Occurrence of hospital infection among interned elderly in a university hospital

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Abstract

Objective
Hospital infection is an important cause of morbidity and mortality in the elderly population. The objective of this study was to evaluate the occurrence of hospital infection and risk factors associated with it.

Methods
This is a prospective study of a sample of 332 elderly people, 60 years and older, interned in a university hospital, between September 1999 and February 2000. Sample size was calculated according to the Fisher and Belle formula, with a confidence interval of 0.95%, from a total of 760 elderly patients interned, in proportion to the number of patients present in each in-patient unit, in the 1997. Criteria for defining hospital infection were those established by the Center for Diseases and Prevention Control. Odds ratio and logistic regression were utilized for statistical analysis of the data.

Results
The rate of hospital infection was 23.6%. The prevalent topographies of infection were respiratory infections (27.6%), urinary tract infections (26.4%) and surgical wound infections (23.6%). The period of hospitalization of patients who did have hospital infections was 6.9 days, while those who had hospital infections were hospitalized for 15.9 days (p<0.05). Mortality rate among hospitalized patients was 9.6% and the rate of lethality among patients with hospital infection was 22.9% (p<0.05). Risk factors found for hospital infection were cholangiography (odds ratio (OR) =46.4, confidence interval 95% (CI95%) =4.4-485); diabetes mellitus (OR=9.9, CI 95% =4.4-22.3); chronic obstructive pulmonary disease (OR=8.3, CI 95% =2.9-23.7); urinary catheters (OR=5, CI 95% =2.7-11.8); hospitalization with community infection (OR=3.9, CI 95% =1.7-8.9) and mechanic ventilation (OR=3.8, CI 95% =1.9-6.3).

Conclusions
Hospital infection presented elevated incidence and lethality and it increased the period of hospitalization among the elderly studied.

INTRODUCTION

Studies concerning the occurrence and risk of infectious diseases are important in as much as these are frequent causes of hospitalization and death. Among populations aged sixty and more, infectious processes result in an increased morbidity and mortality, when compared to younger individuals.[14] The World Health Organization suggests that the age limit for studies concerning older adults should be sixty years and older.[9]

The Brazilian Ministry of Health defined *hospital infection* as that infection acquired after the patient was admitted to the hospital and which manifested itself during his hospital stay or after he was released

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form the hospital, and that may be related to his stay at the hospital or to hospital procedures.[6] During his stay, the elderly patient has a greater risk of developing a hospital infection.[11]

The most frequent topographies of hospital infection are infections of the urinary tract, pneumonia, infections of the site of surgery and sepsis, with distribution, expressed in percentages, varying respectively, from 40.8 to 42%, 11 to 32.9%, 8 to 24% and 5 to 9.2%.[8,15]

Occurrence of hospital infection determines an increase in the length of stay (by 4 days, on the average), in the costs of hospitalization, and in the rates of mortality among the affected population.[7]

The determinants of hospital infection risk may be found among the characteristics and exposures of patients which predispose them to infections. Patients submitted to these risk factors would present higher levels of hospital infection.[8]

There are few studies which analyze risk factors for hospital infection within this age group, a condition which is particularly important within this group.[2,14,15] In a multicentric French study with 4,252 adult patients, 429 developed hospital infection with a 10.1% prevalence. The presence of co-morbidities, neoplasms, neutropenia, previous use of antimicrobian agents, hospital stay in an intensive care unit, transference to another hospital, tracheal intubation for more than 24 hours and prolonged hospital stay were independently associated with hospital infection.[12]

The objective of the present investigation was to study the occurrence of hospital infection in a population of elderly people interned at a university hospital.

METHODS

Seven hundred and sixty (760) patients, sixty years or older interned in a university hospital located in the municipality of Botucatu, in the state of Sao Paulo, during the period between September 1999 and February 2000, were selected for this study. Among these, 322 were evaluated prospectively.

