Carbapenem-resistant Klebsiella pneumoniae ventriculitis

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Carbapenem-resistant Klebsiella pneumoniae (CRKP) ventriculitis refers to an infection of the ventricles of the brain caused by Klebsiella pneumoniae bacteria that are resistant to carbapenem antibiotics.

CRKP ventriculitis typically occurs as a complication of neurosurgical procedures or as a result of the spread of infection from another site. Patients who have undergone neurosurgery, particularly those with indwelling devices such as ventriculostomy catheters, are at higher risk of developing this type of infection.

Carbapenems are broad-spectrum antibiotics that are often considered a treatment of choice for serious infections caused by multidrug-resistant Gram-negative bacteria like Klebsiella pneumoniae. However, CRKP strains have developed resistance mechanisms, such as the production of carbapenemase enzymes (e.g., KPC, NDM, OXA-48) or alterations in the permeability of the bacterial cell wall, making them resistant to carbapenem antibiotics.

The presence of carbapenem resistance complicates the treatment of CRKP ventriculitis, as it limits the effectiveness of standard antibiotic therapy. It requires the use of alternative treatment strategies and often a combination of multiple antibiotics to target the resistant bacteria.

The management of CRKP ventriculitis typically involves a multidisciplinary approach, including infectious disease specialists, neurosurgeons, and critical care teams. Treatment may include the following components:

Antibiotic therapy: The choice of antibiotics is guided by the antimicrobial susceptibility profile of the specific CRKP strain isolated from the patient's infection. In some cases, combination therapy with multiple antibiotics may be necessary to improve effectiveness. The duration of antibiotic treatment

varies but is typically prolonged, often lasting several weeks.

Source control: Identification and removal of the source of infection, such as infected devices or abscesses, are essential. This may involve surgical intervention, such as drainage of abscesses, debridement of infected tissues or removal of indwelling devices contributing to the infection.

Supportive care: Patients with CRKP ventriculitis may require supportive care measures, such as monitoring of intracranial pressure, maintenance of adequate cerebral perfusion, and management of complications like seizures or hydrocephalus.

Infection control measures: Strict infection prevention and control practices are crucial to prevent the spread of CRKP to other patients in healthcare settings. This includes appropriate hand hygiene, isolation precautions, and adherence to protocols for sterilization and disinfection.

The prognosis of CRKP ventriculitis can be variable and depends on factors such as the severity of the infection, the patient's overall health, the timeliness and effectiveness of treatment, and the presence of any underlying conditions. Prompt diagnosis, appropriate antibiotic therapy, and aggressive management of the infection are important for improving outcomes in patients with CRKP ventriculitis.

A retrospective case-control study was conducted involving pediatric and neonatal intensive care units throughout a five-year period (January 2010-December 2014). Clinical and microbiological data were extracted from Hospital Infection Control Committee reports and patients' medical records. Risk factors were assessed in Carbapenem-resistant Klebsiella pneumoniae colonized patients who developed a subsequent systemic infection (cases) and compared to carbapenem-resistant Klebsiella pneumoniae colonized patients who did not develop infection (controls).

Throughout the study period, 2.6% of patients admitted to neonatal intensive care units and 3.6% of patients admitted to pediatric intensive care units had become colonized with carbapenem-resistant Klebsiella pneumoniae. After a mean of 10.6±1.9 days (median: 7 days, range: 2-38 days) following the detection of colonization, 39.0% of the carbapenem-resistant Klebsiella pneumoniae colonized patients in pediatric intensive care units and 18.1% of carbapenem-resistant Klebsiella pneumoniae colonized patients in neonatal intensive care units developed systemic carbapenem-resistant Klebsiella pneumoniae infection. Types of systemic carbapenem-resistant Klebsiella pneumoniae infections included bacteremia (n=15, 62.5%), ventilator-associated pneumonia (n=4, 16.6%), ventriculitis (n=2, 8.3%), intraabdominal infections (n=2, 8.3%), and urinary tract infection (n=1, 4.1%). A logistic regression model including parameters found significant in univariate analysis of carbapenem resistant Klebsiella pneumoniae colonization and carbapenem resistant Klebsiella pneumoniae infection groups revealed underlying metabolic disease (OR: 10.1; 95% CI: 2.7-37.2), previous carbapenem use (OR: 10.1; 95% CI: 2.2-40.1), neutropenia (OR: 13.8; 95% CI: 3.1-61.0) and previous surgical procedure (OR: 7.4; 95% CI: 1.9-28.5) as independent risk factors for carbapenem-resistant Klebsiella pneumoniae infection in patients colonized with carbapenem-resistant Klebsiella pneumoniae. Out of 24 patients with carbapenem resistant Klebsiella pneumoniae infection, 4 (16.6%) died of carbapenem-resistant Klebsiella pneumoniae sepsis.

