Risque de décès lié aux infections associées aux dispositifs médicaux

Risk of mortality due to device associated infection

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RÉSUMÉ

Prérequis: Les infections nosocomiales acquises en milieu de réanimation constituent un problème majeur de santé publique partout dans le monde.

Objectif : Déterminer l'incidence et les facteurs de risque d'infections associées aux dispositifs médicaux (IAD) ainsi que ceux contribuant à la survenue de décès dans une unité de soins intensifs en Tunisie.

Méthodes : Nous avons mené une étude prospective d'incidence durant six mois dans le service de réanimation médicale adulte du CHU Farhat Hached de Sousse (Tunisie). Ont été inclus les patients dont la durée d'hospitalisation était supérieure à 48h.

Résultats : Durant la période d'étude, 105 patients ont été observés; 16 d'entre eux (15,2%) ont développé 17 épisodes d'infections associées aux dispositifs médicaux (16,9 /1000 jours d'hospitalisation). Les infections associées aux cathéters centraux et périphériques étaient les plus fréquentes (respectivement ; 21,4 / 1000 jours d'exposition et 10,2 / 1000 jours d'exposition). La mortalité globale était de 40%. Les facteurs de risque indépendants de contracter une infection en réanimation sont l'exposition au cathéter veineux central (p = 0,031) et la durée prolongée du séjour (0,002), ceux de la mortalité sont l'immunosuppression (p = 0,013), la survenue d'infections associées aux dispositifs médicaux (p = 0,002) et l'exposition au cathéter veineux central (p = 0,001).

Conclusion : Même si les taux d'infections associées aux dispositifs médicaux en milieu de réanimation tunisien étaient inférieures à celles publiées dans certains rapports d'autres pays d'Afrique du Nord, les caractéristiques de ces infections ainsi que le risque de décès, dominés par l'exposition au cathétérisme vasculaire montrent la nécessité de multiplier les efforts de contrôle de ces infections dans notre hôpital.

Mots-clés

Infections associées aux dispositifs médicaux – Unité de soins intensifs - Mortalité- Prévention – facteurs de risque.

SUMMARY

Background: Intensive care unit -acquired infections constitute an important worldwide health problem.

Aim: Our aim was to determine the incidence and risk factors of device-associated infection and those of mortality in a Tunisia ICU.

Methods: We conducted a prospective observational cohort study over a six months period in the adult medical intensive care unit of University Hospital-Farhat Hached (Sousse-Tunisia). Patients admitted to the unit were included in the study if they stayed in the ICU for more than 48 hours.

Results: During the study period, 105 patients were surveyed; 16 of them (15.2%) developed 17 episodes of device associated infections (16.9 DAI/1000 days of hospitalization). The most frequently identified infections were central and peripheral venous catheter -associated infection (respectively, 21.4 CVC-AI/ 1000 CVC-days and 10.2 PVC-AI / 1000 PVC-days). At ICU discharge, overall mortality was 40%. Independent risk factors for acquiring infection in ICU were the use of central venous catheter (p=0.031) and length stay (0.002), those of mortality in ICU were immunosuppression (p=0.013), DAI (p=0.002) and the use of central venous catheter (p = 0.001).

Conclusion: Even if DAI rates in Tunisian ICU were lower than those published in some reports from other North African countries, DAI data and mortality rate, dominated by the use of catheter associated infections show the need for more-effective infection control interventions in our hospital.

Key-words

Device associated infection – Intensive care unit - Mortality- Prevention – risk factors.

Hospital acquired infection (HAI) continues to cause significant morbidity, mortality, length of stay and hospital costs.(1-3) It was extremely frequent and serious, especially in the intensive care unit (ICU),because of the debilitated immune systems of their patients and exposure to invasive devices.(3-6) In fact, patients admitted to ICU are at increased risk for acquiring device associated infections (DAIs) particularly ventilator associated pneumonia (VAP), catheter associated urinary tract infection (CAUTI) and central line-associated bloodstream infection (CLABSI).(3) Many of these DAI could be prevented through effective involvement of intensivists in infection control programs(7)including surveillance of HAIs which have led to a significant reduction in the incidence of infections in the ICU with resulting reduced health care costs.(8) Standardized measures to make institutional surveillance have been developed in many countries such as United States, Canada, Germany, United Kingdom and Australia, in which rates of DAIs in ICUs are reported regularly.(3,9) Data on DAI rates from developing countries are published mainly through the International Nosocomial Infection Control Consortium (INICC), a network of 98 ICUs in 18 countries (mostly in South America). Analysis of these data has revealed 3- to 5-fold higher DAI rates in ICUs in developing countries compared with US ICUs.(4,10) Limited data using standardized international case definitions are available for countries of the Eastern Mediterranean region.(11)

