



## Case report

# A classic case of *Capnocytophaga* induced septic shock with multi-organ failure after a dog bite in an asplenic patient

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## ABSTRACT

We hereby report a case of a 40-year-old male with a recent dog bite, a past history of immune thrombocytopenic purpura (ITP) and therapeutic splenectomy. He presented to the hospital with abdominal pain and shortness of breath, which progressed to sepsis and disseminated intravascular coagulation (DIC). Based on clinical presentation, *Capnocytophaga*-induced sepsis was suspected, and the diagnosis was confirmed through blood culture. Upon confirmation of the diagnosis, the patient was started on IV ampicillin/sulbactam which improved his condition and led to complete recovery without any long-term effects. *Capnocytophaga* is a genus of Gram-negative bacteria that are commensal to the oral cavity of common household pets such as dogs and cats. This case highlights the importance of considering *Capnocytophaga* as a potential pathogen in asplenic patients with recent pet-bites and emphasizes how early recognition and intervention can significantly improve outcomes in these critically-ill patients. It also warrants the need for healthcare providers to consider *Capnocytophaga* infections from minor pet-bites as a differential diagnosis in immunocompromised as well as immunocompetent individuals.

## Case illustration

A previously healthy 40-year-old male presented to the hospital emergency room with abdominal pain and shortness of breath. A week prior, he began experiencing fatigue and dyspnea on exertion (DOE) along with a dry cough. However, his DOE progressively worsened with mild exertional activities, prompting him to seek help at a nearby urgent care facility. Based on his complaints, he was prescribed a cough syrup containing brompheniramine/pseudoephedrine and dextromethorphan along with methylprednisolone Dosepak. His condition continued to worsen with increasing malaise, subjective fever and chills. He also complained of constant generalized abdominal pain that was dull and colicky in nature without any radiation. He rated the pain intensity as 4/10 and denied the presence of exacerbating or relieving factors, nausea, vomiting or diarrhea. Additionally, he denied experiencing headaches, photophobia, hydrophobia, urinary symptoms or urine discoloration, neurological symptoms or joint issues. In the emergency room patient informed the staff that he was bitten by his friends' pet dog on the left hand at the fingertips. According to the report, the dog had received its

routine vaccinations. The patient's past medical history was significant for immune thrombocytopenic purpura (ITP), type 2 diabetes mellitus, hyperlipidemia and bipolar disorder. His past surgical history was significant for therapeutic splenectomy, cholecystectomy and bilateral shoulder joint replacement.

On admission his vital signs were significant, with a temperature of 101.7° Fahrenheit, heart rate of 132 beats per minute, respiratory rate of 29 breaths/min, blood pressure of 75/54 mmHg, and oxygen saturation 98 % on 2 L nasal cannula. On physical examination, the patient was awake and alert but he appeared anxious, tachypneic and restless. His abdominal exam was significant for generalized abdominal tenderness without hepatosplenomegaly. The patient had normal bowel sounds and clear breath sounds bilaterally without any crackles, rhonchi or wheezing. The patient was noted to have oozing blood from gums, petechial hemorrhages bilaterally on upper and lower extremities and conjunctival hemorrhages in both eyes. Additionally, left middle finger had bluish-discoloration at the distal phalanx but capillary refill was intact. A puncture wound was present at the palmar aspect of the left middle finger while another one was found at the dorsum of index finger

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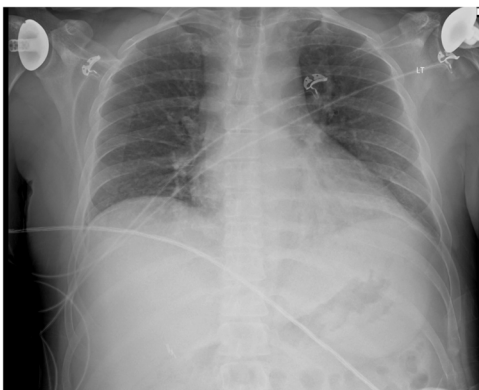


**Fig. 1.** Left hand showing puncture wound in the middle finger and index finger.

(Fig. 1). No signs of fluctuance, swelling, erythema, flexor tenosynovitis or abscess were found.

