Epidemiological profile of health-care-associated infections in the central-east area of Tunisia

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المرتسم الوبائي للعدوى المُواكبة للرعاية الصحية في المنطقة الوسطى الشرقية من تونس

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الخلاصة: استهدفت هذه الدراسة تقدير انتشار عوامل الاختطار للعدوى المُواكبة للرعاية الصحية في جميع المستشفيات التسعة الموجودة في المنطقة الوسطى الشرقية من تونس عام 2005. وتبين أنه من بين 1373 مريضاً أدخلوا المستشفيات ومكثوا فيها لأكثر من ثمان وأربعين ساعة، أصيب أربعةٌ وسبعون مريضاً بالعدوى المُواكبة للرعاية الصحية، بمعدل انتشار قدرُه 5.4٪ (فاصلة الثقة 95٪: 4.2٪ – 6.6٪). وكان معدل الانتشار أعلى على نحو يُعتدّ به إحصائياً في وحدات الرعاية المركّزة (18.4٪) وفي أقسام رعاية الولدان الحديثي الولادة (12.7٪). وكان هناك 79 عدوى، وكان أكثر موقعين من حيث تكرار الإصابة بالعدوى تكراراً هما الجهاز التنفسي والمسالكَ البولية. وقد أجري فحص مكروبيولوجي لـ 25 حالة من الحالات التي أصيبت بالعدوى المُواكبة للرعاية الصحية، واكتشفت الزائفة الزنجارية ثمان منها. ويدل تحليل التحوّف اللوجستي المتعدِّد على ارتباط الإصابة بالعدوى المُواكبة للرعاية الصحية بالسكّريّ (نسبة الأرجحية= 2.0)، وكَبْت المناعة (نسبة الأرجحية = 3.3)، وطول المكث في المستشفى (نسبة الأرجحية = 4.5)، ووجود قثطار وريدي مركزي (نسبة الأرجحية = 2.5)، ووجود قثطار وريدي محيطي (نسبة الأرجحية = 10.2). واستنتج الباحثون أن العدوى المُواكبة للرعاية الصحية تستحق الاهتمام في تلك المنطقة من تونس.

ABSTRACT This study aimed to estimate the prevalence and risk factors for health-care-associated infection (HAI) in all 9 hospitals of the central-east area of Tunisia in 2005. Of 1373 patients admitted for more than 48 hours, 74 developed HAI, a prevalence of 5.4% (95% CI: 4.2%–6.6%). The prevalence was significantly higher in the intensive care units (18.4%) and neonatal departments (12.7%). There were 79 infections and the most frequent sites of infection were respiratory tract and urinary tract. Microbiological examination was performed for 25 cases of HAI and *Pseudomonas aeruginosa* was identified in 8 cases. Multiple logistic regression analysis indicated that HAI was linked to diabetes (OR = 2.0), immunosuppression (OR = 3.3), length of stay (OR = 4.5), central venous catheter (OR = 2.5) and peripheral venous catheter (OR = 10.2). We conclude that HAIs are of concern in this area of Tunisia.

Profil épidémiologique des infections liées aux procédures de soins dans la région du centre-est de la Tunisie

RÉSUMÉ La présente étude visait à estimer la prévalence et les facteurs de risque des infections liées aux procédures de soins dans tous les hôpitaux de la région du centre-est de la Tunisie, comptant neuf établissements, en 2005. Sur un total de 1373 patients séjournant depuis plus de 48 heures à l'hôpital, 74 ont présenté une infection associée aux procédures de soins, correspondant à une prévalence de 5,4 % (IC à 95 % : 4,2 %–6,6 %). La prévalence était nettement plus élevée dans les unités de soins intensifs (18,4 %) et les services de néonatalogie (12,7 %). Au cours de l'étude, 79 infections ont été observées et les sites d'infection les plus fréquents étaient les voies respiratoires et urinaires. Une analyse microbiologique a été réalisée pour 25 cas d'infections liées aux procédures de soins et *Pseudomonas aeruginosa* a été identifié dans 8 cas. Une analyse de régression logistique multiple a indiqué que les infections associées aux procédures de soins étaient liées aux variables suivantes : diabète (OR = 2,0), immunodépression (OR = 3,3), durée du séjour (OR = 4,5), pose d'un cathéter veineux central (OR = 2,5) ou d'un cathéter veineux périphérique (OR = 10,2). Nous en concluons que les infections liées aux procédures de soins constituent un motif de préoccupation dans cette région de Tunisie.

