



Major Article

Daily bathing strategies and cross-transmission of multidrug-resistant organisms: Impact of chlorhexidine-impregnated wipes in a multidrug-resistant gram-negative bacteria endemic intensive care unit



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Key Words:

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Intensive care unit
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Background: Health-care associated infections are a major cause of morbidity and mortality in critical care units. The aim of this study is to evaluate the effectiveness of chlorhexidine gluconate (CHG)-impregnated wipes in the daily bathing of patients in an intensive care unit (ICU) to prevent cross-transmission and colonization by multidrug-resistant organisms (MDROs)

Methods: Prospective cohort study with an intervention of 11 months. The intervention consisted of using CHG-impregnated wipes for the daily bathing of patients on mechanical ventilation or colonized by MDROs. Monthly trends in the number of patients colonized by MDROs and the incidence of nosocomial infections were evaluated.

Results: A total of 1,675 patients were admitted to the unit during the intervention period, and 430 (25.7%) were bathed with chlorhexidine wipes. A significant decrease was observed in the incidence of colonization by MDROs over the months ($\beta = -0.209$; $r^2 = 0.549$; $P = .027$), and in the number of patients colonized compared with the equivalent period of the previous year (22.0% vs 18.4%; $P = .01$). No significant decrease was observed in the incidence of nosocomial infection between the two periods (4.11% vs 4.57%; $P = .355$). No dermatologic problems were observed in the treated patients.

Conclusions: The use of CHG-impregnated wipes reduces cross-transmission and colonization by MDROs in the ICUs in an endemic situation because of multidrug-resistant *Enterobacteriaceae*.

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There has been a significant increase worldwide in bacterial resistance to antimicrobial agents in the last 20 years or so.^{1,2} This situation is of particular concern in hospitals, especially in critically ill patient units, where an endemic situation has been reached in many centers.^{3–7} The infections associated with these multidrug-resistant organisms (MDROs), including⁸ methicillin-resistant *Staphylococcus aureus*, extended-spectrum β -lactamase-producing organisms, carbapenem-resistant *Enterobacteriaceae*, and carbapenem-resistant nonfermenting organisms, such as *Acinetobacter*

baumannii and *Pseudomonas aeruginosa*, are more difficult to treat, and are associated with a poor prognosis and a greater cost.^{9,10}

There are several strategies proposed to reduce colonization caused by MDROs in these units, including applying isolation measures, decontamination of surfaces, various decolonization strategies of the carriers, and promoting handwashing by the professionals.^{11,12} However, despite these measures, the incidence of colonization by MDROs still continues to be elevated in many centers,^{13–15} which means that new preventive measures need to be identified.

Chlorhexidine gluconate (CHG) is a compound with a wide spectrum of action, being effective against gram-positive and gram-negative bacteria.^{16,17} Its action is based on the change in permeability of the bacterial cell membrane.¹⁶ With an action that lasts for approximately 24 hours after being applied topically,¹⁸ it has been used to reduce bacterial colonization of the skin in critically ill patients in its many formulas, including the use of solutions, soaps, and gels.

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Its application in the form of wipes intended for the daily cleaning of patients has led to a decrease in the incidence of infections caused by gram-positive bacteria.¹⁹ However, to our knowledge, its efficacy over multidrug-resistant gram-negative bacteria, especially in units with a high incidence, has not been studied up until now. The aim of this study is to assess the impact on the nosocomial colonization and infection caused by MDRO by introducing CHG-impregnated wipes into the daily bathing of patients admitted to an intensive care unit (ICU).

MATERIALS AND METHODS

A prospective intervention study was designed in a mixed 24-bed ICU, divided into 2 bays (12 beds in each), with a mean of 1,665 admissions annually in the last 3 years. The unit belongs to a 1,000-bed university hospital, attending to patients with mixed nonsurgical medical pathology.

The ICU has a nosocomial infection control program that includes an antimicrobial optimization program, with specific bundles to prevent medical device-related infections, measures for isolating patients colonized because of an MDRO (aprons and gloves worn for contact), and weekly monitoring of compliance with handwashing,²⁰ with a percentage compliance of approximately 60%. Rectal and oropharyngeal specimens are taken, on a weekly basis, from all admitted patients, to detect colonization by an MDRO; however, for those on mechanical ventilation, the specimens, including a bronchial aspirate, are taken twice a week. Those patients admitted from medical wards or other hospitals are screened for an MDRO at the day of admission. Despite these measures, the unit still has a high incidence of colonization by an MDRO, having a constant percentage of >20% of patients colonized during their ICU stay, and the colonization pressure (ratio of number of patients colonized with MDRO days/total number of patient days) being 29.6% during the year prior to the intervention, of which 92.4% were caused by multidrug-resistant gram-negative bacteria. Given this high rate of colonization and the inability of the measures already implemented to reduce it, we decided to carry out a new intervention to reduce the transmission between patients and reduce the passage of local MDROs to other hospitalization units.

