RECyT
Year 24 / Nº 37 / 2022 / 81–85
DOI: https://doi.org/10.36995/j.recyt.2022.37.010

Frecuency of carbapenemase-producing enterobacteriaceae in anal swabs from an adult unit intensive care

Frecuencia de enterobacterias productoras de carbapenemasas en hisopados anales de adultos en una unidad de cuidados críticos

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Received: 14/09/2021; Accepted: 14/12/2021

Abstract

The carbapenemase-producing enterobacteriaceae (CPE) are one of the main concerns of global health, mainly those that are encoded by plasmids. The aim was to describe the progress of colonization by CPE in anal swabs of patients of intensive care unit (ICU) and COVID-ICU in an adult hospital from Chaco province, Argentina. A descriptive retrospective study was carried out between 2021 January to August. 379 anal swabs were studied, in 26% (n=98) CPE were detected. *K. pneumoniae* was the more frequent isolate. In January, in COVID-ICU, 18% of anal swabs where positive, being all identified as KPC carbapenemase. In August, in COVID-ICU, the total of positive anal swab raised to 81% and all detected carbapenemase were MBL type. In ICU, the percentage of positive anal swabs increased from 14% in January to 49% in August, where both KPC and MBL carbapenemases were detected. Of The total of colonized patients, 15% developed CPE infection.
Active surveillance and control measures are necessary to keep down the spread of CPE.

Keywords: Anal swabs; Carriage studies; Carbapenemases; Active surveillance; Metalobetalactamases.

Resumen

Las enterobacterias productoras de carbapenemasas (EPC) constituyen una de las principales preocupaciones de la salud mundial, especialmente las carbapenemasas de tipo plasmídicas. El objetivo fue describir la evolución de las colonizaciones por EPC en hisopados anales de pacientes internados en unidades de cuidados intensivos polivalente (UTI) y COVID-19 (COVID-UTI) en un hospital de adultos de la provincia del Chaco, Argentina. Se realizó un estudio descriptivo retrospectivo entre enero y agosto del 2021. Se estudiaron 379 hisopados anales, el 26% (n=98) fueron positivos para EPC, donde *K. pneumoniae* fue la especie más frecuente. En COVID-UTI, en enero se obtuvo un 18% de portaciones positivas siendo todas del tipo KPC, escalando a un 81% en agosto, donde todas fueron identificadas como MBL. En UTI, se registró un incremento de la positividad de un 14% en enero hasta un 49% en agosto, siendo variable la detección de cepas KPC como MBL. Del total de pacientes colonizados, el 15% desarrolló una infección por EPC.
La vigilancia activa junto a medidas de control son necesarias para limitar la diseminación de EPC.

Palabras clave: Hisopados anales; Estudios de portación; Carbapenemasas; Vigilancia activa; Metalobetalactamasa.

Introduction

Antimicrobial resistance is a natural evolutionary phenomenon that bacteria have developed as a defence mechanism in the presence of an antimicrobial. In recent years, alarm and concern has been generated by the large spread of carbapenem-resistant enterobacteria in which the mechanism involved is the production of β-lactamases called carbapenemases, which spread efficiently by colonising skin, mucous membranes and the environment through contact [1]. Carbapenemases are transferred to other bacteria via mobile genetic elements [2] [3], causing a large number of infections, with limited therapeutic options inhibiting virtually the last therapeutic link against multidrug-resistant gram-negative microorganisms [3][4] [5]. This has taken on great importance worldwide due to

the increase in morbidity and mortality rates and hospital costs.

Numerous studies have shown that the gastrointestinal tract is the main reservoir for this type of multidrug-resistant microorganisms [6][7][2][8][9].

Patients in intensive care units are at high risk of developing a hospital-acquired infection, as they are frequently exposed to invasive devices and have associated comorbidities [10].

One of the primary strategies to prevent the spread of CLD (carbapenemase-producing Enterobacteriaceae) is active epidemiological surveillance. This is done by timely detection of these CLDs through anal swabs from patients. In the event of a positive finding, strict contact isolation measures [8][11] are measures to prevent their spread and possible outbreaks [6][7][12].

Detection of these CLDs is a very important task of microbiology laboratories in hospitals. As their prevalence is increasing worldwide, the implementation of phenotypic screening methods, as well as their subsequent confirmation, represent a challenge for microbiologists [13][14][6].

