

Campylobacter Bacteremia: A Challenging Diagnosis – First Tunisian Case Report and a Literature Review

Bactériémie à Campylobacter: un défi diagnostique – Premier cas clinique tunisien avec revue de la littérature

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ABSTRACT

Introduction: Human infections with *Campylobacter* typically result from consuming undercooked chicken, leading to infectious gastroenteritis. Bacteremia is a rare but potentially serious complication, particularly in immunocompromised individuals.

Observation: The clinical case presented here involved an 18-year-old patient with X-linked agammaglobulinemia (XLA) who presented with mucocutaneous jaundice. During the same hospitalization, the patient was diagnosed with secondary sclerosing cholangitis, considered to be related to his underlying immunodeficiency, and he exhibited *Campylobacter coli* bacteremia without gastrointestinal symptoms or secondary localization. The diagnosis was particularly challenging both clinically and microbiologically. The patient was treated with amoxicillin-clavulanic acid for 15 days, resulting in complete resolution of the *Campylobacter coli* bacteremia, with no relapse over two years of follow-up.

Conclusion: This case highlights that patients with XLA are at risk for systemic campylobacteriosis. To the best of the authors' knowledge, this is the first reported case of *Campylobacter* bacteremia in Tunisia.

Keywords: *Campylobacter* infections, Bacteremia, Blood culture, Delayed diagnosis, Immunocompromised host

RÉSUMÉ

Introduction: Les infections humaines à *Campylobacter* résultent généralement de la consommation de volaille mal cuite, entraînant une gastro-entérite infectieuse. La bactériémie constitue une complication rare, mais potentiellement grave, en particulier chez les personnes immunodéprimées.

Observation: Le cas clinique présenté ici concerne un patient âgé de 18 ans, atteint d'agammaglobulinémie liée à l'X qui s'est présenté avec un ictère cutanéomuqueux. Au cours de la même hospitalisation, il a été diagnostiqué avec une cholangite sclérosante secondaire, liée à son immunodéficience sous-jacente et une bactériémie à *Campylobacter coli* a été mise en évidence, sans symptômes gastro-intestinaux ni localisation secondaire. Le diagnostic s'est avéré particulièrement difficile, tant sur le plan clinique que microbiologique. Le patient a été traité par amoxicilline-acide clavulanique pendant 15 jours, ce qui a entraîné la guérison complète de la bactériémie à *Campylobacter coli*, sans récurrence au cours des deux années de suivi.

Conclusion: Ce cas souligne que les patients atteints d'agammaglobulinémie liée à l'X sont à risque de campylobactériose systémique. Au meilleur des connaissances des auteurs, il s'agit du premier cas de bactériémie à *Campylobacter* rapporté en Tunisie.

Mots clés: Infections à *Campylobacter*, Bactériémie, Hémoculture, Diagnostic tardif, Hôte immunodéprimé

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INTRODUCTION

Campylobacter species are Gram-negative, helical-shaped bacteria belonging to the family *Campylobacteraceae* (1). Forty-four *Campylobacter* species have been identified (2). *Campylobacter jejuni* (*C. jejuni*) and *Campylobacter coli* (*C. coli*) are major causes of human campylobacteriosis (3,4), with *C. jejuni* responsible for approximately 90% of reported infections (3,4). These species, commonly found in the gastrointestinal tracts of various animals (1,3), are primarily transmitted through undercooked poultry leading to gastroenteritis (1,3,4). Bacteremia occurs in fewer than 1% of cases (5), and its diagnosis without gastrointestinal symptoms is challenging (3). Herein, we described a novel case of *Campylobacter* bacteremia without gastrointestinal manifestations in a patient with X-linked agammaglobulinemia (XLA) and secondary sclerosing cholangitis. In addition, we performed a literature review related to *Campylobacter* bacteremia in patients with hypogammaglobulinemia and XLA, covering PubMed case reports from 2003 to 2025.

