

Case report



A FATAL HEALTHCARE-ASSOCIATED INFECTION FOLLOWING SPINAL SURGERY CAUSED BY MULTIDRUG-RESISTANT PATHOGENS: A CASE REPORT

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ABSTRACT:

Background: Healthcare-associated infections (HAIs) caused by multi-drug-resistant (MDR) bacteria represent a major public health challenge, particularly among surgical and critically ill patients. Surgical site infections in neurosurgical practice are frequently associated with prolonged hospitalization, repeated invasive procedures and exposure to hospital environments where MDR pathogens may persist and spread.

This case report **aims** to illustrate the clinical course and fatal outcome of a HAIs following spinal surgery, caused by highly resistant bacterial pathogens.

Methods: We report the case of a 67-year-old male patient who developed a postoperative spinal surgical site infection caused initially by *methicillin-resistant coagulase-negative staphylococci* (CNS-MR) and subsequently by multidrug-resistant *Klebsiella pneumoniae*. Clinical data, imaging findings, microbiological results and therapeutic interventions were retrospectively analyzed. Epidemiological investigations were conducted to assess potential sources and routes of pathogen transmission within the hospital environment.

Results: Despite multiple surgical revisions and targeted antimicrobial therapy guided by susceptibility testing, the infection progressed to systemic inflammatory response and multiorgan failure. The patient had several predisposing risk factors, including advanced age, undiagnosed and uncontrolled type 2 diabetes mellitus, prolonged hospitalization, and repeated high-risk surgical interventions (ASA class III). Identical MDR bacterial strains were detected in the operating room, intensive care units environment, nasal carriage among healthcare workers, indicating ongoing cross-transmission within the clinical setting.

Conclusions: This case highlights the devastating consequences of HAIs caused by MDR pathogens in high-risk inpatient groups. It underscores the critical importance of strict infection prevention and control (IPC) measures, continuous surveillance of antimicrobial resistance and early identification of vulnerable patients to reduce the risk of severe and fatal outcomes. Within a One Health perspective, the professional sharing of single case reports from local clinical settings plays a meaningful role in strengthening IPC practices worldwide.

Keywords: healthcare-associated infection, multidrug resistant bacteria, antibiotic use among inpatients, antimicrobial resistance, infection prevention and control (IPC), case report, One Health,

INTRODUCTION

The rapid global increase in bacterial populations exhibiting antimicrobial resistance (AMR) has emerged as one of the most pressing challenges for contemporary healthcare systems and for global public Health [1]. Infections caused by multidrug-resistant (MDR) pathogens significantly limit therapeutic options and place patients at high risk of severe complications, prolonged hospitalization, and fatal outcomes, particularly in the context of healthcare-associated infections (HAIs). Recent global estimates indicate that, of approximately 8.9 million deaths attributable to bacterial infections in 2019, nearly 5 million were associated with [2, 3]. In response, the World Health Organization (WHO) has identified carbapenem-resistant *Acinetobacter baumannii* and carbapenem- or third-generation cephalosporin-resistant *Enterobacterales* as critical priority pathogens requiring urgent attention [4]. Surgical and critically ill patients represent particularly vulnerable populations, especially those treated in intensive care units (ICUs). In these settings, HAIs are frequently linked to MDR microorganisms persisting in the hospital environment, including contaminated surfaces, medical equipment and invasive devices, facilitating cross-transmission between patients [5, 6, 7]. Prolonged and close contact between healthcare workers and patients during surgical procedures and intensive care interventions further increases the risk of pathogen transmission. Within this context, neurosurgical patients undergoing complex spinal procedures face an elevated risk of surgical site infections, which may rapidly progress to systemic inflammation and multiorgan failure when caused by MDR pathogens.

The aim of the present case report is to describe the clinical course of a fatal healthcare-associated infection in a neurosurgical patient, which originated as a post-

operative surgical site infection and progressed to multiorgan failure due to infection with multidrug-resistant bacteria.

