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Case Report

Two Cases of Acute Perforated Appendicitis Complicated with Multiple Organ Failure

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Abstract

Case 1: A 60-year-old man presented with acute cardiorespiratory failure and disseminated intravascular coagulation (DIC) due to septic shock. The Sequential Organ Failure Assessment (SOFA) score was 14. He was diagnosed with panperitonitis complicated with multiple organ failure (MOF), and an emergency operation was then performed. Following the operative diagnosis of panperitonitis due to appendiceal perforation, appendectomy and drainage were performed. Although he required strict postoperative intensive care and a long period of rehabilitation, he was discharged on the 93rd hospital day.

Case 2: A 70-year-old man presented with acute circulatory failure, acute kidney injury, and DIC due to hypovolemic shock. The SOFA score was 11. He was diagnosed with localized peritonitis due to appendiceal perforation complicated with MOF, and emergency percutaneous abdominal drainage was then attempted. Following this procedure, conservative treatment concomitant with intensive care, including continuous hemodiafiltration, was attempted. After he successfully recovered from MOF, interval appendectomy was performed, and he was discharged on the 55th hospital day.

Keywords: Acute appendicitis, panperitonitis, localized peritonitis, multiple organ failure, appendectomy

Introduction

Acute appendicitis is one of the most common and familiar surgical diseases; its prognosis is widely recognized as quite good. However, a small number of patients with acute appendicitis may rarely develop life-threatening complicated clinical courses with substantial morbidity and, although extremely rare, mortality [1-4]. Herein, we report two cases of acute perforated appendicitis complicated with multiple organ failure (MOF). We also review the relevant literature and discuss the optimal strategy of management for such complicated appendicitis.

Case Reports

Case 1

A 60-year-old man was transferred to our hospital because of deterioration of the level of consciousness. On admission, he appeared cyanotic and showed labored breathing; his Glasgow Coma Scale (GCS) score was 9

(E2V2M5). Body temperature (BT) was 35.9°C; heart rate (HR), 116 beats/minute; respiratory rate (RR), 24 breaths/min; blood pressure (BP), 66/44 mmHg; and peripheral arterial oxygen saturation (SpO_2), 70% (under room air). On physical examination, his abdomen was found to be severely distended with muscular defense, and the extremities were warm to touch. We diagnosed his condition as acute cardiorespiratory failure due to septic shock, and emergency endotracheal intubation followed by mechanical ventilation, fluid resuscitation, administration of vasopressors, and antibiotic therapy were initiated. Results of laboratory tests indicated inflammatory reactions, disseminated intravascular coagulation (DIC), liver and renal dysfunction, hypoxia, and metabolic acidosis (Table 1). The Sequential Organ Failure Assessment (SOFA) score was 14. Plain chest radiography revealed infiltrations in the bilateral lung fields (Figure 1a), and abdominal computed tomography (CT) revealed the presence of intraperitoneal free air and a large amount of ascites (Figure 1b). He was diagnosed with panperitonitis complicated with MOF, and immediately after the elevation of his BP, an emergency operation was performed 4h after the diagnosis of septic shock. During laparotomy, a large amount of purulent ascites and a perforated appendix were observed; there was no perforation in the other gastrointestinal tract organs. Under the operative diagnosis of panperitonitis due to appendiceal perforation, appendectomy, peritoneal lavage, and drainage were performed (*Proteus mirabilis* was cultured from the ascites). After the operation, he developed cardiorespiratory failure, DIC, and severe associated pneumonia and required intensive care. The platelet count increased smoothly, and the arterial partial pressure of O_2/fraction of inspired O_2 ratio improved gradually. However, on the 8th hospital day, he suddenly developed barotraumatic pneumothorax and required percutaneous thoracic drainage; therefore, tracheostomy was performed for prolonged pulmonary care. Following this procedure, pneumonia was rapidly controlled, and on the 10th hospital day, he was withdrawn from mechanical ventilation (Figure 2). Although he required a long period of rehabilitation for the improvement of the respiratory and swallowing functions and muscular atrophy of the lower extremities, he was discharged on the 93rd hospital day.

