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Clostridium perfringens gas gangrene caused by closed abdominal injury: ¹ A case report and review of the literature

Li HY *et al.* *Clostridium perfringens* gas gangrene

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Abstract

BACKGROUND

Abdominal *Clostridium perfringens* (*C. perfringens*) gas gangrene is a rare infection, which has been described in the literature as most frequently occurring in postoperative patients with open trauma. Intra-abdominal gas gangrene caused by *C. perfringens* infection after closed abdominal injury is extremely rare, difficult to diagnose, has rapid progression and a high risk of mortality. It progresses rapidly and has high mortality. We report a case of *C. perfringens* infection caused by closed abdominal injury.

CASE SUMMARY

A 54-year-old male suffered from multiple intestinal tears and necrosis after sustaining an injury caused by falling from a high height, resulting in intra-abdominal *C. perfringens* infection. In the first operation, we removed the necrotic intestinal tube, kept the abdomen open and covered the intestine with a Bogota bag. The vacuum sealing drainage system covered the outer layer of the Bogota bag, and the drainage was flushed under negative pressure. The patient was transferred to the ICU for vital sign support and empirical anti-infective treatment. The antibiotics were not changed until the results of bacterial culturing and drug susceptibility testing were obtained. Two consecutive operations were then performed because of secondary intestinal necrosis. After 3 definitive operations, the patient successfully survived the perioperative period. Unfortunately, he died of Guillain-Barre syndrome 75 d after the first surgery. This paper presents a case of intra-abdominal gas gangrene infection and analyzes the diagnosis and treatment based on the literature.

CONCLUSION

When the intestinal tube is ruptured, leading to intestinal content contamination, *C. perfringens* normally present in the intestinal tract and may proliferate in large numbers, thereby causing intra-abdominal *C. perfringens* infection. Prompt surgical intervention, adequate drainage, antibiotic therapy and intensive care are the most effective treatments. If the abdominal cavity is heavily contaminated, open abdomen may be a beneficial treatment.

Key Words: *Clostridium perfringens*; Intra-abdominal infection; Gas gangrene; Open abdomen; Case report

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Core Tip: Intraabdominal gas gangrene caused by closed abdominal injury is extremely rare. Using laparotomy, vacuum sealed drainage combined with intensive care and antibiotic treatment, the patients passed the perioperative period smoothly. The diagnosis and treatment of this case is of guiding significance in clinic.

INTRODUCTION

Gas gangrene is a serious infection caused by *Clostridium* spp, which can be divided into *Clostridium perfringens* (*C. perfringens*), *Clostridium sordelli*, *Clostridium novyi*, and *Clostridium putrificum*. It occurs more frequently in skin and soft tissue infections. The first case of gas gangrene in an organ was reported by Fraenkel in 1881.

Generally, gas gangrene can be classified into three types: posttraumatic, postoperative and spontaneous^[1]. Both in the past and at present, trauma caused by war and natural disasters has been the main cause of gas gangrene^[2,21,34]. Postoperative gas

gangrene has been reported in hilar cholangiocarcinoma, duodenal papillary carcinoma, bladder cancer, cholecystectomy, and even after implant removal^[1,3-6]. Spontaneous gas gangrene is commonly seen in immunosuppressed patients, including those with diabetes, tumors, chemotherapy and ulcerative colitis^[7-12]. Gangrene after colonoscopy, drug abuse and pregnancy, uterine gangrene caused by endometrial cancer and gas gangrene after intramuscular injection^[13-17] and even spontaneous abdominal gas gangrene^[18] have been reported. Intra-abdominal gas gangrene infection after closed abdominal trauma is extremely rare^[19].

Cline and Turnbull summarized the symptoms of superficial gas gangrene^[20,21], and its diagnosis is relatively simple. The symptoms of uterine gas gangrene have also been summarized^[3,5,6]. Because abdominal gas gangrene is difficult to diagnose considering the lack of specific symptoms, it makes the diagnosis difficult and rarely diagnosed preoperatively, thus resulting in a high risk of mortality. For patients diagnosed with abdominal gas gangrene, very few can be treated conservatively, and timely surgical intervention is usually necessary to reduce the risk of mortality^[20-23].

In the past, open abdomen has been used to treat severe abdominal infection and abdominal compartment syndrome, and vacuum sealing drainage (VSD) is mostly used to treat trunk and extremity infections. Here, we present a case of intra-abdominal gas gangrene caused by intestinal tears caused by closed abdominal injury. In this case, we combined open abdomen and VSD together as the treatment for severe intra-abdominal gas gangrene infection.