The size of the sample was calculated by the Fischer and Belle formula, utilizing a 95% confidence interval with a precision of 3% for the expected prevalence of hospital infection.[4]

The proportion of patients 60 years of age and older with hospital infection at the hospital where this study was conducted, which, in 1997, represented 8.5% of the patients, was taken as a basis for this investigation.

Fisher and Belle Formula:

$$N = \frac{Z\,\alpha^2/2 \; .p.q}{d^2}$$

Where:

N= Sample size

$Z\,\alpha^2/2$ = value which refers to the table of normal distribution for the confidence interval of 95% =1.96

p= Proportion of patients with hospital infection (within the year 1997) =8.5%

q= Proportion of patients without hospital infection (within the year 1997) =91.5%

d= precision =3%

$$N = \frac{1.96^2 \times 0.085 \times 0.915}{0.03^2} = 331.9$$

In the sample, the patients were distributed in proportion to the number of patients registered in each unit of in-patients during the year 1997.

Hospital infection was defined as:[6]
- infection acquired after the patient's admission to the hospital and which manifested itself during of after the period in which the patient was hospitalized, and which could be related to hospitalization or hospital procedures;
- when, at the same topography in which a communitarian infection was diagnosed, a different germ was isolated and the clinical conditions of the patient grew worse;
- the clinical expression of the infection presented itself 72 hours or more after hospital admission, when the period of incubation of the microorganism was unknown and there was no clinical evidence and/or results of laboratory exams indicating infection when the patient was admitted to the hospital;
- the expression of the disease before 72 hours had passed since admission, when it is associated with diagnostic procedures and/or therapies undertaken during this period.

Criteria utilized when defining topographies of hospital infection [HI] were established by the Center for Diseases and Prevention Control (CDC-EUA).[6] Topographies investigated were infection of the site of surgery, of the blood system, of the respiratory tract, of the urinary tract, osteoarticular infection, infec-

tion of the cardiovascular system, of the central nervous system, of the gastrointestinal tract, of the reproductive system, of the skin and soft parts, infection in burns, mastitis, systemic infection and infections which weren't clearly identified.

Patients were evaluated with respect to the main cause of hospitalization, as indicated in the medical records (and classified according to CID-10), whether the patient was submitted to procedures involving risks the day before and the emergence of hospital infection. This assessment was undertaken during a visit, by the investigator or a trained assistant, to the unit where the patient was interned.

Telephone contact with the patient occurred after 30 ± 3 days, when the patient was submitted to any surgical procedure. The patient was then asked about the emergence of infection, according to the definition of infection in a surgical site. This search method presents an 81% sensibility.[3]

The following variables were investigated: sex; age (younger or older than 80 years); presence of an associated disease at the time of hospitalization (neoplasia, diabetes mellitus, chronic obstructive lung disease, dementia); presence of communitarian infection at the time of hospitalization; procedure undertaken before the emergence of hospital infection: vesicle, nasogastric and duodenal catheters, orotracheal and nasotracheal intubation; endoscopies (high digestive, low digestive, laparoscopy, thoracoscopy, mediastinoscopy, bronchoscopy, rhinoscopy, laryngoscopy, cystoscopy, ureteroscopy, colposcopy, arthroscopy, retrogressive endoscopic cholangiography, pancreatoscopy); tracheotomy; trichotomy; peripheral venous catheterization, central (intracath, phlebotomy, tenkoff/schille), arterial, umbilical, intracranial for monitoring pressure; peritoneal dialysis, hemodialysis; transfusion; radiotherapy; use of corticosteroid; use of an antimicrobial agent for prophylactic purposes or in treatments of communitarian infections; use of anti-acids; use of an antineoplasic; use of immunosuppressors; use of respiratory support (mechanical ventilation); change in the circuit of the respiratory apparatus within an interval greater than 48 hours; punction/ drainage (thorax cal, abscess, liquoric, ascitic fluid, articular); total parenteral nutrition; surgery; type of surgery undertaken (clean, potentially contaminated, contaminated, infected; installation of a prosthesis; installation of an orthesis and installation of a skin graft.