PATIENT INFORMATION

An 18-year-old man, with a history of XLA, revealed by acute osteomyelitis of the distal right femur complicated by an abscess at seven months of age and multiple episodes of pulmonary infections from one year of age, has been receiving monthly intravenous immunoglobulin (Ig) replacement therapy. One year ago, the patient was treated with albendazole for a gastrointestinal parasitosis due to *Giardia lamblia*, diagnosed by microscopic stool examination for ova and parasites. At the time of the admission, the patient presented with mucocutaneous jaundice of a few days' duration, without other associated symptoms.

Clinical findings

The patient was initially afebrile and physical examination was normal except for jaundice.

Timeline

Table 1 presents the progression of the patient's clinical course, microbiological diagnostic results, and the therapeutic interventions implemented

Table 1. Chronology of clinical course, microbiological diagnosis and therapeutic interventions

Medical history	X-linked agammaglobulinemia, receiving monthly intravenous immunoglobulin replacement therapy Acute osteomyelitis of the distal right femur with abscess at 7 months of age Multiple episodes of pulmonary infections since one year of age Digestive parasitosis treated one year ago
On admission	The patient was afebrile, with mucocutaneous jaundice Laboratory tests revealed leukocytosis, anemia, cholestasis, hepatic cytolysis and elevated inflammatory markers
Day 5	Onset of high-grade fever (39°C) One set of blood cultures was collected
Day 8	Abdominal ultrasound revealed hepatosplenomegaly First aerobic blood culture bottle turned positive
Day 11	First subculture on COS was positive showing very thin colonies
Day 12 - 16	Subculture on additional media was performed (PVX, SCS and CAM) Failure of several attempts of biochemical differentiation by the VITEK 2-automated system from COS and PVX agar
Day 17	Subculture on CAM was positive Additional tests were carried out (catalase, oxidase, urease)
Day 18	<i>C. coli</i> was identified using the NH card from selective culture media Antimicrobial susceptibility testing was performed
Day 20	Antimicrobial susceptibility testing results were available Identification from the subsequent blood culture bottles confirmed the same germ Magnetic Resonance Imaging was suggestive of sclerosing cholangitis
Day 21	Treatment with ursodeoxycholic acid was initiated A stool culture was ordered, in the absence of gastrointestinal symptoms Intravenous Amoxicillin-clavulanic acid therapy was initiated
Day 24	Stool culture returned positive for an identical strain of <i>C. coli</i>
Day 27	Patient discharged Continuing oral Amoxicillin-clavulanic acid for 9 other days
Day 36	The 15-day course of antibiotic therapy was successfully completed No recurrence of fever was observed, but jaundice persisted

C. coli: *Campylobacter coli*. CAM: Campylosel agar. COS: Columbia agar supplemented with 5% sheep's blood. NH: Neisseria-Haemophilus. PVX: chocolate agar supplemented with Polyvitex. SCS: Schaedler agar supplemented with 5% sheep's blood.

Diagnostic assessment

Laboratory tests revealed leukocytosis (34,000 cells/ μ L, normal range: 4,000-11,000 cells/ μ L) with a predominance of neutrophils (86,1%), anemia (hemoglobin level of 10.6 g/dL, normal range: 13-18 g/dL), a platelet count of 190,000/ μ L (normal range: 150,000-450,000 platelets/ μ L), cholestasis characterized by gamma glutamyl transferase of 201 IU/L (normal range: 7-50 IU/L), alkaline phosphatase of 227 IU/L (normal range: 34-96 IU/L), associated with conjugated hyperbilirubinemia of 76 μ mol/L (normal range: 0-7 μ mol/L), total bilirubin of 135 μ mol/L (normal range: 5-21 μ mol/L), hepatic cytolysis (aspartate aminotransferase of 111 IU/L (normal range: 1-35 IU/L) and alanine aminotransferase of 80 IU/L (normal range: 1-35 IU/L)) with no liver insufficiency (prothrombin time: 86%, normal range: 70-100 %), an elevated C-reactive protein level of 83 mg/L (normal range: $\leq$ 6 mg/L) and elevated procalcitonin of 1.21 ng/mL (normal range: $\leq$ 0.046 ng/mL).

