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(CASE REPORT)

# Primary bacterial peritonitis due to carbapenemase-producing *Enterobacteriaceae*

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## Abstract

Peritonitis is an acute inflammation of the peritoneum, most commonly caused by infections. It is a surgical emergency that can threaten the vital prognosis of patients. Therapeutic management combines surgery and antibiotic therapy, which must be adapted to the ecology and susceptibility profiles of the bacteria usually isolated.

The evolution of antimicrobial resistance in peritonitis is a worrying phenomenon, which has been the subject of numerous publications and the modification of antibiotic therapy protocols

We report in this work a case of primary bacterial peritonitis due to carbapenemase-producing *Enterobacteriaceae*

**Keywords:** Peritonitis; BMR; Aerogenic enterobacter; Carbapenemase; Oxa48

## 1. Introduction

Peritonitis is defined as inflammation of the peritoneum. The mechanism of peritonitis allows it to be classified and distinguished into three distinct entities. Their pathophysiology, clinical presentation and management are radically different.

Primary peritonitis, such as spontaneous infection of cirrhotic ascites fluid, is a so-called spontaneous infection of the peritoneum without invasion of the abdominal cavity or the digestive tract.

Secondary peritonitis includes all abdominal infections following perforation or necrosis of the digestive tract.

Finally, tertiary peritonitis concerns patients with intra-abdominal infection without macroscopic aetiology, but with persistence of germs in the peritoneal fluid [1].

## 2. Observation

This is an 84-year-old diabetic female, who was admitted to hospital because of a generalised abdominal defence with vomiting of 12 days' duration without other associated signs. A CT scan showed a collection of air bubbles in the right flank, an abdominal effusion of low volume and a swollen appendix. Biochemical analyses were requested and revealed a frank biological inflammatory syndrome with hyperleukocytosis, CRP 216, hepatic cytolysis with elevated transaminases.

The patient was immediately placed on antibiotic therapy and suggested for appendectomy with aspiration and collection of the peritoneal fluid.

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The peritoneal fluid was sent to the microbiology laboratory for cytobacteriological examination.

In the laboratory, direct examination revealed a significant cellular reaction with the presence of gram-positive cocci and gram-negative bacilli.

The sample was inoculated onto various enriched and standard culture media: Columbia blood agar, chocolate agar and McConkey and Chapman medium, incubated under aero-anaerobic conditions at 37° Celsius.

The cultures were positive, polymorphic and abundant and the Chapman medium was sterile. The separation of the different colonies on new media allowed us to obtain pure colonies for the biochemical study and the antibiogram. 3 types of colonies were isolated and studied, 3 antibiograms and a biochemical study by API 20 galleries E

An API 20E gallery (Bio Mérieux) was prepared by mixing the colonies in a solution of API suspension medium (5 ml) to obtain a cloudy suspension of 0.5 McFarland.

An antibiogram was prepared using the diffusion technique in agar medium in accordance with the recommendations of the French Society of Microbiology (SFM).

