Factors related to prehospital delay and decision delay among acute stroke patients in a district hospital, Malaysia

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ABSTRACT

Introduction: Time is the greatest challenge in stroke management. This study aimed to examine factors contributing to prehospital delay and decision delay among stroke patients.

Materials and Methods: A cross-sectional study involving acute stroke patients admitted to Seri Manjung Hospital was conducted between August 2019 and October 2020 via face-to-face interview. Prehospital delay was defined as more than 120 minutes taken from recognition of stroke symptoms till arrival in hospital, while decision delay was defined as more than 60 minutes taken from recognition of stroke symptoms till decision was made to seek treatment.

Results: The median prehospital delay of 102 enrolled patients was 364 minutes (IQR 151.5, 1134.3) while the median for decision delay was 120 minutes (IQR 30.0, 675.0). No history of stroke (adj. OR 4.15; 95% CI 1.21, 14.25; *p*=0.024) and unaware of thrombolysis service (adj. OR 17.12; 95% CI 1.28, 229.17; *p*=0.032) were associated with higher odds of prehospital delay, while Indian ethnicity (adj. OR 0.09; 95% CI 0.02, 0.52; *p*=0.007) was associated with lower odds of prehospital delay as compared to Malay ethnicity. On the other hand, higher National Institutes of Health Stroke Scale (NIHSS) score (adj. OR 0.86; 95% CI 0.78, 0.95; *p*=0.002) was associated with lower odds of decision delay.

Conclusion: Public awareness is crucial to shorten prehosital delay and decision delay for better patients' outcomes in stroke. Various public health campaigns are needed to improve the awareness for stroke.

KEYWORDS:
prehospital delay, decision delay, stroke, district hospital

INTRODUCTION

Stroke is a common neurological emergency that carries significant morbidity and mortality, and it is increasing over the years.[1] In Malaysia, stroke is the third leading cause of mortality from the year 2009 to 2020, with a staggering rate of 8.0% of mortality, compared to 15.0% for ischaemic heart disease.[2] Early presentation to hospitals has been shown to predict better functional outcomes in stroke patients. Intravenous thrombolysis within a time window of 3 to 4.5 hours of presentation of stroke have shown to improve the morbidity and mortality of stroke patients (number needed to treat, NNT = 10 – 21)[3] compared to antiplatelet therapy only. Mechanical thrombectomy has produced a better patient outcome with NNT of 3.[4] Better patient outcome was also observed even in those patients who came to hospital earlier but did not undergo thrombolysis or interventions.[5] These studies have clearly proven the adage saying "time is brain", emphasising time is of the essence in managing stroke patients to ensure the best outcomes.

Many efforts have been rolled out globally in order to minimise the delay of stroke patients in seeking medical treatment, but the results were often disappointing. This is owing to the fact that myriad factors are affecting prehospital delay in the presentation of patients to the hospital-like patients' help-seeking behaviour, stroke knowledge and socio-cultural background.[6] Lack of these local data poses great challenge in the mission of establishing more acute stroke-ready hospitals in district populations. To our knowledge, we have limited published data exploring the factors associated with prehospital delay in South-East Asian population, especially in Malaysia. Thus, this study aimed to examine how stroke patients in district setting in Malaysia react to stroke symptoms and factors that contributed to their prehospital delay and decision delay.

MATERIALS AND METHODS

This cross-sectional study was conducted from 1st August 2019 till 30th October 2020, involving 102 patients who were admitted to medical wards in Seri Manjung Hospital with diagnosis of acute stroke within 7 days of symptoms presentation. Seri Manjung Hospital is a non-neurologist acute stroke-ready hospital with Computed Tomography (CT) scan machine and thrombolysis service. It is located in Manjung province, Perak state, Malaysia with 258 000 semi-urban populations.

Patients were selected using non-probability convenience sampling method and approached by the investigators. Patients who met the inclusion criteria without violating the exclusion criteria were recruited in this study. The inclusion

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criteria were: (1) aged 18 and above; (2) presented with clinical features of stroke (ischaemic or haemorrhagic) confirmed by brain imaging. The exclusion criteria were: (1) Patients with stroke mimics and subarachnoid haemorrhage; (2) Patients who present to hospital more than 7 days after the onset of symptoms; (3) Patients who were unable to answer questions throughout hospital admission attributable to either impaired consciousness or neurological deficit; (4) Patients with cognitive impairment or psychiatric illness; (5) Patients who refuse consent for this study. Those who were eligible were interviewed face-to-face using a standardised questionnaire after written consent was obtained. The information comprised of patients' demographic profiles, comorbidities, prehospital details, stroke manifestations and patients' perceptions for stroke. Patients were asked to grade the severity of their symptoms as "mild" or "severe" based on how much the symptoms were affecting their function. In addition, the data on National Institutes of Health Stroke Scale (NIHSS) score and premorbid Modified Rankin Scale (mRS) score was collected by investigators using a standardised data collection form.

