

# Major infections in hospitalized patients with stroke: a prospective study

ORIGINAL

## Abstract

**Objective:** To describe the occurrence of infection in patients with stroke.

**Materials and Methods:** A cohort prospective study of 143 patients admitted to a stroke unit from December / 2014 to June / 2015.

**Results:** The mean age was 67.8 years with history of hypertension and Ischemic Stroke; the main infections were related to the respiratory (8.4%) and urinary tract (7.7%); the invasive devices used, were: peripheral venous access (95.1%) and nasoenteral tube (31.25%); the prevalent microorganisms were *Escherichia coli* and MRSA. Protections to occurrence of infection were related to: non-alcoholic patients and non- HIV infection carriers; non-use of urinary catheter and endotracheal intubation ( $p > 0.05$ ); presence of Hemorrhagic Stroke predisposed to occurrence of urinary tract infection ( $p > 0.05$ ).

**Conclusion:** prognosis of the patient depends on the type of stroke and occurrence of infections related to health care.

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## Keywords

stroke; infection; risk.

## Introduction

The relationship between stroke and infection is complex, due to the multiple variables involving the theme. The terminology *Stroke-Associated Infections* (SAI), is defined as an infectious involvement between five and seven days after the acute stroke episode [1].

The risk of infection related to stroke can be studied in two ways: pre-stroke infections - as a factor which predisposes the occurrence

of stroke; and post-stroke infections - as a powerful aggravating factor of the acute patient with consequent increased risk of death and severity of sequelae [2,3].

Stroke patients commonly present occurrence of infection, which may influence the prognosis. In this context the infection should be considered a key indicator of the patient safety program [4].

Brain damages caused by ischemia or by hemorrhage can lead to systemic immunosuppression which predisposes to infection. The degree of immunosuppression, although being related to stroke severity and dysphagia, clinically reports that impaired immunity may have been induced by the brain, after stroke [5].

The impact of stroke and infectious complications due to immobility, paresis, invasive procedures and co-morbidities, indicate that urinary tract infection (UTI) caused by *Escherichia Coli* bacteria is mainly responsible for up to 85% of the cases [6-7].

Occurrence of infection constitutes a health problem due to high morbidity and mortality and associated costs, being among the most frequent complications of hospitalization [2,5].

Therefore, this study aims to: identify the epidemiological profile of the patients; identify key infections, causing microorganisms and topography; associate clinical and epidemiological variables to the infection event; check if the length of stay and type of CVA are associated with the occurrence of infection related to health care in a stroke unit.

## Materials and Methods

Prospective cohort study at initial clinical phase, in Hospital das Clínicas, Faculty of Medicine of Botucatu, at the stroke unit, comprising medical records in electronic software of 143 patients during hospitalization from December / 2014 to June / 2015. Stroke occurrence was configured as the exposure factor and outcome of the infection.

The study was approved by the Ethics Committee of the Faculty of Medicine of Botucatu, 821,429,

CAAE: 35322914.6.0000.5411, by Brazil Platform.

To avoid selection bias, some criteria were applied for inclusion of patients in the sample: patients with confirmed stroke diagnosis at admission to the Unit by clinical examination and MRI imaging or CT scan. Follow-up was interrupted when patients were discharged, or died.

All patients with ischemic stroke and intraparenchymal hemorrhage diagnoses, regardless of gender and age, and patients necessarily accompanied by neurologists and admitted to the stroke unit, were included.

All patients with transient ischemic attack (TIA), Subarachnoid Hemorrhage (SAH), unconfirmed diagnoses or indeterminate and secondary causes (encephalopathy, acute headache and aneurysm), were excluded.

An electronic data collection instrument was employed, containing the variables of interest during verification on the electronic medical record of each patient included. According to the presence or absence of data, they were transcribed to the instrument.