In Tunisia, national program of HAI surveillance set up since 2005 is based, only, on periodic prevalence study every five years. Aware of the potential frequency and severity ICU-DAI a program of HAI prevention was developed by the Hospital Hygiene Service in collaboration with the ICU practitioner's of University hospital, FARHAT. Hached Sousse - Tunisia, program based on DAI surveillance in order to determine specific prevention actions. The objective of the present study was to measure the incidence of DAIs, examine their risk factors and determine predictive factors of mortality in our ICU.

METHODS

Setting

This prospective study was conducted in the adult medical intensive care unit (ICU) of the Farhat Hached University Hospital (Sousse-Tunisia) during six months from January 1st to June 30st 2012. Our department is a 08-bed medical ICU in a teaching hospital of 600 beds, located in Tunisian east central region. Annual total number of admissions in ICU is about 250 patients.

Patients

Patients admitted to the unit were included in the study if they stayed in the ICU for more than 48 hours during the period of survey. Surveillance for each patient was stopped after the discharge from the ICU or the death. Data were collected on an anonymous standardized survey record form by a medical hygienist assisted by an intensivist designated and formed before the beginning of the surveillance. The variables collected prospectively for each patient comprised demographic status (age, sex), undergoing illness, reason for admission, presence or not of immunosuppression, antibiotic prescription on admission (i.e. antibiotics prescribed during the first 24 hours following admission to ICU), Simplified Acute Physiology Score II (SAPS II)(12), exposure or absence of exposure to invasive devices such as mechanical ventilation (MV), central venous catheter (CVC), peripheral venous catheter (PCV) and urinary catheter (UC),length of stay and outcome on discharge from ICU.

ICU – Acquired infections

Nosocomial infections were defined according to standard Centers for Disease Control and Prevention criteria.(13)

So, an infection was defined as ICU-acquired infection when it originated in the intensive care unit environment; i.e., it was not present or incubating at admission, and which appeared 48 hours or more after admission. Besides, only device associated infection (DAI) were included in our survey such as ventilator-associated pneumonia (VAP), catheter-associated urinary tract infection(CAUTI), central venous catheter associated infection (CVC-AI) and peripheral venous catheter associated infection (PVC-AI). These DAI were defined referred to the CDC-National Nosocomial Infection Surveillance System (CDC-NNIS) and CDC- National Healthcare Safety Network (NHSN) definitions(11,13,14) ,which include laboratory and clinical criteria, along with radiological criteria for VAP, nevertheless, adapted to the methods of diagnostic confirmation usually adopted in ICU of our hospital. In the absence of microbiological documentation, infections were diagnosed by attending physicians using only clinical criteria and were considered as possible infections.

Definition of VAP

Pneumonia was considered as associated to intubation/ventilation if it occurred after the beginning of the intubation and at the most in 2 days which follow the extubation. So:

Certain VAP was defined when a patient present:

Fever (>38° c)with no other cause and new onset of purulent sputum or change in character of sputum and;

new or progressive infiltrates, consolidation, or cavitations in chest radiograph and;

positive pleural fluid culture or positive quantitative culture of broncho-alveolar lavage fluid >10^4 colony-forming units(CFU)/mL or protected tracheal fluid culture > 10^3 CFU/ml

Probable VAP was defined in presence of clinical and radiological criteria's with positive blood culture with no more than 2species of microorganisms (with no other cause).

VAP was considered as *possible* if there is no microbiological documentation in spite of presence of radiological signs and at least one of the following symptoms: new onset or worsening cough, dyspnea or tachypnea, rales or bronchial breathing, worsening alveolar gas exchange, increased oxygen requirement, or increased ventilation demand; additional to clinical criteria's cited previously.

