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Serratia Marcescens Infection of N-Butyl-2-cyanoacrylate Glue After Gastric Variceal Embolization: A Case Report and Literature Review

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1. Abstract

1.1. Introduction

Although rare, secondary infection related to N-butyl-2-cyanoacrylate (NBCA) glue can lead to prolonged and recurrent bacteremia that is difficult to diagnose and treat.

1.2. Case Presentation

We report the case of a 50-year-old man with alcohol-related cirrhosis and type 2 diabetes, initially admitted for upper gastrointestinal bleeding due to ruptured gastric varices and treated with NBCA glue injections. Five weeks later, he developed sepsis due to persistent and then recurrent *Serratia marcescens* bacteremia. Initial investigations did not reveal any source of infection. An [18F]-FDG PET/CT subsequently performed showed focal hypermetabolism at the variceal treatment site, consistent with NBCA glue infection.

1.3. Discussion

This case illustrates the importance of considering biomaterial-associated infection in patients with unexplained prolonged bacteremia and highlights the diagnostic value of metabolic imaging when standard work-up is inconclusive. Although rare, NBCA-associated infection is characterized by sustained and recurrent bacteremia that can be challenging to eradicate. When removal of the biomaterial is not feasible, management relies on prolonged – and occasionally suppressive – antimicrobial therapy.

1.4. Conclusion

NBCA glue infection should be considered in cases of unexplained sepsis following endoscopic variceal treatment. A thorough investigation approach, including [18F]-FDG PET/CT when needed, is essential, and management must be individualized.

2. Introduction

Infectious complications related to biomaterials used in digestive endoscopy are uncommon [1]. The use of N-butyl-2-cyanoacrylate (NBCA) glue is recommended for hemostasis of isolated gastric variceal bleeding and gastroesophageal varices extending beyond the cardia [2]. Other medical conditions in which NBCA glue is used include vascular embolization, tissue adhesive for wound closure, mesh fixation in hernia repair as well as other general surgical applications, due to its rapid polymerization, strong adhesive properties and hemostatic effects [3-6]. In rare cases, its use may promote bacterial biofilm formation, making it difficult to diagnose and treat the underlying infection [3]. We present a case of persistent and recurrent *Serratia marcescens* bacteremia due to NBCA glue infection after gastric variceal embolization.