In order to be included in this study, the patient read and signed a term of informed consent which was provided to him/her or to the person responsible

for the investigator at the moment of the initial evaluation. The data obtained through the application of the survey and through research in the medical records were initially described in terms of discrete or continuous quantitative variables and transcribed in an instrument developed for collecting data.

In order to undertake a preliminary, exploratory analysis, the variables were transformed in binaries and the association with the event hospital infection was tested by the Chi-Square test and by calculating the odds ratio (OR), applied separately to each variable. Only those variables which had a significant effect (p<0,05) for the occurrence of hospital infection were preserved.

Multivariate analysis with logistic regression was undertaken, with the introduction of each variable into the model, one by one, departing from the variable with the largest odds ratio in the univariate analysis to the one with the smallest odds ratio. In the final model, only those variables statistically associated to the event were preserved. The methodology utilized, introducing the variables one by one, made it possible to observe confoundment and interaction.

The statistical program utilized to store and analyze data was SPSS Version 10.

The research project was approved by the Committee on Ethics in Research of the School of Medicine in Botucatu, of the Sao Paulo State University (Unesp).

RESULTS

The percentage of patients studied with hospital infection was 18.6% (61 patients out of 332) and the proportion of hospital infection [HI] among the patients studied was 23.6% (76 episodes in 332).

Table 1 presents the distribution, in percentages, of the topographies of hospital infection. The most prevalent HIs were respiratory infections, (27.6%), infections of the urinary tract (26.4%) and of surgical site infections (23.6%).

Microbiological agents were isolated in 55.2% of the episodes of HI. The agents isolated were: *Pseudomonas aeruginosa* (35.7%), *Staphylococcus aureus* (21.5%), *Escherichia coli* (14.2%), *Staphylococcus coagulase neg*ativa (11.9%), nonfermenting Gram negative *Bacilli* (9.5%) and *Candida sp* (7.2%).

As to the use of antimicrobials, among the 332 patients assessed, 201 (60.5%) received antimicrobials.

The purpose of the use of antimicrobials was pro-

phylactic in 43.8% of the cases, was indicated for treatment of communitarian infections in 25.9% and for treatment of HI in 30.3% of the cases.

Table 2 presents the variables studied which were associated with HI, after statistical analysis by univariate regression. These were: undergoing procedures such as cholangiography, mechanical ventilation, peripheral venous catheters, surgery of the contaminated or infected type, urinary tract catheters, surgery lasting longer than 120 minutes; presence of clinical conditions such as neoplasia, diabetes mellitus, people aged older than 80 years old, chronic obstructive lung disease and communitarian infection.

Table 3 presents the result of variables after multivariate analysis so as to verify the degree of association with the occurrence of HI: cholangiography, diabetes mellitus, chronic obstructive lung disease, urinary catheters, communitarian infection and mechanical ventilation.

Among the patients evaluated, 74 (26.5%) ranged in age from 60 to 65 years of age; 98 (29.5%) were from 66 to 70 years old; 81(24.4%) were from 71 to 75 years old; 48 (14.5%) were from 76 to 80 years old

and 17 (5.1%) were from 80 to 91 years old. The incidence of hospital infection was 14.7% in the age group ranging from 60 to 65 years old; 20.4% in the age group of those from 66 to 70 years old; 14.8% among those from 71 to 75 years of age; 16.6% among patients aged from 76 to 80 years old and 47% among those aged from 80 to 91 years old (p<0,05).

As to their sex, 145 patients (43.7%) were male and 187 (56.3%) were female. There was no differentiation between the sexes as to the occurrence of hospital infection (p=0,33).

The mean period of hospital stay was 8.5 days (standard deviance ±7.2). Occurrence of hospital infection increased the mean period of hospital stay in 8.2 days (±7.8).

The mean period of hospital stay among those patients which did not present hospital infection was 6.9 days (±5.6). The mean period of hospital stay among patients who acquired hospital infection was 15.7 days (±8.9) (p<0.05).

Among the patients assessed, 300 (90.4%) were eventually released from the hospital and 32 (9.6%) evolved to death during their hospital stay.