Materials and Methods

A retrospective descriptive study was conducted, analysing anal carriage studies for CLD in the polyvalent intensive care unit (ICU) and modular COVID (COVID-ICU) services of the Hospital Dr. J. C. Perrando between January and August 2021 [15].

Anal swabs were performed fortnightly on all patients admitted to the Hospital for more than 7 days, patients referred from other institutions and infected/colonised patients after 3 months, according to the active surveillance protocol provided by the Hospital's Infection Prevention and Control Committee [15].

The primary culture was performed on CHROMAGARTM KPC selective medium. Strains growing on this medium were typed to identify the microorganism involved. Carbapenemases were detected by means of the BLUE CARBA and DCMBRIT (Britania) methods using the Kirby-Bauer technique (agar disc diffusion antibiogram) and following the carbapenemase search algorithm provided by the Antimicrobial Service, National Antimicrobial Reference Laboratory, INEI-ANLIS "Dr. Carlos G. Malbrán", in agreement with the National Antimicrobial Reference Laboratory, INEI-ANLIS "Dr. Carlos G. Malbrán". Carlos G. Malbrán, agreed upon for the Latin American Network for Antimicrobial Resistance Surveillance (RELAVRA), (Protocolos |antimicrobianos.com.arantimicrobianos.com.ar). The algorithm proposes the strategic placement of discs, in order to detect the different types of carbapenemases (KPC, MBL, OXA, or double carbapenemases if present) by observing synergies between different antibiotics.

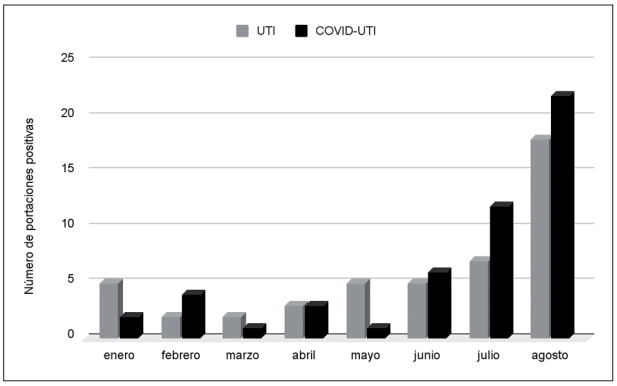
Once the positive portions were detected, it was observed whether these patients developed a subsequent infection involving the same enzyme.

Results

379 anal swabs were performed, 26% (n=98) were positive for CLD.

K. pneumoniae was the most frequent CLD with 69% (35/51) of isolates coming from COVID-UTI and 90% (42/47) from UTI. The remaining carbapenemases were K. aerogenes isolates in 15% (8/51), E. cloacae in 10% (5/51), P. mirabilis, K. oxytoca and C. freundii in 2% (1/51) from COVID-UTI, as well as K. oxytoca, P. mirabilis in 4% (2/47) and C. freundii in 2% (1/47) from UTI.

Figure 1 shows the variation in the number of positive portions in both services in the period under study.

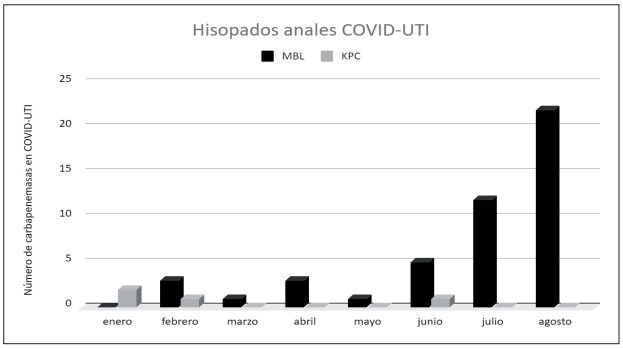


Graph 1: Number of positive carriage between January - August 2021.

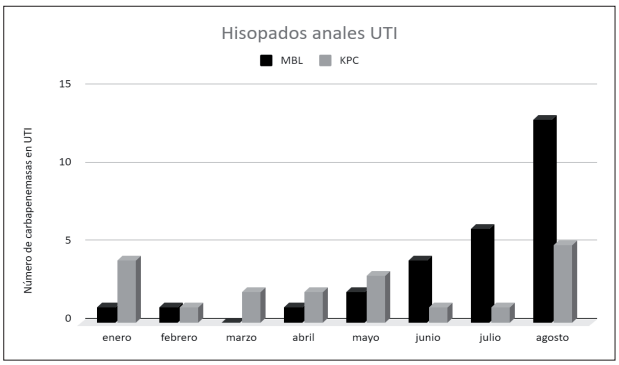
Table 1: Number of positive carriage and type of carbapenemases involved between January - August 2021.

