Case Report

Ruminococcus gnavus, an unusual cause of surgical site infection following vertebral posterior instrumentation: a case report

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Background: *Ruminococcus gnavus* (*R. Gnavus*) is an anaerobic Gram-positive coccus, common commensal of the gastrointestinal tract of animals and humans. Anaerobic organisms as etiologic agents of bone and joint infections (BJI) are uncommon and frequently underestimated. New technologies, such as mass spectrometry techniques and molecular techniques like 16S rRNA, allow for more efficient diagnosis of these anaerobic bacteria. We present the first case report of deep surgical site infection (SSI) due to *R. Gnavus*, following spinal surgery.

Case Description: We report the case of a deep SSI caused by *R. Gnavus* following posterior spinal instrumentation in an 81-year-old woman. The patient underwent extension of her previous fusion L2-L5, due to adjacent segment disease (ASD). We performed a T10 to S2-alar-iliac instrumentation. During the postoperative period, the patient presented with a paralytic ileus that required the placement of a nasogastric tube followed by gastrointestinal bleeding and two gastroscopies. Subsequently the patient showed signs of deep SSI. We performed surgical irrigation and debridement. All six cultures in anaerobic media showed short Gram-positive diplococci, using matrix-assisted laser desorption/ionization time of flight mass spectrometry (Maldi-TOF MS) all six strains were identified as *R. Gnavus*. The patient was treated with amoxicilin 1 g/8 h and ciprofloxacin 750 mg/12 h for 4 weeks. Six months postoperative, she was asymptomatic.

Conclusions: As is the case with our patient, all previously described cases of *R. Gnavus* infection had a history of intestinal disease or immunosupression. We believe the isolation of *R. Gnavus* should raise the possibility of intestinal injury. Immunosuppression is also an important risk factor for the development of *R. Gnavus* infection.

Keywords: *Ruminococcus gnavus* (*R. Gnavus*); spinal instrumentation; deep surgical site infection (deep SSI); case report

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Introduction

Surgical site infection (SSI) following spine surgery can occur in 0.7% to 11.9% of patients with significant morbidity and economic burden (1,2). *Staphylococcus aureus* is the most frequent causal agent (3). Diabetes, smoking, steroids, surgical invasiveness, approach, duration of the procedure, type of fusion, implant use… are some of the main risk factors related to SSI. Malnutrition has been identified as an important and preventable risk factor for the development of SSI. Specifically, having a Modified Glasgow Prognostic Scale (mGPS) score of 1 or more or a low body mass index (BMI <20.39 kg/m^2) have been identified as risk factors for developing SSI after spinal instrumentation surgery (4). Early diagnosis of SSI is of vital importance to reduce morbidity costs and also to allow early treatment. Some inflammatory markers have been identified as particularly useful for early diagnosis after psoterior lumbar surgery: white blood cells (WBCs) count and their subsets, lymphocites counts on postoperative day (POD) 4 and 7, C-reactive protein (CRP) levels on the 7th day after surgery and the neutrophil/lymphocyte count ratio (NLR) (5).

Anaerobic organisms as etiologic agents of bone and BJI are relatively infrequent and their incidence is estimated to be around 3% to 4% of all BJI (6). Moreover, limitations in our current conventional culture-based testing make it difficult to isolate anaerobic organisms, so their incidence is frequently underestimated. New technologies such as mass spectrometry techniques and molecular diagnostic technology, such as 16S rRNA may lead to greater recognition of anaerobic bacteria and their involvement in BJI. *Propionibacterium acnes* is the most prevalent causal agent in BJI, *Bacteroides* spp., *Clostridium* spp., *Finegoldia magna*, or *Peptoniphilus* spp have also been reported (6). In relation to treatment, clindamycin is often the treatment of choice for anaerobic infections, not only because of its ability to penetrate the bone, but also due to its action against both, Gram positive and negative anaerobic bacteria. Amoxicilin and metronidazole are also recommended (6,7).

We present the first case report of deep SSI following spinal surgery due to *R. Gnavus*, a strict anaerobic Gram-positive coccus. We present the following case in accordance with the CARE reporting checklist (available at https://jss.amegroups.com/article/view/10.21037/jss-22-81/rc).

Case presentation

Statement of informed consent

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available for review by the editorial office of this journal.