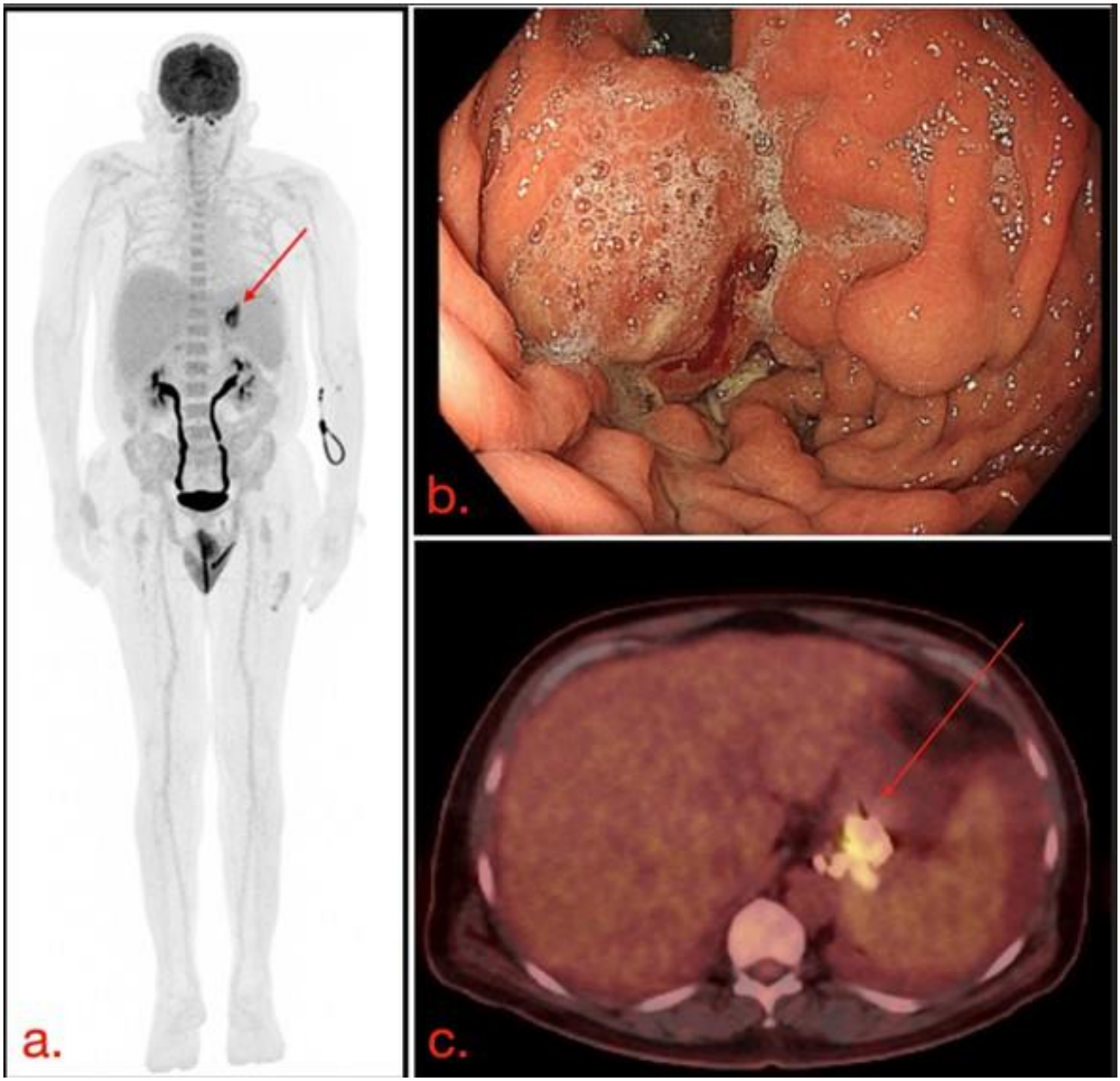

Figure 1: Radiological and endoscopic findings in the present case.
a. Maximum intensity projection (MIP) of the initial [18F]-FDG PET/CT showing an intense increased metabolic uptake within the previously embolized gastric varices (red arrow).
b. Follow-up gastroscopy demonstrating no ulceration or abscess at the NBCA glue injection site.
c. Axial fused images of the second [18F]-FDG PET/CT confirming persistent focal hypermetabolic uptake at the embolization site.

3. Case Presentation

A 50-year-old man with alcohol-related liver cirrhosis and non-insulin-dependent type 2 diabetes was admitted for upper gastrointestinal bleeding due to ruptured gastric varices. During the first endoscopic procedure, elastic band ligation was performed for suspected esophageal variceal bleeding. Recurrent bleeding occurred on day 1, for which a Sengstaken-Blakemore tube was placed as bridging therapy. Definitive treatment was achieved on day 3 with endoscopic injection of NBCA glue in gastric varices. Prophylactic ceftriaxone was administered prior to endoscopy, followed by piperacillin-tazobactam and later imipenem for a total length of 15 days due to suspected ileus and consequent digestive bacterial translocation. His clinical course was favourable, and he was discharged one month after admission.

Five weeks after NBCA injection, he was readmitted with fever (39.4°C), chills, nausea and right-sided abdominal pain. Laboratory tests showed moderately elevated inflammation markers (C-reactive protein [CRP] at 63.8 mg/L, white blood cell count of 7.9 × 10^9/L) and blood cultures were positive for *Serratia marcescens*. Abdominal CT and ultrasound showed no infectious focus or hepatobiliary abnormalities. Due to persistent bacteremia, transesophageal echocardiography was performed and ruled out infective endocarditis. Six days after admission, an [18F]-fluorodeoxyglucose-positron emission tomography/CT ([18F]-FDG PET/CT) revealed an intense increased metabolic uptake within the previously embolized gastric varices (Figure 1a). Follow-up gastroscopy showed no ulceration or abscess at the injection site (Figure 1b). Bacteremia persisted for six days despite appropriate treatment with imipenem (Figure 2 and Supplementary 1). Antibiotic treatment was narrowed to cefepime after bacteremia resolution, with clinical improvement and fever resolution by day 7.

Recurrence of fever and chills was observed after two weeks of ongoing antibiotic treatment and new blood cultures grew *Serratia marcescens* with an identical resistance profile. Amikacin was added to cefepime, and a second [18F]-FDG PET/CT confirmed persistent focal uptake at the glue site, without distant infectious foci (Figure 1c).