Months studied	UTI			COVID-UTI		
	Number Of Positive Portions	Type Of Carbapenemase Involved		Number Of Positive Portions	Type Of Carbapenemase Involved	
		MBL	KPC		MBL	KPC
January	5	1	4	2	0	2
February	2	1	1	4	3	1
March	2	0	2	1	1	0
April	3	1	2	3	3	0
May	5	2	3	1	1	0
June	5	4	1	6	5	1
July	7	6	1	12	12	0
August	18	13	5	22	22	0
TOTAL	**47**	28	19	**51**	47	4

This can be seen graphically in Graphs 2 and 3.



Graph 2: Frequency of carbapenemase types isolated between January - August 2021 in COVID-UTI.



Graph 3: Frequency of types of carbapenemases isolated between January - August 2021 in the UTI.

Of the total number of patients presenting with UTI and COVID-UTI carbapenemase infection in the period studied, only 15% had a previous carriage study involving the same enzyme.

Discussion

Consistent with the literature, K. pneumoniae was the most frequent CLD [16][17][18], although it was found in other species in lower percentages.

In graph 1, a gradual increase in positive carriage was observed in both services, reaching a peak in August. The increase in CLD observed in this period coincided with the increase in patients hospitalised for COVID-19 during the second wave in the province (March-August 2021). Despite all the measures implemented to try to control the spread of infections, closely linked to the cleanliness of the environment in general, hand washing, proper use of personal protective equipment, they have been on the rise.

The observed increase in the number of positive portions was more significant in patients who were in COVID-ICU than in polyvalent ICU, coinciding with the findings of Fernandez et al [19]. This may be due, at least in part, to the seriousness with which these patients are admitted and the longer hospital stay, a factor that predisposes to colonisation by multidrug-resistant microorganisms [1][20].

Recent national studies show that more than 70-80% of patients diagnosed with SARS-COV-2 received antibiotic treatment. This may cause a significant increase in the selection of resistant bacterial pathogens, along with the emergence of other associated infections [24].

Between 2017 and 2019, in Argentina the most frequent carbapenemase type was KPC, which was gradually displaced by MBL types. In our study we were able to observe that the most frequently isolated carbapenemases from carriage studies have been MBLs.

Currently, cases of co-production of MBL + KPC carbapenemases have been reported [21][22]. The Antimicrobial Service of the INEI-ANLIS "Dr. Carlos G. Malbrán" (National Reference Laboratory, LNR) has alerted during the first wave of the COVID-19 pandemic, the emergence and spread of colonisation/infection by carbapenemase combination-producing Enterobacteriaceae in Argentina [23], which put the health system on alert for the abuse or misuse of antibiotics in general and during the context of COVID-19 infection [24]. In March 2021, the Microbiology Service of Hospital Perrando referred a strain with carbapenemase to the National Reference Laboratory for confirmation, which was typed as K. pneumoniae with double carbapenemase KPC + MBL (NDM) (unpublished data).

Faecal colonisation prior to the development of infection in our study was 15%. This is a warning regarding the ability of the mobile genetic elements containing carbapenemases to spread between genera and species, as they were found in different species. This is important to know not only from an infection control point of view, but also for the choice of empirical treatment of these patients [25]. Factors involved in the rapid spread of carbapenemase-producing strains include poor hand and environmental hygiene, indiscriminate use of broad-spectrum antibiotics, poor adherence to infection control measures and overcrowding of the healthcare system.

Conclusions

Colonisation by CLD is one of the main routes for the spread of these resistance mechanisms, which is why it is a priority to carry out systematic active surveillance studies. The institutional protocol for rectal screening is an epidemiological surveillance strategy aimed at preventing outbreaks in the different services, mainly in critical care units, which allows the identification of possible patients colonised by multidrug-resistant microorganisms, thus allowing them to be isolated and the patient to be managed in order to avoid future complications.

We warn about the emergence of multi-resistant microorganisms in closed areas such as intensive care units, where the use of broad-spectrum antibiotics has a strong impact on the flora of the patients assisted, presenting an ideal scenario for the selection of these multi-resistant strains and their consequent dissemination.

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