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Major article

Chlorhexidine-silver sulfadiazine– or rifampicin-miconazole–impregnated venous catheters decrease the risk of catheter-related bloodstream infection similarly

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Background: The objective of this study was to compare the incidence of catheter-related bloodstream infection (CRBSI) with the use of second-generation chlorhexidine-silver sulfadiazine (CHSS)–impregnated catheters, rifampicin-miconazole (RM)–impregnated catheters, and standard catheters.
Methods: Retrospective study of patients admitted to an intensive care unit who received CHSS, RM, or standard catheters in femoral venous access.
Results: We diagnosed 18 CRBSIs in 245 patients with standard catheters in 2,061 days, zero CRBSI in 169 patients with CHSS-impregnated catheters in 1,489 days, and zero CRBSI in 227 patients with RM-impregnated catheters in 2,009 days. Patients with standard catheters compared with CHSS- and RM-impregnated catheters showed a higher rate of CRBSI (7.3%, 0%, and 0%, respectively; $P < .001$) and higher incidence density of CRBSI (8.7, 0, and 0 per 1,000 catheter days, respectively; $P < .001$). We found in the exact Poisson regression that standard catheters were associated with a higher CRBSI incidence than CHSS-impregnated catheters ($P < .001$) and RM-impregnated catheters ($P < .001$), controlling for catheter duration. We found in survival analysis that standard catheters were associated with a lower CRBSI-free time than CHSS-impregnated catheters ($P < .001$) and RM-impregnated catheters ($P < .001$).
Conclusion: We found that CHSS- and RM-impregnated catheters decreased similarly the risk of CRBSI.
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Central venous catheters are commonly used in critically ill patients.[1] Such catheterization may entail mechanical and infectious complications. Catheter-related bloodstream infection (CRBSI) has been associated with increased mortality and assistance costs.[2-6]

The use of antimicrobial impregnated catheters has been a proposed strategy to reduce the incidence of CRBSI. The use of chlorhexidine-silver sulfadiazine (CHSS)– or rifampicin-minocycline–impregnated catheters compared with standard nonimpregnated catheters has been associated with a reduction of CRBSI in several meta-analyses.[7-11]

In a meta-analysis by Ramritu et al,[10] including 2 randomized controlled trials (RCTs),[12,13] the use of rifampicin-minocycline–impregnated catheters compared with CHSS-impregnated catheters reduced the risk of CRBSI (1/394 [0.3%] vs 12/418 [2.9%]; odds ratio [OR] = 0.12; 95% confidence interval [CI], 0.02-0.67). The studies included in that meta-analysis used first-generation CHSS-impregnated catheters (which were impregnated only in the external surface); afterward, second-generation CHSS-impregnated catheters appeared (which were impregnated in external and internal surfaces). The efficacy of first- and second-generation CHSS-impregnated catheters has not been compared; however, a higher effect in CRBSI prevention was found when comparing second-generation CHSS-impregnated catheters versus standard catheters (OR = 0.34; 95% CI, 0.14-0.81; including 1,176 catheters from 3 RCTs)[9] than when comparing first-generation CHSS-impregnated catheters versus standard catheters (OR = 0.66; 95% CI, 0.47-0.93; including 3,761 catheters from 15 RCTs).[10]

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Conflicts of interest: None to report.

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The objective of this study was to compare the incidence of CRBSI with the use of second-generation CHSS-impregnated catheters, rifampicin-miconazole (RM)−impregnated catheters, and standard catheters. To our knowledge, there are no studies that have made this comparison.

MATERIAL AND METHODS

We performed a retrospective study of patients admitted to the intensive care unit of the Hospital Universitario de Canarias (Tenerife, Spain) who received ≥1 femoral venous catheter. The study was approved by the Institutional Ethic Review Board of the Hospital Universitario de Canarias (Tenerife, Spain), and the need for consent was waived by the ethical review board.

The catheters used were as follows: (1) ARROW (Arrow, Reading, PA), which are standard catheters; (2) ARROWg^{+}ard Blue (Arrow, Reading, PA), which are second-generation CHSS-impregnated catheters; and (3) Multistar catheters (Vygon, Ecouen, France), which are RM-impregnated catheters on external and internal surfaces. The decision to use a standard catheter, CHSS-impregnated catheter, or RM-impregnated catheter was made by the patient's physician.

Microbiologic surveillance included twice weekly cultures of urine, tracheal aspirate, throat flora, and wounds during intensive care unit stay. Evidently, necessary clinical samples were taken when infection was suspected. Catheter tip were cultured using the method described by Maki et al.[14]

CRBSI was defined according to the following criteria: positive blood culture obtained from a peripheral vein, signs of systemic infection (fever, chills, or hypotension), no apparent source of bacteremia except the catheter, and catheter-tip colonization (significant growth of a microorganism of >15 colony forming units) with the same organism as the blood culture (the same species with identical antimicrobial susceptibility).

The diagnosis of CRBSI was made by an expert panel blinded to the type of catheter used (standard catheter, CHSS-impregnated catheter, or RM-impregnated catheter). Information about the type of catheter was removed before the expert reviewers examined the patient charts.