On admission, residual serum Ig levels were as follows: IgG, 4.78 g/L (normal range: 7.51–15.60 g/L) and IgA, 0.01g/L (normal range: 0.82-4.53 g/L).

Hepatitis A virus, hepatitis B virus, hepatitis C virus, human immunodeficiency virus serologies and autoimmune tests (anti-nuclear antibodies, smooth muscle antibodies, anti-mitochondrial antibodies, antibodies to liver kidney microsome type-1) were negative.

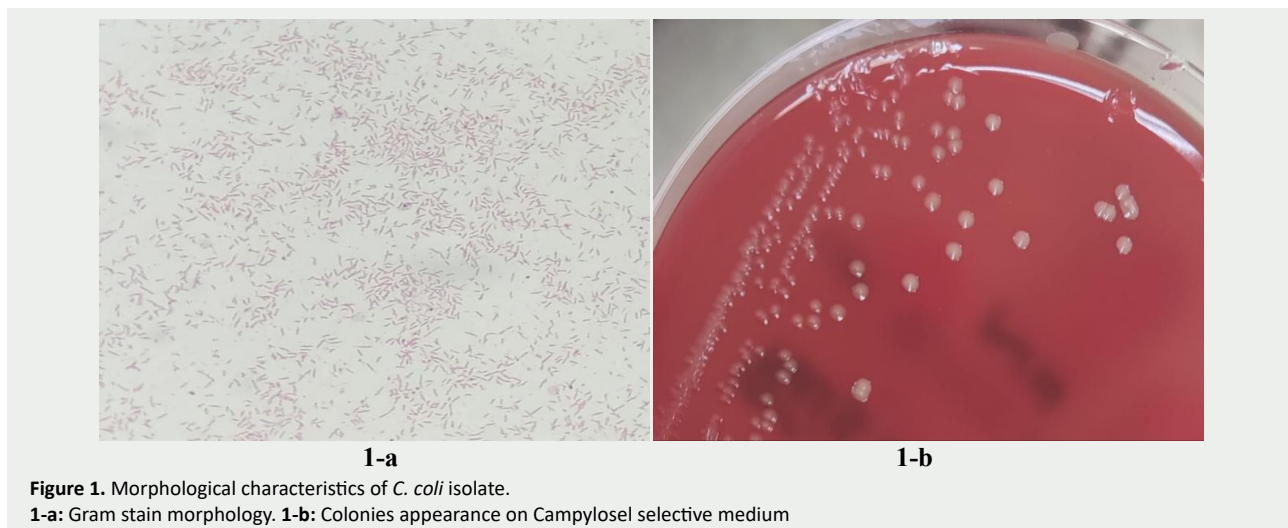
To further investigate the abnormal liver function tests, radiological examinations were performed. Abdominal ultrasound revealed hepatosplenomegaly and magnetic resonance imaging showed intrahepatic bile duct dilatation and stenosis suggestive of sclerosing cholangitis (Supplementary Figure: <https://doi.org/10.5281/>

zenodo.19704285). Secondary sclerosing cholangitis related to XLA was subsequently considered.

On day five of hospitalization, we objectified a fever at 39°C. One set of blood cultures was sent to the laboratory. Four additional sets were collected over the following days, at the frequency of one set per day. The first aerobic blood culture bottle turned positive after three days of incubation in BacT/ALERT (bioMérieux, Marcy-l'Étoile, France). Gram staining was inconclusive. Subculture firstly performed on Columbia agar supplemented with 5% sheep's blood (COS) (bioMérieux) was positive after 72 hours aerobic incubation at 37°C showing very thin, flat, greyish colonies. Gram staining showed thin, curved Gram-negative (GN) bacilli (Figure 1-a).