Definition of CAUTI

For a diagnosis of CAUTI, a patient had to meet the criteria of symptomatic urinary tract infection after placement of a urinary catheter at the time of specimen collection or during the 48 hours after catheter removal, along with at least one of the following signs or symptoms: fever (>38_C) with no other recognized cause, urinary urgency, high frequency of urination, dysuria, and/or suprapubic tenderness and a positive urine culture of 10^5 CFU/mL with no more than 2 species of microorganisms.

Definition of CVC-AI and PVC-AI

Was considered as "Local" CVC-AI or PVC-AI" if there was purulence of the catheter insertion site or tunnel tract inflammation Or Quantitative CVC / PVC culture >10^3 CFU/ml with no signs of systemic infection.

For the diagnosis of *"Systemic" CVC-AI or PVC-AI without bloodstream infection,* two criteria's were used: (1) Total or partial regression of systemic signs infection occurring within 48 hours after removal CVC/ PVC and quantitative CVC/PVC culture >10^3 CFU/ml, with negative blood culture (2) Total or partial regression of systemic signs infection occurring within 48 hours after removal CVC/ PVC without quantitative CVC/PVC culture >10^3 CFU/ml, with negative blood culture.

*Two criteria's was also used to define CVC /PVC-associated bloodstream infection: (1) A*ssociation of a positive blood culture occurring within 48 hours after removal CVC/PVC and quantitative CVC/PVC culture >10_3 CFU/ml (with the same microorganism), (2) Positive blood culture occurring within 48 hours after removal CVC/PVC with no other recognized cause, without quantitative CVC/PVC culture.

ICU-DAI rate calculations

Outcomes measured during the surveillance period included the incidence density rate of all DAI and of specific site infection such as CVC - AI (CVC-AI; number of CVC-AI divided by 1000 CVC-days and multiplied by 1000); PVC-AI (PVC-AI; number of PVC-AI divided by 1000 PVC-days and multiplied by 1000), CAUTI (CAUTI; number of CAUTI divided by 1000 UC-days and multiplied by 1000); and VAP (VAP; number of VAP divided by 1000 MV-days and multiplied by 1000). Device utilization (DU) ratios were calculated by dividing the total number of device-days by the total number of bed-days.(15)

Statistical analysis

We compared, in univariate analysis, categorical variables using chi-square and Fisher's exact tests. We compared continuous variables using Students t tests and analysis of variance. A p value less than 0.05 was considered as statistically significant. Logistic regression with the stepwise method of Hosmer and Lemeshow (16) was used to identify, firstly, independent risk factors of ICU-DAI, comparing patients with versus patients without DAI; and secondarily, risk factors of mortality in ICU, comparing patients who died versus patients who survived at the end of hospitalization. Logistic regression model has included variables whose univariate test value was less than 0.20.(17) Odds ratios (OR) and 95% confidence interval (CIs) were calculated and presented to estimate the impact for risk factors.

RESULTS

Characteristics of patients

During the study period, 105 patients were admitted to the ICU who stayed for more than 48 hours. The mean age of the patients was 57.5 ± 19.2 years (range:18 - 87 years), and 68.4% were male. More than half patients were transferred from another service (67.7%) or establishment (27.6%). On admission, 38.1% of patients were under antibiotics and only 10.5% were immunosuppressed. The mean SAPS II score calculated at admission was 32.5 ± 17.5 (range: 6 - 88). The most frequent underlying illnesses were chronic respiratory failure (48.6%), diabetes (25.7%), arterial hypertension (24.8%) and cardiac failure (23.8%). The main reasons for admission were acute respiratory failure (71.3%), coma (20.8%) and acute circulatory failure (17.1%).The average length of stay was 9.5 ± 11.7days, (range: 3 - 80 days) giving 1004 patient-days. At the end of hospitalization, 45.7 % of patients got back to their home and 40% had died in ICU (Table I).

Table I: Baseline characteristics and outcome of patients admitted to ICU (N=105)

Variables	Number	Relative frequency (%)
Male Sex	72	68.4
Origin of patient		
Transferred from others units	71	67.6
Transferred From others establishment	29	27.6
Direct admission in ICU	5	4.8
Underlying illnesses		
Chronic respiratory failure	51	48.6
Diabetes	27	25.7
Arterial hypertension	26	24.8
Cardiac failure	25	23.8
Other (renal failure, stroke)	8	7.6
Reason for admission		
Acute respiratory failure	75	71.3
Disorders conscience/ coma	22	20.8
Acute circulatory failure	18	17.1
Antibiotics use at admission	40	38.1
Immunosuppression	11	10.5
outcome on discharge		
Back home	48	45.7
Transfer to other unit	15	14.3
Death	42	40

Exposure to invasive devices

DU ratios were variable ranged between 0.37 for CVC, with majority (70.9%) inserted in internal jugular vein, to 0.93 for UC. Furthermore, among 83.8 % patients intubated (ventilated), 21.6 % of whom were re-intubated once or more. Exposure lengths to the various invasive devices are described in the table II.