Case description

The patient first came for consultation in 2020 at the age of 79 years old. She presented with chronic low back pain radiating to groin and anterior region of left thigh and leg. Her medical history included hyperlipidemia, diabetes mellitus, atrophic gastritis and polymyalgia rheumatica. Regarding her nutritional status, her BMI was 27.2 kg/m^2 and serum proteins in the preoperative study were in the normal range (6.9 g/dL).

The magnetic resonance imaging (MRI) showed a voluminous L2-L3 disc herniation and advanced degenerative changes at L3-L4 and L4-L5. She underwent a L2-L3 discectomy and posterior L2-L5 fusion. No complications were recorded during postoperative evolution. Nine months after, the patient presented with worsening back pain, no significant neurological findings on examination. The X-ray showed an adjacent segment disease (ASD) and scoliosis just proximal to the instrumentation. Standing radiographs revealed ASD, as an apex right curve just proximal to the instrumentation (*Figure 1*) and positive sagittal imbalance of 12 cm. The MRI showed no evidence of further complication.

In 2021 at the age of 81, the patient underwent extension of previous fusion from T10 to S2-alar-iliac (Xia 3 System Serrato Stryker), an asymmetric transforaminal interbody device was placed at L1-L2, *in situ* scoliotic correction was performed as well as rod derotation. At levels T10 and T11 cement-augmented screws were used and proximal to the instrumentation, at T9, we performed a prophylactic vertebroplasty. Cancellous allograft in conjunction with local autograft were placed at L1-L2 and L5-S1 levels (*Figure 2*). We used intraoperative neurophysiology monitoring. Two subfascial drains were used. A dose of cefazolin 1 g was administered preoperatively, the dose was repeated 3 h after the start of surgery. During the

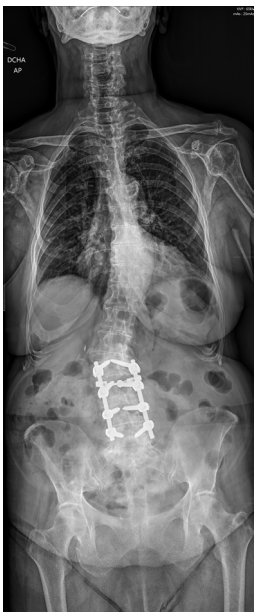

Figure 1 Preoperative standing X-ray showing L2-L5 previous fusion, ASD and scoliosis proximal to the instrumentation. ASD, adjacent segment disease.

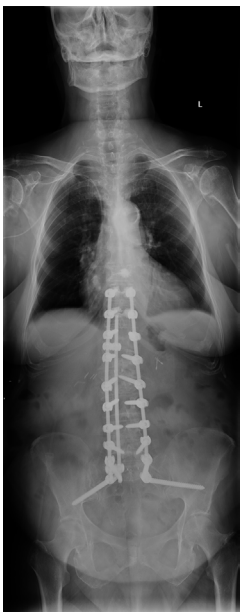

Figure 2 Postoperative anteroposterior X-ray showing T10 to S2-alar-iliac instrumentation.

postoperative period, 3 more doses of cefazolin 1 g were administered every 8 h. Operative time was 7 h 45 min, the patient received two units of red blood cells (RBC) postoperative.

On POD 4, the patient presented with abdominal pain and vomiting. With the suspicion of paralytic ileus in probable relation to opioid consumption, enteral nutrition was indicated and a nasogastric tube was placed. In spite of the nasogastric tube and the suspension of opioids the patient got worse, so on POD 13 a gastroscopy was performed in which a longitudinal gastric ulcer Forrest III was described, hemoclips were placed. On POD 14 the patient presented an episode of gastrointestinal bleeding and hematemesis with secondary anemization (hemoglobin 7 g/dL). A new upper gastrointestinal endoscopy was performed in which normopositioned hemoclips were observed and no active bleeding. Given the possibility that the ulcer was due to the decubitus of the nasogastric tube, we decided to remove it.

The surgical wound evolved favorably until day 17, when it began with seropurulent exudate in the distal region accompanied by leukocytosis and elevated infection markers, leukocytes 12.6×10^9/L, and the CRP level was 71 mg/L. No blood culture was collected, since the patient did not show fever at any time during the follow-up.