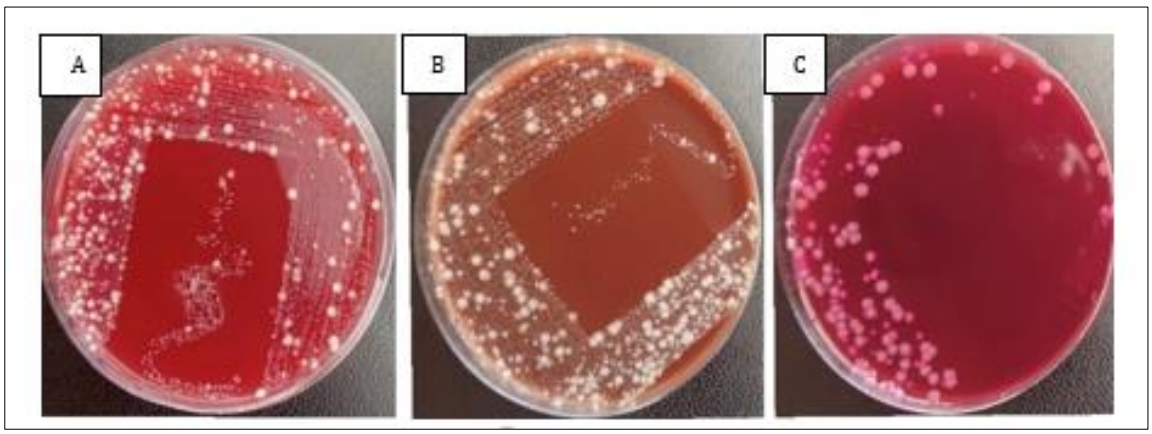
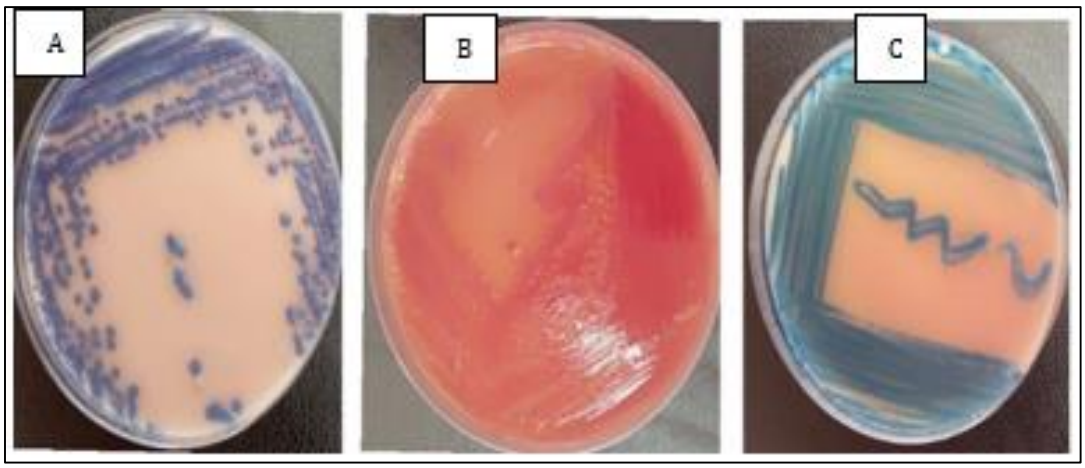



**Figure 1** Polymorphic and abundant positive blood, chocolate and Mc Conkey agar cultures




A: enterobacter , B: E.coli , C: enterococcus

**Figure 2** Subculture on chromogenic media of the 3 types of colonies

The interpretive analysis of the antibiograms, in conjunction with the identification of bacterial strains through biochemical methods, facilitated the isolation of the following strains:

The following bacterial strains were isolated:

- Multidrug-resistant Enterobacter aerogenes
- E. Coli susceptible to all antimicrobial agents
- Enterococcus resistant to β-lactam antibiotics

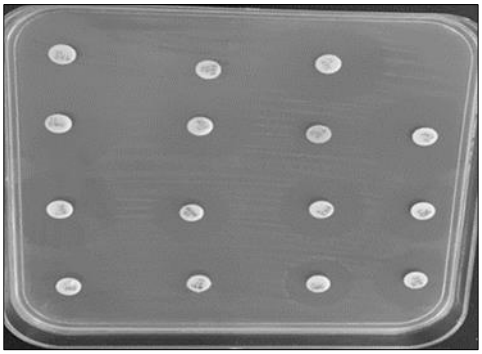


**Figure 3** Antibiogram of an Enterococcus strain resistant to beta-lactams

**Figure 4** API 20E gallery*, E. coli* identification

**Figure 5** API 20 E gallery, for identification of aerogenic Enterobacter

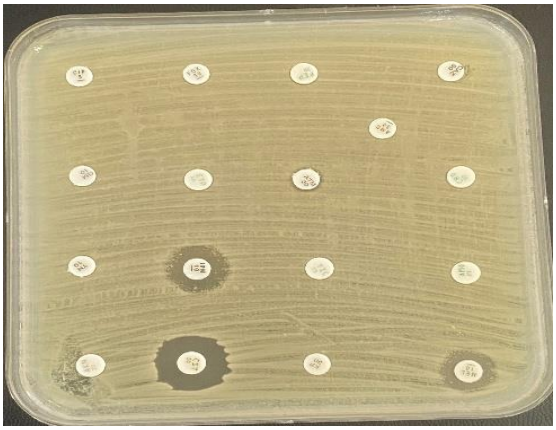


**Figure 6** Antibiogram of an enterobacter strain aerogenes multi-resistant

A multiplex immunochromatographic test was conducted for the purpose of detecting and differentiating major carbapenemases.


**Figure 7** Positive immuno -chromatographic test with 2 oxa-48 and NDM variants

Despite the provision of optimal medical and surgical intervention, the patient ultimately succumbed to their condition.

