Microbiological Characteristics of Catheter-related Bacteremia in a Tunisian Intensive Care Unit

Hatem Kallel, Hassen Damak, Fouzia Mahjoubi*, Mabrouk Bahloul, Hichem Ksibi, Hédi Chelly, Noureddine Rekik, Adnene Hammami*, Mounir Bouaziz .

*Service de Réanimation Médicale - * : Laboratoire de Microbiologie, CHU Habib Bourguiba,Sfax- Tunisie.*
Université de Sfax

H. Kallel, H. Damak, F. Mahjoubi, M. Bahloul, H. Ksibi, H. Chelly, N. Rekik, A. Hammami, M. Bouaziz

Les particularités microbiologiques des bactériémies liées aux cathéters veineux centraux dans un service de réanimation Tunisien

LA TUNISIE MEDICALE - 2010 ; Vol 88 (n°12) : 876 - 879

H. Kallel, H. Damak, F. Mahjoubi, M. Bahloul, H. Ksibi, H. Chelly, N. Rekik, A. Hammami, M. Bouaziz

Microbiological Characteristics of Catheter-related Bacteremia in a Tunisian Intensive Care Unit

LA TUNISIE MEDICALE - 2010 ; Vol 88 (n°12) : 876 - 879

RÉSUMÉ

Prérequis: La prévalence des bactériémies liées aux cathéters veineux centraux dans les unités de soins intensifs est en augmentation tandis que le recours aux cathétérismes veineux centraux est en progression. Une revue de la littérature montre que les cocci gram positive occupent la première place des bactériémies liées aux cathéters veineux centraux et le traitement empirique comporte l'administration systématique des glycopeptides.

But: Rechercher des particularités microbiologiques des bactériémies liées aux cathéters veineux centraux dans un service de réanimation Tunisien.

Méthodes : Il s'agit d'une étude prospective observationnelle réalisée dans le service de réanimation du CHU Habib Bourguiba de Sfax-Tunisie (unité de 22 lits de réanimation médico-chirurgicale). Nous avons inclus tous les patients admis dans l'unité pendant la période de l'étude (du 1er août 2001 au 31 mars 2002) et qui ont eu un cathétérisme veineux central pendant plus de 24 heures. La culture de l'extrémité du cathéter a été réalisée selon une méthode semi-quantitative.

Résultats : Pendant la période de l'étude, 218 cathéters ont été étudiés. La durée moyenne de cathétérisme a été de 8±6,7 jours (extrêmes : 2 et 46 jours). Le site d'insertion du cathéter était la veine sous clavière dans 156 cas (71,6%), la veine jugulaire interne dans 35 cas (16%) et la veine fémorale dans 27 cas (12,4%). Soixante quatorze cathéters (33,9%) ont été enlevés en raison d'une suspicion d'infection liée au cathéter. Le taux de bactériémies liées au cathéter était de 6,1 bactériémies par 1000 jours de cathétérisme. Les germes les plus fréquemment en cause de la bactériémie liée au cathéter étaient les bacilles à Gram négatif (61,7%) notamment Klebsiella pneumoniae et Serratia marcescens.

Conclusion : Dans cette série, les bactériémies liées aux cathéters veineux centraux sont majoritairement causées par les bacilles à Gram négatif témoignant de l'importance de l'étude de la flore de l'unité pour la prescription d'une antibiothérapie probabiliste.

Mots-clés
Cathéter, infection, bactériémie

SUMMARY

Background: Prevalence of catheter-related bacteremia in intensive care units is increasing as central venous catheters (CVC) are used more frequently. In the most of the published literature, Gram positive cocci are the leading cause of catheter-related bacteremia and the systemic empiric treatment recommended include the administration of glycopeptides.

Aim: To search for the microbiological characteristics of catheter-related bacteremia in a Tunisian ICU.

Methods: Prospective observational cohort survey conducted in the ICU of the Habib Bourguiba university hospital, Tunisia (a 22 bed medical-surgical intensive care unit). We had included all patients admitted to the unit over the study period (from August 1st, 2001 to March 31st, 2002), and who submitted to a central venous catheter for more than 24 hours. Catheter-tip specimens were cultured using a semiquantitative method.

Results: During the study period 218 central venous catheters (CVC) were assessed. The mean length of time the catheter was kept in place was 8±6.7 days (range; 2 and 46 days). The CVC insertion site was the subclavian vein in 156 cases (71.6%), the jugular vein in 35 cases (16%), and the femoral vein in 27 cases (12.4%). Seventy four catheters (33.9%) were removed because of suspicion of catheter-related sepsis. The catheter-related bacteremia rate was 6.1 infections/1000 days-CVC. Unlike Gram-positive cocci which caused only one case of catheter-related bacteremia, Gram-negative rods, namely Klebsiella pneumoniae and Serratia marcescens were responsible for 91.7% of cases of catheter-related bacteremia.