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Introduction

Nosocomial or health-care-associated infection (HAI) is an important cause of patient's morbidity and mortality [1]. In recent years, it has become more prominent due to the greater complexity of hospital patients' conditions and to developments in health care, which in some institutions has led to patients becoming more vulnerable to infection. As an adverse outcome of acute hospital care, HAI can be used as a quality indicator for the overall assessment of hospital treatment [2].

Surveillance for HAI is an essential part of infection control and has been widely accepted throughout the world as a primary step for prevention. To accomplish this, prevalence surveys can be used to quantify the burden of disease and to help establish priorities [3]. A study in Morocco reported on the prevalence of hospital-acquired infection in a university hospital [4]. In nearby Tunisia, in order to establish infection control programmes and select priorities, we need to assess the magnitude of HAI in the local context and to identify the major associated factors. In our case, to scope and assess the magnitude of the problem of HAI and to establish control priorities we carried out a prevalence survey of HAI in hospitals in the central-east region of Tunisia as a part of the national prevalence survey (NOSOTUN05).

Methods

Sample

All health care facilities in the central-east region of Tunisia were invited to participant in a cross-sectional study. A total of 9 hospitals participated: 4 teaching hospitals, 3 regional hospitals and 2 private clinics.

Each department was visited on one day. All inpatients present on the day of the study who had a hospital stay exceeding 48 hours were included (*n* = 1373 patients). Data were collected continuously over the 2-month period January and February 2005.

Data collection

A trained public health doctor and a senior technician in hospital hygiene were in charge of data collection in each hospital. The data collection schedule of the investigators was unknown to hospital officials.

Three datasheets (hospital, department and patient) were designed for data collection. Data entry was anonymous. The hospital and department datasheets were used to collected data on the duration of stay for each patient, department of admission and the specialty (medical or surgical). In the patients' datasheet we collected data on age and sex; intrinsic risk factors for HAI (malnutrition, diabetes, neutropenia, immunosuppression and obesity); extrinsic risk factors (urinary catheter, parenteral nutrition, mechanical ventilation, central and peripheral venous catheter); site of infection; antibiotic use; and microorganisms isolated and resistance pattern.

In the surgery department, we collected information for each patient who underwent surgery about: the degree of urgency; the American Society of Anesthesiology (ASA) physical status score [5]; the Altemeier contamination classification [6]; and the use of antibiotic prophylaxis.

Definitions

We adopted the US Centers for Disease Control and Prevention (CDC) definition of HAI [7] as a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) when there is no evidence that the infection was present or incubating at the time of admission to the acute care setting. HAIs may be caused by infectious agents from endogenous or exogenous sources. In the current study only clinically or microbiologically documented cases were considered as positive for HAI.

The following definitions were used: obesity was body mass index > 30 kg/m^2, malnutrition was body mass index < 17 kg/m^2; neutropoenia was < 2000 neutrophils/μL of blood; diabetes was glycemic index > 1.26 g/L; immunosuppression was CD4 count < 500 mm^3.

Data analysis

Analyses were performed using *Epi-info* software, version 6.0. The analysis of factors associated with HAI was based on appropriate statistical tests (Student t-test to compare means, non-parametric tests when a normal distribution of data could not be assumed and chi-squared test for the comparison of percentages). A *P*-value < 0.05 was considered to be statistically significant. Variables with univariate test value ≤ 0.25 were included in a multivariate stepwise logistic regression to control for the effect of confounding variables. In the final model we identified the factors independently associated with HAI.

Results

Patients' demographic and clinical characteristics

The overall majority of the study patients (95.5%) were hospitalized in the university hospitals. Their mean age was 46.4 (standard deviation 22) years, with extremes ranging from 1 day to 91 years and the sex ratio was 1.07.

The median length of stay between patient admission in each department and the date of the inquiry was 7 days (interquartile range 4–14).

Almost three-quarters of all patients (988, 72.0%) presented with 1 or more intrinsic or extrinsic risk factor for HAI (Table 1).

