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ORIGINAL RESEARCH

Determinants of complications in first ever acute stroke patients: a prospective observational study from India

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Abstract

Background and Aims: Post-stroke complications can lead to frequent and major causes of death in the early phases after an acute stroke. Aims of the present study were to determine the association of several risk factors with the occurrence of poststroke complications, the predictors for the development of complications, and to evaluate how these complications affected the overall prognosis among subjects with the first ever acute stroke. This study is the pioneer study of this kind from Eastern India. Previous national and international studies on this lack uniformity in their results probably because of the following reasons: no standard definitions for complications following the stroke, varied follow-up periods ranging from 1 week to 30 months, type and severity of stroke affecting the incidence, and finally, the demographic variables.

Methods: This was an observational, prospective study, in which a total of 521 adult male and female patients who had a first-ever acute stroke, aged between 12 years to 75 years were enrolled over a period of 2 years (September 2016 to September 2018), admitted in Department of Neuromedicine, Bangur Institute of Neurosciences (BIN), Kolkata, India. Patients with first ever acute stroke were studied for post-stroke complications (predefined with standard criteria) during the hospital stay at Bangur Institute of Neurosciences (BIN), Kolkata, India, and their association with risk factors, severity of stroke (National Institutes of Health Stroke Scale Score, NIHSS), length of hospital stay (in days) and outcome (Modified Rankin Scale, MRS) were assessed.

Results: A total of screened 498 patients who were admitted at Bangur Institute of Neurosciences (BIN), Kolkata, India, with first ever acute stroke were recruited. The mean age was 61.02 years (range 23-75 years), the majority being male (n = 307; 61.6%). Post-stroke complication during hospital stay was documented in 270 patients (54.2%) (males and females combined). In logistic regression analysis, multiple risk factors (OR, 1.571; 95% CI, 1.084-2.278; *P*-0.017), severity of stroke (National Institutes of Health Stroke Scale Score, NIHSS) (OR, 1.425; 95% CI, 1.027-1.976; *P*-0.034) and length of hospital stay (in days) (OR, 3.565; 95% CI, 2.029-6.264; $P < 0.0001$) were the most robust predictors of occurrence of complications. The independent predictors of poor outcome in subjects with complications were: chest infection (OR, 2.07; 95% CI, 1.006-4.26; $P = 0.048$), bedsores (OR, 2.26; 95% CI, 1.03-4.94; *P*-0.042), and seizures (OR, 5.072; 95% CI, 1.08-23.79; *P*-0.039).

Conclusion: In our study, the most independent predictors of complications were severity of stroke and length of hospital stay. This observation might help clinicians in taking appropriate measures towards preventing post-stroke complications and thereby improving outcome following a stroke.

Keywords

Post-stroke complications; Length-of-hospital-stay; Post-stroke-outcome; Stroke-severity; Chest-infection

1. Introduction

Stroke itself can result in minor to major, short and long-term physical disabilities [1], cognitive impairments [2, 3], emotional disturbances [4, 5], decreased social interactions [6] and excessive economic burden [7]. In addition to neurological problems appearing in the immediate post-stroke period [8], often there are multiple late complications [9] which should

not to be neglected. These complications have a great impact on one's quality of life after stroke [10], outcomes, and chances of rehabilitation [11].

