Case report

Fatal outcome of gastric perforation due to infection with Sarcina spp. A case report

Adrian Dumitrua,b, Cătălîn Aliușc, Adriana Elena Nica b,d, Iulian Antonia,c,
Daniela Gheorghităeb,c, Sebastian Grădinarub,c

a Pathology Department, University Emergency Hospital Bucharest, Romania
b Carol Davila University of Medicine and Pharmacy, Bucharest, Romania
c 4th Surgical Department, University Emergency Hospital Bucharest, Romania
d Anesthesiology Department, University Emergency Hospital Bucharest, Bucharest, Romania
Politehnica University of Bucharest, Faculty of Materials Science and Engineering, Romania

ABSTRACT

Sarcina ventriculi is an extremely rare pathogen. These gram-positive cocci bacteria are rarely identified in gastric biopsies and usually described in the scientific literature as an incidental finding, particularly in patients with delayed gastric emptying, gastroparesis, emphysematous gastritis or gastric perforation. It occurs most commonly in adult women and can be identified easily by its distinctive morphologic features, such as basophilic staining, cuboidal shape, tetrad arrangement, red blood cell-sized packets, flattened cell walls, and refractile nature in bright field microscopy. Although the pathogenesis of the microorganism is highly debated in humans, this bacterium is a well-known pathogen in livestock. Fewer than 30 cases of human infection have been described in the scientific literature so far, but none mentioned this micro-organism as a potential cause of death. We report the case of a 76-year-old patient with gastric perforation due to massive infection with Sarcina ventriculi. To date, this is the first report of human infection with Sarcina ventriculi in Romania.

© 2020 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Introduction

In the context of a modern changing world, supporting advances in clinical practice is of tremendous importance. Clinical evaluation among with various means of biomaterials investigation such as failure analysis can make a contribution to the progress of medical science and education [1–6]. Case reports and randomized controlled trials occupy an important place in the improvement of patient outcomes, especially when referring to rare diseases [7–10]. Sarcina is a genus of Gram-positive, non-motile, anaerobic bacteria with exclusive carbohydrate fermentative metabolism [11], which is able to survive in a wide range of environmental conditions, even in the low pH of the stomach [12]. Although similar in appearance to Micrococcus species, specific morphological features such as: larger size, and non-cluster forming pattern, help differentiate Sarcina species from Micrococcus [13]. The type species is Sarcina ventriculi, a variety found on the surface of cereal seeds, in soil, mud, and in the stomach of humans, rabbits, and guinea pigs [14]. Sarcina ventriculi was classified as an anaerobic coccus in 1960s and first described in humans by Goodsir [15] and later by Ferrier [16]. Various reports in veterinary literature have implicated Sarcina in the development of gastric dilatation and death of livestock, cats, goats and horses [17].

Sarcina has also been reported to be found in feces of healthy humans consuming a predominantly vegetarian diet [18]. Even though it has been identified as a potential pathogen for humans since 1842 [19] and isolated in pure culture from gastric fluids since 1911 [20], more recent studies have shown an association between Sarcina in the stomach and chronic nausea, dyspepsia, abdominal pain, gastric ulcers, and rarely, emphysematous gastritis and gastric perforation [21–24]. However, Sarcina ventriculi has also been identified in gastric biopsies from asymptomatic patients and no pathologic changes associated to the gastric mucosa, suggesting that it may be an innocent bystander rather than a harmful bacterium [13]. To date, few cases of Sarcina ventriculi isolated from gastric biopsy specimens have been reported, usually in patients with gastroparesis, iron deficiency anemia or delayed stomach emptying, all of which are excellent environments for bacterial overgrowth [24,25]. Also, there are several case reports which linked Sarcina microorganism
coexistence with Helicobacter pylori [26] or on a background of malignancy [27], cystic fibrosis [28], coeliac disease [9], or upper gastric surgery [24,29]. We report a rare case of death-related infection with Sarcina ventriculi in a 76-year-old male patient with gastric ulcer perforation. To our knowledge, less than a dozen cases of Sarcina ventriculi isolated from gastric specimens have been reported, our case being the first one documented in Romania and one of the few reported deaths due to infection with this microorganism.