Conclusion: Our findings translate a specific microbiological flora in our Tunisian intensive care unit and highlight the importance of a treatment strategy based on local epidemiology in patients with catheter related bacteremia.

Key-words
Catheter, Infection, Bacteremia.

Prevalence of catheter-related bacteremia in intensive care units is increasing as central venous catheters (CVC) are used more frequently. Once the diagnosis of catheter-related bacteremia is suspected or established, the prescription of antimicrobials and their adequacy come into question and empiric antimicrobial treatment should provide coverage against the most frequent organisms causing this infection. Even though some organisms are reported to be the leading cause of catheter-related bacteremia, local epidemiology should also be considered. In the most of the published literature, Gram positive cocci are the leading cause of catheter-related bacteremia, as they are responsible for more than 60% of episodes [1-5], and the systemic empiric treatment recommended include the administration of glycopeptides.

The aim of our study is to search for the microbiological characteristics of systemic catheter-related bacteremia and to investigate the appropriateness of glycopeptides as empiric antimicrobial treatment in Tunisian intensive care units.

METHODS

Our study is prospective. It was conducted during an 8 months period (from August 1st, 2001 to March 31st, 2002) in the intensive care unit of the Habib Bourguiba University Hospital (Sfax, Tunisia). Our unit is a 22 bed intensive care unit in a 510-bed tertiary-care teaching center that serves as first line medical center for an urban population of one million inhabitants and as a referral center for a larger population coming from south Tunisia. We had included all patients admitted to our unit over the study period, and who submitted to a central venous catheter for more than 24 hours.

Collection of data

The following variables were recorded: age, gender, dates of admission, of the insertion of the catheter, of the removal of the catheter, and the date of discharge from ICU, clinical, biological, and microbiological data on the day of introduction, on the day of removal and 48 hours after the removal of the catheter.

MATERIAL

Polyurethane monolumen catheters were introduced by the Seldinger method. All catheters were inserted at the bedside in the ICU under strict aseptic conditions. The insertion site was prepared with povidone-iodine (Bétadine® dermique 10%; Viatris, France) without any dilution and draped with sterile towels. Dressings were changed daily and the same antiseptic was used.

Catheters were removed and culture specimens obtained in the events of suspected catheter-related sepsis, uselessness, malfunction, discharge of the patient from the ICU, or death. A catheter-related bacteremia was suspected in case of clinical manifestations of sepsis with: (a) purulence, erythema or tenderness at the insertion site of the catheter and no other cause of sepsis; (b) associated shock [6] or positive blood cultures and no other cause of sepsis. In case of a suspected catheter-related bacteremia, at least 2 blood cultures taken from two different peripheral veins were performed and catheter-tip specimens were cultured using a semiquantitative method [7]. The diagnosis of catheter-related bacteremia (CRB) was confirmed in case of clinical symptoms of sepsis and isolation of the same organism from semiquantitative culture of the catheter tip and from the cultures of blood sampled immediately before or within 48 hours after the catheter removal and no other apparent source of infection. In case of Coagulase negative Staphylococcus, 2 positive blood cultures and a catheter tip culture of at least 15 cfu with isolation of the same organism from the catheter and the bloodstream are mandatory.

Statistical analysis

Categorical variables were expressed in percentage and continuous variables in mean (± SD). Percentages were compared using the Yates Corrected Test and means using the Mann-Whitney Test. A p value equal to or less than 0.05 was considered as statistically significant.

RESULTS

During the study period, 157 patients with 218 episodes of central venous catheterization were assessed.

The mean age was 44.5±21.6 years (range, 1 and 90 years). The gender ratio (male : female) was 1.66. The most frequent causes of hospitalization in ICU were multiple trauma (37.6%), respiratory distress (24.8%), and shock (16.6%). One hundred and seventy nine patients (82.1%) received antibiotics prior to the insertion of the catheter.