Stroke is one of the leading causes of disability, financial burden, and mortality worldwide [12–14]. A study revealed higher prevalence of stroke in younger population and high post-stroke short-term mortality in the South Asian region including India, Bangladesh, Sri Lanka and Pakistan [15]. Most of the traditional risk factors for stroke such as diabetes, hypertension, smoking, and heart disease are prevalent in this region [2]. These aforesaid associated co-morbidities hinder post-stroke recovery and increase complications after stroke [16–25]. However, several complications can arise as a direct result of the brain-insult itself, from the ensuing disability or immobility, or even from stroke-related treatments [26]. Stroke-recovery is a multifactorial, dynamic, complex interplay amid genetic, pathobiologic, sociodemographic, and therapeutic factors [26]. These factors have a substantial effect on the final outcome of patients with stroke [26] and if rehabilitation strategies are not optimized and individual-ized, it will ultimately impede neurological recovery [26]. Johnston KC *et al.* (1998) demonstrated that post-stroke medical complications have an influence on both mortality and functional outcome [27]. Shah SV *et al.* (2015) showed that in-hospital medical complications following an ischemic stroke or transient ischemic attack are a strong predictor (adjusted HR, 1.68; 95% CI, 1.04-2.73) of 30-day all-cause readmission [28]. Similar finding was cited by Bae JH *et al.* [29]. Whereas, Vernino S and colleagues claimed that after the first month of a first ever ischemic stroke, mortality had been higher with cardio-respiratory complications [30]. Early in-hospital complications seriously hinder post-stroke outcome in non-fatal strokes as mentioned by Grube MM and colleagues [31]. Cardiac complications, pneumonia, venous thromboem-bolism, fever; pain, dysphagia, incontinence, and depression are particularly common after stroke [32–35], which usually require specific interventions for their prevention and treat-ment [32–35]. Moreover, Wang PL *et al.*, Wang P *et al.*, and Kumar S and colleagues stated in different studies that in-hospital medical complications were independently associated with a greater risk of death or dependency in patients with stroke [33–35]. However, wide variations are expected to exist in the complication rates of different studies [32–35] which may be due to the lack of standard definitions for complications following stroke, variable follow-up periods ranging from 1 week to 30 months, and the type and severity of stroke [26, 36] affecting the incidence not adjusted for. Finally, some of the variations may be due to the differences in the demographic variables [26, 36].

Moreover, there has been a lack of data to establish guide-lines for the management of these complications [32, 34]. Systematic investigations are therefore needed further to study the effects of medical complications on stroke recovery and to improve interventions for the prevention and treatment of these events.

2. Aims and objectives of the study

This study was conducted primarily to evaluate stroke patients with respect to the development of complications and how that affected their overall prognosis. We studied a relatively large cohort of post-stroke patients for the development of acute complications. We also had tried to determine the associations of several risk factors with the occurrence of complications and tried determining predictors for the development of com-plications. There have been studies in the past which have studied these aspects. However, wide variations exist in the complication rates of different studies, which may be due to the following reasons: no standard definitions for complications following stroke, varied follow-up periods ranging from 1 week to 30 months, type and severity of stroke affecting the incidence and finally, some of the variations may be due to demographic variables.

Knowledge regarding these parameters is largely lacking in this part of the world and this study is the first of its kind from Eastern India.

3. Materials and methods

The study was conducted with prior approval of the insti-tutional ethics committee (IPGME&R/IEC/2017/294). This is an observational, prospective study, in which a total of 521 adult male and female patients of first-ever stroke, aged between 12 years to 75 years were enrolled over a period of 2 years (September 2016 to September 2018) who were admitted in Department of Neuromedicine, Bangur Institute of Neurosciences (BIN), IPGME&R, Kolkata, India. Out of these, 498 adult male (n = 307) and female (n = 191) patients were recruited with informed consent for participation from the patient or patient's relatives, based on the inclusion criteria. All patients attending our centre with first-ever acute stroke excluding who were willing to participate in the study were included. Patients with history of stroke, recurrent stroke, non-acute (old) stroke, age > 75 years and < 12 years, and patients with sub-arachnoid hemorrhage & cortical venous sinus thrombosis were excluded.

The World Health Organization (WHO) defines stroke as: "rapidly developing clinical signs of focal (or global) distur-bance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin" [37].

The study included in-hospital medical complications after first-ever acute stroke. The patients were observed daily for any signs of complications until discharge. All complications were checked on a daily basis by the treating neurologists and electronically recorded by stroke team research workers. These complications were defined according to Langhorne P *et al.* criterion system [32].