This study was approved by Medical Research Ethical Committee (KKM/NIHSEC/P19-1753(6)).

Stroke was diagnosed based on rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with no apparent cause other than of vascular origin[7], which was further confirmed by brain CT imaging.

Stroke subtypes were classified according to Oxfordshire Community Stroke Project (OCSP) system that include partial anterior circulation infarct (PACI), total anterior circulation infarct (TACI), lacunar infarct (LACI) and posterior circulation infarct (POCI).[8] The severity of stroke was measured using NIHSS scoring system.[9] Stroke symptoms were categorised by FAST (Facial asymmetry, Arms or lower limb weakness, Speech difficulty Test).[10] Prehospital delay was defined as the time taken from onset of symptoms till arrival to the emergency department of study hospital. Decision delay time was the time of recognition of stroke symptoms till decision was made to seek treatment, either from medical or non-medical personnel. Transport delay time was calculated from time of decision-making till arrival to hospital. Transport delay was not analysed in this study as it depends on the local geographical data, patients' accessibility to transport, emergency medical response and interfacility transfer, which were not studied in this research. If it was a wake-up stroke, we considered the time when patients first recognised their symptoms as the onset. When the time of symptom onset was recorded as "morning," "afternoon," "evening" or "night," we assumed the time of onset to be 8 AM, 12 PM, 3 PM, 9 PM, respectively.

The data collected were analysed using Statistical Package for the Social Sciences (SPSS) Version 20. Demographic data and clinical profiles of study subjects were presented descriptively. Mean and standard deviation was used for normally distributed continuous data while median and interquartile range was used for non-normally distributed continuous data. Categorical data were reported as numbers and percentages.

In the analysis of factors related to prehospital delay, patients were dichotomised into non-prehospital delay (<120 minutes) and prehospital delay groups (>120 minutes). In the further subset analysis of decision delay, the patients were dichotomised into non-decision delay (<60 minutes) and decision delay (>60 minutes). These cut-off points were in reference to previous studies[11,12] and the consideration of the recommended thrombolysis time window of 3 hours and door-to-needle time for thrombolytic therapy (in-hospital delay) of $\leq$60 minutes.[13]

Logistic regression was used to identify variables independently associated with prehospital delay and decision delay, respectively. All variables with p value <0.25 in univariate analysis were included at the model entry for multivariate analysis. A stepwise approach was used to identify independent predictors of both prehospital delay and decision delay separately. The results of multiple logistic regression were reported as adjusted odd ratios with 95% CIs. A p value <0.05 was deemed significant.

RESULTS

Patients' Characteristics

A total of 102 patients were recruited in this study. Table I shows the characteristics and demographic profiles of the studied patients. The mean age of the patients was 59$\pm$12.7 years, and they were predominantly male (63.7%) and Malay ethnic (65.7%). The commonest underlying comorbid were hypertension (71.6%), followed by diabetes mellitus (38.2%), dyslipidemia (28.4%) and history of previous stroke (17.6%). One-fifth of the patients studied had no previously diagnosed comorbidity (20.6%). Majority of the patients had premorbid mRS of 0 (89.2%). During the data collection period, there was no patient with haemorrhagic stroke who fulfils the inclusion and exclusion criteria. LACI was the most prevalent (80.4%), followed by PACI (10.8%), POCI (5.9%) and TACI (2.9%), with the median NIHSS on admission of 5 (IQR 2.0, 8.0). All the patients have ischaemic stroke. Of 92 patients who presented with limb weakness, 59 of them perceived it as severe (57.8%). The number of patients who presented with severe facial asymmetry or severe dysarthria were 11 (10.8%) and 25 patients (24.5%), respectively. Other symptoms reported by patients included severe giddiness, gait instability, and disinhibition.

The median prehospital delay time was 364 minutes (IQR 151.5, 1134.3). A total of 80 patients (78.4%) arrived at study hospital more than 2 hours after the onset of stroke symptoms (delayed). The median decision delay time was 120 minutes (IQR 30.0, 675.0), of which 47 of the patients (46.1%) achieved equal or less than 60 minutes (non-delayed). Transport delay time showed a median of 161 minutes (IQR 80.0, 272.5), but this was not analysed in this study.