Subculture of the same bottle was then performed on chocolate agar supplemented with Polyvitex (PVX) (bioMérieux), incubated in an atmosphere of 5-10% CO₂, on Schaedler agar supplemented with 5% sheep's blood (SCS) (bioMérieux), incubated anaerobically. After 72 hours of incubation, growth was observed only on the PVX, with thin and greyish colonies. The biochemical differentiation by the VITEK 2-automated system (bioMérieux, Marcy-l'Étoile, France), from colonies grown on COS and PVX, with the GN bacilli and *Neisseria-Haemophilus* (NH) cards, has failed.

Considering the failure to identify the isolate, its Gram-stain morphology and its growth characteristics, we performed a subculture on *Campylobacter*-specific and selective agar: Campylosel agar (CAM) (bioMérieux), incubated in a microaerophilic atmosphere. After 72 hours of incubation, the CAM agar showed flat, greyish, shiny colonies of larger size than on COS and PVX (Figure 1-b). The urease test was negative. Catalase and oxidase tests were positive.



The pathogen was finally identified as *C. coli* with an excellent confidence level (99% probability at the species level) when tested from CAM agar and using the NH card. All the other blood culture bottles were detected positive after two to three days' incubation in BacT/ALERT and revealed the same germs.

Antimicrobial susceptibility testing was carried out on Mueller-Hinton Fastidious agar (diffusion method) in

accordance with Antibiogram Committee of the French Society for Microbiology/European Committee on Antimicrobial Susceptibility Testing recommendations 2023. After 48 hours of incubation in an atmosphere of 5-10% CO₂, the isolated strain was sensitive to amoxicillin-clavulanic acid, Azithromycin, Clarithromycin, Gentamicin, Ertapenem, Imipenem and was resistant to only 3 antibiotics:

Ampicillin, Ciprofloxacin and Tetracycline. A stool culture was ordered in search of an entry point, and the same strain was isolated. The stools were of soft consistency and no diarrheal episodes had been reported in the last 12 months.

Therapeutic intervention

On day 21, the patient initiated treatment with ursodeoxycholic acid, at a dose of 600 mg per day, for his secondary sclerosing cholangitis. He also received intravenous amoxicillin-clavulanic acid 1g three times daily (weight of 41 kg) for 6 days for his *C. coli* bacteremia, in accordance with the antibiotic's susceptibility profile. The patient was subsequently discharged and continued oral amoxicillin-clavulanic acid for an additional nine days.

Follow-up and outcomes

At discharge, laboratory tests revealed a C-reactive protein level of 30 mg/L. Liver function tests showed improvement but persistent abnormalities, with gamma-glutamyl transferase of 80 IU/L, alkaline phosphatase of 200 IU/L, conjugated bilirubin of 43 µmol/L, total bilirubin of 78 µmol/L, aspartate aminotransferase of 77 IU/L and alanine aminotransferase of 51 IU/L. Residual serum Ig levels were as follows: IgG, 6.88 g/L and IgA, 0.01g/L. Blood examination indicated an elevated white blood cell count of 32,300 cells/µL. There were no signs of secondary localization such as endocarditis, osteomyelitis or pyogenic arthritis. The patient has been thoroughly educated to seek medical evaluation promptly at the earliest sign of infection.

The patient was treated with amoxicillin-clavulanic acid, for fifteen days, resulting in sustained apyrexia with persistent jaundice. Marked leukocytosis persisted for six months and was reactive to low doses of intravenous Ig. Following dose escalation from 0.8 g/kg every 4 weeks to 1 g/kg, with a target residual IgG level of approximately 10 g/L, the patient's serum IgG level reached 8.73 g/L, and the white blood cell count normalized (9,600 cells/µL). Furthermore, after six months of ursodeoxycholic acid therapy, we observed progressive resolution of jaundice and liver function tests showed near normalization (gamma-glutamyl transferase of 52 IU/L, alkaline phosphatase of 175 IU/L, conjugated bilirubin of 2 µmol/L, total bilirubin of 10 µmol/L, aspartate aminotransferase of 28 IU/L and alanine aminotransferase of 28 IU/L). Ursodeoxycholic acid was continued as long-term therapy. The patient is being followed at the day hospital every four weeks, and no recurrence of *C. coli* bacteremia has been observed over two years of follow-up.