The following variables were recorded for each patient: age, sex, Acute Physiology and Chronic Health Evaluation II score, admission diagnostic, chronic obstructive pulmonary disease, diabetes mellitus, chemotherapeutic agents, steroid agents, hematologic tumor, solid tumor, use of antimicrobials, mechanical ventilation, tracheostomy, paralytic agents, duration of the catheter, and type of catheter.

Continuous variables are reported as median (25th-75th percentile), and categorical variables are presented as frequencies and percentages. We compared catheters groups (standard catheter, CHSS-impregnated catheter, or RM-impregnated catheter) by analysis of variance for continuous variables and Kruskal-Wallis test or Jonckheere-Terpstra test for categorical variables.

We used exact Poisson regression analysis to calculate the magnitude of the effect of the type of catheter (standard catheter, CHSS-impregnated catheter, or RM-impregnated catheter) on the occurrence of CRBSI, controlling for duration of catheter insertion. The magnitude of the effect was expressed as odds ratios and 95% confidence intervals. Survival analysis was carried out using catheter duration as the dependent variable, type of catheter (standard catheter, CHSS-impregnated catheter, or RM-impregnated catheter) as the independent variable, and CRBSI as the event; curves were represented using the Kaplan-Meier method, and log-rank test was used to compare distributions of CRBSI-free time between different catheter groups. The P values $<$ .05 were considered statistically significant.

Statistical analysis was performed with SPSS 17.0 (SPSS, Chicago, IL), LogXact 4.1, (Cytel, Cambridge, MA), and StatXact 5.0.3 (Cytel, Cambridge, MA).

RESULTS

We diagnosed 18 CRBSIs in 245 patients with standard catheters in 2,061 days, zero CRBSI in 169 patients with CHSS-impregnated catheters in 1,489 days, and zero CRBSI in 227 patients with RM-impregnated catheters in 2,009 days.

As shown in Table 1, there were no statistically significant differences between patients with standard catheters, CHSS-impregnated catheters, and RM-impregnated catheters in age, sex, Acute Physiology and Chronic Health Evaluation II score, admission diagnostic, chronic obstructive pulmonary disease, diabetes mellitus, chemotherapeutic agents, steroid agents, hematologic tumor, solid tumor, use of antimicrobials, mechanical ventilation, tracheostomy, paralytic agents, and duration of the catheter. However, patients with standard catheters compared with CHSS- and RM-impregnated catheters showed a higher rate of CRBSI (7.3%, 0%, and 0%, respectively; $P < .001$) and higher incidence density of CRBSI (8.7, 0, and 0 per 1,000 catheter days, respectively; $P < .001$).

We found in the exact Poisson regression that standard catheters were associated with a higher incidence of CRBSI than CHSS-impregnated catheters ($P < .001$) and RM-impregnated catheters ($P < .001$), controlling for catheter duration (Table 2).

We found in the Kaplan-Meier analysis that standard catheters were associated with a lower CRBSI-free time than CHSS-impregnated catheters ($P < .001$) and RM-impregnated catheters ($P < .001$) (Fig 1).

DISCUSSION

To our knowledge, this is the first study comparing the incidence of CRBSI with the use of second-generation CHSS-impregnated catheters, RM-impregnated catheters, and standard catheters. We found that second-generation CHSS-impregnated catheters and RM-impregnated catheters showed a lower risk of CRBSI than standard catheters, and we did not find differences in the CRBSI incidence between second-generation CHSS-impregnated and RM-impregnated catheters.

Our findings were different to those of the meta-analysis by Ramritu et al.[10] This meta- analisis, including 2 RCTs,[12,13] showed that rifampicin-minocycline-impregnated catheters compared with CHSS-impregnated catheters had a lower incidence of catheter tip colonization (32/394 [8.1%] vs 94/418 [22.5%]; OR ¼ 0.36; 95% CI, 0.25-0.53) and CRBSI (1/394 [0.3%] vs 12/418 [2.9%]; OR ¼ 0.12; 95% CI, 0.02-0.67). In the study by Marik et al, there were no significant differences found between rifampicin-minocycline−impregnated catheters and CHSS-impregnated catheters in the incidence of catheter colonization (4/38 [10.5%] vs 7/36 [19.4%]; OR = 0.54; 95% CI, 0.17-1.69) and CRBSI (0/38 [0%] vs 1/36 [2.8%]; OR = 0.32; 95% CI, 0.01-7.52).[12] In the study by Darouiche et al, the use of rifampicin-minocycline−impregnated catheters compared with CHSS-impregnated catheters reduced the incidence of catheter colonization (28/356 [7.9%] vs 87/382 [19.4%]; OR = 0.35; 95% CI, 0.23-0.52) and CRBSI (1/356 [0.3%] vs 11/382 [2.9%]; OR = 0.08; 95% CI, 0.01-0.63).[13]

The differences between our findings and those of the meta-analysis by Ramritu et al[10] may be caused by several reasons. First, in our study we used second-generation CHSS-impregnated catheters (impregnated in external and internal surfaces), and in the 2 previous studies first-generation CHSS-impregnated catheters were used (impregnated only in the external surface). Second,

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