Table 1: Laboratory data on admission (Case 1)

Hematology		**Blood chemistry**	
WBC	12,900/mm^3	Albumin	1.5 g/dL
Myelo	10%	T-Bil	0.7 mg/dL
Meta	33%	AST	277 IU
Stab	15%	ALT	88 IU
Seg	29%	LDH	226 IU
Lymph	9%	ALP	285 IU
Hb	8.9 g/dL	BUN	23.8 mg/dL
Ht	25.1%	Cr	2.23 mg/dL
Plt	7.3 × 10^4/mm^3	Na	127 mEq/L
Coagulation		K	4.2 mEq/L
PT	15.9 sec	Cl	107 mEq/L
PT-INR	1.98	Amy	83 IU
APTT	47.7 sec	CK	411 IU
FDP	7.6 μg/mL	Glucose	97 mg/dL
Blood gas (FiO_2 1.0 SIMV)		CRP	12.6 mg/dL
pH	7.277		
$PaCO_2$	29.0 Torr		
PaO_2	169.5 Torr		
HCO_3^-	13.2 mmol/L		
BE	-12.0 mmol/L		
Lactate	2.9 mmol/L		

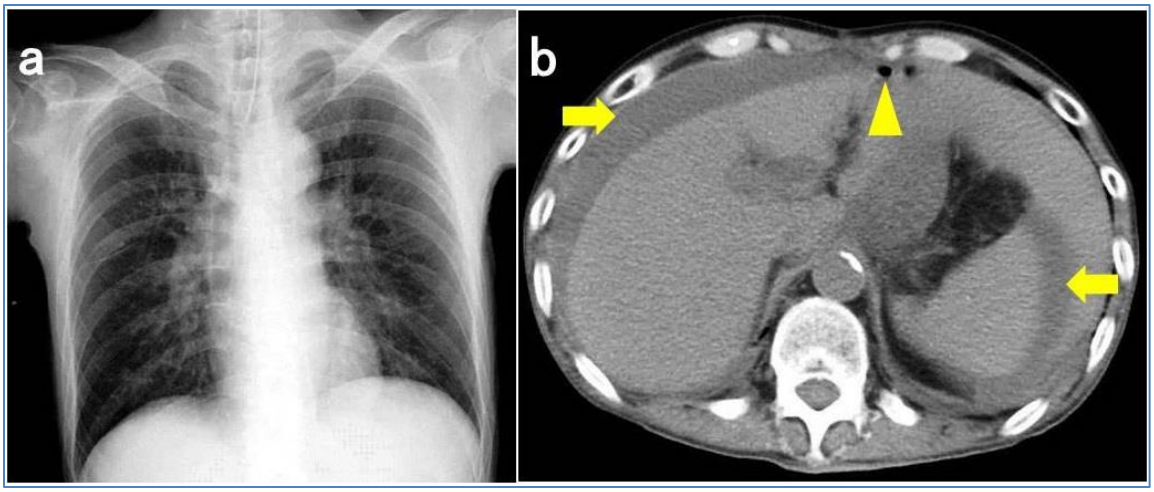

Figure 1: Case 1 (a) Plain chest radiography revealed infiltrations in the bilateral lung fields. (b) Abdominal computed tomography revealed the presence of intraperitoneal free air (*arrow head*) and a large amount of ascites (*arrows*).