DISCUSSION

This case highlighted the diagnostic challenge of *C. coli* bacteremia presenting in a patient with XLA in the absence of any gastrointestinal symptom. Human infections caused by *C. jejuni* and *C. coli* typically

present with mild symptoms such as fever, abdominal cramps and diarrhea (4). More severe outcomes, like bloodstream infections can arise, particularly in older adults and those with underlying conditions like diabetes mellitus or cancer (4).

Campylobacter bacteremia is more frequent in immunocompromised patients (1). One series reported underlying immunodepression in 51.6% of cases, including 15.6% with hypogammaglobulinemia (5). The main species involved were *C. jejuni* and *Campylobacter fetus* (*C. fetus*) (5). In our case, *C. coli* was isolated from blood culture of an XLA patient.

Previous studies have shown that patients with humoral immune depression experience recurrent episodes of *Campylobacter* bacteremia (5,6). It's probably related to the incapacity of the immunocompromised host to eliminate the pathogen (5,6). Those with XLA receive regular Ig replacement therapy to sustain serum IgG levels in order to prevent infections by enteropathogenic organisms. However, this therapy does not provide IgA, crucial for gut bacterial elimination. Thus, there is a need for alternative approaches to enhance gut immunity (6,7). Cellulitis often accompanies bacteremia episodes, especially in the lower limbs (8).

We reviewed the literature on PubMed over a 22-year period (2003-2025) and identified nine cases of XLA and three cases of antibody deficiency of undetermined origin, including two hypogammaglobulinemia and one agammaglobulinemia, all with documented *Campylobacter* bacteremia (Table 2). Among these 12 cases (6,7,11-20), six patients presented with cellulitis (6,7,11,14,15,18), and seven experienced one or more relapses (6,7,11,12,15-17). Stool cultures were positive for *Campylobacter* species in six cases (6,7,11,12,16,18), but only two patients had diarrhea (6,19). In our case, there was no cellulitis and no gastrointestinal symptoms but the stool culture revealed the presence of *C. coli*. Our patient had no relapse after two years of follow-up.

Campylobacter bacteremia remains a challenging diagnosis, due to the pathogen's demanding nature and the difficulty of phenotypic identification (9). In our case, the pathogen's fastidious nature delayed identification, as it did not grow well on standard media used for subculturing blood cultures. Furthermore, biochemical identification was only successful when performed from the specific medium. The NH card identified *C. coli* with an excellent confidence level (99%).

However, it is well recognized that biochemical and automated phenotypic systems may yield inconclusive or low-confidence results. In such situations, complementary approaches—including species-specific PCR assays, 16S rRNA gene sequencing, or matrix-assisted desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS)—have been shown to significantly improve identification accuracy (10). These techniques are not available in our laboratory.

Table 2. Overview of published case reports of *campylobacter* bacteremia in patients with hypogammaglobulinemia and X-linked agammaglobulinemia.

