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Brief communication

Epidemiology of healthcare-associated infections among patients from a hemodialysis unit in southeastern Brazil

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ABSTRACT

Patients submitted to hemodialysis are at a high risk for healthcare-associated infections (HAI). Presently there are scarce data to allow benchmarking of HAI rates in developing countries. Also, most studies focus only on bloodstream infections (BSI) or local access infections (LAI). Our study aimed to provide a wide overview of HAI epidemiology in a hemodialysis unit in southeastern Brazil. We present data from prospective surveillance carried out from March 2010 through May 2012. Rates were compared (mid-*p* exact test) and temporally analyzed in Shewhart control charts for Poisson distributions. The overall incidence of BSI was 1.12 per 1000 access-days. The rate was higher for patients performing dialysis through central venous catheters (CVC), either temporary (RR = 13.35, 95% CI = 6.68–26.95) or permanent (RR = 2.10, 95% CI = 1.09–4.13), as compared to those with arteriovenous fistula. Control charts identified a BSI outbreak caused by *Pseudomonas aeruginosa* in April 2010. LAI incidence was 3.80 per 1000 access-days. Incidence rates for other HAI (per 1000 patients-day) were as follows: upper respiratory infections, 1.72; pneumonia, 1.35; urinary tract infections, 1.25; skin/soft tissues infections, 0.93. The data point out to the usefulness of applying methods commonly used in hospital-based surveillance for hemodialysis units.

Patients with end-stage renal disease (ESRD) undergoing hemodialysis are especially prone to acquiring healthcare-associated infections (HAI).[1] This is due to both the dialysis procedure and to the immune compromising effects of the underlying disease.[2] However, like all HAI, those happening in hemodialysis patients can be prevented with the implementation of infection control protocols.[3]

There is a substantial amount of literature on HAI in hemodialysis units (HU) for outpatients.[4,5] Most reports on this subject focus specifically on bloodstream infections (BSI)

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or local access infection (LAI).[6,7] Also, the vast majority of studies were conducted in developed countries.[4] Since benchmarking is a useful tool for measuring the effectiveness of infection control policies, data on the incidence of HAIs in hemodialysis in developing countries are needed.

In 2011, the Brazilian Society of Nephrology estimated that there were 45,000 patients undergoing hemodialysis in Brazil.[8] Approximately 91% of patients' therapies were supported by the Brazilian Public Health System ("Sistema Único de Saúde" – SUS). Though there are governmental rules for collecting HAI data in HU, no public report is presently available.[9] Our study aimed to contribute to the knowledge on this issue, presenting and analyzing data on the epidemiology of HAI in a HU in the city of Botucatu, São Paulo State, southeastern Brazil.

The HU is affiliated to the Botucatu Medical School teaching hospital. It is the reference for hemodialysis for an area comprising 500,000 inhabitants. Prospective active surveillance of HAIs has been carried out since March 2010. Our study focuses on data from March 2010 through May 2012. Surveillance methods included daily visits to the unit, inspection of catheters access sites and real-time review of medical charts. We also performed monitoring of microbiological results. The HAI definitions followed the Centers for Diseases Control and Prevention (CDC) guidelines.[10] The incidence density of BSI and LAI was expressed in infections per 1000 access-days. Incidence was calculated for groups using different vascular accesses: temporary catheters; permanent catheters; grafts; or arteriovenous fistulas. For all other HAIs, incidence was expressed in infections per 1000 patient-days.

Comparisons of groups were performed using the mid-*p* exact test in OpenEpi software (©Emory University, Atlanta, USA). Forest plot charts were built in a free online applicative (http://www.stattools.net/ForestPlot_Pgm.php).

We also assessed the temporal behavior of those infections, using Shewhart control charts.[11] Briefly, we built charts based on the Poisson distribution (also known as *u*-charts). Monthly incidence rates were used. The mean rate (*u*) was calculated for the whole period with the following formula:

$$u = \frac{\text{sum of monthly HAI cases}}{\text{sum of monthly access days}}$$

The standard error (sigma) was obtained for each month with the formula:

$$\text{sigma} = \text{square root}\left(\frac{u}{\text{monthly access days}}\right)$$

Finally, we defined "upper warning limit" (UWL) and "upper control limit" (UCL) as two and three *sigma* values above the mean rate, respectively. Following guidelines proposed by Sellick,[11] we defined atypical occurrences based on the finding of one month's incidence above the UCL or values above UWL for two consecutive months.

