Original Article

Predictors of In-hospital complications in patients of posterior circulation ischemic strokes — a study from a tertiary care centre in Eastern India

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In-hospital complications (neurological and medical) occurring after acute stroke are important prognostic factor dictating the final outcome. So anticipating these complications at the time of admission can enhance surveillance and lead to preventive and timely therapeutic measures improving the outcome in stroke patients. So this study was done to determine the factors predicting in-hospital complications in patients of posterior circulation strokes. This study was aimed to determine the factors that could predict in-hospital complications in patients of posterior circulation strokes. This prospective study included all patients of posterior circulation ischemic strokes admitted in a tertiary care centre in Eastern India over a one year period (n=76). Neurological & medical complications (NMC) included neurological deterioration [ie, worsening by 4 points or more of the National Institute of Health Stroke Scale (NIHSS) score during the hospital stay] and all other medical complications that the patients developed during their hospital stay prior to their discharge or in-hospital mortality. In 30.3% of patients with ischemic stroke developed NMC. Patients who experienced NMC had a higher mean baseline NIHSS score at admission (6.4 *versus* 4.2,P <0.01).Patients having diabetes as a risk factor had significantly higher rates of complications. In hospital complications were significantly higher in patients having cardio-embolism as the stroke mechanism and in those having infarcts in the distal territory of posterior circulation (distal to and including Superior Cerebeliar Artery (SCA) territory). 30-day mortality and 6 month outcome was significantly poor in patients having complications. Higher NIHSS score (>4), diabetes as a risk factor, cardio-embolism as the stroke mechanism and distal territory infarcts (distal to and including SCA territory)were significant predictors of NMC in patients of posterior circulation strokes which ultimately dictated the 30-day mortality and 6 month outcome. The clinical significance of these findings requires further evaluation in larger prospective studies.

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Neurological and medical complications (NMC) occur frequently in patients of stroke, especially during the acute phase and are responsible for a poor clinical outcome. Early neurological deterioration occurs in as many as 40% of patients with acute stroke[1-3]. Several patho physiological mechanisms like recurrence or extension of infarction, hemorrhagic transformation or fresh hemorrhage, cerebral edema, seizures or hydrocephalus may be responsible for this early neurological deterioration. Besides these post-stroke neurological events, several medical complications like urinary infections, chest infections and aspiration, pressure sores, deep venous thrombosis, pulmonary embolism, gastro-intestinal bleed and congestive cardiac failure occur frequently and turn out to be a major cause of mortality and morbidity in the acute and sub acute phases of stroke[2,4-6]. Hence, it is very important to predict these complications as early as possible in patients of stroke so that appropriate interventions at an appropriate time can be undertaken to achieve a favourable outcome.

The National Institutes of Health Stroke Scale (NIHSS) is widely used as a standard instrument to evaluate the severity of a patient's neurological deficit[7]. The NIHSS score is very easy to assess by neurologists as well as non-neurologists after appropriate training[8,9]. NIHSS has been used in many stroke trials to evaluate neurological outcome and has been shown to have very good reliability

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and validity[10,11]. Further more, evidence exists to show that the NIHSS is associated with final outcome after a stroke in terms of length of stay[12], survival and discharge destination[13]. However, it is not known whether NIHSS score at onset can predict the occurrence of neurological and medical complications during the acute phase of stroke, especially in posterior circulation strokes. Hence this study was carried out to know whether any such association exists and to determine other predictors of in-hospital complications in patients of posterior circulation strokes.

MATERIAL AND METHODS

This prospective longitudinal study was carried out at a tertiary care centre of Eastern India. All consecutive cases of posterior circulation ischemic strokes admitted during one year period were enrolled in this study. Posterior circulation ischemic strokes included the ischemic strokes occurring in the area supplied by the two vertebral arteries, basilar artery, posterior cerebral arteries and their branches. Patients with a transient ischemic attacks, absence of a corresponding ischemic lesion, poor initial prognosis (comatose or intubated patients, pulmonary infection or severe sepsis at admission), patients with onset of symptoms more than 6 hours earlier, patients with multiple lesions affecting both anterior and posterior circulations and patients with any evidence of hemorrhage were excluded. Cranial computed tomography and/or magnetic resonance imaging, 12-lead electrocardiography, cervical Doppler ultrasonography, transthoracic echocardiography, and standard laboratory tests were performed in all patients on admission. Transesophageal echocardiography, specialized laboratory tests, and Holter electrocardiographic monitoring were performed in selected patients.