MATERIALS AND METHODS

This manuscript presents a case report describing the course, management and outcome of a HAI in a neurosurgical patient. The study is based on a retrospective review of the patient's medical records, including clinical observations, laboratory and microbiological findings, imaging studies and therapeutic interventions. The temporal sequence of clinical events, diagnostic procedures and treatment decisions was systematically documented and analyzed to ensure an accurate and comprehensive presentation of the case. Epidemiological and infection prevention-related findings relevant to the inpatient setting were also considered in order to contextualize the clinical course and its public health implications.

RESULTS OF THE CASE REPORT:

This section provides a concise and precise description of the Case report, the course of development, professional interpretations, and the therapeutic and public health conclusions that can be drawn.

2.1. First hospitalization

A 67-year-old male patient was admitted to the Neurosurgical Clinic with severe lower back pain radiating to the right inguinal region and ankle following a traumatic contusion. Neurological examination revealed vertebral and radicular syndrome at lumbar levels L3–L5 on the right side, with positive Valleix and Lasègue signs. The admission diagnosis was a closed lumbar spine fracture.

Baseline laboratory findings showed a white blood cell count (WBC) of $7.5 \times 10^9/L$, hemoglobin (Hb) level of 146 g/L, serum glucose of 8.12 mmol/L, creatinine of 107 $\mu\text{mol/L}$ and urea of 5.9 mmol/L. Liver enzymes and serum electrolytes were within normal ranges.

Computed tomography (CT) of the lumbar spine revealed median and bilateral paramedian disc protrusions. Preoperative consultations identified previously undiagnosed type 2 diabetes mellitus and stage III arterial hypertension, corresponding to an increased operative risk classified as American Society of Anesthesiologists (ASA) class III.

On the second day of hospitalization, the patient underwent pedicle fixation and decompression at spinal levels L2–L5, followed by surgical lavage and placement of active drainage. Postoperative management included intravenous fluids, analgesics, cefuroxime (1.5 g three times daily for five days) and low-molecular-weight heparin prophylaxis. The postoperative course was uneventful, and the patient was discharged on postoperative day six in stable condition.

2.2. Second hospitalization

Twenty-one days after the initial surgery, the patient was readmitted due to worsening lower back pain

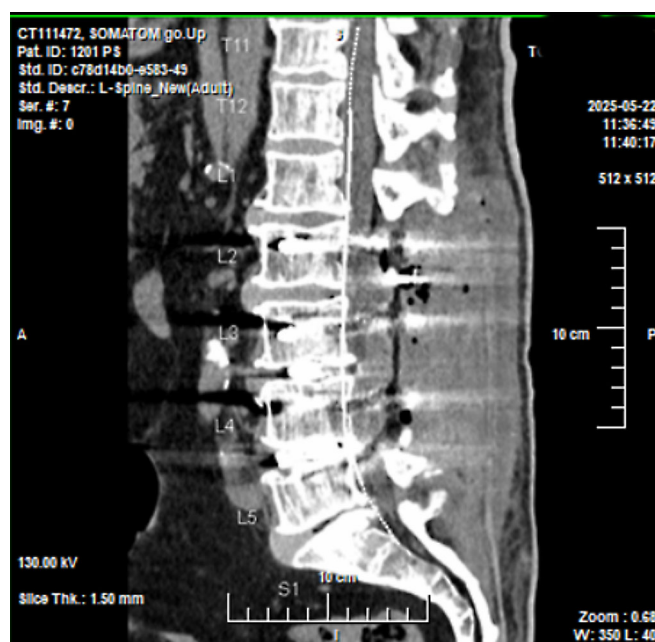
and purulent discharge from the surgical wound, which developed shortly after suture removal on postoperative day fourteen. On admission, vital signs were stable, with blood pressure of 130/80 mmHg and heart rate of 75 beats per minute.

Laboratory investigations demonstrated signs of acute inflammation, including a WBC count of $10.3 \times 10^9/L$, Hb level of 110 g/L, serum glucose of 9.4 mmol/L and C-reactive protein (CRP) level of 209.46 mg/L. Renal function parameters were mildly elevated.

2.3. Imaging findings

Chest radiography showed no pulmonary infiltrates or pleural effusions. CT of the lumbar spine revealed postoperative metal stabilization at levels L2–L5, paravertebral muscle edema, and a localized fluid collection measuring approximately 4 cm in the anteroposterior dimension at L2–L5 (Fig. 1). Magnetic resonance imaging (MRI) confirmed the presence of an epidural fluid collection consistent with a postoperative spinal abscess.