Detailed information on the history of demographic profile of the patient with first ever acute stroke, clinical features (motor deficits, non-motor deficits, and impaired conscious-ness), risk factors, and type of stroke were noted. Type of stroke was classified as ischemic and hemorrhagic according to the neurio-imaging characteristics. Site of the lesion was broadly categorized as hemispheric cortical and hemispheric

subcortical. The strokes involving both cortex and subcortex were classified as hemispheric cortical. Severity of stroke was classified using the National Institutes of Health Stroke Scale (NIHSS) as mild (score range: 0-5), moderate (score range: of 6-10), moderately severe (score range: 11-15), or severe (score > 16) [38]. The length of hospital stay was also recorded, and patients were divided into 2 groups according to length of stay (7 days and > 7 days). The days of occurrence of complications were noted.

Subjects were clinically examined by conventional bedside neurological examination methods after detailed history taking. Patients had undergone the following investigations: complete blood count, Biochemical parameters-Urea (mg/dL, Creatinine (mg/dL), fasting and 2-hour postprandial blood glucose levels (mg/dL) & lipid profile (mg/dL), 12-leads-electrocardiogram (ECG), computed tomography (CT) scan of brain (axial images) and magnetic resonance imaging (MRI) of brain (axial-T1, T2, FLAIR, GRE/SWI, DWI, sagittal-T1, T2, coronal T2, SPGR sequences) when required.

Functional outcome was assessed using the modified Rankin scale (mrs) at the time of discharge (table given below). Good outcome (mrs score 0-2) was defined as survival with no or minimal neurologic deficits and functional independence. Poor outcome (mrs score: 3-6) was defined as survival with significant neurologic deficits/functional dependence requiring institutional care or death directly related to the stroke or its complications.

All statistical analyses were done using SPSS 16.0 (SPSS Inc., Chicago, IL, USA). The Chi square and Fisher's exact tests were done to study the factors associated with and without complications. The means of continuous variables were compared using the Student t-test. Univariate analysis included the following factors: age, sex, clinical features, type of stroke, risk factors for stroke, length of hospital stay (> 7 days or 7 days), stroke severity based on NIHSS (mild to moderate: NIHSS 0-10; moderately severe to severe: NIHSS > 11) and the functional outcome of stroke based on Modified Rankin Scale (mrs) (good: mrs score 0-2; poor: mrs score 3-6). Multivariate binary logistic regression analysis was done to explore the factors associated with complications after adjusting for confounding factors, such as age, sex, and risk factors for stroke. In addition, multivariate logistic regression was performed to explore the association between individual complications and outcome. A P value of < 0.05 was considered significant.

4. Results and analysis

In our study, the mean age of the patients was found to be 61.02 years (SD = 9.69). Majority (74.9%, n = 373) patients were aged 50 years or more, of which 56.30% (n = 210) developed at least one complication during hospital stay (Table 1: Characteristics of Patients). Majority were males (n = 307, 61.65%). The most common risk factor noted in our study was hypertension (n = 247, 49.60%), followed by diabetes (n = 133, 26.70%) and smoking (n = 122, 24.50%). Other factors which contributed to potential risk were CAD (16.90%, n = 84), dyslipidemia (18.70%, n = 93), hypothyroidism (8.40%, n = 42), alcohol (9.80%, n = 49), AF (6.80%, n = 34), and RHD

(1%, n = 5). Multiple risk factors (at least two) were present in 49.60% (n = 247) of the patients suffering from the first ever acute stroke, whereas a single risk factor was present in 50.4% (n = 251) of our study population.