Case N°	Authors Sex Age (years)/ country	Medical history	Presenting sign/ symptom	Positive blood cultures Isolated species from blood culture Stool culture	Treatment	Outcome
1	Tokuda et al. (11) M 16 Japan	XLA receiving infusions of IV gammaglobulin every 3 weeks	Right lower leg cellulitis	4 times <i>C. coli</i> Positive for <i>C. coli</i> (on 3 rd + 4 th adm)	Cefoperazone/Sulbactam Imipenem/Cilastatin + Amikacin Panipenem/Betamipron Panipenem/Betamipron + Kanamycin	Multiple relapses then resolved
2	Kim et al. (6) M 18 Korea	HGG (diagnosed at 1 year of age) receiving IV Ig replacement therapy every 3 weeks (genetic studies for XLA had not been performed)	Fever, diarrhea and cellulitis	4 times <i>C. jejuni</i> Positive for <i>C. jejuni</i> (on 4 th + 6 th adm)	Cefazolin + Amikacin + Roxithromycin Amoxicillin - clavulanic acid + Amikacin Cefazolin + Arbekacin + Roxithromycin Cefazolin + Arbekacin + Clarithromycin Meropenem + Doxycycline + Amikacin Doxycycline	Multiple relapses then resolved
3	Hagiya et al. (7) M 37 Japan	XLA receiving subcutaneous Ig replacement therapy every 3 weeks	Left leg cellulitis and fever	7 times <i>C. coli</i> Positive for <i>C. coli</i>	Meropenem Tebipenem-pivoxil Tebipenem-pivoxil + Faropenem Biapenem + Minocycline	Multiple relapses then resolved
4	Van den Bruele et al.(12) M 15 Netherlands	XLA, Anti-epileptic medication	Loss of appetite, fever, failure to thrive	2 times <i>C. jejuni</i> Positive for <i>C. jejuni</i>	Meropenem Erythromycin Azithromycin Doxycycline	Relapses then resolved
5	Yamagami et al. (13) M 24 Japan	HGG diagnosed during hospitalization (the definitive diagnosis underlying primary hypogamma-globulinemia remains unclear, XLA was ruled out)	High fever, general malaise, left pleural effusion pleuritis	1 time <i>C. fetus</i> Not specified	Ceftriaxone Meropenem	Resolved
6	Poizeau et al.(14) M 19 France	XLA receiving IV gammaglobulin	Shifting cellulitis in both legs without fever, appendicitis without intestinal signs	1 time <i>C. jejuni</i> Not specified	Azithromycin	Resolved
7	Okada et al.(15) M 33 Japan	XLA receiving Ig replacement therapy every two weeks	Sustained fever and cellulitis of the left leg	9 times <i>C. coli</i> Negative	Ciprofloxacin + Gentamicin Imipenem/Cilastatin Imipenem + Gentamicin Meropenem + Ciprofloxacin + Minocycline Azithromycin Kanamycin	Relapses then resolved
8	Arai et al.(16) M/35 Japan	XLA (genetic studies were performed during hospitalization)	Sustained fever, pain and swelling of the left ankle joint (Reactive arthritis)	4 times <i>C. coli</i> Negative then positive (at the 2 nd relapse)	Ceftazidime, Minocycline Cefepime Meropenem, Minocycline	Relapses then resolved
9	Jirapongsananuruk et al.(17) M 19 Thailand	XLA, receiving IV Ig treatment every 4 weeks	Fever, cough, dyspnea and headache	4 times <i>C. lari</i> Negative	Ceftazidime + Gentamicin Cefotaxime + Amikacin Azithromycin Amoxicillin - clavulanic acid Azithromycin	Relapses then resolved
10	Nakamura I. et al. (18) M 47 Japan	Agammaglobulinemia, Bronchiectasis	Low-grade fever, left lower tibia cellulitis	1 time <i>C. jejuni</i> Positive for <i>C. jejuni</i>	Minocycline Fosfomycin	Resolved
11	Zhuo R. et al. (19) M 43 United States	XLA-related inflammatory bowel disease, receiving IV Ig every 3 weeks and chronic prednisone for many years, HIV, thrombocytopenia	Diarrhea and abdominal pain related to the fifth recurrence of <i>C. jejuni</i> bacteremia	5 times <i>C. jejuni</i> Not specified	Cefepime + Doxycycline Cefepime + Moxifloxacin	Resolved
12	Fettingner NB et al. (20) M 11 United States	XLA receiving monthly IV Ig	Abdominal pain, nausea, emesis, tea colored urine, fatigue, fever, congestion, nonproductive cough, headaches, pallor, jaundice and myalgias	1 time <i>C. coli</i> Not specified	Meropenem + Clarithromycin Amoxicillin + Clarithromycin	Resolved

Adm: admission. HGG: hypogammaglobulinemia. Ig: immunoglobulin. IV: intravenous. M: male. XLA: X-linked agammaglobulinemia.

In this context, Martiny et al. (10), in their comparative evaluation of biochemical identification systems including API Campy and the VITEK 2 NH card, proposed that only results categorized as “excellent” or “very good” identification to species level according to the manufacturer’s criteria should be considered reliable; in all other situations, molecular methods or MALDI-TOF MS should be performed when accurate identification is required.