1

CASE PRESENTATION

Chief complaints

A 54-year-old male presented to the emergency department with complaints of “lower back pain, abdominal pain and extreme abdominal distension for 24 h after falling from height”.

History of present illness

Twenty-four hours before presenting to the emergency department, the patient fell from a height of approximately 3 meters, causing lower back pain, and was treated in another hospital. The X-ray showed twelve thoracic vertebral compression fractures. After hospitalization, the patient experienced unbearable severe abdominal distension and abdominal pain and was then transferred to our hospital.

2

History of past illness

The patient had no surgical or relevant medical history.

2

Personal and family history

The patient had no family disease history.

Physical examination

Temperature 36 °C, blood pressure: 85/60 mmHg, respiration rate: 30 breaths per minute, heart rate: 145 beats per minute, blurred consciousness, flat abdomen, tension of all abdominal muscles, obvious abdominal tenderness with rebound tenderness and absent liver dullness and bowel sounds.

Laboratory examinations

A complete blood analysis was performed: WBC: 4800/mm³, N: 75.3%, Hb: 143 g/L, CRP: 130 mg/L, blood gas analysis Po₂ 54.5 mmHg, and Pco₂ 26 mmHg.

Imaging examinations

Abdominal CT showed pneumoperitoneum, ascites and portal venous gas (Figure 1A and B).

FINAL DIAGNOSIS

A large number of gram-positive bacilli were found in the pus smear, and the results of bacterial identification by gas chromatography and bacterial culturing of the pus were

consistent. The patient was diagnosed with closed abdominal injury with intestinal necrosis and gas gangrene.

TREATMENT

After aggressive fluid resuscitation, emergency laparotomy was performed. A large amount of foul-smelling gas was released during laparotomy, and there was 1.5 L of purulent liquid in the abdominal cavity. The jejunum was transected 100 cm away from ligament of Treitz, and approximately 40 cm from the upper end was necrotic. The remaining intestines had multiple contusions. The left colon showed necrosis, a large amount of gas could be seen in the intestinal wall, and crepitus and snow-ball crepitation were obvious between the greater omentum layers. A large number of gram-positive bacilli were found in the pus smear, and the patient was diagnosed with intra-abdominal gas gangrene infection. The necrotic small intestine and left colon were removed, and transverse colostomy and upper jejunostomy were performed. The abdomen was kept open, the intestine was covered with a Bogota bag, and a gap was left in the middle to facilitate drainage. A VSD device was used to cover the outer layer of the Bogota bag and flush the drainage under negative pressure (Figure 1C and D). After the operation, the patient was transferred to the ICU negative pressure ward, strictly isolated in a single room and assisted by a ventilator. The patient was given 8 million U penicillin, 3 times/d, as well as sulperazon as antibiotic treatment. The results of bacterial identification by gas chromatography and bacterial culturing of the pus were consistent. *C. perfringens* is sensitive to penicillin G, ampicillin, rifampicin, levofloxacin, linezolid, ceftriaxone, ceftazidime, cefepime and cefazolin and resistant to teicoplanin, vancomycin, erythromycin and clindamycin. On postoperative day (POD) 6, intestinal contents were found in the abdominal drainage tube. Exploratory reoperation revealed ileal necrosis and a perforation 100 cm away from the ileocecal part and multiple lamellar necrosis of the transverse colon. However, the colon was not perforated. Because the intestinal loop was uncultivated, we repaired the seromuscular layer of the transverse colon at the necrotic mucosa. The transverse colon necrosis was

repaired , and terminal ileostomy was performed. On POD 10, jejunal necrosis and perforations were found 150 cm away from the ligament of Treitz, debridement and drainage were adopted, and the abdomen was kept open. The bacteria cultured for 3 consecutive days were *Escherichia coli* rather than *perfringens*, the antibiotics were changed, and the patient was released from isolation. On POD 12, the patient was removed from the ventilator, and enteral nutrition was restored. On POD 20, fascial closure was performed.