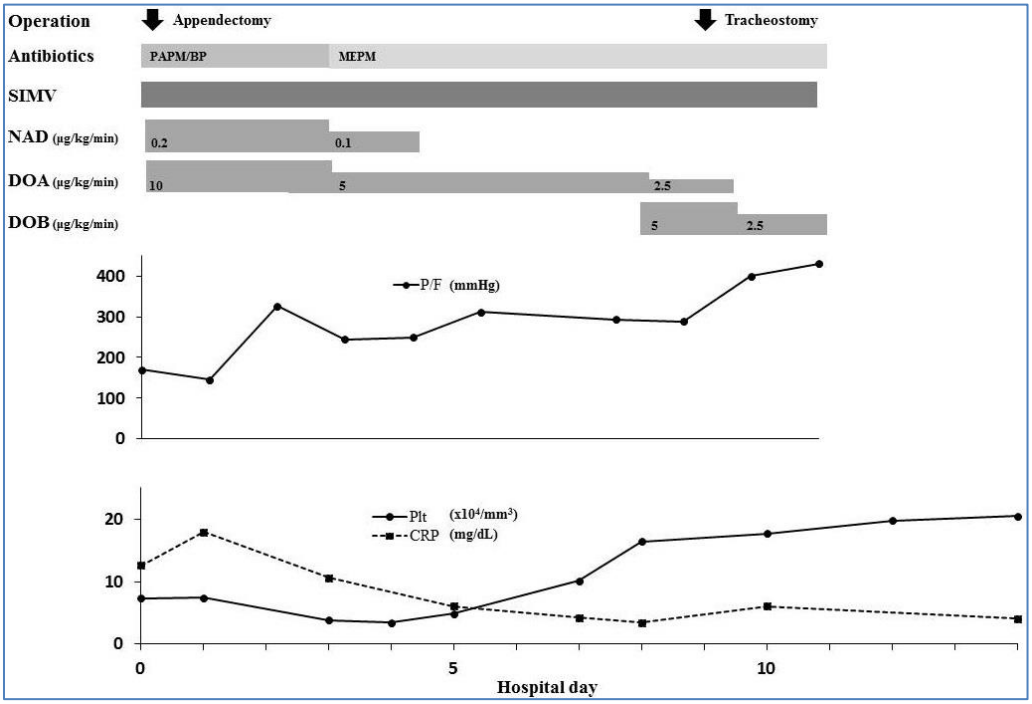

Figure 2: Clinical course (Case 1). PAPM/BP: Panipenem/betamipron; MEPM: Meropenem hydrate; SIMV: Synchronized intermittent mandatory ventilation; NAD: Noradrenaline; DOA: Dopamine hydrochloride; DOB: Dobutamine hydrochloride; P/F: Arterial partial pressure of oxygen (PaO_2) / fraction of inspired oxygen (FiO_2) ratio; Plt: Platelet; CRP: C-reactive protein

Case 2

A 70-year-old man was transferred to our hospital because of a 5-day history of vomiting and following oliguria. On admission, he appeared pale and tachypneic; his GCS score was 12 (E3V3M6). BT was 35.1°C; HR, 103 beats/minute; RR, 30 breaths/min; BP, 80/50 mmHg; and SpO_2, 97% (under room air). On physical examination, his abdomen was distended with rebound tenderness in the right lower quadrant, and the extremities were cold to touch. Results of laboratory tests indicated inflammatory reactions, DIC, renal dysfunction, and metabolic acidosis (Table 2). The SOFA score was 11. We diagnosed his condition as acute circulatory failure and acute kidney injury (AKI) due to hypovolemic shock, and administration of O_2 using a facial mask, fluid resuscitation, and administration of diuretics

were initiated. Abdominal CT showed a swollen appendix with a fecal stone and an inflammatory status with fluid collection around the cecum (Figure 3a). He was diagnosed with localized peritonitis due to appendiceal perforation complicated with MOF, and emergency percutaneous abdominal drainage using a 12-Fr trocar was attempted (Figure 3b), and 250 mL of purulent fluid was aspirated (*Escherichia coli* was cultured from the aspirated fluid). Following this procedure, intensive care, including continuous hemodiafiltration (CHDF), administration of vasopressor, anticoagulation therapy, and antibiotic therapy were attempted. Owing to these treatments, both the local and systemic inflammation were well- controlled; the urinary output and platelet count increased smoothly; and the blood urea nitrogen and creatinine levels decreased gradually. He successfully recovered from MOF; however, localized peritonitis recurred on the 14th hospital day. Therefore, interval appendectomy and drainage were performed on the 18th hospital day (Figure 4). The postoperative course was uneventful and following rehabilitation for muscular atrophy of the lower extremities, he was discharged on the 55th hospital day.

Table 2: Laboratory data on admission (Case 2)

Hematology		**Blood chemistry**	
WBC	7,900/mm^3	Albumin	2.9 g/dL
Meta	8%	T-Bil	1.3 mg/dL
Stab	37%	AST	12 IU
Seg	37%	ALT	15 IU
Lymph	14%	LDH	335 IU
Hb	15.8 g/dL	ALP	192 IU
Ht	49.4%	BUN	154.2 mg/dL
Plt	7.8 × 10^4/mm^3	Cr	11.52 mg/dL
Coagulation		Na	139 mEq/L
PT	15.0 sec	K	4.6 mEq/L
PT-INR	1.24	Cl	98 mEq/L
APTT	34.6 sec	Amy	55 IU
FDP	54.5 μg/mL	CK	141 IU
Blood gas (O2 6 L/min facial mask)		Glucose	247 mg/dL
pH	7.152	CRP	37.4 mg/dL
$PaCO_2$	24.2 Torr		
PaO_2	248.0 Torr	**Others**	
HCO_3^-	8.1 mmol/L	BNP	77.5 pg/mL
BE	-19.9 mmol/L	Procalcitonin	6.26 ng/mL
Lactate	4.8 mmol/L		

