has advanced. After the first 2 days,
treatment with negative-pressure wound therapy to
promote granulation and closure has been found to be
effective (18). Hyperbaric oxygen treatment has also
been applied (2,4). Repeated debridement is usually
necessary, until FG is found to be no longer advancing
and causing tissue necrosis.

Perineal and scrotal soft-tissue defects can be
extensive; they frequently lead to chronic wounds
that can require reconstructive surgery. If fecal con-
tamination of the wound becomes problematic, an
enterocutaneous stoma might become necessary to
divert stool from the wound (19). Colectomy has also
been performed in patients with severe colonic disease
(19). Physical and mental debility might persist for a
long period after discharge (19). In patients on PD
who develop FG, imaging should address the potential
for involvement of the abdominal wall proximally to
the PD catheter tunnel and of the catheter exit site or
tunnel. Spent dialysate should be monitored for signs
of infection. In the absence of signs of peritoneal
involvement, PD can continue. As has been reported
with other severe infectious processes affecting PD
patients (20), FG has a large effect on nutrition.
Nutrition and physical rehabilitation require special
attention in patients with FG.

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