During the study period, a total of 49,831 patient-days were counted, which was equal to the sum of access-days. The number of access days for specific groups was: temporary catheter, 2460; permanent catheter, 19,110; graft, 900; fistula, 27,361.

The pooled BSI incidence for the study period was 1.12 per 1000 access-days (95% confidence interval [CI], 0.86–1.45). The incidence (per 1000 access-days) for access groups was as follows: temporary catheters, 7.32 (95% CI, 4.47–11.34); permanent catheters, 1.15 (95% CI, 0.74–1.71); grafts, 1.11 (95% CI, 0.06–5.48), and fistula, 0.55 (95% CI, 0.32–0.88). The BSI incidence was significantly higher ($p < 0.05$) for both catheters groups, as compared to the fistula group (Fig. 1). The most frequent agents of BSI (recovered from blood cultures) were: *Staphylococcus aureus* (36.6%), coagulase-negative staphylococci (CoNS; 20.0%), *Klebsiella* spp. (16.7%), and *Pseudomonas aeruginosa* (15.0%). Other Gram-negative bacilli accounted for 13.3% of cases. The resistance pattern of those agents was noteworthy. Among Gram-positive cocci, resistance to methicillin was found in 72.7% of *S. aureus* and 100% of CoNS. Gram-negative bacilli were also often multidrug-resistant. Resistance to third generation cephalosporins was found in three out of ten *Klebsiella* spp. and in the two *Escherichia coli* strains causing BSI in the study period. On the other hand, *P. aeruginosa* resistance to carbapenems (11.1%) and ceftazidime (22.2%) was low.

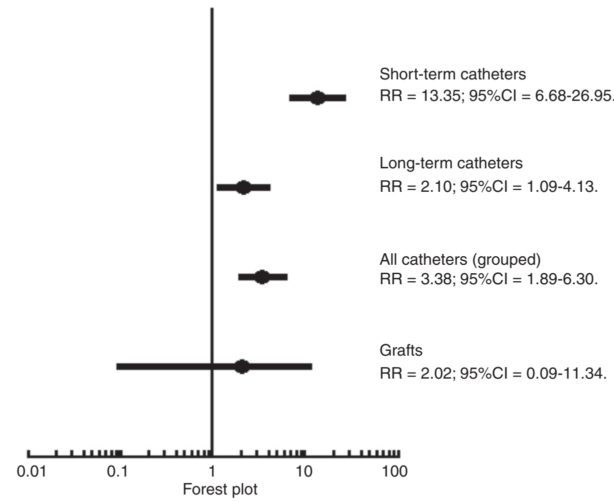

Fig. 1 – Graphic comparison (forest plot) of the incidence of bloodstream infections related to several vascular accesses, using arteriovenous fistula as a reference category. *Note.* RR, rate ratio; CI, confidence interval.

The pooled LAI incidence was 3.80 (95% CI, 3.30–4.39) per 1000 access-days. The incidence was significantly higher for patients with permanent catheters (9.58; 95% CI, 8.26–11.04) when compared to those with temporary catheters (2.03, 95%CI, 0.66–4.74). LAI incidence for fistulas was 0.07 (95% CI, 0.01–0.24) per 1000 access-days. There was no LAI in grafts in the study period.

Incidence rates for other HAI (per 1000 patients-day) were as follows: upper respiratory infections, 1.72 (95% CI, 1.35–2.16); pneumonia, 1.35 (95% CI, 0.73–1.97); urinary tract infections (UTI), 1.25 (95% CI, 0.94–1.93); skin/soft tissues infections, 0.93 (95% CI, 0.67–1.26); other sites, 0.12 (95% CI, 0.04–0.27). Gram-negative predominated among agents of UTI: *Klebsiella* spp. (33.9%), *E. coli* (27.5%), *Enterobacter* (14.5%) and *P. aeruginosa* (14.5%). Two thirds of *Klebsiella* and *E. coli* isolates produced extended-spectrum beta-lactamases.

We used control charts to analyze temporal behavior of BSI and LAI (Fig. 2). The charts characterized an outbreak of BSI caused by *P. aeruginosa*, on April 2010, comprising seven cases,