Table 2 : Exposure of patients to invasive devices in ICU

Invasive devices	Exposure number	Exposure Proportion (%)	Exposure length (days) Mean(±SD)	Median	DU ratios
UC	99	94.3	9.5 ± 11.2	7	0.93
Intubation/ MV	88	83.8	7.3 ± 9.5	5.5	0.63
Reintubation	19	21.6	___	___	___
PCV	90	85.7	6.6 ± 7.9	5	0.59
CVC	55	52.4	6.9 ± 8.7	3	0.37

Notes: SD= standard deviation; UC= urinary catheter; MV= mechanical ventilation; PCV= peripheral venous catheter; CVC= central venous catheter

ICU-DAI

Incidence rates

Sixteen patients (15.2%) developed seventeen episodes of ICU-DAI (16.9 ICU-DAI/1000 ICU days). The mean delay between admission and the occurrence of ICU-DAI was 10±1.5 days (range: 3 - 36 days). Regarding the type of infection, CVC-AI and PVC-AI were the most

frequent DAI identified (8 CVC-AI and 6 PVC-AI among 17 DAI) with incidence density rates of 21.4 CVC-AI/ 1000 CVC-days and 10.2 PVC-AI / 1000 PVC-days, respectively. All CVC-AI were arisen on jugular site insertion. Only three cases of VAP were detected with a rate of 4.7 VAP/1000 days of mechanical ventilation. However, no case of CAUTI was registered during the period of study.

Diagnostic criteria and microbiological documentation

Among 17 recorded infections, 26 microbiological analyses were practiced among which 5 in order to confirm VAP (2 Protected tracheal fluid and 3 blood culture), 10 others to confirm CVC-AI (5 quantitative CVC culture and 5 blood culture) and finally 11 samples were carried out when an PVC-AI was suspected (5 quantitative PVC culture and 6 blood culture). Overall, only 4 micro organisms were identified: 3 Gram-negative bacteria: a multiresistant *Escherichia Coli* isolated on a blood culture from patient with high suspicion of VAP and 2 *Proteus Mirabilis* identified respectively on CVC culture and blood culture from patients with signs of vascular associated infections. Finally, a Gram-positive Cocci was found on a PVC culture, it was coagulase-negative staphylococci.

Referred to definitions criteria's of DAI adopted in our study, seven CVC-AIs and five PVC-AIs were considered as "Systemic CVC-AI or PVC-AI" without bloodstream infection. One case of "local CVC-AI" and another of PVC-associated Bloodstream infection were also confirmed. Cases of VAP were classified as "Probable" for one patient and "Possible" for the two others cases (Table III).

Table 3 : Pathogens associated with DAIs

DAI	Microbiological analysis	Results of Microbiological analysis
		1 positive blood culture
VAP	Blood cultures (n=3)	*Multi resistant*
«Probable VAP» (n=1)	Protected tracheal	*Escherichia Coli*
«Possible VAP» (n=2)	fluids (n=2)	
CVC-AI		
«Local CVC-AI » (n=1)	CVC cultures (n=5)	*1 positive CVC culture (n=1)*
«Systemic CVC-AI » (n=7)	Blood cultures (n=5)	*Multi resistant Protéus mirabilis*
PVC-AI		
«Systemic PVC-AI» (n=5)	PVC cultures (n=5)	*1 positive PVC culture coagulase-negative staphylococci*
«PVC-Bloodstream AI» (n=1)	Blood cultures (n=6)	*1 positive blood culture Proteus mirabilis*

Risk factors

Univariate analysis was first employed to identify possible risk factors for acquiring DAI inside the ICU environment (Table IV). Using multivariate analysis, only 2 factors were independent risk factors for acquiring DAI in ICU: length of ICU stays which increase the risk of DAI by 1.10 per day (95% CI [1.03- 1.17]; p=0,002), and the use of CVC increased the risk by 3.29 (95% CI [1.36- 7.95]; p=0,031) (Table IV).

