



Research article

Impact of the COVID-19 pandemic on the incidence and the epidemiology of catheter-related bloodstream infection two years later

María Jesús Pérez-Granda^{a,b,c,d,*}, Almudena Burillo^{a,c,e}, Julia Serrano-Lobo^a, Pablo Martín-Rabadán^{a,b,c}, Patricia Muñoz^{a,b,c,e}, Emilio Bouza^{a,b,c,e}, María Guebbe^{a,c,**}

^a Department of Clinical Microbiology and Infectious Diseases, Hospital General Universitario Gregorio Marañón, Madrid, Spain

^b CIBER de Enfermedades Respiratorias-CIBERES (CB06/06/0058), Madrid, Spain

^c Instituto de Investigación Sanitaria Gregorio Marañón (IiSGM), Madrid, Spain

^d Department of Nursing, School of Nursing, Physiotherapy and Podiatry, Universidad Complutense de Madrid, Spain

^e Medicine Department, School of Medicine, Universidad Complutense de Madrid, Madrid, Spain

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ABSTRACT

Introduction: The COVID-19 pandemic increased catheter-related bloodstream infections (C-RBSI), but its subsequent impact has not been adequately described. Our hospital has already depicted the effects of the COVID-19 pandemic in the first wave. However, we still do not know whether C-RBSI rates and aetiology are similar to those described before the COVID-19 pandemic. We aimed to evaluate the impact of the COVID-19 pandemic on the evolution of C-RBSI in a large tertiary teaching hospital two years later.

Material and methods: We prospectively collected all confirmed C-RBSI episodes in a clinical microbiology laboratory database by matching blood cultures and catheter tip cultures with the isolation of the same microorganism (s). We compared our C-RBSI incidence rates and aetiology from 2018 to 2023. C-RBSI was defined as bacteremia or fungemia in a patient with clinical manifestations of infection and no other apparent source except the catheter.

Results: During the study period, we collected 556 C-RBSI episodes. C-RBSI incidence rate per 1000 admissions each year was as follows: 2018: 2.2; 2019: 1.7; 2020: 3.29; 2021: 2.92; 2022: 2.69. and 2023: 2.01. Mainly, C-RBSI episodes occurring in critical care units each year were, respectively: 2018: 57 (54.8 %), 2019: 38 (45.2 %), 2020: 89 (63.6 %), 2021: 69 (60.5 %), 2022: 58 (50.9 %) and 2023 (61.4 %). The distribution of microorganisms showed an increase in Gram-negative episodes after the pandemic.

Conclusion: Our study shows an increase in the incidence rate of C-RBSI during the COVID-19 pandemic, with a discrete decrease after that. C-RBSI episodes were mainly caused by coagulase-negative Staphylococci but with a rise in Gram-negative bacilli.

* Corresponding author. Servicio de Microbiología Clínica y Enfermedades Infecciosas, Hospital General Universitario Gregorio Marañón, Doctor Esquerdo 46, 28007 Madrid, Spain.

** Corresponding author. Servicio de Microbiología Clínica y Enfermedades Infecciosas, Hospital General Universitario Gregorio Marañón, Doctor Esquerdo 46, 28007 Madrid, Spain.

E-mail addresses: massus@hotmail.es (M.J. Pérez-Granda), mariaguebbe@hotmail.com (M. Guebbe).

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1. Introduction

During the COVID-19 pandemic, an increased incidence of nosocomial-acquired infections has been described in some centres [1–3]. In particular, an increase in both central line-associated bloodstream infections and catheter-related bloodstream infections (C-RBSI) rates has been communicated [4,5].

C-RBSI is associated with a longer hospital stay and a high mortality rate [6,7], and all measures are aimed at prevention [8,9]. However, no studies describe whether a change occurred in the aetiology of C-RBSI after the COVID-19 pandemic.

We aim to evaluate the impact of the COVID-19 pandemic on the evolution of C-RBSI in a large tertiary teaching hospital.

2. Materials and methods

2.1. Setting

Our institution is a general reference hospital with 1350 beds and approximately 55,000 admissions/year.

2.2. Study design

We performed an ecological prospective study with historical controls to analyze patients with C-RBSI. We analyzed and compared the pre-COVID (2018–2019), during-COVID (2020–2021), and post-COVID (mid-2022–2023) periods.

Patients were included if they met the definition of C-RBSI.

2.3. Endpoints of the study

The primary endpoint was to assess the incidence of C-RBSI episodes.

Secondary endpoints were to evaluate the aetiology, location of C-RBSI, and type of catheter during the 6-year study period.