In our study, 86.90% (n = 433) of the patients were admitted within 72 hours after the occurrence of the first ever acute stroke, while only 13.10% (n = 65) of the patients were admitted after 72 hours (Table 2: Characteristics of Stroke). Regarding presenting clinical features, the majority of the patients, i.e. 65.3% (n = 325), developed motor deficits (hemiparesis, dysarthria, ataxia, seizure, dysphagia) after stroke; 21.7% (n = 108) of the patients developed non motor deficits (headache, hemisensory loss, vertigo, aphasia, social inhibition, vomiting, neglect and hemi-anopia); and 13.5% (n = 67) of the patients presented with impaired consciousness. Majority of the study population 63.1% (n = 314) suffered from ischemic stroke and the rest 36.9% (n = 184) suffered from hemorrhagic stroke. The majority of the patients (70.1%; n = 349) developed stroke due to lesions in the hemispheric subcortex, while 29.9% (n = 149) of them developed lesions in the hemispheric cortex. A total of 66.9% (n = 333) patients developed moderate to severe stroke (NIHSS > / = 11), while 33.1% (n = 165) of the patients developed mild to moderate strokes (NIHSS < 11). The majority of the post stroke patients (75.1%, n = 374) had a shorter length of stay of 7 days and 24.9% (n = 124) of the patients had a prolonged length of stay in the hospital (> 7 days). A total of 69.7% (n = 347) of the post-stroke patients had good outcome at the time of discharge (mrs 0-2) and 30.3% (n = 151) of the total number of patients had poor outcome (mrs 3-6) at the time of discharge.

Out of 498 patients with first ever acute stroke, 270 (54.2%) developed at least one complication (Table 3: Complications in stroke patients). The most frequent complication was infections accounting for 34.2% (n = 170) of the total study population. Among infections, UTI was the most common (n = 73; 14.7%), followed by Chest infection (n = 72; 14.5%). Other infections (Any febrile illness lasting for > 24 hours) were found in 5% (n = 25).

Various factors were associated with complications on univariate analysis as shown in Table 1. These significant factors (P < 0.05) were hypertension (P-0.011), diabetes (P-0.027), smoking (P-0.004), time of admission > 72 hours (P-0.009), Ischemic stroke (P-0.01), hemispheric cortical strokes (P < 0.0001), motor deficit (P-0.009), non motor deficit (P < 0.0001), impaired consciousness (P-0.011), NIHSS and length of stay more than 7 days.

In logistic regression analysis (Table 4), multiple risk factors (2) (OR, 1.571; 95% CI, 1.084-2.278; P-0.017), stroke severity (NIHSS Score) (OR, 1.425; 95% CI, 1.027-1.976; P-0.034) and length of hospital stay (OR, 3.565; 95% CI, 2.029-6.264; P < 0.0001) were the most robust predictors of occurrence of complications.

The independent predictors of poor outcome (Table 5) in subjects with complications were chest infection (OR, 2.07; 95% CI, 1.006-4.26; P = 0.048), bedsores (OR, 2.26; 95% CI, 1.03-4.94; P = 0.042), and seizure (OR, 5.072; 95% CI, 1.08-23.79; P = 0.039).

TABLE 1. Characteristics of Patients.

PATIENT CHARACTERISTICS		WITH COMPLICATIONS (%)	WITHOUT COMPLICATIONS (%)	*P* VALUE
AGE	> 50	56.30%	43.70%	0.107
(YEARS)	< 50	48.0%	52.0%	
SEX	MALE	56.67%	43.33%	0.162
	FEMALE	50.26%	49.74%	
RISK FACTORS				
HYPERTENSION	Present	59.9%	40.1%	0.011*
	Absent	48.6%	51.4%	
DIABETES	Present	62.4%	37.6%	0.027*
	Absent	51.2%	48.8%	
SMOKING	Present	65.6%	35.4%	0.004*
	Absent	50.5%	49.5%	
ALCOHOL	Present	42.9%	57.1%	0.093
	Absent	55.5%	44.5%	
CAD	Present	58.3%	41.7%	0.406
	Absent	53.4%	46.6%	
AF	Present	61.8%	38.2%	0.360
	Absent	53.7%	46.3%	
HYPOTHYROID	Present	42.9%	57.1%	0.123
	Absent	55.3%	44.7%	
DYSLIPIDEMIA	Present	46.2%	53.8%	0.087
	Absent	56.0%	44.0%	