On POD 20 the patient underwent surgical irrigation and debridement, purulent-appearing fluid was encountered within the subcutaneous tissues and deep to the fascia. Exudate, soft tissue and bone samples were sent to microbiology. Thorough debridement of the area was performed, saline and povidone-iodine irrigation was done. One gram of vancomycin powder was applied directly to the subcutaneous tissue just prior to closure. Vancomycin powder was sprinkled liberally over the area. Empirical antibiotic therapy was administered with meropenem 1 g and teicoplanin 600 mg according to the usual protocol for musculoskeletal infections in our center.

Six out of six cultures on anaerobic conditions revealed short chains of Gram-positive diplococci. All the strains isolated from the different samples were identified as *R. Gnavus* by Maldi-TOF MS (Compass 1.4, version 3.4, build 3.4.76.0 by Bruker Daltonics) with score values ranging between 1.820 and 2.100. In addition, one of the samples yielded positive for a single colony, fully sensitive *Escherichia coli* (*E. Coli*), we considered it as a possible contaminant.

Susceptibility testing of *R. Gnavus* was performed using a commercial broth microdilution method (Sensititre™ ANAERO3, Thermo Scientific) and showed the following results: penicillin (≤0.06 µ/mL), amoxicillin (≤0.25 µ/mL),

amoxicillin/clavulanate (≤0.25/0.125 µ/mL), piperacillin (≤16 µ/mL), piperacillin/tazobactam (≤16/4 µ/mL), cefoxitin (8 µ/mL), imipenem (≤0.06 µ/mL), chloramphenicol (≤2 µ/mL), erythromycin (>128 µ/mL), clindamycin (1 µ/mL), metronidazole (≤0.5 µ/mL), moxifloxacin (8 µ/mL), tetracycline (8 µ/mL), and vancomycin (≤2 µ/mL). Moreover, E-test method (bioMérieux, Marcy l'Etoile, France) was used for other antimicrobials and the following results were obtained: linezolid (2 µ/mL), levofloxacin (>32 µ/mL), daptomycin (0.047 µ/mL), cotrimoxazole (>32 µ/mL), and rifampicin (<0.002 µ/mL). Penicillin, amoxicillin, amoxicillin/clavulanate, piperacillin, piperacillin/tazobactam, imipenem, chloramphenicol, clindamycin, and metronidazole minimum inhibitory concentration (MIC) breakpoints were those established by European Committee on Antimicrobial Susceptibility Testing (EUCAST) (8). The breakpoint MICs for the rest of antibiotics were established according to Clinical and Laboratory Standards Institute (CLSI) documents for anaerobic bacteria and other sources (7). According to these criteria, all antimicrobials tested were active against *R. Gnavus* except for erythromycin, moxifloxacin, levofloxacin, and cotrimoxazole.

After obtaining microbiological results, antibiotics were switched to amoxicilin 1 g/8 h and ciprofloxacin 750 mg/12 h for a further 4 weeks. Given the good clinical outcome, the patient was discharged on POD 29 after first surgery. On the patient's last assessment, 6 months after surgery, she was asymptomatic, she had no back pain, she showed no sign of surgical wound infection and inflammatory markers were normal.

Discussion

R. Gnavus is a strict anaerobic Gram-positive coccus. It can be motile or nonmotile, non-spore-forming. Gram staining shows them as diplococci or short chains. It belongs to the Clostridia class. It is commonly found in the intestinal flora in humans and ruminant animals. In humans, *R. Gnavus* is among the 15 most frequent species in the microbiota (9). Several lines of evidence have shown an increase in the presence of *R. Gnavus* in patients suffering from Crohn's disease or ulcerative colitis, suggesting *R. Gnavus* might have an important role in modulating inflammatory activity in the bowel (10).

As we mentioned above, anaerobic bacteria identification is often difficult given limitations in our current conventional culture-based testing. With the introduction of MALDI-TOF MS as a routine technique, anaerobic bacteria identification has improved considerably. Bacterial proteins are ionised by a laser beam, then we elaborate a unique protein spectrum for each bacterium (11). Subsequently, we compare the spectrum obtained with those collected in previous databases. Depending on the degree of concordance we will make the diagnosis. A score higher than 2 is a sure identification of the species, scores between 1.7 and 2 are a sure identification of the genus. In our hospital we use this technique routinely for the identification of anaerobic bacteria. In our patient MALDI-TOF MS revealed *R. Gnavus* presence in 6 out of 6 intra-operative samples.