Table 4 : Risk factors of ICU-DAI

	Univariate analysis		Multivariate analysis (final model)		
Variables	**Nosocomial infection+ (N=16)**	**Nosocomial infection - (N=89)**	**p value**	**OR [95% CI]**	**P value**
Age; mean ± SD (years)	59.06 ±16.63	57.16 ± 19.71	0.686		
Male sex; n (%)	11 (68.8%)	61 (68.5%)	0.987		
Antibiotic at admission; n (%)	5 (31.3%)	35 (39.3%)	0.54		
SAPSII ; mean ± SD	33.19 ±11.62	32.45 ±18.51	0.835		
Length of stay, mean ± SD (days)	22.75 ±22.91	7.19±6.01	$< 10^{-4}$	1.10 [1.03 - 1.17]	0.002
Intubation/MV; n (%)	16 (100%)	72 (80.9%)	0.068		
Reintubation; n (%)	7 (43.8%)	12 (16.7%)	0.041		
Length of intubation, mean ± SD (days)	17.33 ±18.58	5.10 ± 4.02	$< 10^{-4}$		
PVC; n (%)	15 (93.8%)	75 (84.3%)	0.542		
Length of PVC; mean ± SD (days)	12.47 ±16.62	5.45 ± 3.75	0.001		
Number of PVC,mean ± SD	2.93 ±1.33	2.23±1.68	0.129		
CVC; n (%)	15 (93.8%)	40 (44,9%)	$< 10^{-4}$	3.29 [1.36 - 7.95]	0.031
length of CVC; mean ± SD (days)	11.8 ± 13.89	5.05 ± 4.73	0.001		
Number of CVC, mean ± SD	1.47 ±0.74	1.13 ±0.52	0.065		

Notes: SD= standard deviation; MV= mechanical ventilation; PCV= peripheral venous catheter; CVC= central venous catheter.

Risk factors of mortality

Using univariate and multivariate analysis (Table V), independent risk factors of mortality in ICU were immunosupression (OR= 6.34; 95% CI[1.46 – 27.36]; p=0.013), use of central venous catheter (OR=5.35; 95% CI[1.98 – 14.46]; p=0.001)and ICU-DAI (OR=3.83; 95% CI[1.04 – 14.07]; p=0.043).

DISCUSSION

Prevention of nosocomial infections in ICUs is a priority of health care systems all around the world. Yet, their control requires an understanding of epidemiological data collected in these units.(18) Indeed, Haley and al.(19)demonstrated that an integrated infection control program that includes intensive surveillance can reduce the incidence of nosocomial infections by as much as 30%, which can result in significant reductions in healthcare costs. Thus, our prospective surveillance has the merit of being conducted for the first time in medical ICU of our university hospital (F.HACHED - SOUSSE) over a long enough period of six months. The incidence rate of DAI was 16.9 ICU-DAI/1000 ICU Days. CVC was the most commonly identified ICU-DAI (21.4 CVC-AI/ 1000 CVC-days), followed by PVC-AI (10.2 PVC-AI / 1000 PVC-days). The rate of mortality was 40%.

Incidence density rate estimated in the present study(16.9DAI /1,000 ICU-days) is lower than that described in some European ICUs (between 23 and 47DAI /1,000 patient-days)(20), in Turkish ICUs(34.2/1000 patient-days)(18) even to that found in Tunisian ICU (34.7/1,000 patient-days)(21), but is higher than that reported in China(22) and in US ICUs.(23) Several factors explain the variations observed between countries, even within the same country such as heterogeneity of intrinsic and extrinsic risk population into different units («casemix»), differences in the definitions case used, in type of unit (medical, surgical or mixed) and in populations studied (all patients or only patients hospitalized for more than 48 h).(24) It is also possible that these differences can be explain, in part, by differences in the efficiency of measures implemented for the control and prevention, as has been suggested by large epidemiological studies.(5)

Comparison according to specific incidence densities by type of invasive device shows that it is often were VAP, which are predominant in most countries such as Turkey(25), China(26), India(27), USA(28), France(29,30) and even in Tunisia(21), followed by CAUTI or primary bloodstream infections. However, during our survey, only 3 cases of VAP were recorded and fortunately no case of CAUTI, although higher DU ratios of MV and UC. This result can be explained by effectiveness of prevention measures implemented in this unit such as politics regarding regular and meticulous lung drainage at ventilated patients, reasoned use of antibiotics and quality of placement and manipulation of these invasive devices.