The mean age of the patients was found to be 61.02 years (SD = 9.69). Majority (74.9%, n = 373) patients were aged ≥ 50 years, of which 56.30% (n = 210) developed ≥ 1 complication during hospital stay. Majority were males (n = 307, 61.65%). The most common risk factor noted in our study was hypertension (n = 247, 49.60%), followed by diabetes (n = 133, 26.70%) and smoking (n = 122, 24.50%). Multiple risk factors (≥ 2) were present in 49.60% (n = 247) of the patients suffering from first ever acute stroke.

5. Discussion

This study was carried out with the aim of studying the occurrence of complications in patients presenting with a first ever episode of acute stroke, determining factors predicting the development of such complications and how they affect the functional outcome of these patients.

A total of 498 screened patients out of 521 patients were recruited for our study. The most noteworthy observation in our study was that more than half of the study population developed at least one complication during their hospital stay, comparable to the frequency of complications reported in previous studies by Langhorne P *et al.* (complications in 85% of patients [32], Ingeman A *et al.* in 25.2% [39], Roth EJ *et al.* in 75% [40], Kitisomprayoonkul W *et al.* in 70.3% [41], Hung JW *et al.* in 44% [42], and Kalra L and colleagues in 60% [43].

More than half of the patients who developed complications were above the age of 50 years. This is in keeping with a study published by Doshi VS *et al.* [44], which also found an increasing rate of complications with increasing age. Another study by Knoflach M *et al.* [45] also showed poor functional outcome in stroke patients with a higher age. This may be ascribed to the established fact that the elderly population bears

the major portion of the burden of co-morbid ailments.

Compared to females, a greater percentage of males were found to have complications in this study. A study by Colbert JF *et al.* [46] showed that females are less likely to develop post-stroke complications like pneumonia and sepsis. However, there are two studies that show an increased rate of complications among female patients [44, 47], especially an increased rate of certain complications like UTI and depression among females [44]. This gender discrepancy may be ascribed to poor healthcare delivery to women particularly the elderly women in rural India and the prevailing gender discrimination [48–51].

The most common complication noted in almost one-third of the study population was infection followed closely by pain and problems arising out of immobility like pressure sore, falls, and pulmonary embolism. Amidst infectious processes, urinary tract and chest infections were seen almost equally to be the predominant sources of sepsis. The other common complications noted were depression, coronary artery disease, cardiac conduction defects, and gastro-intestinal hemorrhage. Development of respiratory tract infection was also associated with a poor functional outcome, whereas seizures and bedsores are the other two worth mentioning predictors of poor

T A B L E 2. Characteristics of Stroke.

STROKE CHARACTERISTICS		WITH COMPLICATIONS (%)	WITHOUT COMPLICATIONS (%)	*P* VALUE
TIME OF ADMISSION				
> 72 HOURS		69.20%	30.80%	0.009*
< 72 HOURS		52.00%	48.00%	
CLINICAL FEATURES				
MOTOR DEFICIT	Present	58.50%	41.50%	0.009*
	Absent	46.2%	53.8%	
NON MOTOR DEFICIT	Present	33.30%	66.70%	< 0.0001*
	Absent	60.0%	40.0%	
IMPAIRED CONSCIOUSNESS	Present	68.70%	31.30%	0.011*
	Absent	52.0%	48.0%	
TYPE OF STROKE				
ISCHAEMIC		58.60%	41.40%	0.010*
HAEMORRHAGIC		46.70%	53.30%	
SITE OF LESION				
HEMISPHERIC CORTICAL		68.50%	31.50%	
HEMISPHERIC SUBCORTICAL		48.10%	51.90%	< 0.0001*
NIHSS				
		71.80%	28.20%	< 0.0001*
11		18.80%	81.20%	
LENGTH OF STAY				
7 DAYS		86.30%	13.70%	< 0.0001*
7 DAYS		43.60%	56.40%	
FUNCTIONAL OUTCOME (mrs)				
POOR OUTCOME (mrs 3-6)		80.80%	19.20%	< 0.0001*
GOOD OUTCOME (mrs 0-2)		42.70%	57.30%	