2.4. Preventive measures during pre-pandemic periods

Catheter manipulation included hand hygiene with alcohol-based solutions, daily recording of the need for catheter use, daily monitoring of the insertion site, skin disinfection with 2 % alcoholic chlorhexidine, disinfection of the connector with 70 % alcohol wipes before use, chlorhexidine-impregnated dressings on central venous catheters, and use of split-septum closed connectors (CLAVE, ICU Medical, Inc., San Clemente, CA, USA).

2.5. Definitions

C-RBSI: Presence of bacteremia or fungemia in a patient with clinical manifestations of infection and no other apparent source of bloodstream infection (except for the catheter). A semiquantitative catheter-tip culture isolating the same microorganism(s) as in the blood cultures was also required [10–12].

Non-C-RBSI: We considered non-C-RBSI episodes of bacteremia those with a non-documented catheter origin.

2.6. Statistical analysis

Values are expressed as the mean (SD) or median (IQR) for continuous variables and as percentages, with a 95 % confidence interval (95 % CI), when applicable, for categorical variables. Categorical variables were evaluated using the chi-square test or a 2-tailed Fisher exact test. Statistical significance was set at $p < 0.05$ (2-tailed).

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp, Armonk, New York, USA).

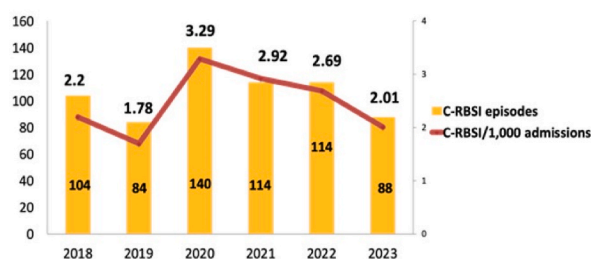


Fig. 1. Incidence rate of C-RBSI episodes per 1000 admissions.

3. Results

During the study period (2018–2023), the total number of hospital admissions was 261,816, and a total of 644 episodes of C-RBSI were recorded.

The distribution of the number of episodes/1000 admissions by year was as follows: 2018, 2.2; 2019, 1.7; 2020, 3.29; 2021, 2.92; 2022, 2.69 and 2023, 2.01 (Fig. 1).

The comparison of C-RBSI rates/1000 admissions between periods was the following: pre-COVID (2018–2019) vs. during COVID (2020–2021), $p < 0.001$; pre-COVID (2018–2019) vs. post-COVID (2022–2023), $p = 0.099$; and during COVID (2022–2021) vs. post-COVID (2022–2023), $p < 0.003$.

During the pandemic, there were 1.57 times more C-RBSI cases than in the pre-pandemic (95%CI: 1.30–1.8).

During 2020, the incidence rate of C-RBSI doubled; although they have decreased, we still have not recovered the pre-pandemic incidence rate.

The 644 episodes occurring in critical care units (ICUs) were distributed as follows: 2018: 57 (54.8 %), 2019: 38 (45.2 %), 2020: 89 (63.6 %), 2021: 69 (60.5 %), 2022: 58 (50.9 %), and 2023: 54 (61.4 %).

After the COVID-19 pandemic, we observed an increase in peripherally inserted central catheter-related bloodstream infections. The distribution of catheter types is detailed in Fig. 2.

During the years 2020, 2021, 2022 and 2023, the patients (%) with C-RBSI and who had COVID-19 on admission were, respectively: 70/140 (50 %), 25/114 (21.9 %), 6/114 (5.3 %) and 1/88 (1.1 %).

Regarding the aetiology of C-RBSI, most episodes were caused by Gram-positive bacteria in the pre-COVID period, with *Staphylococcus epidermidis* and other coagulase-negative staphylococci the most frequent. However, in post-COVID, we observed an increase in Gram-negative bacilli. (Fig. 3).

4. Discussion

We observed an increase in the incidence rate of C-RBSI during the COVID-19 pandemic, with a discrete decrease after that, mainly caused by coagulase-negative Staphylococci but with a significant rise in Gram-negative bacteria.

C-RBSI is associated with more extended hospital stays and higher readmissions and mortality rates [6]. Moreover, it is considered an average cost of \$36,441 per C-RBSI episode [13]. Therefore, it is necessary to implement preventive measures to reduce C-RBSI rates, both in general wards and in the ICUs, as it has been shown in our study that half of the C-RBSI episodes occurred outside the ICUs.

Most preventive measures to reduce C-RBSI are already implemented in hospitals; “zero tolerance” projects have decreased C-RBSI rates, especially in ICUs [14,15]. The most important measures that have demonstrated their effectiveness in meta-analysis are the following: dressings impregnated with chlorhexidine, patient bathing with chlorhexidine, passive disinfection with antiseptic caps for needle-free connectors, and catheters impregnated with antimicrobials [9,16–21].