Furthermore, our study reveals a predominance of CVC-AI with an incidence density rate (21.4 CVC-AI / 1000 CVC-days) two times higher than that observed in Colombia (11.3 CVC-AI / 1000 CVC-days)(9) and seven times higher than that reported in the United States (3,4 CVC-AI / 1000 CVC-days).(31) The incidence of CVC-AI varies considerably with the type of catheter, frequency of catheter

Table 5 : Risk factors of mortality in ICU

Variables	Univariate analysis			Multivariate analysis (final model)	
	Non survivors (n=42)	Survivors (n=63)	p value	OR [95% CI]	p value
Age, mean ±SD (years)	59.10±17.52	56.35 ±20.33	0.47		
Sex (male : female), n(%)	28 (66.7)	44 (69.8)	0.73		
Transfer, n(%)	42 (100)	58 (92.1)	0.08		
Antibiotic at admission,n (%)	20 (47.6)	20 (31.7)	0.10		
Immunosupression, n(%)	7 (16.7)	4 (6.3)	0.17	6.34 [1.46 – 27.36]	0.013
SAPS II, mean ±SD	38.67±18.41	28.49 ±15.89	0.003		
length of stay, mean±SD (days)	9.83 ±12.54	9.38 ±11.27	0.84		
Intubation, n(%)	39 (92.9)	49 (77.8)	0.04		
Length of intubation, mean ±SD (days)	8.81 ±8.88	6.06 ±7.37	0.19		
PVC, n(%)	37 (88.1)	53 (84.1)	0.56		
Length of PVC, mean ±SD (days)	7.33±10.86	6.15 ±5.10	0.49		
CVC, n(%)	32 (76.2)	23 (36.5)	$< 10^{-4}$	5.35 [1.98 – 14.46]	0.001
Length of CVC, mean ±SD (days)	6.23 ±8.51	7.87 ±9.14	0.5		
UC, n(%)	41 (97.6)	58 (92.1)	0.39		
Length of UC, mean ±SD (days)	10.05±12.06	9.26±10.68	0.73		
ICU-DAI, n(%)	12 (28.6)	4 (6.3)	0.002	3.83 [1.04 – 14.07]	0.043

Notes: SD= standard deviation; UC= urinary catheter; MV= mechanical ventilation; CVC= central venous catheter; PCV= peripheral venous catheter; ICU-DAI= device associated infection acquired in intensive care unit.

manipulation and patient-related factors such as underling disease and acuity of illness.(32) These infections were followed, in our study, by PVC-AI. While the incidence of local or bloodstream infections associated with PVC is usually low, serious infectious complications are recognized by clinicians because of the large numbers of such catheters that are placed. Indeed, PVCs are the most frequently used venous access devices.(32) In this context, a recent randomized controlled trial conducted in three French ICUs comparing the rate of catheter-related insertion or maintenance complications in patients received central venous catheters or peripheral venous catheters as initial venous access. Results shows that major and minor catheter-related complications were greater in the peripheral venous catheter than in the central venous catheter group.(33)

Risk factors of ICU-DAI were identified by multivariate analysis, which allows finding real independent risk factors without the confounding effects of multiple variables. As frequently found in other studies (6, 21, 34-36), a further risk factor was the length of stay, due to severity of illness, duration of patient care and exposure to invasive devices. Severity of illness was not always associated with length of stay, explaining why SAPS II was not found to be a risk factor in our study, and, similarly, the Acute Physiology and Chronic Health Evaluation II score was not found in the final analysis in the multicentre European Prevalence of Infection in Intensive Care (EPIC) study (6) or in Craven et al.'s study (34) to be a risk factor. The National Nosocomial Infections Surveillance System (37) revealed no association between severity of illness scores and device-associated infection rates. In addition, CVC were independently associated with a higher risk of ICU-DAI, as in the studies of Craven et al.(34) and Vincent et al.(6) This finding is consistent with the results of our study, given that the majority of DAI are represented by CVC-AI. More specific analyzes are needed to explore the association between exposure to CVC and risk of CVC-AI in our study. Other risk factors have been reported in the literature as significantly associated with occurrence of ICU- DAI but not revealing through the final analysis of this study. These factors are related to the patient's clinical profile (immunosuppression, renal failure...) (38), to care received (antibiotic at admission)(21) or to others invasive devices such as mechanical ventilation.(39)