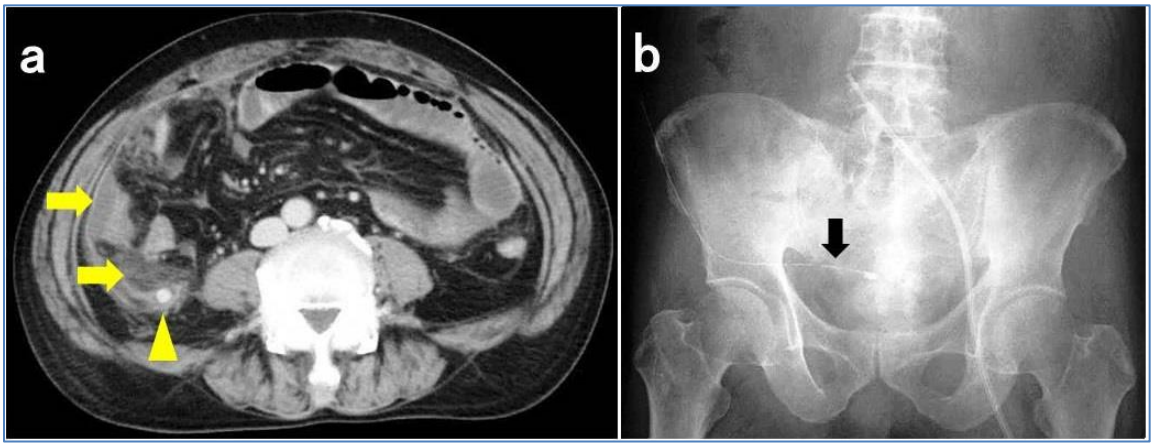

Figure 3: Case 2. (a) Abdominal computed tomography showed a swollen appendix with a fecal stone (*arrow head*) and an inflammatory status with fluid collection around the cecum (*arrows*). (b) Percutaneous abdominal drainage tube (*arrow*) was inserted.

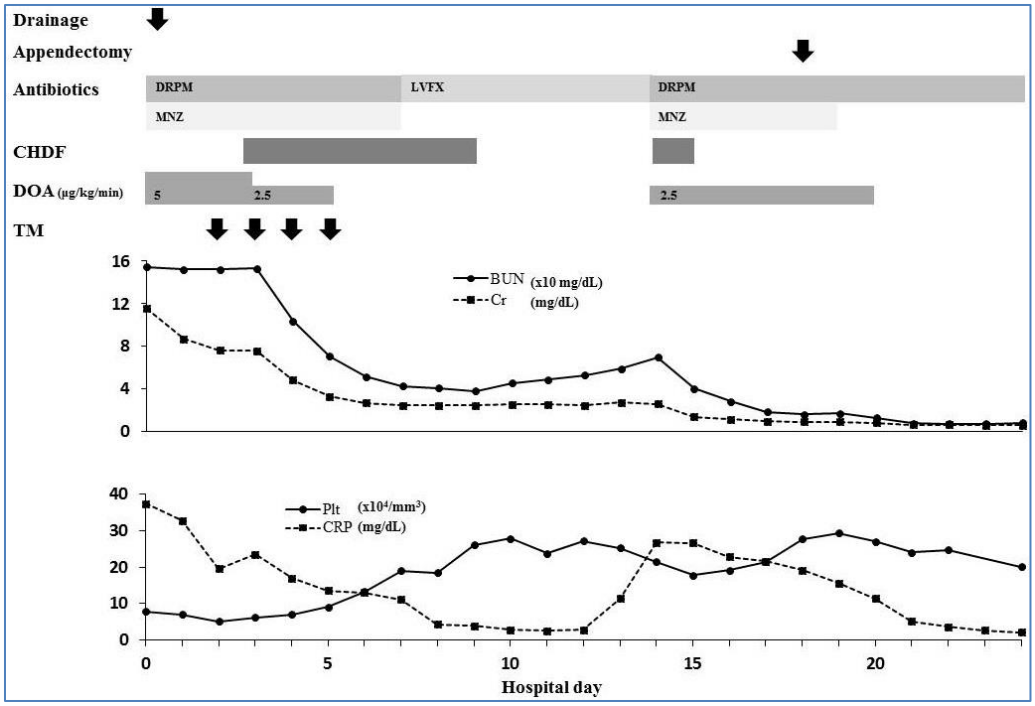

Figure 4: Clinical course (Case 2). DRPM: Doripenem hydrate; LVFX: Levofloxacin hydrate; MNZ: Metronidazole; CHDF: Continuous hemodiafiltration; DOA: Dopamine hydrochloride; TM: Thrombomodulin alfa; BUN: Blood urea nitrogen: Cr: Creatinine; Plt: Platelet; CRP: C-reactive protein