Fig. 1. Sagittal lumbar spine CT demonstrating post-metal stabilization changes at L2–L5, with paravertebral muscle edema and a localized fluid collection at L2–L5 measuring approximately 4 cm in anteroposterior diameter.



2.4. Surgical Revisions and Microbiological Findings

Based on clinical, laboratory and imaging findings, a diagnosis of postoperative spinal abscess was established. Surgical revision revealed an open fistulous tract extending from the fascia to the dura mater, with purulent material. The abscess cavity was evacuated, the fistulous tract resected, and the surgical site irrigated with antiseptic solution and normal saline. Two active subfascial drains were placed.

Microbiological cultures obtained intraoperatively

yielded growth of methicillin-resistant coagulase-negative *staphylococci* (CNS-MR), susceptible only to vancomycin and linezolid, and *Enterococcus faecalis*, susceptible to amoxicillin–clavulanic acid, ampicillin–sulbactam, tigecycline and vancomycin.

Empirical antimicrobial therapy with gentamicin and metronidazole was initiated and subsequently adjusted according to susceptibility testing to vancomycin in combination with ampicillin–sulbactam.

2.5. Clinical Deterioration and ICU Course

On postoperative day eight following the second surgery, the patient's clinical condition deteriorated, with recurrent febrile episodes up to 39.5°C. Laboratory findings demonstrated persistent systemic inflammation and progressive renal impairment (WBC 14.1×10^9 /L, CRP 395.75 mg/L, creatinine 227 µmol/L). Follow-up MRI revealed a persistent epidural fluid collection at levels L2–L5.

A further surgical revision was performed, after which the patient was transferred to the ICU. Mechanical ventilation and central venous catheterization were required for five days. Following transient stabilization, the patient was returned to the neurosurgical ward, where daily wound care, glucose monitoring and insulin therapy were initiated in collaboration with endocrinology and nephrology specialists.

Subsequent CT imaging revealed bilateral pleural effusions and a recurrent fluid collection at the surgical site measuring 85 × 40 mm. Emergency surgical revision was performed, and wound cultures grew multidrug-resistant *Klebsiella pneumoniae*, susceptible only to colistin. Antimicrobial therapy was adjusted accordingly.

2.6. Final Outcome

Despite intensive care management, the patient's condition further deteriorated. He developed coma (Glasgow Coma Scale score of 4), severe renal dysfunction, ventilator-associated pneumonia and systemic inflammatory response syndrome. *Klebsiella pneumoniae* with an identical resistance profile was isolated from lower respiratory tract secretions. Blood cultures remained negative.

Multiple complications ensued, including bilateral pleural effusions, reactive arthritis of the hip joints, decubitus ulcers and progression of diabetic nephropathy. On day sixty-one of the second hospitalization, the patient developed multiorgan failure and died.

DISCUSSION:

This case report describes a fatal HAI in a neurosurgical patient, sequentially caused by two MDR pathogens: methicillin-resistant coagulase-negative *staphylococci* (CNS-MR) and MDR *Klebsiella pneumoniae*. The clinical course illustrates how the interaction between patient-related vulnerability, invasive surgical procedures and hospital environmental exposure can lead to severe infectious complications with a fatal outcome.

Several predisposing risk factors contributed to the unfavorable progression of the infection. Patient-related

factors included advanced age, previously undiagnosed and uncontrolled type 2 diabetes mellitus and impaired immune response. Procedure-related factors comprised multiple surgical interventions, re-operations and prolonged hospitalization, all of which increased exposure to potential sources of MDR microorganisms. The operative risk was classified as ASA class III–IV, further highlighting the patient's susceptibility to postoperative complications. Although the initial spinal procedure was categorized as a clean surgery, the absence of preoperative antimicrobial prophylaxis and the subsequent placement of open drainage systems after multiple revisions may have facilitated the persistence and progression of the local inflammatory process.