Majority of 55 out of 80 (68.8%) patients with prehospital delay had decision delay. It is worthy to note that in this study, all the patients with decision delay ended up with prehospital delay.

Only 39 patients (38.2%) perceived the symptoms as stroke. That left 20.6% of patients who did not think of stroke, and

Table I: Socio-demographic and clinical characteristics of enrolled patients (n=102)

Characteristics	n (%)
Age in years, Mean (SD)	59 (12.7)
Gender	
Male	65 (63.7)
Female	37 (36.3)
Ethnicity	
Malay	67 (65.7)
Chinese	26 (25.5)
Indian	7 (6.9)
Others	2 (1.9)
Comorbidities	
Hypertension	73 (71.6)
Diabetes mellitus	39 (38.2)
Dyslipidemia	29 (28.4)
Ischemic heart disease	15 (14.7)
Atrial Fibrillation	2 (1.9)
Congestive cardiac failure	2 (1.9)
Chronic kidney disease/end stage renal disease	4 (3.9)
Previous stroke	18 (17.6)
None	21 (20.6)
Subtype of stroke	
LACI	82 (80.4)
PACI	11 (10.8)
POCI	6 (5.9)
TACI	3 (2.9)
NIHSS Score, median (IQR)	5 (2.0, 8.0)
Symptoms	
Limb weakness	92 (89.3)
Mild	32 (31.4)
Severe	59 (57.8)
None	11 (10.8)
Facial asymmetry	31 (30.1)
Mild	20 (19.6)
Severe	11(10.8)
None	71 (69.6)
Dysarthria	56 (54.4)
Mild	31 (30.4)
Severe	25 (24.5)
None	46 (45.1)
Others*	7 (6.8)
Mild	4 (3.9)
Severe	3 (3.0)
None	95 (93.1)
Premorbid mRS Score	
0	91 (89.2)
1-2	5 (4.9)
3-5	6 (5.9)
Decision delay time in minutes, median (IQR)	120 (30.0, 675.0)
Transport delay time in minutes, median (IQR)	161 (80.0, 272.5)
Prehospital delay time in minutes, median (IQR)	364 (151.5, 1134.3)
Decision delay	
Delayed	55 (53.9)
Non-delayed	47 (46.1)
Prehospital delay	
Delayed	80 (78.4)
Non-delayed	22 (21.6)
Types of first helper	
Family members and relatives	83 (81.4)
Friends	10 (9.8)
Emergency medical services	7 (6.9)
Self	2 (1.9)
Medical contact(s) before study hospital	
***may choose more than 1**	
None, straight to study hospital	48 (47.1)
Basic care hospital	9 (8.8)
Health clinic	23 (22.5)
General practitioner clinic	21 (20.6)
Traditional medicine	1 (1.0)
Haemodialysis centre	1 (1.0)
Pharmacy	1 (1.0)

cont..... pg 244

cont from..... pg 243

Table I: Socio-demographic and clinical characteristics of enrolled patients (n=102)

Characteristics	n (%)
Number of stops before study hospital	
0	48 (47.1)
1	52 (51.0)
2	2 (1.9)
Reason for decision delay	
Mild symptoms	23 (33.8)
Non-progressive symptoms	7 (10.3)
Not perceived as stroke	11 (16.2)
Unable to get help	13 (19.1)
Unconscious	2 (2.9)
Others**	27 (39.7)
Perception of Stroke	
Yes	39 (38.2)
No***	21 (20.6)
Not sure***	42 (41.2)
Awareness of thrombolysis service	
Yes	4 (3.9)
No	98 (96.1)

SD, Standard deviation; IQR, Interquartile range; LACI, Lacunar infarct; PACI, Partial anterior circulation infarct; POCI, Posterior circulation infarct; TACI, Total anterior circulation infarct; NIHSS, National Institutes of Health Stroke Scale; mRS, Modified Rankin Scale
*Other symptoms include: Giddiness, disinhibition, unsteady gait.
**Other reasons for decision delay include: Symptoms perceived as self-limiting, fear of hospital treatment, not knowing what to do.
***Other perceptions towards the presenting symptoms include: non-medical causes (e.g. being exhausted, weather or dietary causes), musculoskeletal injury, psychological effect and other non-scientific causes.