Asymptomatic colonization with carbapenem-resistant Klebsiella pneumoniae in intensive care units of pediatric departments should alert health care providers about forthcoming carbapenem-resistant Klebsiella pneumoniae infection. Those carbapenem-resistant Klebsiella pneumoniae colonized patients at risk of developing infection due to carbapenem-resistant Klebsiella pneumoniae may be

targeted for interventions to reduce subsequent infection occurrence and also for timely initiation of empirical carbapenem-resistant Klebsiella pneumoniae active treatment, when necessary [1].

Case reports

A 57-year-old man with an open traumatic brain injury presented with dyspnea, high fever, and seizures associated with surgery.

Intracranial infection caused by Carbapenem-resistant Klebsiella pneumoniae was diagnosed.

On the advice of a clinical pharmacist, the patient was given tigecycline (100 mg IV + 3 mg IVT q12h) combined with amikacin (0.8 g IV + 30 mg IVT qd) anti-infective therapy. Ultimately, the pathogens in the cerebrospinal fluid were eradicated after 7 days, and the CNSIs were completely cured after 14 days.

The patient recovered and was discharged from the hospital without adverse reactions.

A series of in vitro and in vivo synergy tests of carbapenem-resistant K. pneumoniae showed that tigecycline combined with aminoglycosides had good synergistic effects and effectively suppressed bacterial resistance selection. Intravenous plus intraventricular tigecycline-amikacin seems to be a safe and effective treatment option for carbapenem-resistant K. pneumoniae CNSIs [2].

A 53-year-old male underwent a decompressive craniectomy and was referred for cerebrospinal fluid leakage and persistent fever.

The minimum inhibitory concentration of polymyxin B in this patient increased from 2 to 4 μg/mL during the course of treatment. He was diagnosed with polymyxin-resistant XDR Klebsiella pneumoniae ventriculitis. They successfully treated the infection with intravenous ceftazidime/avibactam (CAZ/AVI) combined with ventricular injection of tigecycline according to cerebrospinal fluid microbiological culture.

CAZ/AVI combined with tigecycline may be an effective salvage treatment for CNS infections caused by polymyxin-resistant XDR Klebsiella pneumoniae [3]

Two cases of post-neurosurgical ventriculitis caused by carbapenem-resistant Gram-negative pathogens were successfully treated with high-dose ceftazidime/avibactam. The existence of a real-time clinical pharmacological advice program, enabling the optimization of the PK/PD targets overtime at the infection site, turned out to be very helpful [4].

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3 patients were diagnosed with MDR/XDR Gram-negative bacillus-associated CNS infections, and effectively treated with CAZ/AVI. Moreover, we performed literature reviews. Before the onset of CNS infections, the 3 patients were subjected to neurosurgical operations, and treated with mechanical ventilation, long-term intensive care unit therapy, and various antibiotics. By intravenously administering CAZ/AVI, combined with another antibiotic, the MDR/XDR K. pneumoniae and P.

aeruginosa-associated ventriculitis were effectively treated in the 3 patients.

CAZ/AVI is a viable treatment option for CNS infections caused by MDR/XDR Gram-negative bacteria [5].

A patient was admitted to the emergency department with intracranial hemorrhage and ventriculitis due to traumatic injury. A ventriculostomy and, subsequently, a ventriculoperitoneal (VP) shunt were placed. After approximately a month of treatment with various antibiotic regimens, the patient's VP shunt was externalized, and a CSF culture speciated carbapenem-resistant K. pneumoniae and Pseudomonas aeruginosa. The patient was then switched to i.v. ceftazidime-avibactam and intrathecal amikacin therapy. His CSF cultures were sterile 3 days after initiation of those antibiotics, and subsequent CSF cultures resulted in no growth. After the patient was treated with intrathecal amikacin 30 mg daily for 4 weeks and i.v. ceftazidime-avibactam 2.5 g every 8 hours for 6 weeks, the ventriculitis resolved, the external ventricular drain was removed, and he was transferred to a long-term care facility for rehabilitation.

Conclusion: A man with ventriculitis caused by P. aeruginosa and carbapenem-resistant K. pneumoniae was successfully treated with i.v. ceftazidime-avibactam and intrathecal amikacin [6].

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