Case report

A 76-year-old male with severe abdominal pain was admitted to the Emergency University Hospital in Bucharest for evaluation of acute abdominal pain with generalized rebound tenderness and altered mental status. Arterial blood gases confirmed elevated lactate with severe metabolic acidosis. After initial fluid resuscitation a plain film of the abdomen (PFA) showed bilateral pneumoperitoneum and a large hiatus hernia. Although such clinical presentation and PFA findings should undoubtedly prompt emergency surgery the differential diagnosis with adenocarcinoma, lymphoma and perforated ulcer is mandatory in stable patients in order to tailor the surgical intervention appropriately. Hence the PFA was followed by a CT of the abdomen and pelvis for further characterization of the viscera demonstrating: large pneumoperitoneum with parietal tear along the lesser curvature of the stomach with no features suggestive of obstruction, lymphadenopathies or intra-abdominal masses. Intraoperative findings confirmed gastric dilatation and rupture of the gastric wall along the lesser curvature with no gastric outlet obstruction or other macroscopic findings to support a causal relation.

During the surgical procedure in which the perforation of the gastric wall was repaired, tissue samples were subsequently sent for evaluation to the Pathology Department of the same hospital. The specimen samples were fixed with 10% buffered formalin and were processed by conventional histopathological methods using paraffin embedding, 2 microns sectioning and Hematoxylin–Eosin (H.E.) staining. Unfortunately, the patient died shortly after surgery, due to the complications induced by sepsis and multiorgan failure.

Histopathological examination of standard-stained H.E. slides revealed marked acute inflammation, hemorrhagic areas and extensive necrosis of the fatty tissue. No gastric mucosa was identified. However, there was abundant bacterial overgrowth, including the presence of Sarcina ventriculi microorganisms with characteristic microscopic features: tetrad or packet-forming arrangement of large cuboidal basophilic bacteria with thin surface walls. Many such bacteria were present in the blood capillaries of the analyzed fragments (Fig. 1a, b), this confirming an active infection and excluding a possible contamination. Ancillary special stains such as Gram, Periodic Acid–Schiff (PAS) and Giemsa have been performed, in order to confirm the diagnosis. As expected, the bacteria were highlighted by strong positivity in Gram (Fig. 2) and Giemsa stains (Fig. 3), but were negative in PAS staining. The final diagnosis of infection with Sarcina ventriculi was established based on the characteristic morphology of this microorganism and strong Gram positivity, without the need for additional studies, such as polymerase chain reaction and sequencing of the 16S ribosomal RNA gene and pyruvate decarboxylase gene.

Discussion

Although the pathogenesis of Sarcina spp. is well studied in veterinary literature, its role in human disease is not entirely
understood and very few scientific studies identify this microorganism as a potential cause of death. Even if the presence of this bacteria is rarely documented in humans, the infection in animals is well-known to cause abomasal bloating (the abomasum is the fourth component of the stomach in ruminants) in goats [21], gastric bloating in lambs and calves [22] and acute gastric dilatation in dogs and horses [23], all with severe outcome for the host.

In humans, it is unclear if the presence of microorganisms from Sarcina spp. signifies an indicator for another disease state or represents a causative agent itself, which would require medical intervention. Some authors [13] suggest that most cases could represent overgrowth of a commensal organism, and therefore do not require pharmacological intervention. If Sarcina spp. are identified in patients with dysphagia or substernal burning, a combination of proton pump inhibitors and prokinetic therapy is recommended. However, if the microorganism is associated with ulceration of the gastro-esophageal mucosa, eradication with antimicrobials is required, in order to avoid perforation [30]. Confirmation of eradication also warrants follow up endoscopy.

It is presumed that infections in both humans and animals occur due to ingestion of contaminated food [28]. One particular case reports a veterinary doctor who developed infection with Sarcina spp., probably due to close animal contact [24]. Any deferment – delay in gastric output which leads to accumulation of food debris associated with low gastric pH provides an ideal environment for Sarcina spp. overgrowth and can result in a characteristic frothy vomit known as “sarcinous vomit” and/or emphysematous gastritis [25].