Initial laboratory work was notable for a hemoglobin level of 13.5 g/dL, mean corpuscular volume (MCV) 92 fL, mean corpuscular hemoglobin (MCH) 29 pg and a strikingly low platelet count of 10,000/uL. The white blood cell (WBC) count was 19,000/uL, with a differential count of 52 % bands, 20 % neutrophils, 6 % monocytes and 2 % lymphocytes. Peripheral smear reported the presence of intracellular bacilli. Serum electrolyte studies reported sodium, potassium, chloride, magnesium and glucose within normal limits, however serum bicarbonate level was 18 mEq, blood urea nitrogen (BUN) 32 mg/dL, serum creatinine 3.26 mg/dL, total protein 5.1 g/dL, albumin 2.8 g/dL and total bilirubin 6.3 mg/dL. The liver function tests (LFTs) were markedly elevated with AST 1139 U/L, ALT 880 U/L, alkaline phosphatase 133 U/L, serum lactate dehydrogenase 1975 U/L and serum lactic acid of 6.5 mmol/L. The arterial blood gas test revealed severe metabolic acidosis, with a pH of 7.05, PaCO<sub>2</sub> 45 mmHg, PaO<sub>2</sub> 92 mmHg, bicarbonate 12.4 mEq/L and 92 % Oxygen saturation on 2 L nasal cannula. Urinalysis was significant for urine protein 100 mg/dL, ketones 10 mg/dL, leukocyte esterase 25 Leu/uL, 11–20 urine WBC/HPF, 20 RBC cast/HPF and granular casts 11–20/HPF. Urine pH and specific gravity were within normal range, whereas urobilinogen, bilirubin, glucose and nitrite were undetectable in urine. Coagulation studies showed an international normalization ratio (INR) of 3.1, fibrinogen levels 141 mg/dL, D-dimer > 20.00 ug/ml FEU, prothrombin time (PT) 31.9 s, activated partial prothrombin time (aPTT) 81.8 s and factor VIII activity > 300 %. According to patients' medical records, the platelet count, serum creatinine, BUN and LFTs were within normal range two days prior to hospital admission when he was tested at the urgent care center.

Chest x-ray on admission showed either patchy infiltrates bilaterally or atelectasis in the retrocardiac region in the left lower lobe along with bilateral shoulder arthroplasty (Fig. 2). The EKG was significant for sinus tachycardia however did not show any ST-T wave changes. The abdominal ultrasound revealed moderate amount of right-sided pleural



**Fig. 2.** Chest X-ray on admission.

effusion and a surgically absent gallbladder and spleen. No abnormalities of liver, pancreas or kidneys were noted.

The patient was diagnosed with septic shock, accompanied by multi-organ failure. A normal saline fluid bolus of 3 L was initiated, along with broad-spectrum antibiotics including vancomycin and piperacillin/tazobactam after blood cultures were drawn. Despite fluid resuscitation, the patient remained hypotensive and norepinephrine was administered. Severe metabolic acidosis and tachypnea raised concerns for respiratory failure, leading to the patient being intubated in the emergency room and transferred to the medical ICU for further management.

Within the first 12 h of admission to the ICU, the patient's blood cultures were reported to consist of Gram-negative rods. Negative results were reported for respiratory pathogens PCR panel including SARS-CoV-2, flu and RSV. The patient's thrombocytopenia was attributed to either disseminated intravascular coagulation (DIC) or bone marrow suppression due to severe sepsis. The deranged LFTs and coagulation profile were presumed to signify shock liver from profound hypotension. Serum BUN, creatinine and urinalysis indicated acute kidney injury, due to which patient was initiated on continuous renal replacement therapy. Peripheral blood-smear leukocytosis with a left shift, toxic granulations and intracytoplasmic rod-like organism corroborated the suspicion of bacteremia and septic shock; however, schistocytes and platelet clumps were not reported. CT scan of the abdomen was obtained (Fig. 3A–C) which showed small bilateral pleural effusions, and findings suggestive of inflammation of distal ileum and entire colon, concerning for ileocolitis.

The patient's current stool culture as well as serology ruled out any infectious organism but the concern for *Capnocytophaga* was high due to the recent dog bite, asplenia and peripheral smear indicating Gram-negative bacteremia. Therefore, the patient's antibiotics were changed to IV meropenem and clindamycin and hand surgery was consulted to evaluate the wound site. The surgical team recommended to continue empiric antibiotics without surgical intervention as there was an intact arterial circulation. 48 h later, the patient's blood culture came back positive for *Capnocytophaga* species and the patient's antibiotics were tailored to IV ampicillin/sulbactam (Unasyn) (Fig. 4A–C). While the patient's clinical condition improved and he was extubated 72 h later to nasal cannula, he remained on IV Unasyn to complete his 14-day course. His kidney function gradually recovered to serum creatinine of 1.17 mg/dL, platelet count improved to 185,000/uL and his LFTs were reported within normal range. The patient was eventually discharged home with a recommendation for follow-up appointment with his primary care.