Study variables were divided into epidemiological and clinical, comprising: demographic data; comorbidities (hypertension, diabetes mellitus, smoking, alcohol consumption, dyslipidemia, HIV infection +, antibiotic therapy, and previous stroke and thrombolysis); use of invasive devices, such as central and peripheral venous catheters, nasoenteral tube, urinary catheter and orotracheal tube, which were associated to the occurrence of infectious outcomes of the respiratory tract, urinary tract and bloodstream.

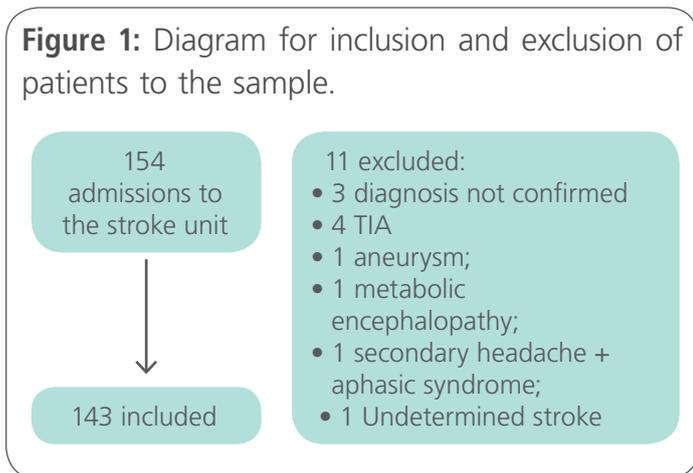
Criteria for identifying infection in the stroke unit are defined by routine laboratory screening: CRP, blood count, blood cultures, urine cultures, chest X-ray and urinalysis, aiming to identify the etiologic agents and start the treatment. The identification of infection associated with stroke was based on the medical progress notes of the patients in electronic medical records, and defined by occurrence during the length of stay at the stroke unit, and non- in-

cupation at the time of admission.

Chi-square test was used to assess associations between occurrence of infection or no infection, with the variables of interest, and considered for analysis  $p < 0.005$  as statistical significance level.

## Results

**Figure 1** shows a diagram with inclusion and exclusion criteria of the patients; the sample of 143 patients was characterized as: 136 (94.4%) subjects were affected by ischemic stroke and seven (4,9%) by hemorrhagic stroke.



The average age of patients was 67.8 years, predominated by females (76 / 53.1%). Hypertension was the most common comorbidity (125 / 87.4%) followed by diabetes mellitus (62 / 43.4%), smoking (31 / 21.7%), dyslipidemia (28 / 19.6 %) and alcohol consumption (12 / 8.4%).

Other variables were also analyzed for presence and absence; the previous stroke occurred in (23/16%), antibiotic therapy in (38 / 26.6%) and thrombolysis procedure was performed in (17 / 11.9 %).

The use of invasive device was found in (139 / 97.2%), comprising peripheral venous access (136 / 95.1), nasoenteral tube (54 / 37.8%), urinary catheter (16 / 11.2%), central venous catheter (4 / 2.8%) and orotracheal tube (3 / 2,1%).

A total of 26 infections were found, and regarding infection topography, 8.4% are related to the respiratory tract infection, 7.7% to urinary tract infection and 2.1% to bloodstream.

There was no evidence of skin infections, soft tissue and surgical site of the patients. Multiresistant microorganisms are observed in 1.4% of the patients.

Prevalence of 8.4% respiratory infection rate was evidenced, plus 7.7% urinary tract infection rate, which corroborates the data from the major current studies in stroke units. It is very low, if compared to nosocomial infections occurrence in critical care units, which present approximately 30% of RTI [9].

A 2.1% bloodstream infection rate was obtained, and three multiresistant microorganisms were identified.

The microorganisms isolated and identified by the culture of microbiological examination were: *Enterobacter aerogenes* (1) *Escherichia coli* (4), *Citrobacter freundii* (1), *Acinetobacter baumannii* (1), MRSA (2) *Staphylococcus epidermidis* (1), *Candida krusei* (1) mixed microbiota (1), *Sphingomonas paucimobilis* (1) *Pantoea spp* (1), *Pseudomonas aeruginosa* (1), and one infection event was caused by fungus, and another by mixed microbial contamination.