Although this microorganism has been known for more than 170 years, less than 30 cases have been reported in the literature, most of them during the past 10 years. In a review published in 2016, Al Rasheed et al. found that 68 % cases of Sarcina spp. were reported in female patients and more than half of the documented cases had a history of gastrointestinal surgery, gastroparesis, or gastric outlet obstruction [25]. Also, there are reports which found Sarcina ventriculi in patients with gastric perforation [23], emphysematous gastritis [20] and in association with malignancies such as gastric and pancreatic cancer [13,27]. There are even cases of Sarcina ventriculi isolated from the blood of the patients with suffering from congenital chloride diarrhea [15] a rare inherited disease that belongs to the Finnish disease heritage caused by mutations in the SLC26A3 gene on the chromosome 7 [25] leading to the function disruption of the major anion exchanger on the surface of intestinal epithelial cells. Our patient did not have a known genetic disease and it is not known whether or not this micro-organism was present in his blood, however multiple intracapillary Sarcina colonies can be observed on the histopathological specimen.

In vitro culture of Sarcina spp. is challenging due to the intricate nutritional necessities of the bacterium, which explains our inability to culture the pathogen. Sarcina maxima, recently reclassified to Clostridium maximum may be differentiated from Sarcina ventriculi (also phylogenetically placed into Clostridiaceae family, Firmicutes phylum) [15] based on its fermentation characteristics, such as production of butyrate by the former organism and production of ethyl alcohol by the latter. However, morphological differentiation between these two bacteria is not readily achieved since they resemble each other in bright field microscopy.

Scientific literature suggests that favourable outcome may be achieved by early treatment with antimicrobials effective against anaerobes. Current reports indicate successful eradication of Sarcina ventriculi, with treatment consisting of metronidazole in combination with another antibacterial, but there is no consensus on the type and duration of treatment [13,20,24]. Since Sarcina involves carbohydrates for fermentation, another important aspect is to maintain nil per os (nothing at all by mouth).

Conclusion

Given its association with life threatening illness, we believe that patients identified with Sarcina ventriculi should initiate treatment with antibiotics and anti-ulcer therapy, until further understanding of this microorganism is achieved.

Ethical standards

We undersign, that the procedures and the experiments we have done respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2000 (5), as well as the national law.

CRedIT authorship contribution statement

Adrian Dumitra: Conceptualization, Methodology, Validation, Investigation, Writing - original draft, Project administration.

Catalin Alip: Methodology, Software, Resources, Writing - original draft, Visualization.

Adriana Elena Nica: Conceptualization, Formal analysis, Data curation, Writing - original draft.

Iulia Antonie: Validation, Formal analysis, Investigation, Writing - original draft, Writing - review & editing, Visualization, Supervision.

Daniela Cheorghiba: Software, Data curation, Writing - original draft, Visualization.

Sebastian Gradinariu: Conceptualization, Methodology, Validation, Resources, Data curation, Writing - original draft, Writing - review & editing, Supervision.

Declaration of Competing Interest

The authors declare no competing interests.

References

[1] Antonie I, Lapteu D, Tecu C, Milea C, Gradinariu S. Synthetic materials for osteochondral tissue engineering. Osteochondral Tissue Engineering: Nanotechnology, Scaffold-related Developments And Translation 2018:1058:31-52.

[2] Jurc R, Savu O, Popsescu BA, et al. Primary cardiac leiomysarcoma when valvular disease becomes a vascular surgical emergency. Circulation 2010;121(21):E415–8. 

[3] Antonie IV, Bureea M, Ionescu RD, et al. IOL’s opacification: a complex analysis based on the clinical aspects, biomaterials used and surface characterization of explanted IOLs. MatPlast 2015;52(1):109–12.

[4] Costache VS, Moldovan H, Arsenescu C, et al. Aortic valve surgery of the 21st century: sutureless AVR versus TAVI. Minerva Cardioangiol 2018;66(2):191–7.

[5] Cirstoiu M, Cirstoiu C, Antonie I, et al. Levonorgestrel-releasing intrauterine systems: device design, biomaterials, mechanism of action and surgical technique. MatPlast 2015;52(2):258–62.

[6] Guazzo R, Gardin C, Bellin G, et al. Graphene-based nanomaterials for tissue engineering in the dental field. Nanomaterials 2018:8(5):349.

[7] Gradinariu Fometescu S, Costache M, Coveney A, et al. Peritoneal fibronectin activity and adhesiogenesis. Chirurgia 2013;108(3):331–40.

[8] Dumitrescu D, Savlovici C, Bocan R, et al. Clinical case - voluminous diaphragmatic hernia - surgically acute abdomen: diagnostic and therapeutic challenges. Chirurgia 2011;106(5):657–60.