Increasing evidence highlights the growing clinical relevance of coagulase-negative *staphylococci* as etiological agents of surgical site infections, particularly in the context of HAIs. Once considered low-virulence contaminants, CNS have emerged as significant pathogens due to their capacity for biofilm formation, AMR and persistent colonization of both human hosts and hospital environments. Long-term microbiological surveillance in the hospital has demonstrated a marked increase in the proportion of CNS among staphylococcal surgical site infections, as well as a rising prevalence of methicillin-resistant strains, consistent with findings reported by other authors [9,10].

The epidemiological investigation conducted in this case revealed persistent nasal carriage of CNS-MR among members of the surgical team, as well as environmental contamination in both the operating room and the ICU. These findings underscore the importance of healthcare workers as potential reservoirs and vectors for pathogen transmission when IPC practices are insufficient. Periodic screening of nasal carriage among healthcare personnel has shown increasing rates of mupirocin-resistant CNS strains, limiting the effectiveness of decolonization strategies and contributing to the persistence of resistant reservoirs within hospital settings [8]. Even minor lapses in hand hygiene, aseptic technique or appropriate use of personal protective equipment may significantly increase infection risk for vulnerable inpatients.

The patient's prolonged stay in the ICU further amplified the risk of exogenous transmission. Mechanical ventilation, central venous catheterization, and frequent wound care required close and repeated contact with healthcare personnel and medical devices, often in proximity to other patients colonized or infected with MDR pathogens. In this case, identical *Klebsiella pneumoniae* MDR strains were isolated from neighboring ICU patients and from the hospital environment, strongly suggesting ongoing cross-transmission. Previous studies have demonstrated that contamination of healthcare workers' hands and gloves after contact with environmental surfaces poses a transmission risk comparable to direct contact with colonized patients [6, 11].

The ICUs represent clinical settings where high antimicrobial consumption, invasive procedures and close patient–staff interactions converge, creating favorable

conditions for the selection and dissemination of multidrug-resistant organisms. Prolonged and repeated antibiotic exposure not only alters the hospital microbiome but also disrupts patients' endogenous microbiota, facilitating the emergence of severe healthcare-associated infections of both endogenous and exogenous origin [6, 12, 13]. The ability of MDR pathogens to persist on inanimate surfaces and form biofilms further complicates environmental decontamination and infection control efforts [14, 15, 16].

In countries with a high burden of AMR, such as Bulgaria, the clinical and public health relevance of HAIs caused by MDR pathogens is particularly pronounced. At the primary healthcare level, growing concerns regarding inappropriate antibiotic use have already prompted public debate and the introduction of targeted health policy measures aimed at optimizing antibiotic prescribing and consumption. Recent evidence from Bulgaria demonstrates that even a single health policy instrument can significantly influence antibiotic use at the community level, highlighting the potential for coordinated interventions to mitigate AMR in inpatient settings as well [17].

Within this national context, the present case report provides additional support for ongoing discussions and policy initiatives focused on strengthening the organization and IPC measures at the hospital level. By illustrating the severe consequences of HAIs caused by MDR pathogens in a high-risk surgical patient, this case underscores the need for harmonized IPC strategies across healthcare sectors, aligning hospital-based infection control with broader antimicrobial stewardship and One

Health-oriented public health policies.

From a broader perspective, this case exemplifies the complex interplay between human Health, healthcare environments and microbial ecology, aligning with the principles of the One Health framework. AMR is not confined to individual patients or institutions but represents a shared global challenge that requires coordinated surveillance, IPC strategies across disciplines and settings. The detailed reporting of severe outcomes associated with MDR pathogens, even within a single local clinical context, contributes valuable evidence for strengthening IPC practices worldwide.

CONCLUSION/S/:

Healthcare-associated infections associated with MDR microflora are among the leading concerns in high-risk inpatient groups. Increased age at hospitalization, comorbidities and immunosuppressive conditions further elevate the risk of severe progression of the infectious process. It underscores the critical importance of strict IPC measures, continuous surveillance of AMR and early identification of vulnerable inpatients to reduce the risk of severe and fatal outcomes. Within a One Health perspective, the professional sharing of single case reports from local clinical settings plays a meaningful role in strengthening IPC practices worldwide.

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