OUTCOME AND FOLLOW-UP

The patient was able to move with protective gear 30 d after the operation and was discharged after recovery. Unfortunately, 3 wk after discharge, the patient developed limb weakness, which worsened progressively, and was hospitalized again. After admission, nutrition was strengthened, and the patient had difficulty breathing. The patient was transferred to the ICU again, and placed under ventilation to assist breathing. The electromyography showed that there was multiple nerve damage in the whole body. Lumbar puncture indicated that the pressure of the cerebrospinal fluid was normal. Routine tests of cerebrospinal fluid showed that the number of cells was 7/L, and biochemical tests showed that the protein level was 2734. The department of neurology was consulted to consider Guillain-Barre syndrome after trauma and severe infection. The patient's muscle strength did not recover significantly after methylprednisolone pulse therapy. Seven days later, the patient and his family asked to discontinue treatment. On POD 75, he died of respiratory failure.

DISCUSSION

C. perfringens spores are widely distributed in nature, including on clothing surfaces, as well as in the biliary tract, intestinal tract and female reproductive tract^[20]. If there is an appropriate growth environment, such as in closed abdominal trauma or abdominal tissue or organ ischemia and necrosis, the *C. perfringens* in the intestine will multiply in large numbers, causing intra-abdominal gas gangrene infection.

The diagnosis of abdominal organ gas gangrene is based on the symptoms of uterine gas gangrene, except gram-positive bacteria would be found in peritoneal puncture fluid instead of dirty vaginal secretions. X-ray is useful for the diagnosis of soft tissue gas gangrene but is limited to the abdomen^[34]; CT and MR can clearly show interstitial gas, but MR takes a longer time^[9,34]. Portal venous gas was once an indicator of poor prognosis^[3,24]. With the development of imaging, mortality has decreased significantly. In any case, the presence of gas in solid organs and walls of hollow organs is abnormal and should be considered^[25]. Surgical exploration is the main method. If the gas and liquid in the abdominal cavity are foul-smelling and accompanied by gas accumulation in the tissue space and obvious snowball crepitation, gas gangrene infection should be highly suspected. Bacterial culture of *C. perfringens* from paracentesis fluid or pus is the definitive method of diagnosis, but the positive rate is not high^[2,34]. In our case above, *C. perfringens* was cultured from drainage fluid.

For patients who are diagnosed with intra-abdominal gas gangrene, the removal of necrotic tissue and effective drainage are key to treatment. Open abdomen, although controversial for severe abdominal infection, is part of the damage control strategy and is considered a beneficial treatment^[26-28]. Temporary closure of the abdominal cavity and the use of VSD meet the requirements of negative pressure therapy^[10,17,29] and can be applied to the open abdomen until the requirements of abdominal fascia closure are met^[27,28,30,31]. Negative pressure drainage in the treatment of soft tissue gas gangrene has also been reported^[30]. To our limited knowledge, we are the first to successfully apply an open abdomen and Bogota bag + VSD in the treatment of intra-abdominal gas gangrene, even though the patient eventually died of Guillain-Barre syndrome.

The application of antibiotics is necessary, and penicillin is the first choice. Although some experiments have proven that clindamycin is more active than penicillin in experimental gas gangrene^[20,21,32,33], other broad-spectrum antibiotics should be used in combination to treat possible combined infections, and empirical drugs are also recommended before diagnosis^[33,34]. Appropriate antibiotics should not be selected

until the drug susceptibility results are obtained. In the case above, the patient was resistant to clindamycin.

Hyperbaric oxygen therapy is recommended for the treatment of gas gangrene^[20,21,34], but it was not used in our case.

CONCLUSION

Closed abdominal injury may cause intra-abdominal gas gangrene infection. Timely diagnosis, surgery and anti-infective therapy are keys to treatment, and intensive care is necessary. If the abdominal cavity is heavily contaminated, open abdomen is a beneficial treatment.