In this study, 86.90% (n = 433) of the patients were admitted within 72 hours after occurrence of first ever acute stroke. 65.3% (n = 325) developed post stroke motor deficits, 21.7% (n = 108) developed non-motor deficits and 13.5% (n = 67) presented with impaired consciousness. 63.1% (n = 314) suffered from ischemic stroke and the rest 36.9% (n = 184) had hemorrhagic stroke. 70.1% (n = 349) developed stroke due to lesions in the hemispheric subcortex, while 29.9% (n = 149) developed lesions in the hemispheric cortex. A total of 66.9% (n = 333) patients had NIHSS 11, while 33.1% (n = 165) had NIHSS < 11. 24.9% (n = 124) had prolonged length of stay in the hospital (> 7 days). A total of 69.7% (n = 347) had good outcome at the time of discharge (mrs 0-2) and 30.3% (n = 151) had poor outcome (mrs 3-6) at the time of discharge.

prognosis. Most studies have published results similar to our findings [52–55]. A multi-center Indian study published by Pandian JD *et al*. [56], concluded with similar results with chest and urinary tract infections being the most common sources of infection among stroke patients, which also resulted in a poor outcome. Westendorp *et al*. [57] also found such infections to be the most common complication in their study and pneumonia was the most important cause of death in their patients. Such findings are probably because a large number of patients are catheterized for a considerable length of time in post stroke period, which serve as an important source of urinary tract infection in these patients. Most patients, owing to immobility, showed decreased consciousness levels, and poor

reflexes, and aspirated food particles or oral secretions leading to respiratory tract infections.

In our study, hypertension was the most common risk factor, followed by diabetes and smoking. Patients with ischemic stroke were found to have higher chances of developing post-stroke complications, and most of these complications occurred within the first week after acute stroke. We used the most widely used and validated stroke scale-National Institutes of Health Stroke Scale (NIHSS) [38], to accurately establish stroke severity and prognosis in our patients. It was seen that patients with moderate to severe stroke (NIHSS score $\geq$ 11) had more complications than those with milder stroke (NIHSS score < 11), thus portending a poorer outcome. Most studies

T A B L E 3. Complications in stroke patients.

COMPLICATIONS		NUMBER (N)	PERCENT (%)
Infections	Chest Infection	72	14.5
	UTI	73	14.7
	Other Infection	25	5
Neurological	Seizure	31	6.2
	Recurrent Stroke	10	2
Immobility	Bedsore	58	11.6
	Falls	5	1
	DVT	10	2
	Pulmonary Embolism	5	1
Pain	Shoulder Pain	68	13.7
	Other Pain (Neck pain, LBP, joint pain other than shoulder and others)	70	14.1 (cumulative)
Psychological	Depression	69	13.9
	Other psychological (confusion, anxiety, emotionalism)	47	9.44 (cumulative)
Miscellaneous	AMI, cardiac arrhythmias, GI haemorrhage and dysfunctional uterine bleeding.	14	2.8

Out of 498 patients of first ever acute stroke 270 (54.2%) developed ≥ 1 complication. The most frequent complication was infections (34.2% (n = 170)); among which, UTI was the most common (n = 73; 14.7%) followed by chest infection (n = 72; 14.5%).

T A B L E 4. Predictors of complications by multivariate logistic regression analysis.

