The Predictors of Early Infection After An Acute Ischaemic Stroke

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ABSTRACT

Background and purpose: Infection is a frequent complication after an acute stroke and may affect stroke outcome. We identified predictors of early infection, type of infection, their relation to initial disability, and the eventual outcome during the in-patient period.

Methods: This was a study of patients with acute ischaemic stroke admitted to Universiti Kebangsaan Malaysia Hospital from June 2000 to January 2001. A single observer, using pre-defined diagnostic criteria recorded information on demography, the type, time of onset, and frequency of infections that occurred during the inpatient period.

Results: One hundred and sixty three patients with acute ischaemic stroke were enrolled in the study. Early infection was observed in 26 (16%) patients. The infections observed were pneumonia (12.3%), and urinary tract infection (3.7%). Using multivariate analysis, the independent predictors of early infection were Barthel index (BI) less than 5 (OR 4.23; 95%CI 1.70 to 5.11), middle cerebral artery (MCA) territory infarcts (OR 4.91; 95%CI 1.57 to 8.82), and a Glasgow coma score (GCS) less than 9 (OR 5.12; 95%CI 2.98 to 15.52). The presence of early infection increased mortality (OR 14.83; 95%CI 4.31 to 51.07).

Conclusions: Severe disability, large MCA infarct and poor GCS independently predict the development of early infection.

Keywords: early infection, ischaemic stroke, mortality

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INTRODUCTION

Stroke is the third leading cause of death in the world after heart disease and cancer. The annual incidence of stroke in the community is about 2 per 1,000 population[1]. Patients who have had an acute stroke are at risk of developing a wide range of complications. These complications are important because they may cause death or delay successful rehabilitation[2-4]. Several studies had shown that death occurring in the following weeks was mainly due to potentially preventable problems especially early infection[5-7].

Common early infections after an acute stroke are urinary tract infection, chest infection, and skin infection. Davenport et al[8] reported that the commonest complication after an acute stroke was mainly infection; urinary tract infection (16%), and chest infection (12%). Silver et al[7] reported that approximately 40% of deaths were from medical complications in a series of nearly 1,000 ischaemic stroke patients. They also noted that most deaths in the second and third week after stroke could be attributed to medical complications, which were mainly infection. The relationship between predictors of early infection and mortality has not been systematically examined. The purpose of this study was to describe the frequency of early infection in an acute ischaemic stroke cohort and then to investigate the predictors of early infection and their impact on mortality.

MATERIALS AND METHODS

In a single hospital (HUKM), a cohort of patients was identified. They consisted of consecutive patients who were either admitted to the general medical ward, high dependency ward or the intensive care unit with a clinical diagnosis of ischaemic stroke (first ever or recurrent within one week of onset of symptoms) or had suffered a stroke during an inpatient stay during the period June 2000 to January 2001. Acute stroke was defined as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin", according to the World Health Organisation (WHO) criteria[9]. Early infection was defined as infection occurring within three days after the onset of the stroke. A single observer, using pre-defined diagnostic criteria, recorded the type, and frequency of early infection that occurred during the inpatient period. The parameters on admission, which included the glucose levels, Glasgow coma score (GCS) and the Barthel activities of daily living (ADL) index were also recorded. On discharge, the length of stay and outcome were recorded. All patients were subjected to a brain CT before being admitted to the wards.

Statistical Analyses: Two separate analyses were conducted. In the first analysis, the presence of early infection was determined to be the dependent variable. Independent variables were demographic characteristics, admission parameters, and type of cerebral infarcts. Variables which were found to have a significant relationship ($p<0.05$) with presence of early infection were included in a multiple logistic regression model. Logistic regression was carried out using the step backward method. In the second analysis, similar steps were followed except that early infection was now considered an independent variable and mortality was made the dependent variable. In both univariate and multivariate analyses, odd ratios with 95% confidence intervals (CI) were used to estimate the effects of each factor.