Figure Legends

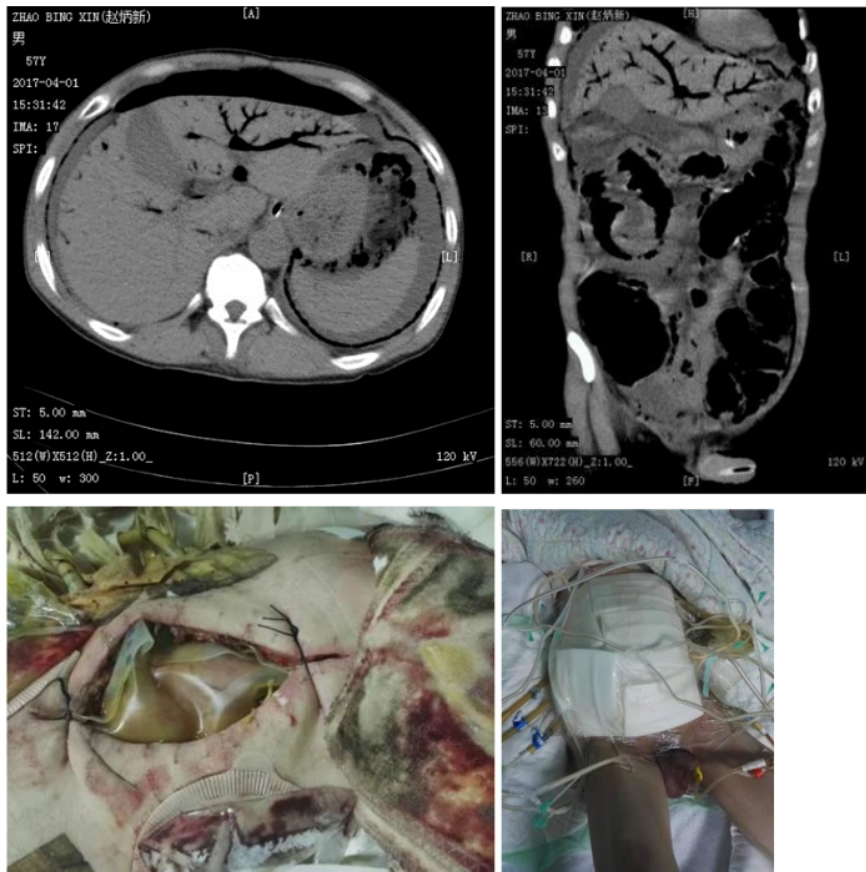


Figure 1 Image examination and treatment. A: Preoperative computed tomography (CT) showing pneumoperitoneum and portal venous gas; B: Coronal view of abdominal CT showing extensive portal venous gas; C: Bogota bag before the second surgery; D: Vacuum sealing drainage.

Table 1 Timeline of information from this case report

Date	Time	Major event	Treatment
3/31/2017	-	Fall from a high height	Admitted to another hospital
4/1/2017	-	Severe abdominal distension and unbearable abdominal pain	Transferred to our hospital
	14:30	Shock	Anti-shock therapy
	18:00	Abdominal CT showed pneumoperitoneum, ascites and portal venous gas	Emergency laparotomy
	18:00-23:50	First operation; crepitus and snow-ball crepitation were obvious between the greater omentum layers	Intraoperative bacterial smear; ICU life support after surgery
4/2/2017	1:00	Suspected gas gangrene	Anti-infective therapy with penicillin, Sulperazon and ornidazole
	1:20	Critical values in coagulation tests were reported	Plasma transfusion
	10:00	A large number of <i>Gram-positive bacilli</i> was found in pus smear	Open abdomen
4/3/2017	7:30	Critical values in coagulation tests were reported	Plasma transfusion
4/4/2017	10:00	<i>Clostridium perfringens</i> were cultured with drainage fluid	Continue anti-infective therapy
4/7/2017	9:00	Intestinal contents were found in abdominal drainage fluid	Second operation
4/11/2017	9:00	Multidrug-resistant bacteria were found in sputum culture	Added imipenem to anti-infective

			therapy
	10:00	<i>Clostridium perfringens</i> culture - was negative	
	12:00	Intestinal contents were found in abdominal drainage fluid	Third operation
4/12/2017	10:00	<i>Clostridium perfringens</i> culture - was negative; patient regained consciousness	
4/13/2017	10:00	<i>Clostridium perfringens</i> culture was negative; restored enteral nutrition; SBT experiment was implemented	Stopped using penicillin; removed endotracheal tube
4/14/2017	10:00	<i>Enterococcus faecium</i> were found in sputum culture	Replace other antibiotics with vancomycin
4/21/2017	15:30	Fascial closure	-
4/24/2017	15:00	Patient was transferred to general ward	Antibiotics were downgraded to Cefoxitin
4/27/2017	10:00	<i>Escherichia coli</i> were cultured with drainage fluid	Antibiotics were replaced with sulperazon and amikacin
5/1/2017	10:00	The patient was able to move with protective gear	Removed abdominal drainage tube
5/12/2017	10:00	The patient was discharged	-
5/30/2017	-	The patient developed progressive myasthenia	Diagnosed with Guillain-Barre syndrome
6/14/2017	-	The patient died of respiratory failure	-

CTA: Computed tomography; SBT: Small bowel transit.

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