A total of 302 patients underwent a surgical procedure. Among them, 4.0% were classified as Altemeier surgical contamination classes 3 and 4, 4.0% had ASA physical status score 3+ and

Table 1 Risk factors for health care associated infection

Risk factor	Total patients (*n* = 1373)		Infected patients (*n* = 74)		Uninfected patients (*n* = 1299)		Statistics	
	No.	%	No.	%	No.	%	OR	95% CI
Immunosuppression	29	2.1	6	8.1	23	1.8	4.1	1.51–11.2
Malnutrition	72	5.2	8	10.8	64	4.9	2.4	1.10–5.20
Diabetes	304	22.1	26	35.1	278	21.4	1.9	1.13–3.07
Obesity	193	14.1	9	12.2	184	14.2	0.7	0.34–1.54
Neutropenia	8	0.6	3	4.1	5	0.4	7.2	1.38–38.1
Mechanical ventilation	38	2.8	9	12.2	29	2.2	5.4	2.38–12.3
Parenteral nutrition	38	2.8	8	10.8	30	2.3	5.2	2.30–11.9
Urinary catheter	138	10.1	15	20.3	123	9.5	2.3	1.23–4.19
Peripheral venous catheter	597	43.5	60	81.1	537	41.3	2.6	1.58–4.28
Central venous catheter	26	1.9	5	6.8	21	1.6	8.6	3.79–19.6

OR = odds ratio; CI = confidence interval.

63.0% received antibiotic prophylaxis (Table 2).

Overall prevalence

During the survey, 74 of the 1373 patients were diagnosed with HAI, an overall prevalence of 5.4% (95% CI: 4.2%–6.6%). Five patients had more than 1 infection and so the total number of infections was 79: respiratory infections were the most common (45.6%) followed by urinary tract infections (16.5%) and surgical site infections (15.2%).

The median length of hospital stay was significantly higher for infected patients [12.5 days (interquartile range 9–19)] and than for noninfected patients [7 days (interquartile range 4–13)] ($P < 0.01$).

Prevalence by department

The prevalence of HAI was significantly higher in the intensive care units (8/43, 18.6%) and neonatal care units (11/54, 20.3%) compared with other hospital departments ($P < 0.001$). Of the patients in intensive care units, 18/43 (42%) were under mechanical ventilation, with a high rate of nosocomial pneumonia in this group (4/18, 22.2%) ($P < 0.01$).

Table 2 Prevalence of health care associated infection for patients undergoing surgery

Surgery characteristics	Total surgery patients (*n* = 302)		Infected patients (*n* = 26)		Uninfected patients (*n* = 276)		*P*-value
	No.	%	No.	%	No.	%	
ASA physical status score							
1	214	70.9	16	61.5	198	71.7	
2	76	25.2	8	30.8	68	24.6	0.4
3+	12	4.0	2	7.7	10	3.6	
Endoscopy							
Yes	192	63.6	13	50.0	179	64.9	0.3
No	110	36.4	13	50.0	97	35.1	
Urgency of procedure							
Elective	248	82.1	2	7.7	246	89.1	0.2
Urgent	54	17.9	24	92.3	30	10.9	
Altemeier contamination class							
1	136	45.0	12	46.2	124	44.9	
2	154	51.0	12	46.2	142	51.4	0.8
3 and 4	12	4.0	2	7.7	10	3.6	
Antibiotic prophylaxis							
Yes	191	63.2	20	76.9	171	62.0	0.4
No	111	36.8	6	23.1	105	38.0	

ASA = American Society of Anesthesiology.

The prevalence of HAI in surgery departments was 8.6% (26/302) (Table 2). In this group, urinary tract infection was the most common infection (9/26 cases). The median length of stay in the surgical department was significantly greater for infected patients [18 days (interquartile range 12–22)] than for noninfected patients [8 days (interquartile range 4–15)] ($P < 0.01$).

Microbiology data

Microbiology findings were available for only 25 cases of HAI; Gram-negative bacilli were identified in 80% (20/25) of cases, predominately *Pseudomonas aeruginosa* (8/20 cases). Among cases for which microbiology findings were available, 11 cases of antibiotic resistance were detected, 4 in *P. aeruginosa*.

Antibiotics were prescribed for 58 HAI patients, with more than 1 antibiotic for 30 (52%) of cases. The most frequently used antibiotics were β-lactamases (45%), quinolones (15%) and aminoglycosides (13%).

Risk factor analysis

Except for obesity, all the studied risk factors were significantly associated with HAI ($P < 0.01$) (Table 1).