Among the 219 patients that did not present hospital infection, seven (3.1%) died whereas 14 of the 61 patients with hospital infection, (22.9%) died while they were hospitalized (p<0.05).

DISCUSSION

In recent years, the epidemiology of hospital infections has received attention in the medical literature.

Table 1 - Topography of hospital infections in a sample of hopitalized elderly patients, from September 1999 to February 2000.

Topography	Episode (N)	%
Respiratory infection	21	27.6
Urinary tract infection	20	26.4
Surgical site infection	19	23.6
Blood infection	9	11.9
Gastrointestinal tract infections	5	6.6
Infection of skin and soft part/tissues	3	3.9
Total	76	100

Table 2 - Variables associated with hospital infection in a sample of hospitalized elderly patients from September 1999 to February 2000.

Variable	N	*Odds ratio*	(CI 95%)	p-value
Cholangiography Yes no	5	18.94	2.07 – 172.66	0.000
Mechanical ventilation Yes no	15	10.42	3.42 – 31.78	0.000
Neoplasia Yes no	16	7.64	2.61 – 22.39	0.000
Diabetes mellitus Yes no	49	7.14	3.69 – 13.83	0.000
Peripherical venous catheters Yes no	204	4.52	2.14 – 9.54	0.000
Aged 80 or older Yes no	17	4.39	1.62 – 11.90	0.001
Contaminated or infected surgery Yes no	17	4.39	1.53 – 12.90	0.001
Chronic obstrutive lung disease Yes no	22	4.36	1.85 – 10.29	0.003
Urinary catheters Yes no	96	4.24	2.37 – 7.57	0.000
Surgical time greater than 120 min Yes no	32	2.61	1.18 – 5.57	0.01
Comunitarian infection Yes no	73	2.20	1.20 – 4.06	0.009

Table 3 - Results of the adjustment of the model of logistic regression of the variables associated with hospital infection in a sample of hospitalized elderly patients, September 1999 to February 2000.

Variable	N	Odds ratio	(CI 95%)	p-value
Cholangiography Yes no	5	46.44	4.44 – 485.22	0.001
Diabetes melittus Yes no	49	9.90	4.46 – 22.34	0.000
Chronic obstrutive lung diseases Yes no	22	8.31	2.91 – 23.70	0.000
Urinary catheters Yes no	96	5.71	2.75 – 11.86	0.000
Comunitarian infection Yes no	73	3.95	1.75 – 8.91	0.001
Mechanical ventilation Yes no	15	3.84	1.93 – 6.34	0.007

Populations at risk for acquiring hospital infections have been defined in terms of demographic characteristics (the elderly amongst the latter), medical diagnosis and procedures of increased risk.[11]

The elderly frequently need to be interned in the hospital to care for clinical conditions. However, infections acquired in the hospital environment is very significant in this age group due to its high lethality.[13,14] The elderly individual is more susceptible to acquiring hospital infection due to physiological changes associated to aging, to a decline in the immunological response and to invasive procedures undertaken.[14]

The percentage of patients with hospital infection was 18.6% and the rate of hospital infection among the elderly population studied was 23.6%. Beaujean et al indicated that the population interned in a geriatric ward in Holland presented a 33.3 % rate of patients with hospital infection and the rate of hospital infection was 42%. In a study with adult patients, those with hospital infection represented 17.5% (226/1291).[2] In the first brazilian investigation concerning hospital infections,[10] 8,624 patients were assessed, 2,294 of them were over 60 years old. The percentage of patients with hospital infection was 13% and among the elderly patients, it was 11.9%. The geriatric population studied presented lower rates of hospital infection than an investigation undertaken among an elderly population and a higher rate than was found among elderly patients in the Brazilian study on hospital infection.[1,10] Different population profiles should be taken into consideration when discussing the rates of hospital infection; patients submitted to procedures of increased risk and those at age extremities (neonates and the elderly) have increased rates of hospital infection.[8,14]

The prevalent topographies of HI in the hospital investigated were respiratory infection (27.6%), urinary infection (26.4%) and infection of the surgical site (23,4%). According to Prade et al,[10] in a multicentric Brazilian study with populations of all age groups, the prevalent topographies were respiratory infection (28.9%), infection of the surgical site (15.6%) and of the skin (15.5%). Zamir et al[15] state that the most frequent topographies of hospital infection were infection of the urinary tract, pneumonia and sepsis with the following rates respectively, 40.8%, 32.9% and 9.2%. It may be observed that the population studied presented topographies similar to those indicated in the literature, although the distribution was different.