This case was discussed in a multidisciplinary meeting involving gastroenterologists, visceral surgeons and infectious diseases specialists. Given the patient's comorbidities and high perioperative mortality risk, glue removal by partial gastrectomy was deemed at high risk. Decision was made to pursue a total of 12 weeks antibiotic treatment from the last febrile episode. Owing to bacteremia recurrence under adequate antibiotic treatment, cefepime was replaced with a combination therapy using meropenem and ciprofloxacin, the latter selected for its anti-biofilm activity and excellent tissue penetration. After three weeks of combination therapy, treatment was pursued with oral ciprofloxacin alone. After five weeks of outpatient treatment, acute interstitial nephritis occurred and was attributed to ciprofloxacin. Treatment was subsequently switched to trimethoprim-sulfamethoxazole for the remainder of the planned 12-week course, after which antibiotics were discontinued at the patient's request. No recurrence was observed at six-month follow-up.

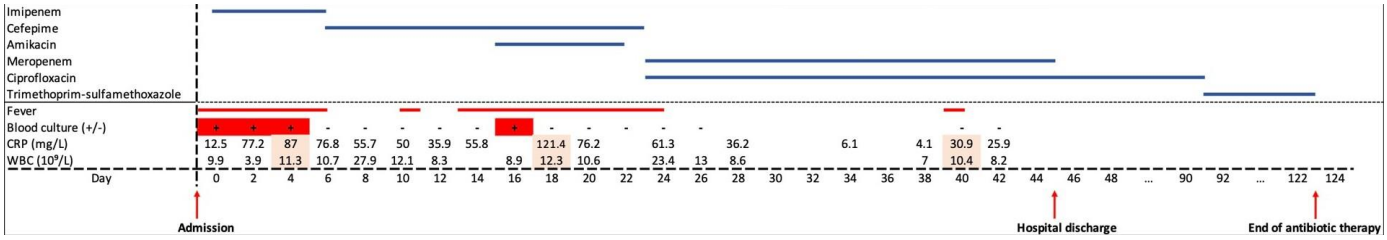

Figure 2: Timeline summarizing antibiotic treatment, fever episodes, blood cultures positivity, and inflammatory marker levels.
CRP: C-reactive protein; WBC: white blood cells count

4. Discussion

Infections related to biomaterials, including NBCA glue, remain rare. Randi *et al*. reported one case and reviewed six other cases of recurrent bacteremia following NBCA injection, highlighting the diagnostic and therapeutic challenges associated with the presence of foreign materials and the risk of biofilm formation [7]. In addition, five other case reports documented recurrent bacteremia following NBCA glue injection [8-12].

As summarized in Table 1, the bacterial species implicated are highly diverse. In 10 out of the 13 published cases, at least one Enterobacterales species or *Pseudomonas aeruginosa* was isolated (10/13, 76.9 %), suggesting a particular propensity of these organisms to colonize polymer-based substrates. To our knowledge, this is the first reported case of NBCA glue infection due to *Serratia marcescens*, an opportunistic pathogen recognized for its biofilm-forming ability and intrinsic multidrug resistance [13]. The mean time from glue injection to bacteriemia was 13.0 weeks, with a median of eight weeks, and frequently exceeded five weeks as observed in our case.

From a diagnostic point of view, this case is of particular interest because [18F]-FDG PET/CT revealed a focal area of increased metabolic activity that was not detected by conventional imaging or upper gastrointestinal endoscopy, both of which showed no evidence of abscess formation or endoluminal ulceration. Only one other published case reported a similar constellation without any finding on endoscopy and positive metabolic PET imaging [9]. This highlights the added value of [18F]-FDG PET/CT in the evaluation of persistent bacteremia of unknown origin following NBCA injection, especially when standard diagnostic modalities are inconclusive. Radiolabeled leukocytes scintigraphy was used in three cases, one of which successfully identified a contiguous abscess [9,14,15]. Gallium-67 citrate scintigraphy was performed in one case, with no evidence of infection [16]. It remains unclear whether SPECT/CT (Single Photon Emission Computed Tomography CT) was employed in these instances, although its ability to provide more precise 3D localization would likely have been beneficial. [18F]-FDG PET/CT is currently recommended as second-line imaging modality in fever of unknown origin (FUO) when initial evaluation is unrevealing, due to its higher sensitivity, broad applicability, and superior spatial resolution [17,18]. When [18F]-FDG PET/CT is unavailable, contraindicated, or with equivocal findings, radiolabeled leukocyte SPECT/CT remains a valuable alternative due to its high ability to distinguish inflammation from infectious processes and has been validated in selected contexts, such as prosthetic valve endocarditis or cardiac device-related infection [17,19]. In bone and joint infections, radiolabelled leukocyte SPECT/CT may be useful when conventional imaging is inconclusive, particularly in cases of suspected osteomyelitis, prosthetic joint infection, or hardware-associated infection [20].