RESULTS

During the eight-month study period, 163 ischaemic stroke patients were identified. The mean age was 62.2 years (35 to 88 years), and 105 patients (48.2%) were male. There were 83 (50.9%) Chinese patients, 66 Malay (40.5%) patients, 13 Indian (8.0%) patients, and 1 patient from other races (0.6%). The types of ischaemic stroke found were middle cerebral artery (MCA) territory (26.4%), lacunar infarcts (62.6%), and others (11.0%). On admission, the mean systolic blood pressure (SBP) was 170.3 mmHg (84 to 275 mmHg), diastolic blood pressure (DBP) 89.4 mmHg (30 to 158 mmHg), random blood glucose 12.3 mmol/l (2.6 to 27.5 mmol/l), Glasgow coma score (GCS) 13.5 (3 to 15) and Barthel index (BI) 10.1 (0 to 20).

Early infection was observed in 26 (16%; 95% CI 10.7-22.5) patients; pneumonia 20 (12.3%; 95% CI 7.7-18.3), and urinary tract infection 6 (3.7%; 95% CI 1.4-7.8). The case fatality rate for ischaemic stroke was 11.7% (95% CI 7.2-17.6). The mean length of stay (sd) was 7.48 (3.67) days. Three variables (BI<5, GCS<9, and MCA infarct) were associated with early infection in the univariate analysis (Fig. 1). Independent predictors of early infection using multivariate analysis were Barthel index (BI) less than 5, middle cerebral artery (MCA) territory infarcts, and a Glasgow coma score (GCS) less than 9 (Table I). No interactions were found between these predictors. There was no significant increase in risk of early infection in the other parameters observed, namely old age, past history of Diabetes Mellitus, and blood glucose on admission (Fig. 1). Early infection following acute stroke increased mortality (OR 14.83; 95% CI 4.31 to 51.07)(Table II).

DISCUSSION

The study was hospital-based. Patients were identified using an internationally recognised definition of stroke and were seen at least once by the consultant neurologist to ensure case ascertainment. These patients were then assessed by a single observer for infection and death.

The overall mean length of stay was 7.48 days. This was shorter compared to other studies which documented much longer mean lengths of stay such as 28 days (Van Straten et al[10]), 37 days (Davenport et al[8]), and 52 days (Dromerick et al[11]). Among the reasons for the longer stay cited by these studies were delays in provision of equipment and home adaptations and delays in placing patients in private nursing homes. In Malaysia, these delays are probably less relevant as we have different cultural practices. Patients are often sent home to their families as the long-term care is considered the responsibility of the patient's family. Nonetheless, in our hospital, patients can only be discharged when the family and patient were prepared and ready to go home. Caregivers were taught basic patient rehabilitation care (feeding, transferring, physiotherapy, communication, use of special mattresses and stockings, etc) by our stroke team. Discussions and explanations were also held regularly in weekly stroke meetings.

Early infection occurred in 16% of patients. This figure is similar to that reported by Kammersgaard LP, et al[12]. The commonest early infection in our study was pneumonia (12.3% of patients). This is consistent with other series[8,12,13]. We postulate the reason for the high incidence of pneumonia was that the patients were usually fed at home before being admitted and the patient

Fig. 1 Univariate analysis for predictors for early infection after an acute ischaemic stroke. BI indicates Barthel index; GCS, Glasgow Coma Score; BG, blood glucose; CI, confidence interval; and OR, odds ratio.