Macrolides remain the treatment of choice for gastrointestinal infections caused by *Campylobacter* (2). Although no formal recommendations exist for the treatment of invasive *Campylobacter* infections, some authors suggest combination antibiotic therapy including a beta-lactam (amoxicillin–clavulanic acid or a carbapenem) or a fluoroquinolone (if the strain is susceptible), combined with gentamicin. Bacteremia treatment typically spans seven days, extendable if secondary sites of infection are present (2). In our case, the patient was treated with amoxicillin-clavulanic acid for fifteen days with favorable outcome.

CONCLUSION

Although bacteremia is a rare occurrence in *Campylobacter* infections, it should be considered in patients with XLA, who are at increased risk for systemic involvement, even in the absence of gastrointestinal symptoms or an obvious route of entry. In this context, providing detailed clinical information is essential, as it guides the laboratory toward appropriate diagnostic strategies. Therefore, all necessary measures for the pathogen’s isolation and identification should be implemented when handling blood cultures from patients with XLA.

Patient Perspective

The patient reported satisfaction with the treatment outcome and expressed understanding of the need for prolonged antibiotic therapy given his underlying condition.

Patient Consent

Written informed consent was obtained from the patient for publication.

REFERENCES

1. Kaakoush NO, Castaño-Rodríguez N, Mitchell HM, Man SM. Global Epidemiology of *Campylobacter* Infection. Clin Microbiol Rev. 2015;28(3):687-720. doi:10.1128/CMR.00006-15.
2. Lehours P. Infections à *Campylobacter*. EMC - Biol Med. 2023;1-10. doi:10.1016/S2211-9698(23)42156-5
3. Fitzgerald C. *Campylobacter*. Clin Lab Med. 2015 Jun;35(2):289-98. doi:10.1016/j.cll.2015.03.001.
4. Jehanne Q, Pascoe B, Bénégat L, Ducournau A, Buissonnière A, Mourkas E, et al. Genome-Wide Identification of Host-Segregating Single-Nucleotide Polymorphisms for Source Attribution of Clinical *Campylobacter coli* Isolates. Appl Environ Microbiol. 2020 Nov 24;86(24):e01787-20. doi:10.1128/AEM.01787-20
5. Fernández-Cruz A, Muñoz P, Mohedano R, Valerio M, Marín M, Alcalá L, et al. *Campylobacter* bacteremia: clinical characteristics, incidence, and outcome over 23 years. Medicine (Baltimore). 2010 Sep;89(5):319-30. doi:10.1097/MD.0b013e3181f2638d.
6. Kim Y, Shin JA, Han SB, Cho B, Jeong DC, Kang JH. Recurrent *Campylobacter jejuni* bacteremia in a patient with hypogammaglobulinemia. Medicine (Baltimore). 2017 Jun 23;96(25):e7238. doi:10.1097/MD.0000000000007238.
7. Hagiya H, Kimura K, Nishi I, Yoshida H, Yamamoto N, Akeda Y, et al. Emergence of Carbapenem Non-susceptible *Campylobacter coli* after Long-term Treatment against Recurrent Bacteremia in a Patient with X-linked Agammaglobulinemia. Intern Med. 2018 Jul 15;57(14):2077-80. doi:10.2169/internalmedicine.0312-17.
8. Monselise A, Blickstein D, Ostfeld I, Segal R, Weinberger M. A case of cellulitis complicating *Campylobacter jejuni* subspecies *jejuni* bacteremia and review of the literature. Eur J Clin Microbiol Infect Dis. 2004 Sep;23(9):683-5. doi:10.1007/s10096-004-1201-x