It should be emphasized that increased FDG uptake at the site of NBCA glue injection may also reflect a physiological inflammatory response rather than infection. However, in this case, the absence of any alternative infectious focus on whole-body PET/CT - including no evidence of septic thrombosis or other metastatic infection site - strongly supported the hypothesis that the observed hypermetabolism reflected an NBCA-related infectious process. This diagnostic conclusion was further reinforced by the persistence and recurrence of *Serratia marcescens* bacteremia, a pathogen with a well-recognized ability to adhere to biomaterials and form biofilm.

From a therapeutic standpoint, surgical or endoscopic removal of infected glue was not feasible due to high operative risk, leading us to adopt a prolonged 12-week antibiotic regimen without subsequent suppressive antibiotic therapy (SAT). Among previously reported cases, seven received at least six weeks of antibiotics, with a mean duration of 8.4 weeks. The decision to administer a total of 12 weeks of antibiotic therapy was based on the previously documented relapse and the characteristics of the pathogen. For other pathogens, such as *Escherichia coli*, shorter treatment courses may be sufficient. SAT was used in four cases [7,12,14,15]. Source control through surgery or endoscopic resection was attempted in four patients, two of whom died [14,21]. The overall mortality rate reached 30.8% (4/13 patients, 30.8%), reflecting both the severity of these chronic biomaterial-associated infections and the frailty of affected patients, often with significant comorbidities. Among those who died, only one had been placed on long-term SAT, underscoring the absence of standardized or clearly optimal treatment strategy (12).

Table 1: Characteristics of 13 patients with bacteremia following N-butyl-2-cyanoacrylate (NBCA) glue injection for bleeding gastric varices.
AMC: amoxicillin-clavulanate; CIP: ciprofloxacin; CTR: ceftriaxone; CXM: cefuroxime; ESBL: extended spectrum beta-lactamase;
MDR: multidrug-resistant; NA: not available; SAT: suppressive antibiotic therapy; TMP-SMX: trimethoprim-sulfamethoxazole;
TZP: piperacillin-tazobactam; UK: United Kingdom.