The highest incidence was related to Gram negative (10 / 66.6%), when compared with Gram positive (5 / 33.3%).

**Tables 1** and **2** show the associations between the study variables and infections occurrence, according to infections topographies. Protection variables were observed in infections occurrence (respiratory and urinary tract infection), since non-alcoholic, non-HIV patients, who were protected from respiratory and urinary tract infections occurrence. It was also observed that the absence of invasive devices use (urinary catheter and central venous catheter) protected against urinary tract infection, as for dyslipidemic patients.

**Table 1.** Association between epidemiological variables and respiratory, urinary and bloodstream infections occurrence. Botucatu, 2016.

Variables	Categories	Respiratory Infection	Urinary tract infection	Bloodstream Infection
Gender	F	4	5	1
	M	8	6	2
		>0,05	>0,05	>0,05
Type of Stroke	Ischemic	11	10	3
	Hemorrhagic	1	1	0
		>0,05	<0,05	>0,05
Hypertension	Presence	9	8	2
	Absence	3	3	1
		>0,05	>0,05	>0,05
Diabetes Mellitus	Presence	2	2	1
	Absence	10	9	2
		>0,05	>0,05	>0,05
Smoker	Presence	3	2	1
	Absence	9	7	2
		>0,05	>0,05	>0,05
Alcoholic	Presence	0	0	0
	Absence	12	11	3
		<0,05	<0,05	>0,05
Dyslipidemia	Presence	1	1	1
	Absence	11	10	2
		>0,05	<0,05	>0,05
HIV Infection	Presence	0	0	0
	Absence	12	11	3
		<0,05	<0,05	>0,0005
Antibiotic therapy	Presence	12	11	3
	Absence	0	0	0
		<0,05	<0,05	>0,05
Previous Stroke	Presence	2	1	1
	Absence	10	10	2
p-value <0,05		>0,05	>0,05	>0,05

Hemorrhagic stroke suggests predisposition to UTI occurrence, however, data should be interpreted with caution, due to the low number of infected patients in this category.

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**Table 2.** Associations between the variables of the clinical profile and respiratory, urinary and bloodstream infections occurrence. Botucatu, 2016.

Variables	Categories	Respiratory Infection	Urinary tract infection	Bloodstream Infection
Procedures and invasive devices	Presence	11	10	3
	Absence	1	1	0
		>0,05	>0,05	>0,05
Orotracheal tube	Presence	0	1	0
	Absence	12	10	3
		>0,05	<0,05	>0,05
Central venous catheter	Presence	2	2	0
	Absence	10	7	3
		>0,05	>0,05	>0,05
Urinary catheter	Presence	1	0	1
	Absence	11	11	2
		>0,05	<0,05	>0,05
Peripheral venous catheter	Presence	12	1	3
	Absence	0	10	0
		>0,05	>0,05	>0,05
Nasoenteral tube	Presence	7	6	3
	Absence	5	5	0
		>0,05	>0,05	>0,05
Thrombolysis	Presence	2	2	0
	Absence	10	9	3
p-value <0,05		>0,05	>0,05	>0,05

Among the identified invasive devices used in patients, the peripheral venous access predominated, followed by the nasogastric tube. It is worth noting a low frequency of the urinary catheter, central venous catheter and orotracheal tube use, which meets the guidelines of the *American Heart Association* and the *European Stroke Association* [9].

**Table 3** indicates the variable length of stay and occurrence of infections, concerning the patients studied.

**Table 3** indicates as hospital stay increases, the higher the possibility of infection. The occurrence of infection is also related to care and minimum invasive procedures which stroke patients were submitted. The average residence time in the unit is related to the infection rate, since for respiratory infections the average residence time was 5.6 days; for urinary tract infections was 8.7 days and bloodstream infections the average length of stay was 6.3 days.