Patients were assessed for age, gender, risk factors – hypertension, diabetes, dyslipidemia, Rheumatic heart disease (RHD), atrial fibrillation, smoking, alcoholism, ischemic heart disease, history of transient ischemic attack (TIA), migraine and family history. Hypertension was diagnosed as per the JNC7 criteria[36], diabetes as per the ADA guidelines[37] and dyslipidemia as per the NCEP-ATPIII criteria[38]. Infarcts were localized into four categories – proximal, middle, distal and multiple[39]. The proximal territory included regions supplied by the intracranial vertebral artery – the medulla oblongata and the posterior inferior cerebellar artery supplied region of the cerebellum. The middle territory included brain regions supplied by the basilar artery upto the superior cerebellar artery branches – the pons and anterior inferior cerebellar artery supplied region of cerebellum. The distal territory included regions supplied by rostral basilar artery, superior cerebellar artery, posterior cerebral artery and their penetrating branches – midbrain, thalamus, superior cerebellar artery supplied cerebellum and the posterior cerebral artery territories. The

Stroke mechanism were classified according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification[43]. Outcome at 6 months was considered good if Modified Rankin Scale (MRS)[40,41] score was 0-3 and poor if MRS score was 4-6. Detailed neurological examination was done. NIHSS[42] score at the time of admission was assessed. Patients were carefully monitored during the course of hospitalization for the development of neurological and medical complications. A neurological event was defined as worsening by 4 points or more of the NIHSS score during the hospital stay. This clinical deterioration was systematically documented by instrumental examination (brain computed tomography scan and/or magnetic resonance imaging to determine the mechanism of this complication). For other medical events, the occurrence of infectious complications was recorded prospectively. The presence of other complications was confirmed by records in the patients charts, clinical sign and diagnostic tests. Whenever needed, a specialist consultation was used to confirm a diagnosis.

Appropriate approval was taken from the institutional ethics committee. All the statistical analysis was done using the SPSS statistical software version 24.

RESULTS

Out of total 76 patients of ischemic stroke, 23 patients (30.26%) suffered from NMC. Table 1 shows the frequency of different medical complications. Table 2 shows the various variables that we compared among the two groups (those with complications and those without complications) including risk factors, NIHSS at admission, mechanism of stroke and outcome.

Risk factors : Incidence of diabetes was significantly higher in the complications group as compared to the non-complication group. There was no significant difference in the incidence of the other risk factors in the two groups.

NIHSS at admission : The mean NIHSS at admission of the group having was NMC was significantly higher than group without NMC.

Stroke Mechanism : Complications were significantly higher when cardio-embolism was the stroke mechanism as compared to the other stroke mechanisms.

Localization of stroke : When localization of infarct was considered, complications were significantly higher in the patients having distal territory infarcts as compared to the proximal, middle or multiple territory infarcts (Table 2).

Outcome : 30-day mortality and poor outcome at 6 months was significantly higher in the group having NMC as compared to the groups without NMC (Table 3).

Table 1 — *In-hospital Neurological and Medical Complications*	
Complications	Frequency
Chest Infections	9
Urosepsis	4
Dyselectrolytemia	6
Post stroke sepsis	4

When frequency of various complications was reviewed, chest infections was the most common complication seen in 11.8% of patients (Table 1).

DISCUSSION

The present study showed that an increased baseline NIHSS score in ischemic stroke patients was associated with an increased risk of NMC. NIHSS assessment may be a useful approach to predict all NMC, even in patients with posterior circulation infarction, because it can alert the physician to the anticipated risk of NMC in an individual patient and can thus affect early decisions about further management.

In this study, 30.3% of patients experienced complications. This is similar to the incidence of complication reported by Boone et al (27%)[14] and other recent studies[2,15,16] whereas in the older studies[6,17-19], this complication rate was around 90%. Improved care of patients in established stroke units[23] could be a reason for this significant drop in the incidence of complications in these recent studies[2,14-16]. Also, differences in study designs, criteria used for identifying complications, and also variations in identification and recording of complications might be another possible explanation for this heterogenous results in various studies. Chest infection is the most frequent complication in most of these studies[4]. Age more than 65 years, impaired consciousness, dysphagia, speech impairement and cognitive impairment are the predominant risk factors for the development of chest infections[24-26]. High NIHSS score at admission, associated with several other clinical variables, can identify stroke patients at higher risk of chest infections[27]. Increased age and stroke severity have also been postulated as important predictors of urinary tract infections[28,29], another frequent complication in acute stroke patients reported in these studies.