PREDICTORS OF COMPLICATIONS	P Value	OR	95% CI	
			Lower	Upper
1. MULTIPLE RISK FACTORS (2)	0.017	1.571	1.084	2.278
2. NIHSS	0.034	1.425	1.027	1.976
3. Length of Hospital Stay (days)	0.000	3.565	2.029	6.264

In logistic regression analysis, multiple risk factors (2) (OR, 1.571; 95% CI, 1.084-2.278; P-0.017), severity of stroke (NIHS Score) (OR, 1.425; 95% CI, 1.027-1.976; P-0.034) and length of hospital stay (OR, 3.565; 95% CI, 2.029-6.264; P < 0.0001) were the most robust predictors of occurrence of complications.

T A B L E 5. Predictors of poor outcome by multivariate logistic regression analysis.

PREDICTORS OF POOR OUTCOME	P Value	OR	95% CI	
			Lower	Upper
1. CHEST INFECTION	0.048	2.070	1.006	4.260
2. SEIZURE	0.039	5.072	1.081	23.793
3. BEDSORE	0.042	2.255	1.029	4.940

The independent predictors of poor outcome in subjects with complications were chest infection (OR, 2.07; 95% CI, 1.006-4.26; P-0.048), bedsores (OR, 2.26; 95% CI, 1.03-4.94; P-0.042), and seizure (OR, 5.072; 95% CI, 1.08-23.79; P-0.039).

have established NIHSS score as a good predictor of outcome and prognosis of stroke [58–60]. A study by Haeusler *et al*. [61] showed that a higher NIHSS score was the best predictor of development of infections in patients with stroke. Pandian JD *et al*. [56] in 2012 and a study by Roth EJ *et al*. [25] also showed similar results.

We also attempted to find how the length of hospital stay affected the development of complications and outcomes in stroke patients. In our study, the majority of the patients had a shorter length of stay of 7 days and only one-third patients had a longer length of stay in the hospital (> 7 days). We found that those who had a longer length of stay developed at least one complication during their stay. Interpretation of observational data on complications and length of stay is

a challenge as pointed out in earlier studies, where medical complications were also associated with longer length of stay among patients with acute stroke [62, 63]. Previous studies by Tong X *et al*., Spratt N *et al*., Tirschwell DL *et al*., found that infections particularly were associated with longer length of stay [64–69]. It is therefore difficult to determine whether a longer length of stay is caused by medical complications or whether a longer length of stay itself was a cause of these complications. Langhorne P *et al*. [32] found that most of the medical complications developed early after hospital admission, which might support the hypothesis that medical complications per se may increase the length of stay. In this study, the majority of patients who suffered from at least one complication during their hospital stay were associated with poor outcome (mrs 3-6) at the time of discharge.

The presence of multiple risk factors was found to be the other important predictor of the occurrence of complications and functional outcome as assessed by multivariate logistic regression analysis. There are several studies which have shown that the presence of risk factors like hypertension, diabetes, smoking, and even aging all portend a poorer prognosis in stroke [16–25, 70–74]. Most of our patients had multiple risk factors, suggesting that the presence of more than one risk factor worsens prognosis in stroke.

6. Limitations of the study

However, this study had a few limitations. The complications were noted only during the hospital stay, and they were not categorized according to severity. Besides, for a study on assessment of post-stroke cognitive impairment, at least three months of post-stroke follow-up would have been required, which is however beyond the scope of this study. Hence, comments on post-stroke cognition were not discussed in this particular study. Undoubtedly, a long-term study with follow-up would give a more clear idea regarding the development of late complications and a picture of the resultant morbidity.

7. Conclusions

In this study, the most independent predictors of after-stroke complications were; 1) presence of multiple risk factors, 2) severity of stroke, and 3) length of hospital stay. Predictors of poor outcome were noted to be 1) chest infection, 2) pressure sore, and 3) seizures. These observations might help clinicians in taking appropriate measures towards preventing post-stroke complications and thereby improving post-stroke outcome. Further studies to evaluate long term complications and outcomes are required to formulate definite guidelines regarding the prophylaxis and secondary prevention of complications in patients with stroke.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted with prior approval of the institutional ethics committee (IPGME&R/IEC/2017/294).

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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