Additionally, partial 16S rRNA gene sequencing can be useful as a confirmation of MALDI-TOF MS or as an alternative when MALDI-TOF MS does not provide identification. The samples were not saved and we do not routinely perform 16S sequencing if MALDI-TOF MS is conclusive.

R. Gnavus has been described previously in few case reports. Two cases of polymicrobial bacteriemia associated with diverticulitis (12), bacteriemia in a patient with a gall bladder perforation (13), sepsis in a patient suffering from multiple myeloma (14), sepsis due to bowel perforation (15) and 4 cases of BJI: a case of septic arthritis in a native hip (16) and 3 periprosthetic hip jont infections (17-19). In all cases the patients had a previous history of intestinal disease or immunosuppression. Previously published cases are listed in *Table 1*.

To our knowledge, *R. Gnavus* has not been previously described in SSI after spinal surgery. We believe that the patient presented a hematogenous infection due to translocation from the gut, after gastrointestinal manipulation.

As previously pointed out by other authors, the isolation of *R. Gnavus* should lead us to consider the possibility of intestinal injury. Immunosuppression appears to be another important risk factor. Our patient was not immunosuppressed perse, however the surgical aggression may have been an immunocompromising event that favored infection.

Table 1 Literature review of previous *R. Gnavus* infections

Study	Year	Country	Study design	Age (years)	Infection	Microorganisms isolated	*R. Gnavus* identification	Possible cause	Treatment and outcomes
Hansen (12)	2013	Denmark	Case report	67	Bacteriemia	*E. Coli*	MALDI-TOF	Diverticular disease	Exploratory laparotomy
					Perforated peritonitis	*R. Gnavus*	16S rRNA	Lung carcinoma receiving chemotherapy	Piperacillin tazobactam
									He died one week later
				90	Bacteriemia	*P. aeruginosa*	MALDI-TOF	Diverticular disease	Cefuroxime and metronidazole
						R. Gnavus	16S rRNA		Complete recovery
Kim (13)	2017	South Korea	Case report	82	Bacteriemia	*R. Gnavus*	MALDI-TOF	Gall bladder perforation	Antibiotics
							16S rRNA	DM	Asymptomatic
Gren (14)	2019	Denmark	Case report	76	Bacteriemia	*R. Gnavus*	MALDI-TOF	Multiple myeloma	Piperacillin
								Myelodysplastic síndrome	Tazobactam
								Immunosupression	Amoxicilin
									Metronidazole
Lefever (15)	2019	Belgium	Case report	66	Bacteriemia	*E. Coli*	16S rRNA	Infectious enterocolitis	Levofloxacin
					Fecal peritonitis	*R. Gnavus*			Ornidazol
									Meropenem
									Critical illness polyneuropathy
Titécat (16)	2014	France	Case report	47	Septic arthritis	*R. Gnavus*	MALDI-TOF	Squamous cell carcinoma	Vancomycin
					Bacteriemia		16S rRNA	Immunosupression	Cefotaxime
									She died 4 weeks later of pneumonia
Fernández-Caso (17)	2017	Spain	Case report	72	Total hip arthroplasty late infection	*R. Gnavus*	MALDI-TOF	None	Replacement surgery
									Cefazolin
									Clindamycin
									Gentamycin
									Complete recovery
Roux (18)	2015	France	Case report	62	Total hip arthroplasty late infection	*R. Gnavus*	MALDI-TOF	Ulcerative colitis	Irrigation and debridement
							16S rRNA		Amoxicilin
									Metronidazole
									Complete recovery
Arnáez Solís (19)	2017	Spain	Case report	93	Total hip arthroplasty late infection	*R. Gnavus*	MALDI-TOF	DM	Replacement surgery
								Immunosupression	She died two weeks after

R. Gnavus, *Ruminococcus gnavus*; MALDI-TOF, matrix-assisted laser desorption/ionization time of flight; DM, diabetes mellitus.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at https://jss.amegroups.com/article/view/10.21037/jss-22-81/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jss.amegroups.com/article/view/10.21037/jss-22-81/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study studies were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available for review by the editorial office of this journal.

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