Journal of Hospital Infection 92 (2016) 78–81

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Short report

Risk factors for carbapenemase-producing Enterobacteriaceae colonization of asymptomatic carriers on admission to an Italian rehabilitation hospital

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ARTICLE INFO

Article history:
Received 23 September 2015
Accepted 26 October 2015
Available online 9 November 2015

Keywords:
Carbapenemase
Carriage
Rehabilitation
Resistance epidemiology
Surveillance

SUMMARY

The spread of carbapenemase-producing Enterobacteriaceae (CPE) has become a worldwide problem. Early identification and isolation of asymptomatic carriers are important for infection prevention and control measures. All inpatients ($N = 1427$) admitted to 'Fondazione Santa Lucia' Rehabilitation Hospital in 2014 were screened by rectal swab; 10.2% of them were CPE-colonized. The multivariate analysis on anamnestic data showed that both previous admission to an intensive care unit (odds ratio: 4.04; 95% confidence interval: 2.20–7.44; $P < 0.001$) or post-acute care hospitals (2.88; 1.74–4.77; $P < 0.001$) and presence of a central venous catheter (2.19; 1.34–3.59; $P < 0.001$) were significant risk factors.

Introduction

Enterobacteriaceae are emerging as extremely drug-resistant pathogens. The most important mechanism of resistance is the production of carbapenemases. Introduced in the 1980s, carbapenems are the most potent group of antimicrobial agents available for the treatment of severe sepsis. The first report of carbapenemase-producing Enterobacteriaceae (CPE) was published in 1993. CPE have since been described worldwide as a consequence of the acquisition of carbapenemase genes. Over the last decade CPE have emerged as a significant public health threat. In Italy the first report dates back to the early 2000s.[1] The current extensive CPE spread in post-acute care hospitals (PACHs) in Italy is an important source of concern. PACH patients are at risk of colonization and infection with multidrug-resistant bacteria (MDR) and have been associated with hospital outbreaks in which person-to-person transmission plays an important role.[2] In 2013 the Italian Ministry of Health (MoH) suggested the implementation of active CPE surveillance of asymptomatic carriers by rectal swabs for patients transferred or admitted to hospital wards at risk for

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http://dx.doi.org/10.1016/j.jhin.2015.10.012

Table I
Univariate analysis of potential risk factors and outcomes for all patients admitted from hospitals

Characteristics	Total admitted ($N = 1164$)	CPE-colonized ($N = 145$)	OR (95% CI)	*P*
Age (years)				
≤50	263 (22.6%)	51 (19.4%)	–	–
51–65	285 (24.5%)	35 (12.3%)	0.58 (0.36–0.93)	0.023
66–75	284 (24.4%)	40 (14.1%)	0.68 (0.43–1.07)	0.097
>75	332 (28.5%)	19 (5.7%)	0.25 (0.14–0.44)	0.000
Sex				
Female	529 (45.4%)	53 (10.0%)	–	–
Male	635 (54.6%)	92 (14.5%)	1.52 (1.06–2.18)	0.021
Admission from				
Other wards	1083 (93.0%)	118 (10.9%)	–	–
At-risk units (UAR)	81 (7.0%)	27 (33.3%)	4.09 (2.48–6.74)	0.000
ICU	54 (4.6%)	22 (40.7%)		
Haematology/oncology units	21 (1.8%)	4 (19.0%)		
Transplant units	1 (0.1%)	1 (100%)		
Spinal/neurorehabilitative units	5 (0.4%)	0		
Previous hospitalization				
ICU	261 (22.4%)	89 (34.1%)	7.83 (5.39–11.36)	0.000
PACH	115 (9.9%)	37 (32.2%)	4.13 (2.66–6.4)	0.000
Conditions/procedures at admission				
Oncological	108 (9.3%)	17 (15.7%)	1.35 (0.78–2.35)	0.278
Bedsores	238 (20.4%)	57 (23.9%)	3.00 (2.07–4.34)	0.000
Previous surgical invasive procedures	532 (45.8%)	104 (19.5%)	3.49 (2.38–5.11)	0.000
CVC	154 (13.2%)	50 (32.5%)	4.63 (3.11–6.89)	0.000
Tracheotomy	95 (8.2%)	41 (43.2%)	7.05 (4.48–11.09)	0.000
Nasogastric tube	118 (10.1%)	36 (30.5%)	3.77 (2.43–5.85)	0.000
PEG	43 (3.7%)	16 (37.2%)	4.56 (2.39–8.69)	0.000
Urinary catheter	663 (57.0%)	102 (15.4%)	1.94 (1.33–2.82)	0.000

CPE, carbapenemase-producing Enterobacteriaceae; OR, odds ratio; CI, confidence interval; UAR, units at risk for CPE dissemination; ICU, intensive care unit; PACH, post-acute care hospital; CVC, central venous catheter; PEG, percutaneous endoscopic gastrostomy.

CPE dissemination as a core strategy to contain the health impact of CPE infections.[3] The MoH listed intensive care units (ICUs), spinal/neurorehabilitation units, transplant units, oncology, and haematology as units at risk for CPE dissemination (UAR).[3] Moreover, the prevention of CPE spread relies on the accurate detection of resistance at the time of admission or discharge of patients from UAR and on the application of strict contact isolation measures.

Patients in spinal/neurorehabilitation units are at risk of CPE colonization and potential infection since the majority of them have been hospitalized for an extended period of time and received treatment in ICU with the use of medical devices. Another risk factor, associated with the acquisition of CPE, is a poor functional status that is recurring in patients admitted to spinal/neurorehabilitation units. Furthermore rehabilitation protocols and hospital/ward social activities make it difficult to respect isolation protocols due to patient characteristics and environmental features.[4] This study is aimed at obtaining a more accurate estimate of the occurrence of CPE.

Methods

Carbapenemase-producing Enterobacteriaceae surveillance was conducted in the 'Fondazione Santa Lucia' (FSL), a 310-bed neurorehabilitation hospital and scientific institute for hospitalization and treatment, located in Rome. During the study period the hospital admitted around 1675 patients generating 108,000 inpatient-days (average length of stay: 64 days). This facility has focused its activities on the rehabilitation, functional and cognitive hospitalization of both inpatients and outpatients with complex diseases, grouped in the following categories: multiple trauma patients especially with spinal cord and severe brain injuries, post-surgery brain cancer patients, patients with post-anoxic encephalopathy, patients in a vegetative state, patients with cerebrovascular diseases, Parkinson disease, and multiple sclerosis, patients with lower limb amputation and joint replacement. The surveillance implemented in the FSL rehabilitation hospital is consistent with the protocol described in the circular letter 'Surveillance and control of infection due to carbapenemase-producing bacteria (CPE)' by the Italian MoH in 2013.[3] During the period of January to December 2014, as a part of routine screening, all the 1427 inpatients admitted to the FSL hospital were consecutively screened for CPE by rectal swabbing within 12 h of admission, and a culture-based direct CPE screening was carried out. The rectal swabs were inoculated directly on to selective chromogenic Chrom ID agar Plate (bioMérieux S.p.A, Florence, Italy). After 48 h of incubation at 37°C, all isolates from selective plates were identified to the species level and tested for carbapenem resistance using the Vitek2 system (bioMérieux).[5] A phenotypic confirmation test of carbapenemase production was performed on Enterobacteriaceae