CHG wipes (ClinellWash Cloths; Clinell; Healthcare, London, United Kingdom),²¹ impregnated with 2% CHG plus softening agents, were introduced into the unit in February 2015, for the daily bathing of patients on mechanical ventilation, and for those patients colonized by MDROs. Washcloths were used in sequential order to rinse all the body, avoiding contact with eyes and mucus. Soap and water were only allowed for cleaning stool or other organic material secretions. This intervention replaced the traditional wash with soap and water in these patients. As indicated by the manufacturers, the wipes were stored packaged in an oven designed for these at a temperature of 40°C–45°C until being used on patients. During the intervention period, no other changes were made in patient care or antimicrobial prescribing protocols.

To evaluate the efficacy of the CHG-impregnated wipes, an analysis was performed over 11 months (February–December 2015), using the monthly trend in the number of patients with MDRO acquisition associated with the ICU stay, defined as acquisitions that occurred 72 hours after admission and excluding those patients with MDRO colonization before ICU admission. In January 2016, a new protocol on selective digestive decontamination was started in the unit; therefore, we decided to stop data collection because an important confusion factor would be introduced in our data.

Secondary end points included the reduction in the incidence of colonization and nosocomial infections compared with the patient group admitted to the unit in the equivalent period in the year prior to the intervention. Moderate and severe rash episodes observed

by the nursing staff during the daily bathing of the patients were collected.

Data analysis was performed using the Stata 13.0 statistics program (StataCorp, College, Station, TX). The comparison of the continuous variables was carried out using the Wilcoxon rank-sum test, whereas the comparison of the qualitative variables was made with the Fisher exact or χ^2 test, using 2-tailed tests. The Mann-Kendall test was used to evaluate the trend over time of the incidence of colonization by MDROs and nosocomial infections during the period of the study. To compare the change in incidence before and after the introduction of the chlorhexidine wipes, the regression line slope of the incidence with time was calculated using a linear regression and a least squares adjustment. A segmented Poisson regression model was used, accounting for time trend to assess changes in incidence of MDRO colonization slope during the preintervention and intervention periods. A value of $P < .05$ was considered statistically significant. The study protocol was approved by the Hospital La Fe Bioethics Committee.

RESULTS

A total of 1,675 patients were admitted to the unit during the intervention period, 430 (25.7%) of whom were bathed using CHG wipes (315 were receiving mechanical ventilation, and 287 were MDRO carriers). The baseline characteristics of the patients included in the pre- and postintervention periods are shown in [Table 1](#).

Effect of chlorhexidine-impregnated wipes on colonization by MDROs

The trend over time in the incidence of colonization during the study period is shown in [Figure 1](#). During the period prior to the intervention, no significant trends were observed in the incidence of colonization by MDROs during ICU stay ($\beta = -0.04$; $r^2 = 0.085$; $P = .227$). After the introduction of the CHG-impregnated wipes, a significant reduction was observed in the incidence of patients colonized by MDROs over the months ($\beta = -0.209$; $r^2 = 0.549$; $P = .027$). Significant difference was found between preintervention and intervention colonization slopes ($P < .01$). During the same period, no changes were observed in the incidence of MDRO colonization in the surgical critical care unit, where CHG wipes were not used ($\beta = 0.037$; $r^2 = 0.619$; $P = .725$). Significant differences were found in the total (22.0% vs 18.4%; $P = .01$) and gram-negative (19.9% vs 16.8%; $P = .02$) number of patients colonized between the pre- and postintervention periods ([Fig 2](#)), and the colonization pressure caused by MDROs (29.6% vs 15.8%; $P < .01$), respectively.

Effect of the chlorhexidine-impregnated wipes on infections caused by MDROs

There was no significant reduction in the overall incidence of nosocomial infections regarding the equivalent period prior to the intervention (preintervention: 11.45 vs postintervention: 9.97 per 1,000 patients day; $P = .934$), or in those caused by MDROs (preintervention: 4.84 vs postintervention: 5.05 per 1,000 patients day; $P = .956$) ([Fig 3](#)). There was no significant difference in antimicrobial consumption between the 2 periods (281 vs 298 defined daily dose per 100 patient days, respectively; $P = .544$).

Safety

None of the treated patients had moderate or severe skin reactions after the application of the chlorhexidine-impregnated wipes during the period of the intervention.

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