The catheters were introduced with a mean delay of 6±12 days (range; 0 and 95 days after admission). The CVC insertion site was the subclavian vein in 156 cases (71.6%), the jugular vein in 35 cases (16%), and the femoral vein in 27 cases (12.4%). Seventy four catheters (33.9%) were removed because of suspicion of catheter-related infection. The mean length of time the catheters were kept in place was 8±6.7 days (range; 2 and 46 days) giving a total duration of catheterization of 1807 days. Catheter-related bacteremia was diagnosed in 11 cases (5% of the catheters) giving a CRB rate of 6.1 infections/1000 days-CVC. Twelve organisms were responsible for the 11 episodes of CRB; they were Gram-negative rods in 10 cases (83.3%), Gram-positive cocci in one case (8.3%) and yeast in one case (8.3%) (Table I). In one case, the CRB was caused by two microorganisms (Enterobacter sp and A.baumanii). The most commonly isolated microorganisms were Klebsiella pneumoniae (n=3; 25%) and Serratia marcescens (n=3; 25%). Serratia marcescens was susceptible to third generation cephalosporins in all cases and Klebsiella pneumoniae, and Acinetobacter baumanii were extended spectrum ,-lactamase producers in all cases.

A peak of frequency of catheter-related bacteremia was observed during August and September (54.6% of the catheter-related bacteremia). Signs of catheter-related sepsis were found in 7 of the 11 cases of CRB (63.6%) on the day of the catheter removal (p=0.02). However, no other of the studied parameters was found as predictive of CRB (Table II).

Table 1 : Micro-organisms responsible of catheter-related bacteremia

	n	%
Gram positive cocci	1	8.3
Coagulase negative staphylococcus	1	8.3
Gram negative rods	10	83.3
Klebsiella pneumoniae	3	25.0
Serratia marcescens	3	25.0
Enterobacter sp	2	16.7
Acinetobacter baumanii	1	8.3
Providencia sp	1	8.3
Yeast	1	8.3
Total	12	100

Table 2 : Clinical parameters in the day of placement and the day of removal of the catheter.

	Catheter-related bacteremia		p
	Yes(n=11)	No(n=207)	
Catheter placement parameters			
Insertion site (%)			
Subclavian vein	5.1	5.1	P=0.88*
Jugular Vein	5.7	5.7	P=0.75λ
Femoral vein	3.7	3.7	P=0.71μ
Active infection (%)	72.7	72.7	0.6
Mechanical ventilation (%)	81.8	81.8	0.4
Shock (%)	63.6	63.6	0.6
Catheter removal parameters			
Duration of catheterization (day)	8.2±4.9	8.2±4.9	0.9
Signs of catheter-related sepsis (%)	63.6	63.6	0.03

* p=0.88 when the subclavian site compared to the jugular site
λ P=0.75 when the subclavian site compared to the femoral site
μ P=0.71 when the jugular site compared to the femoral site

DISCUSSION

Our findings suggest that the most frequent organisms causing catheter-related bacteremia in our unit are Gram-negative rods, and that systemic empiric antimicrobial treatment in these cases should not include necessarily the administration of glycopeptides as it is suggested in all guidelines for the treatment of catheter-related sepsis throughout the world.

In this study, the rate of catheter-related bacteremia was found to be of 6.1 infections/1000 days-CVC. Several investigators using quantitative or semiquantitative culture methods reported equivalent rates [5, 8-10, 11]. In our study, the method that we used to culture the catheter tip was the Maki's semiquantitative method [7]. Compared to the quantitative method [12], its limitation lies in its low sensitivity and specificity because it detects bacteria only on the outer surface of the catheter. Despite the superiority of the quantitative procedure, the Maki's semiquantitative method is still used in most busy clinical microbiology laboratory with a sensitivity of 85% and a specificity of 85% in the diagnosis of catheter-related bacteremia as it is reported by Siegman-Ygra et al [12] in a meta-analysis. The high frequency of catheter-related bacteremia observed in August and September can be explained by the usual heat during these two months, and the role of sweating in the contamination of the catheters. Indeed, sweating does not allow keeping a dry dressing and leads to difficulties with dressing adherence.

In our study, Gram-negative rods were the most common organisms causing catheter-related bacteremia and were responsible for 83.3% of episodes whereas Gram-positive cocci were responsible for catheter-related bacteremia in only one case (8.3%). These results are different from those reported in the most of the published literature where Gram-positive cocci are responsible for more than 60% of episodes of catheter-related bacteremia and Gram-negative rods cause only 10 to 20% of episodes. Theses data translates a different microbiological flora in our hospital where the endemic strains are non fermentative Gram-negative rods. This flora can not be explained by the insertion site of the catheter or the duration of the catheterization. In addition, we would precise that the very high rate of Gram negative bacteria found in our study is not related to an outbreak and that these organisms are the usually isolated from other infected sites in our hospital [13]. This flora can be explained in part by the high prevalence of antibiotics prescription (both for curative or prophylactic reason) and which exceeds 80% in our study.