The variables included in the multivariate analysis model were: diabetes, malnutrition, immunosuppression, neutropenia, urinary catheter, central venous catheter, peripheral venous catheter, mechanical ventilation, parenteral nutrition, length of stay and age (divided into classes). The model retained 5 variables independently associated with HAI: diabetes (OR = 2.0), immunosuppression (OR = 3.3), length of stay (OR = 4.5), central venous catheter (OR = 2.5) and peripheral venous catheter (OR = 10.2) ($0.001 < P < 0.03$) (Table 3).

Discussion

Although HAI includes infections contracted in ambulatory care departments, our present study was limited to hospital infections. By using a prevalence survey with standard methods [8] and the CDC definition of HAI we are able to compare our study with other prevalence surveys using the same methods and definition. The data collection by a public health doctor and a senior technician in hospital hygiene ensured that the survey was conducted in a consistent and correct manner. The study achieved its objectives in terms of determining the prevalence and associate factors of HAI.

We found that the prevalence of HAI in this region of Tunisia was 5.4%. This rate is similar to other studies using the same methods [9,10]. The highest risk specialties were intensive care and neonatal care units, where the prevalence of HAI was 18.6% and 12.7% respectively. These observations are confirmed by the literature and are the result of several factors related to the patients (such as age, co-morbidities) [11] and the use of invasive procedures, especially central venous catheters [12].

In our study, multivariate analysis shows that diabetes, length of stay, immunosuppression and use of central line and peripheral venous catheters were independent risk factors of HAI. Use of a peripheral venous catheter was the most important risk factor (OR = 10.2); this may be because less care is taken in insertion of these catheters as staff see it as a simple, everyday activity. We also found a linear correlation between the number of risk factors and the rate of HAI. Similar results were reported by another study [13].

The most frequently infected site was the respiratory tract. It has been demonstrated that pneumonia is the most common nosocomial infection, and respiratory infection is especially common in intensive care units because of the use of artificial ventilation [14]. These results were confirmed in our study, in which 42% of intensive care unit patients were under mechanical ventilation, with a high rate of nosocomial pneumonia (22.2%)

Among operated patients, and in accordance with the literature, surgical site infections were the most common infections [15,16]. The ASA physical status score, which consists of 5 classes [5], and the Altemeier contamination classification, which separates interventions depending on the degree of cleanliness [6], were predictors of infection risk in surgical patients. Overall, surgical site infections were in fourth position, which demonstrates the attention given to surgical site asepsis to avoid surgical wound infection. However, less attention was given to other important aspects such as urinary catheter insertion under aseptic conditions and regular catheter changes.

The rate of microorganisms, based on microbiological examination, usually exceeds 60% [17,18]. In our case,

Table 3 Independent risk factors of health care associated infections

Risk factor	Wald	OR (exp β)	95% CI	*P*-value
Diabetes	4.34	2.0	1.03–3.02	0.03
Length of stay	24.01	4.5	2.47–8.24	0.01
Immunosuppression	5.14	3.30	1.17–9.27	0.02
Central venous catheter	12.16	2.53	1.50–4.28	0.01
Peripheral venous catheter	27.04	10.20	4.25–24.5	0.001

OR = odds ratio; CI = confidence interval.

microbiological testing was performed in only one-third of cases of HAI. This low rate of ordering microbiological testing may be related to the type of infection. Diagnosis of respiratory tract infections (the most frequent type of infection inours tudy) is usually done by clinical suspicion and treated without microbiological confirmation.

Microbiological testing in HAI cases usually shows that Gram-negative bacilli are the most frequent, especially *P. aeruginosa* [19]. Our study confirmed these findings, with a predominance of Gram-negative bacilli (80% of cases), and 4 out of 11 cases of antibiotic resistance related to *P. aeruginosa*. Other studies have also found high rate of resistant organisms [20,21]. These resistances have multiple causes, especially the inappropriate use of antimicrobial agents [22,23] and can be avoided by appropriate antibiotic therapies based on guidelines informed by local epidemiological data.

Conclusions

Our findings highlight that HAIs are of concern in the central-east area of Tunisia. The prevalence was significantly higher in the intensive care units and neonatal departments. The most frequent infection sites were respiratory and urinary tract. Risk factors for HAI were diabetes, length of stay, immunosuppression and use of peripheral and central venous catheters. We suggest that prophylactic measures against these infections should be implemented through the establishment of a national prevention strategy.

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