## Discussion

This case illustrates the classical progression of localized *Capnocytophaga* spp. skin infection to bacteremia and septic shock in an asplenic patient. The sequelae of septic shock resulted in DIC as well as multi-organ failure with injurious effects on liver, lungs, gastrointestinal tract and kidneys. While the mortality rate of septicemic individuals with *Capnocytophaga* spp. infection is more than 30 %, early intervention and timely management were the key to our patient's recovery [1].

*Capnocytophaga* is a genus of Gram-negative, facultative anaerobic, capnophilic, non-spore-forming, non-motile bacteria that survive as commensals in oral cavity of humans and domestic animals, including dogs and cats [2]. They belong to the *Flavobacteriaceae* family and have a characteristic safety pin appearance on Gram-stain [2]. A case review conducted by Abu Saleh and group indicated that approximately half of all identified *Capnocytophaga* infections in the United States are caused by the human oral commensals, with *C. sputigena* being the most commonly identified species [3]. The other half of *Capnocytophaga* spp infections are caused by animal transmission of bacteria of which the most clinically relevant species that thrives as oral commensals in dogs is *C. canimorsus* [3–7]. *Capnocytophaga canimorsus*, formerly called *Centers for Disease Control group dysgenic fermenter (DF) 2*, was first discovered in 1976 [2,8]. The majority of *C. canimorsus* infections are



Fig. 3. (A) shows non-contrast CT abdomen with bilateral pleural effusions. Fig (B) and (C) include non-contrast CT abdomen indicating the presence of ileocolitis.

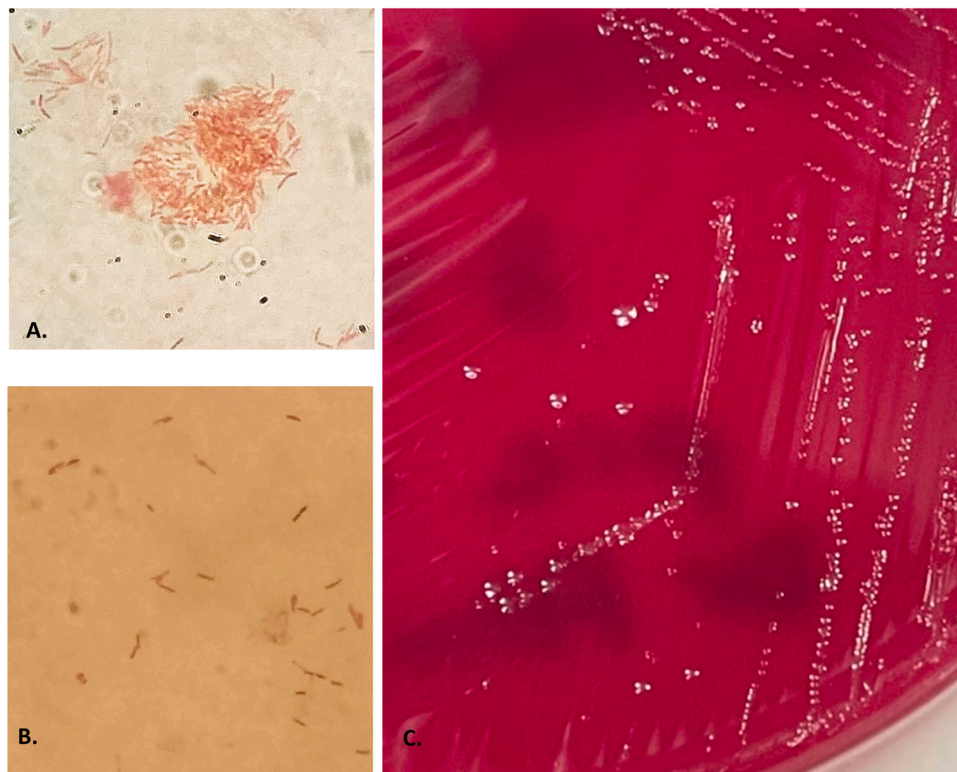


Fig. 4. (A) shows light-microscopic view of numerous bacilli in patient blood specimen. (B) indicates multiple gram-negative rods upon Gram-staining of patient's blood culture specimen, later confirmed as *Capnocytophaga* species. (C) Encapsulated, non-hemolytic *Capnocytophaga* spp. growth on blood agar plate.

attributed to mammalian bites (54 % of cases) however, scratch (8.5 %) or animal exposure (27 %) are also considerable sources of transmission especially in immunocompromised individuals [1]. While human-oral *Capnocytophaga* group is reported to cause bacteremia in only the

immunocompromised, *C. canimorsus* sepsis has been reported in immunocompetent individuals as well [1,9]. Among a variety of reasons for immunocompromise, the absence of spleen remains the most common associated risk factor for systemic infections with *Capnocytophaga*

spp. after a dog bite [1,10–14].