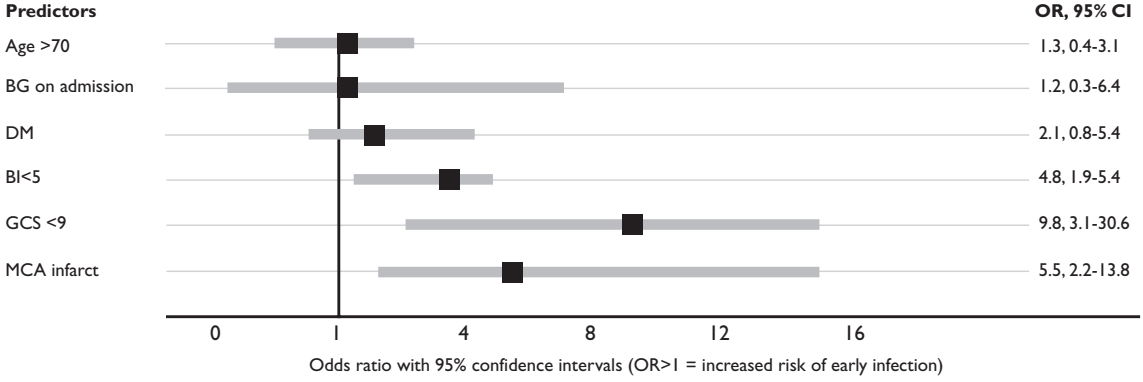

Table I. Multivariate analysis for predictors of early infection.

Variable	p Value	Odds Ratio	95% Confidence Interval	
			Lower	Upper
BI<5	0.023	4.23	1.70	5.11
GCS<9	<0.0001	5.12	2.98	15.52
MCA infarct	0.0014	4.91	1.57	8.82

Table II. Multivariate analysis for risks of mortality.

Variable	p Value	Odds Ratio	95% Confidence Interval	
			Lower	Upper
MCA infarct	0.005	9.03	1.92	42.30
GCS<5	0.007	4.11	1.78	15.82
Early Infection	<0.001	14.83	4.31	51.1

or relatives were not aware of swallowing problems or aspiration. Pneumonia is a frequent sequelae of aspiration and the failure to recognise this may have contributed to the high frequency of chest infection. Patients with infection were subjected to intravenous antibiotics and needed longer time to recover. Thus, delay in discharge was unavoidable[12].

The overall mortality rate was 11.7%. This result is similar to that reported by other series[8,13,14]. It is imperative to identify ischaemic stroke patients who have a high risk of developing early infection. The presence of early infection increased mortality (OR 14.83; 95% CI 4.31 to 51.07). Several factors were examined in this study, which included age, risk factors for atherosclerosis (diabetes, hypertension, smoking, hypercholesterolaemia, etc), admission parameters (blood pressure, blood glucose, GCS, and BI score), and type of infarct. We believe this observation may have important implications as prevention and identification of early infection will improve the mortality rate of stroke patients. Furthermore, avoiding unnecessary prolongation of hospital stay will also have tremendous reduction in the overall financial cost. The independent predictors of early infection were a Barthel index (BI) less than 5 (OR 4.23; 95% CI 1.70 to 5.11), middle cerebral artery (MCA) territory infarcts (OR 4.91; 95% CI 1.57 to 8.82), and a Glasgow coma score (GCS) less than 9 (OR 5.12; 95% CI 2.98 to 15.52). As expected, poor GCS (less than 9) was a major predictor for early infection. This is also the case for large cerebral infarcts (MCA territory). Large cerebral infarcts usually produce marked functional disability and low GCS. A poor GCS was associated with almost 10 times the risk of early infection followed by large MCA infarcts and very severe functional disability (BI less than 5) respectively. The measurement of the Barthel ADL index in this study was important as it determined the actual clinical functional disability. Some patients with small lacunar infarcts also had severe disability due to dense hemiplegia. These patients almost always had a full GCS. Nonetheless, it was also found to be an independent risk factor for early infection. These patients were usually bed-ridden and predisposed to chest and urinary tract infections.

The type and quality of care patients receive may influence infection rates. Patients cared for in a dedicated stroke unit, and who are under more meticulous observation by experienced staff, may experience fewer complications such as early infection. Aspiration pneumonia and urinary tract infection may appear to be more frequent simply because of better recognition and documentation rather than a real increase. If this was the case, one might be able to identify, anticipate and institute treatment at an earlier stage, thus improving prognosis. In our study, the occurrence of early infection clearly increased the risk of mortality and any effort to reduce the early infection rate will be expected to reduce mortality. This had also been shown in several other studies[7,8,12].

CONCLUSION

Early infection was found to increase mortality. The independent predictors for the occurrence of early infection were a poor GCS (less than 9), MCA territory infarcts, and very severe disability (BI less than 5). Therefore, patients who have the aforementioned predictors should be carefully monitored and promptly treated.

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