We explored also through data monitoring risk factors of death in ICU because at the discharge 40% of patients had died, proportion approximating that observed in Turkey (46.7%)(25) but higher than that observed in other Tunisian ICU (29.9%). (21) Three independent risk factors of mortality in ICU were kept in final model of multivariate analysis. Thus, our finding that mortality is higher among patients with ICU-DAI is consistent with other studies of nosocomial infection and mortality in intensive care unit patients(25, 40-43).Indeed, Vosylius et al.(41) noted that the occurrence of infection in ICU was significantly related to increased mortality. Cevik, et al.(40) observed that the occurrence of ICU-AI increases the risk of mortality by a factor of 1.7.Girou, et al.(43), in a matched case control study of ICU patients, demonstrated that mortality attributable to nosocomial infection was about 44%. Furthermore, the magnitude of the potential for CVCs to increase risk mortality in our study could be explained by the frequency of infectious complications that have been generated, as well as was confirmed in others previously reported.(21,44-47) Collignon PJ and Heiselman D estimate attributable mortality for these CVC-AI between 12% and 25%.(46,47)Increased risk of death associated with CVC could also be related to the fragility of the clinical condition. Particularly, presence of immunosuppression appears to be significantly determinant in the occurrence of death with an OR equal to 6.34 (p=0.013).

The most important limitation of our study, low microbiological documentation, did not allow a better knowledge of microbial ecology in our ICU, particularly, their profile antibiotics resistance which could probably explain high risk of mortality by DAI.

Finally, considering consequences in terms of morbidity and mortality of catheter-associated infections, effective prevention strategies should be implemented in our ICU. Therefore, even though it is still questions must be explored in research programs, we have already effective prevention protocols for most of HAI in ICU. As illustrated by French Anesthesia and Intensive Care Society and The French Intensive Care Society consensus, preventing each HAI is based on a "bundles» witch have been documented to decrease CVC-AI and CVC-related mortality7if associated with educational interventions and feedback of monitoring results to ICU practitioners.(48)

Thus, our monitoring data were returned to health care team to sensitive them about importance of prevention catheters associated infections. A training program with a monthly session, during the 1st half-year of 2013, was assured reminding main measures, adapted to the ICU uses, that must be respected to reduce morbidity and of mortality associated with catheters (improvement of hand hygiene, respect aseptic condition at catheter insertion, site access, use of alcohol-based disinfectants, procedures for line and dressing maintenance, immediate replacement of moistened, soiled or disrupted dressings, removal of useless catheters).(49) Therefore, care protocols insertion, manipulation and removal of CVC and PVC have been updated and adapted to the available resources, with agreement of ICU team during the last training sessions. Furthermore, teams were congratulated and encouraged to the efforts undertaken to control risk infectious associated with MV and UC.

CONCLUSION

Longitudinal surveys are important in ICUs to assess the incidence of nosocomial infections and to determine risk factors. They are more accurate than prevalence studies, but it takes longer to collect and analyze the data. Efficacy depends on early analysis and conveying the information to the ICU team. Our study determined incidence rates and risk factors and also evaluated the feasibility of routine surveillance of DAI in ICUs. The main difficulty highlighted by this study was that of achieving truly standardized definitions and methods of diagnosis of DAI which could be applied by several units. Anyway, these surveillance data have established an action plan for prevention of DAI primarily targeting the vascular catheter infections. This plan is mainly based on the training and education of staff care service as well as the evaluation of resources and practices of insertion, manipulation and removal of vascular lines. Evaluation of professional practices and impact of actions in terms of reduction of morbidity and mortality associated to DAI are later planned.

Finally, It should be noted that for more than 15 years, intensivists are engaged in programs infection control. Real progress has been made but only a continuous improvement of the quality and safety of care, particularly the observance of good practice, will likely further reduce

the occurrence of HAI. In this context, the quality of management is essential so that everyone feels involved and «co-responsible» for the quality and safety of care. Everyone must be sure he is an actor of prevention and monitoring, at any level of the hierarchy whatsoever. Behaviors also depend on what can and should be made to facilitate compliance.

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