Discussion

Acute appendicitis is known to be a very common disease, and a majority of the affected patients progress with favorable clinical courses. However, under some special conditions, such as extremely old age, delayed diagnosis, an immunocompromised state (such as steroid use) [1], underlying uncontrolled diabetes mellitus [2], and complicated with necrotizing fasciitis or septic shock [1-4], the prognosis of the patients might worsen. Although extremely rare, the clinical course of the disease, especially when complicated with MOF, may result in the death of the patient [2-4].

Acute appendicitis may be of two types: simple (non-perforated) and complex (perforated) appendicitis [5]. Emergency appendectomy has traditionally been considered the first option of choice for the management of patients with simple appendicitis, except for children [6]. This strategy is based on the surgical principle of removing the offending organ, i.e., the source of infection, to resolve the infection [7]. Moreover, appendectomy for simple appendicitis is significant for preventing the perforation of the inflamed appendix. Conversely, the optimal strategy of the management for complex appendicitis remains a matter of debate, i.e., whether to select emergency appendectomy or conservative treatment as the initial treatment [3,7,8]. Emergency appendectomy is obviously a definitive treatment for complex appendicitis. However, several studies [7,8] suggest the advantages of initial conservative treatment for complex appendicitis with localized peritonitis or appendiceal abscess with a high success rate of 92-93% [1]. The reason for this opinion is explained as follows [7,8]: surgical stress at the peak of the inflammatory process may be a second insult to the host patient, which may lead to the subsequent stimulation of an already primed inflammatory system with excessive activation of the cytokine cascade. This excessive release of inflammatory cytokines (the so-called “cytokine storm”) may result in substantial adverse effects on the host patient. Therefore, appendectomy should be delayed until the induced systemic inflammatory response has been controlled. We believe that this theory applies certainly to patients with conditions complicated with organ failure; initial

conservative treatment concomitant with intensive care might be the appropriate first management option of choice for acute appendicitis complicated with organ failure. Brown et al. [8] advocated that when attempting conservative treatment for complex appendicitis, percutaneous abdominal drainage for the control of local infection should be performed, together with systemic antibiotic therapy. The significance of percutaneous drainage is not only offering minimally invasive drainage of the sources of infection, but also obtaining samples for identifying the pathogen and determining appropriate antibiotic therapy. However, for complex appendicitis with panperitonitis, it is difficult to drain the complete peritoneal cavity suitably via percutaneous drainage only; therefore, emergency appendectomy and drainage cannot be avoided even during severe inflammation [7,8]. After such emergency operation, several serious postoperative complications might develop, as seen in case 1, and stricter intensive care might be necessary. According to the aforementioned theory and strategy, we used initial conservative treatment concomitant with intensive care in case 2. From our experience, we supposed that CHDF likely played an important role in the recovery from MOF; CHDF might be effective for not only the management of AKI, but also the reduction of the high levels of inflammatory cytokines [9].

The necessity for interval appendectomy following successful conservative treatment for complex appendicitis is also controversial [6-8]. Authors who are in favor of interval appendectomy emphasize that without this procedure, the risks of recurrent appendicitis and missed pathological findings, especially malignancy, cannot be excluded [7,8]. In contrast, Karaca et al. [6] reported a low frequency of recurrent appendicitis and missed malignancy. In case 2, we performed interval appendectomy because of recurrence of localized peritonitis after recovery from MOF.

Owing to the recent advances in equipment and techniques, laparoscopic surgery for acute appendicitis has been increasingly accepted, and the advantages of this method have been described in many studies [10]. In our cases, we were concerned with the increased intraabdominal pressure induced by the pneumoperitoneum technique used during laparoscopy and longer operative time because of the lack of our experience of performing laparoscopic surgery for complex appendicitis. Therefore, we selected laparotomy instead of laparoscopy. However, even for complex appendicitis, laparoscopic appendectomy may be considered, depending on the experiences and skills of the surgeon.

Conclusion

We propose that initial conservative treatment, including percutaneous abdominal drainage, concomitant with intensive care might be the optimal strategy for the management of acute appendicitis complicated with MOF. However, for patients experiencing panperitonitis due to appendiceal perforation, even when complicated with MOF, emergency appendectomy and drainage followed by strict intensive care might be necessary.

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