In patients of ischemic stroke, the stroke severity is increasingly been measured using NIHSS. In anterior circulation strokes, lesion volumes correlate well with the NIHSS score[30], but it is not so in posterior circulation strokes where usually there is a great mismatch between the NIHSS score and the lesion volume[31]. In this study, NIHSS score at admission was significantly associated with occurrence of in-hospital complications. Though posterior circulation strokes have varied clinical presentations which cannot be captured as deficits on the NIHSS, the findings of our study highlight the importance of NIHSS score for predicting in-hospital complications in addition to monitoring of stroke severity. This can help the physicians to redirect the preventive strategies in patients with high risk of complications by anticipating them on the basis of NIHSS. Boone et al made an important observation in this regard. Their study also confirms that higher the NIHSS score, higher the risk of complications. But they also

Table 2 — Determinants of in-hospital complications			
	NMC-yes (n=23)	NMC-no (n=53)	P value
Mean Age	55.39	53.72	0.617
Gender Male	16	38	0.851
Female	7	15	
Hypertension	13	29	0.884
Diabetes	9	8	0.021
Smoking	6	22	0.20
Alcoholism	0	7	0.094
Dyslipidemia	6	16	0.717
Rheumatic Heart Disease	6	6	0.105
Ischemic Heart Disease	3	6	0.831
Transient Ischemic Attack	1	3	0.81
Family History of Stroke	1	11	0.072
Mean Baseline NIHSS	6.39	4.19	<0.001
TOAST Classification			
Large-artery atherosclerosis	10	29	0.368
Small vessel disease	3	3	0.359
Cardio-embolism	10	10	0.025
Strokes of other			
determined etiology	0	5	0.183
Strokes of undetermined etiology	0	6	0.169
Territory			
Distal	17	24	0.021
Middle	1	7	0.248
Proximal	4	17	0.189
Multiple	1	5	0.45
NMC- Neurological and medical complications			

Table 3 — Outcome of stroke patients			
	NMC-yes (n=23)	NMC-no (n=53)	P value
30-day Mortality	11	0	<0.001
Poor outcome at 6 months	18	3	<0.001
NMC- Neurological and medical complications			

showed that in patients of posterior circulation strokes (but not those with anterior circulation strokes) who had a baseline NIHSS score of 0 could also experience in-hospital complications. Similar finding was also reported by Sato et al[32]. These findings indicate that NIHSS score alone cannot be used to rule out the risk of complications in posterior circulation infarction patients and that the NIHSS does not substitute for heightened surveillance and timely preventive strategies.

In this study, incidence of complications was highest in the patients having distal territory infarcts as compared to the proximal and middle territories. This is one of the highlights of our study as none of the previous studies have described any relation of the risk of complications with the localization of the infarcts in the posterior circulation to the best of our knowledge. The reason that we postulate for this finding is that the distal territory infarcts involve the thalamus and midbrain, leading to involvement of reticular activating system leading to depressed levels of consciousness and subsequently increased risk of infections.

In our study, complications were higher in the patients having cardio-embolism as the stroke mechanism. Patients

with cardioembolism tend to have embolism in other vascular territories as well. Also, patients with cardio-embolism tend to require anticoagulation leading to increased risk of bleeding complications. This is in contrast to the findings of Boone et al[14] who found that complications were higher in patients with large artery atherosclerosis as the stroke mechanism. Boone et al[14] postulated that stroke patients suffering from large vessel atherosclerosis have a higher risk of morbidity from other clinical manifestations of atherosclerotic disease, such as myocardial infarction, angina, peripheral artery disease, and vascular death[33,34]. Furthermore, the presence of large vessel atherosclerosis reflects inflammation, and there is evidence to suggest that systemic inflammation is predictive of poor outcome after stroke.

When various risk factors were compared, complications were significantly higher in the patients having diabetes. The greater frequency of infections in diabetic patients is caused by the hyperglycemic environment that favors immune dysfunction (eg, damage to the neutrophil function, depression of the antioxidant system, and humoral immunity), micro- and macro-angiopathies, neuropathy, decrease in the antibacterial activity of urine, gastrointestinal and urinary dysmotility, and greater number of medical interventions in these patients, besides the increased frequency of complications inherent to diabetes such as diabetic ketoacidosis, non-ketotic hyperosmolar coma and hypoglycemia[35].

This study has several potential limitations. Baseline NIHSS scoring was not performed in the emergency department but in the in-patient department. There is a possibility of patients deteriorating during the transfer from emergency to in-patient department leading to higher NIHSS scores being recorded, leading to a potential bias. However, we did not include patients with onset of events 6 hours prior to recording of NIHSS score, leading to minimization of this bias. Secondly, this study was conducted in a single academic hospital setting ; also the sample size is relatively small. So how these results fare in different settings and in general population need to confirmed by conducting larger studies in different population groups.

CONCLUSION

Higher baseline NIHSS at admission, cardioembolism as the stroke mechanism, diabetes as the risk factor and distal territory as the stroke localization are the important predictors of in-hospital complications in patients of posterior circulation strokes. Occurrence of complications leads to poor outcome in the form of 30-day mortality and MRS at 6 months. High vigilance and timely preventive strategies in patients with these predictors of complications can significantly improve the outcome in patients with posterior circulation strokes. Prospective validation in larger population based studies is required to extrapolate findings of these studies to general population.

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