Study	N°	Age	Country	Comorbidities	Onset (week)	Episodes	Microorganism	Endoscopy/ Surgery (findings)	Metabolic imaging (type)	Metabolic imaging (findings)	Treatment	Total length (weeks)	SAT	SAT duration (weeks)	Outcome
Wahl P, 2004 (14)	1	60	Switzerland	Alcoholic cirrhosis + portal hypertension	12	3	1. *Cutibacterium acnes* + *Actinomyces odontolyticus* 2. *Cutibacterium acnes* + *Streptococcus anginosus* + *Prevotella* species 3. *Prevotella oralis*	No	Radio-labeled leukocytes scintigraphy	Normal	1. CTR 2. AMC 3. Moxifloxacin + surgical debridement	NA	No	NA	Death
	2	57	Switzerland	Alcoholic cirrhosis + portal hypertension	52	2	1-2. *Klebsiella aerogenes*	Inflammation around plug	No	NA	1. CTR 2. AMC	>12 (NA)	CIP	12	Remission
Lidove O, 2007 (8)	3	54	France	Nodular regenerative hyperplasia related portal hypertension	12	1	*Pseudomonas aeruginosa*	Infected plug	PET/CT	Focal uptake	First antibiotic NA, then meropenem + colistin	NA	NA	NA	Death
Wright G, 2009 (16)	4	38	UK	Alcoholic cirrhosis + portal hypertension	24	3	1-3. *Escherichia coli* ESBL	Normal	Gallium scintigraphy	Normal	Ertapenem	6	No	NA	Remission
Galperine T, 2009 (15)	5	69	France	Idiopathic portal vein thrombosis + portal hypertension	24	2	1-2. *Parvimonas micra*	Ulceration	Radio-labeled leukocytes scintigraphy	Contiguous abscess sign	1. CTR then amoxicillin 2. Amoxicillin then imipenem + clindamycin	12	CXM	10	Remission
	6	46	France	Viral cirrhosis + portal hypertension + HIV infection	2	3	1-3. *Klebsiella pneumoniae*	Normal	No	NA	1. TZP + CIP 2. TZP + CIP then AMC 3. CTR + TMP-SMX	12	No	NA	Remission
Reuken PA, 2012 (21)	7	77	Germany	Alcoholic cirrhosis + portal hypertension	12	2	1-2. *Escherichia coli* ESBL	Necrotic ulceration	No	NA	1. Imipenem 2. NA + cardia resection and splenorenal shunt	NA	No	NA	Death
Joo K, 2013 (9)	8	63	Korea	Viral cirrhosis	4	1	*Streptococcus viridans*	Normal	a. PET/CT b. Radio-labeled leukocytes scintigraphy	a. Plug hypermetabolism b. Normal	TZP + amikacin then penicillin G + gentamicin	4	No	NA	Remission
Randi B, 2015 (7)	9	43	Brazil	Autoimmune cirrhosis + portal hypertension + diabetes mellitus	8	3	1. *Streptococcus anginosus* 2. Group C beta-hemolytic *Streptococcus* + *E. coli* 3. *E. coli* + *E. faecalis*	Normal	PET/CT	Normal	1-2 CTR 3. Ampicillin + CTR	4	AMC	NA	Remission
Briceno E, 2020 (10)	10	69	Chile	Chronic liver disease + diabetes mellitus	2	2	1. MDR *E. coli* + *Streptococcus sanguinis* + *Staphylococcus warneri* 2. NA	Diffuse inflammatory process	PET/CT	Oesogastric hypermetabolism	1. CXM + metronidazole then TZP then CTR + imipenem 2. Ceftazidime-avibactam + partial gastrectomy + splenectomy + distal pancreatectomy	6	No	NA	Remission
Sempere A, 2024 (11)	11	34	Spain	Metabolic cirrhosis (Wilson's disease) + portal hypertension	8	3	1-3. *Pseudomonas aeruginosa*	Infected plug	PET/CT	Inflammatory signs around plug	1. Ceftazidime 2. Ceftolozane-tazobactam + CIP + amikacin 3. Ceftazidim + CIP + liver transplantation and vertical gastrectomy	6	No	NA	Remission
Martins Mendes T, 2024 (12)	12	47	Portugal	Alcoholic cirrhosis	4	5	1. Multi susceptible *E. coli* 2. *Klebsiella pneumoniae* ESBL + *Enterococcus faecalis* 3. *Klebsiella pneumoniae* ESBL + *E. coli* 4. *Klebsiella pneumoniae* ESBL 5. NA	Biopsy with sign of infection	PET/CT	Duodenal hypermetabolism	1. AMC 2. Ertapenem + ampicillin 3. Tigecycline + colisitin then ceftazidime 4. Ertapenem	10	TMP/ SMX	NA	Death
***Present case**, 2025*	13	50	Switzerland	Alcoholic cirrhosis + diabetes mellitus	5	2	1-2. *Serratia marcescens* complex	Normal	PET/CT	Focal hypermetabolism around gastric varices	1. Imipenem then cefepime 2. Cefepime + amikacin then meropenem + CIP then CIP alone then TMP-SMX	12	No	NA	Remission at 6 months of follow-up

5. Conclusion

This case highlights the need to consider NBCA glue infection in febrile patients after endoscopic variceal treatment, particularly when no other source is identified. In this context, [18F]-FDG PET/CT can be particularly helpful, as it allows whole-body evaluation and may reveal occult infectious focus when conventional imaging is unrevealing. The ability of radiolabelled leukocyte SPECT/CT to distinguish true infection from sterile inflammatory reaction has not yet been explored in this setting and deserves further study. Although rare, NBCA-infection is severe, with high recurrence and mortality rates. Management should be individualized, balancing pathogen characteristics and patient condition. Source control is the preferred management when feasible; otherwise, prolonged-targeted antibiotics, with or without SAT, may be required. Evidence is still lacking regarding optimal treatment duration, anti-biofilm strategies, and indications for long-term suppression therapy.

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During the preparation of this work, the authors used ChatGPT in order to improve readability and language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Supplementary 1: *Serratia marcescens* susceptibility pattern including MIC when available.
MIC: minimum inhibitory concentration; NA: not available; NR: not relevant.

	Serratia marcescens	
Antibiotics	**Susceptibility**	**MIC (mg/l)**
Ampicillin	R	NR
Amoxicillin/clavulanic acid	R	NR
Piperacillin/tazobactam	S	NA
Cefepime	S	0.125
Imipenem	S	0.5
Meropenem	S	0.064
Ertapenem	S	NA
Gentamicin	S	NA
Ciprofloxacin	S	0.094
Trimethoprim/Sulfamethoxazole	S	0.19
Fosfomycin	S	NA
Nitrofurantoin	R	NR