In addition to implementing measures, it is necessary to provide ongoing training to all professionals who insert and maintain catheters and to periodically assess the surveillance of the professionals’ adherence to the recommended measures [22].

However, despite implementing these recommended measures in our hospital, we observed decreased C-RBSI episodes without recovering the rates we obtained during the pre-pandemic period [5]. After the pandemic, we have reinforced the training of all professionals with an online course, and posters with catheter care are available in all hospital areas. Also, we have implemented passive disinfection with antiseptic barrier caps used to disinfect the needle-free connector before accessing the catheter to ensure better adherence in some areas of the hospital. It may be necessary to incorporate it into the whole hospital to decrease C-RBSI. The incorrect handling of the connectors may justify the increase of Gram-negative bacilli.

The workers’ fatigue, less training, and more care load may explain failure to recover pre-pandemic incidence rates.

Regarding the aetiology of C-RBSI, we observed a trend of an increase in C-RBSI caused by Gram-negative bacilli, as recently

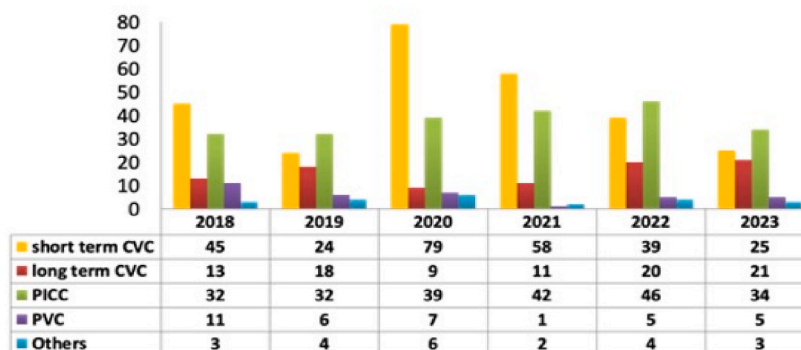


Fig. 2. Type of catheter during the study period.

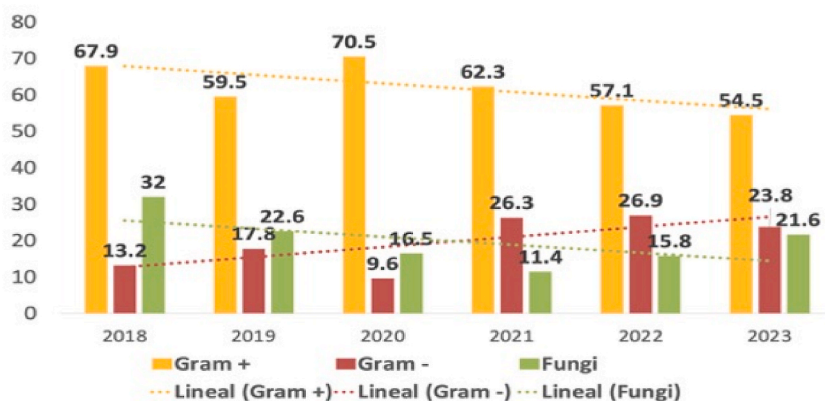


Fig. 3. Aetiology of C-RBSI episodes.

reported [23]. This is important because we cannot forget to empirically cover Gram-negative bacilli when there is a clinical suspicion of C-RBSI.

The main limitation of our study is that it was performed in a single institution and may not reflect the situation in other centres. We have not collected data from the patients included in the study or from the catheters, so we cannot perform a risk factor analysis or any other type of analysis.

5. Conclusion

Our study shows an increase in the incidence rate of C-RBSI during the COVID-19 pandemic, with a discrete decrease after that, with a significant increase of Gram-negative microorganisms as the causative agents. It is necessary to reinforce staff training and incorporate hospital measures to reduce the C-RBSI rate widely.

Ethics approval and consent to participate

The Ethics of Hospital General Universitario Gregorio Marañón approved the study. The Ethics Committee of Hospital General Universitario Gregorio Marañón (MICRO.HGUGM.2020-030) waived the need for informed consent for this study.

5.2. Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this article.

Competing interests

The authors declare no conflicts of interest.

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CRedit authorship contribution statement

María Jesús Pérez-Granda: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Almudena Burillo:** Writing – review & editing, Supervision, Data curation. **Julia Serrano-Lobo:** Writing – review & editing, Supervision, Data curation. **Pablo Martín-Rabadán:** Writing – review & editing, Writing – original draft, Data curation. **Patricia Muñoz:** Writing – review & editing, Writing – original draft, Supervision, Data curation. **Emilio Bouza:** Writing – review & editing, Writing – original draft. **María Guembe:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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