41.2% was unsure of reason. Only 4 patients (3.9%) were aware of thrombolysis treatment in stroke. There were 81.4% of patients who first sought help from family members or relatives, followed by friends (9.8%). Merely 6.9% of the patients actually called for EMS. Slightly less than half of these patients (47.1%) went straight to the study hospital; there were 43.1% went to health clinics or general practitioner clinics, and 8.8% went to a basic care hospital (without CT facility). The reasons for their decision delay included symptoms being mild, unable to get help, symptoms being perceived as self-limiting and not knowing how to react.

Factors Associated with Prehospital Delay

Table II shows the univariate and multivariate logistic regression analyses of factors predicting prehospital delay. In the univariate analyses, Indians had lower odds of prehospital delay as compared to Malays (OR=0.12, 95% CI 0.02, 0.61; *p*=0.011). Patients with no history of stroke were more likely to have prehospital delay as compared to those with previous stroke (OR=4.00, 95% CI 1.34, 11.93; *p*=0.013). Prehospital delay was higher among patients who were unsure of having stroke attack as compared to those who were certain of having a stroke episode (OR=3.00, 95% CI 1.01, 8.93; *p*=0.048) and patients who were not aware of thrombolysis service as compared to those who were aware (OR=12.47, 95% CI 1.23, 126.66; *p*=0.033). Patients who had a detour before presenting to study hospital also had higher odds of prehospital delay as compared to those who went directly to stroke ready hospital (OR=2.92, 95% CI 1.07, 7.97; *p*=0.036). The multivariate analyses for prehospital delay retained two positive predictors: no previous stroke (adj. OR=4.15, 95% CI 1.21, 14.25; *p*=0.024) and not being aware of thrombolysis service (adj. OR=17.12, 95% CI 1.28, 229.17; p=0.032), and one negative predictor: Indian ethnicity (adj. OR=0.09, 95% CI 0.02, 0.52; *p*=0.007).

Factors Associated with Decision Delay

Table III shows the univariate and multivariate logistic regression analyses of factors predicting decision delay. Only NIHSS score was significantly associated with decision delay in which higher NIHSS score (adj. OR=0.86, 95% CI 0.78, 0.95; *p*=0.002) was associated with lower odds of decision delay.

DISCUSSION

Definition of prehospital delay in our study was relatively consistent with previous studies, but decision delay was defined differently. Decision delay cut-off was taken as 60 minutes in most studies, but some definitions were inclusive of the time till help arrived.[12,15-16] The definitions of decision time delay in wake-up strokes were also different as the onset of stroke symptoms was defined as the time at which the patients last known to be well before sleep.[12,15] We considered the time of awareness of symptoms as the earliest time to seek help, which is a more sensible starting point to examine the patients' responsiveness.[16]

The median decision delay time we reported in study (120 minutes) is similar in other developed countries.[17] In a study by Carroll et al, the median time for patients to decide to call for help after experiencing symptoms was 30 minutes. Majority of the studies showed less than half of the stroke patients actually arrived at hospital within 3 hours.[17] Previous studies have shown that decision delay has been a significant factor to be considered in prehospital delay in the presentation of stroke patients to hospital for treatment.[15] This is similar to the finding in our study.

Prior stroke experience may have taught patients to take a more direct path to the hospital, resulting in less prehospital delay among those who had a history of stroke, but there is

Table II: Univariate and multivariate analysis of factors related to prehospital delay