[9] Moldovan H, Popsescu D, Buliga T, et al. Gastric adenocarcinoma associated with acute endocarditis of the aortic valve and coronary artery disease in a 61-Year-Old male with multiple comorbidities-combined surgical management-case report. Medicina-Lithuania 2019;55(6).

[10] Antonie Iulian, Negruoiu Mihai, Mardare Mihai, et al. Adverse local tissue reaction after 2 revision hip replacements for ceramic liner fracture A case report. Medicine 2017;96(19):e6687.

[11] Claus D, Wilmanns H. Enrichment and selective isolation of Sarcina maxima Lindner. Arch Microbiol 1974;96(3):201–4.

[12] Lowe SE, Pankratz HS, Zeikus JG. Influence of pH extremes on sporulation and ultrastructure of Sarcina ventriculi. J Bacterial 1985;171(7):3775–81.

[13] Lam-Himlin D, Tsatis AC, Montgomery E, Pai RK, Brown JA, Razavi M, et al. Sarcina organisms in the gastrointestinal tract: a clinicopathologic and molecular study. Am J Surg Pathol 2011;35:1700–5.
[14] Sarcina ventriculi. Stedman’s medical spellchecker. Lippincott Williams & Wilkins; 2006 Retrieved 31 March 2010.
[15] Good sir XXIII J. History of a case in which a fluid periodically ejected from the stomach contained vegetable organisms of an undescribed form. J Nat Hist 1843;11(68):125–6.
[16] Ferrier D. The constant occurrence of Sarcina ventriculi (Good sir) in the blood of man and the lower animals: with remarks on the nature of sarcinous vomiting. Br Med J 1872;1(578):98–9.
[17] Edwards GT, Woodger NG, Barlow AM, Bell SJ, HarwoodDG OA, Wight AR. Sarcina-like bacteria associated with bloat in young lambs and calves. Vet Rec 2008;163:391–3.
[18] Crowther J S. Sarcina ventriculi in human faeces. J Med Microbiol 1971;4:343–50.
[19] Tuominen T, Suomal P. Vuorinen S Sarcina ventriculi in blood: The first documented report since 1872. BMC Infect Dis 2013;13:169.
[20] Beijerinck M. An experiment with Sarcina ventriculi. Proceedings, Sect Sci Koninklijke Ned. 1911;13:1234–40.
[21] Laass MW, Pargac N, Fischer R, Bernhardt H, Knoke J. Emphysematous gastritis caused by Sarcina ventriculi. Gastrointest Endosc 2010.
[22] Aggarwal S, Tyagi R, Sethi PK, Garg A, Sood A, Sood N. Coinfection of Sarcina ventriculi and Candida in a patient of gastric outlet obstruction: an overloaded pyloric antrum. Diagn Cytopathol 2018;(July):1–3.
[23] Tolentino LE, Kallichanda N, Javier B, Yoshimori R, French SW. A case report of gastric perforation and peritonitis associated with opportunistic infection by Sarcina ventriculi. Lab Med 2003;34:535–7.
[24] Ratuapli SK, Lam-Himlin DM, Heigh RJ. Sarcina ventriculi of the stomach: a case report. World J Gastroenterol 2013;19(April (14)):2282–5 ISSN 1007-9327 (print) ISSN 2219-2840 (online).
[25] Rashied MRH A, Senseng CG. Sarcina ventriculi- review of the literature. Arch Pathol Lab Med 2016;140(December):1441–5.
[26] Sauer J, Nayar S, Anders P, DAmico M, Butnor K, et al. Co-existence of Sarcina organisms and Helicobacter pylori Gastritis/Duodenitis in pediatric siblings. J Clin Anat Pathol I 2013:1–3.
[27] Darch R, Harrison J, Rashid M. Sarcina ventriculi Bacteria in stomach and duodenum of a patient with gastrooesophageal obstruction by adenocarcinoma. J Univers Surg 2016;4(46).
[28] DiMaio MA, Park WG, Longacre TA. Gastric Sarcina organisms in a patient with cystic fibrosis. Hum Pathol Case Rep 2014;1:45–8.
[29] Karaküçük E. Kısğıç bölgeli CT Coincidence of celiac disease with Sarcinia infection. Turk J Gastroenterol 2015;25:318.
[30] Medlicott SAC, Adams F. Sarcina ventricularis complicating a patient status post vertical banded gastroplasty: a case report. J Ghr 2014;2:1481–4.