Asplenic patients are at an increased risk of fulminant infections throughout their lifetime, primarily due to the absence of splenic macrophages. The spleen plays a major role in opsonophagocytosis of encapsulated bacteria such as *Capnocytophaga*, pneumococci, meningococci, and *Escherichia coli* [15,16]. Various studies have collectively shown that the risk of overwhelming post-splenectomy (OPSI) infections, including *Capnocytophaga* spp, is much higher in individuals who undergo surgical removal of spleen due to hematologic issues compared to other reasons for splenectomy [11,15–17]. OPSI carries a significant mortality of 38–69 % [18].

Although seldom, *Capnocytophaga* infections mainly present as acute onset of fulminant sepsis (41 %), however cellulitis, meningitis, endocarditis, pneumonia, peritonitis and peripheral gangrene have also been reported [1,3,5,19,20]. Our patient presented with systemic inflammatory response resulting in multiorgan failure and consumption coagulopathy. The presence of elevated creatinine and LFTs indicated acute kidney and liver damage and the injury to lungs and gastrointestinal tract was confirmed through imaging studies. Literature mentions that patients with *Capnocytophaga* infections can often present with predominant shortness of breath appreciated as bilateral pulmonary infiltrates on X-ray and this clinical picture can be mistaken for viral or bacterial pneumonia, leading to delayed treatment [21]. Similarly, an acute abdomen can be mistaken for other causes of infections, and *Capnocytophaga* should be included among the differentials of patients presenting with sudden onset abdominal discomfort [22]. The presence of DIC in our case is of particular interest. While profound thrombocytopenia, prolonged PT and PTT, elevated D-dimers and low fibrinogen level supported the existence of DIC, the presence of greater than normal factor VIII activity and the absence of schistocytes or platelet clumps raise concerns for other etiologies. Acute hepatic failure can similarly present with a deranged coagulation profile and elevated factor VIII activity, while the presence of bone marrow suppression in fulminant sepsis can lead to thrombocytopenia as seen in this patient [12, 23, 24]. Therefore, we predict that our patient sustained acute liver failure and DIC, in the presence or absence of bone marrow suppression.

Aggressive management and prompt antibiotic administration is the key to successful clinical outcome without long-term morbidities in patients with *Capnocytophaga* sepsis. Antibiotic susceptibility reports are often received late in the course of bacteremia; therefore, the choice of an empiric therapy must be recommended as soon as peripheral blood smear indicates presence of intracellular or extracellular Gram-negative organisms. In high-risk patients with severe sepsis, beta-lactam-beta-lactamase combinations or carbapenems are generally recommended [25,26]. The initial therapy in this patient with piperacillin/tazobactam followed by meropenem improved the severity of his clinical conditions. He was later switched to ampicillin/sulbactam when susceptibility reports disclosed an antibiotic sensitive strain of *Capnocytophaga*. It is noteworthy to mention that the laboratory at our hospital utilizes matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF) for identification of bacteria grown in culture, and it was unable to categorize this organism at species level. These results encourage the concurrent use of nucleic acid tests alongside proteomic-identification and underscore the pitfalls of a limited MALDI-TOF database to precisely identify rare bacterial pathogens.

Finally, the dog bite wound in our case signifies that a trivial bite-mark can often be ignored due to its superficial involvement of skin. However, cases with fulminant *Capnocytophaga* infections have been reported after minor wounds in immunocompetent as well as immunocompromised individuals [1,27–29]. In certain cases of non-human commensal *Capnocytophaga* infections, there is no recollection of animal-exposure, which prompts us to consider that insignificant domestic animal interactions can often lead to serious consequences. *Capnocytophaga* is not a reportable disease in the US, therefore, its true incidence can be underestimated and diagnosis can be delayed. Nevertheless, an asplenic patient should always be educated by their health

care providers of the recommended guidelines for splenectomy, which includes necessary lifestyle modifications, dangers from animal contacts and the risks of post-splenectomy sepsis. Our overall goal is to highlight the life-threatening crises as.

## Consent

All authors ascertain that patient confidentiality has been maintained and a verbal informed consent to publish this case study was obtained from the patient by one of the authors.

## Ethical approval

Ethical approval for the case report manuscript submitted in IDcases journal titled “A Classic Case of *Capnocytophaga* Induced Septic Shock with Multi-Organ Failure after a Dog-Bite in an Asplenic Patient (Abstract ID 4435211)” was not applicable.

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## CRediT authorship contribution statement

**Myles Duncan:** Writing – original draft. **Muhammad Khan:** Data curation, Supervision; **Monica Ahuja:** Analysis, Supervision. **Henna Iqbal:** final writing, Writing – review & editing.

## Conflict of interest statement

The authors certify that they have no competing financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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