Antibiotic therapy for catheter-related bacteremia is often initiated empirically. According to the most of the published literature, systemic empiric therapy with glycopeptides must be employed. However, the initial choice of antibiotics for the treatment of nosocomial infection must take into account the local epidemiology. Since Gram-negative rods are the most common organisms causing catheter-related infection in our hospital, systemic empiric therapy should contain broad-spectrum ,-lactams. However, glycopeptides should be used only when a Gram-positive coccus is isolated in the microbiological cultures. Indeed, the systematic use of glycopeptides as a systemic empiric therapy for catheter-related infections can lead to an overuse of glycopeptides and the emergence of glycopeptide-resistant Gram-positive microorganisms. On the other hand, systemic antibiotic therapy without coverage of the Gram-negative rods can lead to inadequate antimicrobial treatment which is found to be associated with a greater hospital mortality compared with adequate antimicrobial treatment of hospital acquired infections [14].

CONCLUSION

Gram-negative rods are the leading cause of catheter-related bacteremia in our intensive care unit since they are responsible for more than 80% of episodes. Thus, empiric antimicrobial

treatment with activity against gram-negative rods is required and glycopeptides should be used only when gram-positive cocci are isolated in the microbiological cultures. These results demonstrate that empiric treatment for nosocomial infections must take into account the local epidemiology in order to avoid inadequate antimicrobial treatment and the misuse of antibiotics.

Références

1. Coopersmith CM, Rebmann TL, Zack JE, et al. Effect of an education program on decreasing catheter-related bloodstream infections in the surgical intensive care unit. Crit Care Med. 2002; 30: 59-64.
2. Graninger W, Assadian O, Lagler H, Ramharter M. The role of glycopeptides in the treatment of intravascular catheter-related infections. Clin Microbiol Infect. 2002; 8: 310-5.
3. Oncu S, Ozsut H, Yildirim A, et al. Central venous catheter-related infections: Risk factors and the effect of glycopeptide antibiotics. Ann Clin Microbiol Antimicrob. 2003; 2:3.
4. Timsit JF, Sebille V, Farkas JC, et al. Effect of subcutaneous tunneling on internal jugular catheter-related sepsis in critically ill patients: a prospective randomized multicenter study. JAMA. 1996; 276: 1416-20.
5. Warren DK, Zack JE, Elward AM, Cox MJ, Fraser VJ. Nosocomial primary bloodstream infections in intensive care unit patients in a nonteaching community medical center: a 21-month prospective study. Clin Infect Dis. 2001; 33: 1329-35.
6. American College of Chest Physicians/Society of Critical Care Medicine Consensus Conference: definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. Crit Care Med. 1992; 20: 864-74.
7. Maki DG, Weise CE, Sarafin HW. A semiquantitative culture method for identifying intravenous-catheter-related infection. N Engl J Med. 1977; 296: 1305-9.
8. Gastmeier P, Schumacher M, Daschner F, Ruden H. An analysis of two prevalence surveys of nosocomial infection in German intensive care units. J Hosp Infect. 1997; 35: 97-105.
9. Legras A, Malvy D, Quinioux AI, et al. Nosocomial infections: prospective survey of incidence in five French intensive care units. Intensive Care Med. 1998; 24: 1040-6.
10. Eggimann P, Harbarth S, Constantin MN, Touveneau S, Chevrolet JC, Pittet D. Impact of a prevention strategy targeted at vascular-access care on incidence of infections acquired in intensive care. Lancet. 2000; 355: 1864-8.
11. Bouza E, San Juan R, Munoz P, Pascau J, Voss A, Desco M. Cooperative Group of the European Study Group on Nosocomial Infections (ESGNI).A European perspective on intravascular catheter-related infections: report on the microbiology workload, aetiology and antimicrobial susceptibility (ESGNI-005 Study). Clin Microbiol Infect. 2004; 10: 838-42.
12. Siegman-Igra Y, Anglim AM, Shapiro DE, Adal KA, Strain BA, Farr BM. Diagnosis of vascular catheter-related bloodstream infection: a meta-analysis. J Clin Microbiol. 1997; 35: 928-36.
13. Kallel H, Bahoul M, Ksibi H, et al. Prevalence of hospital-acquired infection in a Tunisian hospital. J Hosp Infect. 2005; 59 : 343-7.
14. Pittet D, Hulliger S, Auckenthaler R. Intravascular device-related infections in critically ill patients. J Chemother. 1995; 7 (Suppl 3) : 55-66.