**Table 3.** Variables average length of stay in days and standard deviation of the occurrence of respiratory, urinary and bloodstream infections. Botucatu, 2016.

Length of stay (N=143)				
	Mean	Minimum	Maximum	
	4.51	0.00	22.00	
Respiratory Infection	Mean	Stand. Dev.	Minimum	Maximum
Absence	4.5889	3.4312	0	22.00
Presence	5.6364	3.2333	2.00	13.00
Urinary tract Infection	Mean	Stand. Dev.	Minimum	Maximum
Absence	4.3043	2.6301	0	16.00
Presence	8.7778	6.7966	2.00	22.00
Bloodstream Infection	Mean	Stand. Dev.	Minimum	Maximum
Absence	4.6061	3.3649	0	22.00
Presence	6.3333	5.7735	3.00	13.00

## Discussion

Studies show that diabetic patients are 10 times more likely to develop a stroke than non-diabetic patients. Diabetic patients, in this study, have presented a higher number of infectious complications during hospitalization and an increased risk of mortality [8].

It corroborates the literature, considering that the stroke unit provides a service with early actions aimed at rehabilitation, patient mobilization during the acute phase, helping to decrease the risk of developing pneumonia [9].

Preventive actions in this regard are listed by the American Heart Association and European Stroke Association: prophylactic antibiotic therapy not recommended, decrease in indwelling catheters residence time, encouraging patient mobility, swallowing evaluation before eating or drinking. Regarding the nutritional value, supplementation use is

recommended only for patients without dysphagia problems and malnourished, patients who can not receive oral feeding should use tubes (nasogastric or nasoenteral) [9].

These results demonstrate the care of epidemiological surveillance by CCIRAS institution, considering the rate of infection as an indicator of quality care at the stroke unit [10].

The literature shows that microorganisms observed in the intensive care unit for treatment of stroke, are: *Pseudomonas*, *Staphylococcus aureus*, *Klebsiella*, *Enterobacter aerogenes* and *Acinetobacter baumannii* [11].

In relation to age, gender and the low rate of patients infected with hemorrhagic stroke, studies indicate that the female patient, bedridden, under intensive care, presents greater change in microbiota, and due to urinary retention, or difficulty of total bladder emptying and general dysfunction of the

bladder, the risk of infection is increased [12].

Prophylactic antibiotic therapy in patients with acute stroke is not recommended by the *American Heart Association* and *European Stroke Association*, for systematic reviews do not show the benefits regarding treatment and patient prognosis [9].

But, when observing only the variable length of stay, regarding urinary tract infection occurrence, corroborating data in stroke unit covering an average of 9.8 days [13]. Occurrence of pneumonia is observed in 11 days and for urinary tract infection, 10 days.

In another study, data show assessment of the risk of developing pneumonia in patients with hemorrhagic stroke and conclude that the probability increases in patients interned in hospital for more than 48 hours [14].

NIHSS is a scale used in the clinic, to quantify the neurological deficit associated with the episode of acute stroke; it is valid for predicting lesion extension and severity.

The permanence time higher than seven days and NIHSS higher than 11, are associated with the occurrence of non-serious infectious complication. However, when these factors were compared with the patient's prognosis worsening, hospital permanence longer than 7 days constitutes a complicating factor [15-16].

In this same study, dysphagia, the use of central catheters, intermittent bladder catheterization, mechanical ventilation and length of hospital stay of 17 days, as average, were factors associated to the occurrence of respiratory infection and urinary tract infection.

## Conclusion

The main infections observed during post-stroke are constituted by respiratory, urinary and bloodstream infections, which are related to the profile of patients interned in the stroke unit, with advanced age, hypertension and diabetes mellitus. Patients who did not use orotracheal tube and urinary catheter

ter were protected from urinary tract infection occurrence. Hemorrhagic stroke predisposes to urinary tract infection. The predominant microorganisms were *Escherichia coli* and MRSA, respectively identified in the urinary tract and bloodstream. Hospitalization length of stay constituted a risk factor for the development of post-stroke infections.

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