In this study, the mean period of prolonged hospital stay, after the patient acquired hospital infection was 8.2 days. This represents a longer period than that indicated in the Study of Efficacy of Nosocomial Infection (SENIC), which describes an average of four days of prolonged hospital stay,[7] indicating that when the elderly acquire hospital infection they require a longer period of internment.

A study with 645 adult patients in a university hospital in England presented a rate of hospital infection of 15%.[5] The following risk factors were described: endotracheal intubation (OR 10.6), urinary catheters (OR 5.6), central venous catheters (OR 3.4), non-elective admission to the hospital (OR 3.4), patients over 65 years old (OR 2.9), white race (OR 2.0), male sex (OR 1.7), surgical procedure performed (OR 1.6). In this study, the risk factors related to the development of HI were cholangiography (OR 46.44), diabetes mellitus (OR 9.9), chronic obstructive lung disease (8.31), urinary catheters (OR 5.71), communitarian infection (OR 3.95) and mechanical ventilation (OR 3,84). The factors observed were similar to those described in the literature, except for the presence of cholangiography. The latter presented an elevated rate of HI per procedure (80%) and, although there were a limited number of cases analyzed (five patients), suggests that further studies of this risk factor for HI should be undertaken. An important data of this study was the observation of clinical conditions (diabetes mellitus, chronic obstructive lung disease and communitarian infection) and the absence of the use of central venous catheters and of surgical procedures, described in the literature as risk factors for hospital infection.[2,5]

Microbiological agents were isolated in 55.2% of the episodes of hospital infection. The frequency with which these agents were identified were: *Pseudomonas aeruginosa* in 35,7% of the episodes, *Staphylococcus aureus* in 21.5%, *Escherichia coli* in 14.2% and *Staphylococcus coagulase negative* in 11.9%. According to data from the *National Nosocomial Infections Surveillance System*, from 1990 to 1994, the pathogens most frequently isolated in hospital infections were: *Escherichia coli* in 12,3% of the cases, *Staphylococcus aureus* in 11.4%, *Enterococcus sp* in10.9% and *Pseudomonas aeruginosa* in 10.6%.[8] In this study, the isolated agents found were the same as those described in the literature, however the frequency was different. It is interesting to note that the diagnosis of the etiological agent was only diagnosed in 55% of the cases.

The general rate of mortality of patients assessed was 9.8%. The rate of lethality among patients assessed with HI was 22.3%. Findings of the SENIC Project indicate that 10% of the patients with HI died in the american hospitals.[7] This data indicate how the population which has acquired a hospital infection presents a higher rate of lethality than the population which has not acquired hospital infection.

Among the patients included in this study, 60.5% (201) made use of antimicorbial agents during their hospital stay. The reason they did so was for a prophylactic end in 43.8% of the cases, 25.9% utilized these agents in treatments for communitarian infections and 30.3% utilized these agents in treatments for hospital infection. In the first Brazilian investigation on hospital infections,[10] 48% of the patients of all age groups assessed utilized antimicrobials. The total percentage of elderly patients in the hospital studied which used antimicrobial agents is greater than that indicated in the international literature.

Hospital infections among elderly patients in this sample presented increased incidence and rates of lethality and the length of stay in the hospital also increased. The elderly people which presented greater risks of developing HI were the diabetes mellitus carriers, those that had chronic obstructive lung disease and communitarian infections when they were admitted to the hospital as well as the patients submitted to an endoscopic regressive cholangiography, urinary catheters and mechanical ventilation.

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