9. Gallo MT, Di Domenico EG, Toma L, Marchesi F, Pelagalli L, Manghisi N, et al. *Campylobacter jejuni* Fatal Sepsis in a Patient with Non-Hodgkin’s Lymphoma: Case Report and Literature Review of a Difficult Diagnosis. Int J Mol Sci. 2016 Apr 12; 17(4):544. doi:10.3390/ijms17040544.
10. Martiny D, Dediste A, Debruyne L, Vlaes L, Haddou NB, Vandamme P, et al. Accuracy of the API Campy system, the Vitek 2 Neisseria–Haemophilus card and matrix-assisted laser desorption ionization time-of-flight mass spectrometry for the identification of *Campylobacter* and related organisms. Clin Microbiol Infect. Jul 2011;17(7):1001-6. doi:10.1111/j.1469-0691.2010.03328.x
11. Tokuda K, Nishi J, Miyanohara H, Sarantuya J, Iwashita M, Kamenosono A, et al. Relapsing Cellulitis Associated With *Campylobacter coli* Bacteremia in an Agammaglobulinemic Patient. Pediatr Infect Dis J. 2004 Jun;23(6):577-9. doi:10.1097/01.inf.0000130080.86862.d5
12. Van Den Bruele T, Mourad-Baars PEC, Claas ECJ, Van Der Plas RN, Kuijper EJ, Bredius RGM. *Campylobacter jejuni* bacteremia and *Helicobacter pylori* in a patient with X-linked agammaglobulinemia. Eur J Clin Microbiol Infect Dis. 2010 Nov; 29(11):1315-9. doi:10.1007/s10096-010-0999-7
13. Yamagami K, Miyashita T, Nakamura T, Shirano M, Nakamura T, Kameda K, et al. *Campylobacter fetus* Bacteremia with Purulent Pleurisy in a Young Adult with Primary Hypogammaglobulinemia. Intern Med. 2014;53(11):1221-5. doi:10.2169/internalmedicine.53.1622
14. Poizeau F, Droitcourt C, Saillard C, Poirot M, Le Gallou T, Perlat A, et al. Shifting cellulitis in a patient with X-linked hypogammaglobulinemia. Ann Dermatol Venereol. 2016 Jun-Jul; 143(6-7): 453-6. doi:10.1016/j.jannder.2016.03.006
15. Okada H, Kitazawa T, Harada S, Itoyama S, Hatakeyama S, Ota Y, et al. Combined Treatment with Oral Kanamycin and Parenteral Antibiotics for a Case of Persistent Bacteremia and Intestinal Carriage with *Campylobacter coli*. Intern Med. 2008; 47(14):1363-6. doi:10.2169/internalmedicine.47.1161
16. Arai A, Kitano A, Sawabe E, Kanegane H, Miyawaki T, Miura O. Relapsing *Campylobacter Coli* Bacteremia with Reactive Arthritis in a Patient with X-linked Agammaglobulinemia. Intern Med. 2007;46(9):605-9. doi:10.2169/internalmedicine.46.6108
17. Jirapongsananuruk O, Wanotayan K, Phongsamart W, Choekphaibulkit K, Visitsunthorn N, Luangwedchakarn V, et al. Recurrent *Campylobacter lari* Bacteremia in X-Linked Agammaglobulinemia: a case report and review. Asian Pac J Allergy Immunol. 2006;24(2-3):171-4
18. Nakamura I, Kobayashi T, Fukuzawa M, Komori K, Yamaguchi T. Cellulitis with bacteremia due to multidrug-resistant *Campylobacter jejuni* in a case of agammaglobulinemia and bronchiectasis. IDCases. 2024 Jun 7;37:e02010. doi:10.1016/j.idcr.2024.e02010.
19. Zhuo R, Younes RL, Ward K, Yang S. Carbapenem resistant *Campylobacter jejuni* bacteremia in a Bruton’s X-linked agammaglobulinemia patient. Eur J Clin Microbiol Infect Dis. 2024;43(12):2459-63. doi:10.1007/s10096-024-04937-1.
20. Fettingner NB, Bradley JS, Ramchandran N. An 11-Year-old Male With X-linked Agammaglobulinemia and Persistent Abdominal Pain. Pediatr Infect Dis J. 2021 avr; 40(4):356-8. doi:10.1097/INF.0000000000003056