## 3. Discussion

The pathogenic bacteria identified in peritonitis cases are consistent with those typically found in the digestive tract, with the exception of primary peritonitis. The bacterial flora differs in number and type depending on the organ affected. Gram-negative bacilli (BGN) constitute over 40% of the bacteria identified, with the majority being Escherichia coli (E. coli). Gram-positive cocci (CGP) account for approximately 30%, with the majority being Enterococcus and Streptococcus. The presence of anaerobic bacteria is observed in approximately 20% of cases, while the detection of yeast is noted in a minority of instances, at a rate of 3 to 4% [2].

the specific type of germ, the quantity present, and the resistance profile vary depending on the type of peritonitis. In contrast to secondary peritonitis, primary peritonitis is most frequently monomicrobial. Tertiary peritonitis is characterised by the highest prevalence of multi-resistant bacteria (MRB) [3]. The Enterobacter is widely distributed in the environment, including in water and soil. Furthermore, E. aerogenes is a commensal of the human digestive tract.

However, the bacteria are acquired by the patient from one of three sources: the patient's local environment, healthcare personnel, or the patient's own intestinal flora, which may become resistant to antibiotics during treatment.

The initial French studies demonstrated that E. aerogenes was the causative agent of epidemic episodes resulting from the contamination of a few patients by genotypically distinct strains, which subsequently disappeared [4].

It was subsequently estimated, based on the genotypic analysis of a large number of strains, that in 75% of cases, the bacteria were transmitted from patient to patient, while in 25% of cases, they were acquired from the patient's own flora. [5].

At the present time, the epidemiology of this bacterium in France is characterised by the dissemination of a clone that harbours a plasmid carrying the gene coding for TEM-24 type β-lactamase. It is noteworthy that the majority clone has been observed to harbour other ESBLs, including TEM-1, 2, 3 and SHV-4 [6, 7]. This extended-spectrum β-lactamase (ESBL) is frequently observed in clinical isolates in conjunction with a high-level cephalosporinase of chromosomal origin. It seems probable that the significant dissemination of the prevalent clone of E. aerogenes resulted from its effective adaptation to antibiotics as well as to the hospital environment, given that it is equipped with effective enzymatic mechanisms. Imipenem remains the only β-lactam that retains efficacy against clinical strains of E. aerogenes exhibiting derepressed ESBL and cephalosporinase. Consequently, the prescription was increased in this situation.

The isolation of carbapenemase-producing Enterobacteriaceae strains is becoming increasingly prevalent on a global scale. These are essentially KPC-type beta-lactamases, IMP/VIM metallo-beta-lactamases and more recently NDM-1 metallo-beta-lactamase and OXA-48. OXA-48 is one of the most recently described carbapenemases, exhibiting a distinct

structural profile compared to previous variants. Its prevalence is largely concentrated in Mediterranean countries, as evidenced by epidemiological studies [8].

The genes for these carbapenemases are most often located on plasmids, with the majority being found in hospital strains. However, there have been reports of their community diffusion. These carbapenemases are present in strains that are multi-resistant to antibiotics. The treatment of infections caused by carbapenemase-producing Enterobacteriaceae is challenging, and the lack of effective therapeutic options can lead to therapeutic dead ends. The treatment of infections caused by these bacteria is challenging.

The difficulty in detecting these bacteria (both infected and carriers) would explain their low-noise diffusion, which has dramatic therapeutic consequences.

The inevitable adaptation of the bacteria to antimicrobial agents resulted in the emergence of strains that became resistant to imipenem in treated patients [5]. The emergence of imipenem-resistant bacterial infections presents an additional challenge in clinical practice. Indeed, the therapeutic armoury is severely restricted, leaving clinicians to grapple with the prospect of a therapeutic impasse.

## 4. Conclusion

The study of bacterial resistance during peritonitis can be considered from two perspectives: firstly, the study of the resistance mechanisms, and secondly, the study of the factors that facilitate the activation of such mechanisms. The utilisation of antibiotics represents a significant contributing factor to the emergence of bacterial resistance.

Points to remember:

- The rise in bacterial resistance to antibiotics represents a significant public health challenge that necessitates a unified response at the community level and within healthcare facilities.
- It is imperative that all healthcare establishments implement an active policy to combat BMRs as part of the ongoing effort to combat nosocomial infections.
- The policy is based on the implementation and strict adherence to standard hygiene precautions for all patients during potentially contaminating care, as well as the appropriate use of antibiotic medications.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No disclosure of conflict of interest

### *Statement of informed consent*

Informed consent obtained from all individual participants and included in the study by signing the Free and Informed consent.

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