Variable	Prehospital delay, n (%)		Univariate analysis			Multivariate analysis		
	No	Yes	Crude OR	95% CI	*p* value[a]	Adj. OR	95% CI	*p* value[b]
Age in years, mean (SD)	60 (8.9)	59 (13.6)	1.00	(0.96, 1.03)	0.787			
Gender								
Male	14 (63.6)	51 (63.8)	1.00	(0.38, 2.68)	0.992			
Female	8 (36.4)	29 (36.2)	1.00					
Ethnicity					0.032			0.019[†]
Malay	9 (40.9)	58 (72.5)	1.00			1.00		
Chinese	8 (36.4)	18 (22.5)	0.35	(0.12, 1.04)	0.058	0.36	(0.11, 1.24)	0.105
Indian	4 (18.2)	3 (3.8)	0.12	(0.02, 0.61)	0.011	0.09	(0.02, 0.52)	0.007[†]
Others	1 (4.5)	1 (1.2)	0.16	(0.01, 2.71)	0.202	0.05	(0.00, 1.05)	0.054
Comorbidity								
Hypertension								
No	6 (27.3)	23 (28.8)	1.08	(0.37, 3.09)	0.892			
Yes	16 (72.7)	57 (71.2)	1.00					
Diabetes Mellitus								
No	12 (54.6)	51 (63.8)	1.47	(0.56, 3.81)	0.433			
Yes	10 (45.4)	29 (36.2)	1.00					
Dyslipidaemia								
No	13 (59.1)	60 (75.0)	2.08	(0.77, 5.59)	0.148			
Yes	9 (40.9)	20 (25.0)	1.00					
Ischemic heart disease								
No	19 (86.4)	68 (85.0)	0.90	(0.23, 3.50)	0.873			
Yes	3 (13.6)	12 (15.0)	1.00					
Atrial fibrillation								
No	21 (95.5)	79 (98.8)	3.76	(0.23, 62.69)	0.356			
Yes	1 (4.5)	1 (1.2)	1.00					
Congestive cardiac failure								
No	22 (100.0)	78 (97.5)	0.00	(0.00, -)	0.999			
Yes	0 (0.0)	2 (2.5)	1.00					
Chronic kidney disease/end stage renal failure								
No	22 (100.0)	76 (95.0)	0.00	(0.00, -)	0.999			
Yes	0 (0.0)	4 (5.0)	1.00					
Previous stroke								
No	14 (63.6)	70 (87.5)	4.00	(1.34, 11.93)	0.013	4.15	(1.21, 14.25)	0.024[†]
Yes	8 (36.4)	10 (12.5)	1.00			1.00		
No comorbid								
No	19 (86.4)	62 (77.5)	1.00	(0.49, 6.92)	0.368			
Yes	3 (13.6)	18 (22.5)	1.84		0.205			
Diagnosis								
LACI	15 (68.2)	67 (83.8)	1.00					
PACI	4 (18.2)	7 (8.8)	0.40	(0.10,1.51)	0.174			
POCI	1 (4.5)	5 (6.2)	1.12	(0.12, 10.30)	0.921			
TACI	2 (9.1)	1 (1.2)	0.11	(0.01, 1.32)	0.082			
NIHSS Score, median (IQR)	5.5 (2.0, 11.3)	5 (2.0, 7.0)	0.91	(0.84, 1.00)	0.050	0.90	(0.80, 1.00)	0.057
Premorbid MRS Score					0.592			
0	19 (86.4)	72 (90.0)	1.00					
1-2	2 (9.1)	3 (3.8)	0.40	(0.06, 2.54)	0.329			
3-5	1 (4.5)	5 (6.2)	1.32	(0.15, 11.98)	0.805			
Types of helper					0.884			
Family members and relatives	17 (77.3)	66 (82.5)	1.66	(0.39, 7.12)	0.492			
Friends	3 (13.6)	7 (8.8)	1.00					
Emergency medical services	2 (9.1)	5 (6.2)	1.07	(0.13, 8.98)	0.949			
Self (No helper)	0 (0.0)	2 (2.5)	$6x10^8$	(0.00, -)	0.999			

cont..... pg 246

cont from..... pg 245

Table II: Univariate and multivariate analysis of factors related to prehospital delay

Variable	Prehospital delay, n (%)		Univariate analysis			Multivariate analysis		
	No	Yes	Crude OR	95% CI	*p* value[a]	Adj. OR	95% CI	*p* value[b]
Symptoms								
Limb weakness					0.876			
Mild	7 (31.8)	25 (31.2)	1.34	(0.28, 6.43)	0.715			
Severe	12 (54.6)	47 (58.8)	1.47	(0.34, 6.39)	0.608			
None	3 (13.6)	8 (10.0)	1.00					
Facial asymmetry					0.369			
Mild	3 (13.6)	17 (21.2)	1.93	(0.51, 7.34)	0.338			
Severe	1 (4.6)	10 (12.5)	3.40	(0.41, 28.41)	0.259			
None	18 (81.8)	53 (66.3)	1.00					
Dysarthria								
Mild	8 (36.4)	23 (28.8)	0.70	(0.24, 2.07)	0.790			
Severe	5 (22.7)	20 (25.0)	0.97	(0.29, 3.30)	0.518			
None	9 (40.9)	37 (46.2)	1.00		0.965			
Other symptoms								
Mild	0 (0.0)	4 (5.0)	$4x10^8$	(0.00, -)	0.273			
Severe	2 (9.1)	1 (1.2)	0.13	(0.01, 1.55)	0.999			
None	20 (90.9)	75 (93.8)	1.00		0.107			
Perception of Stroke					0.085			
Yes	13 (59.1)	26 (32.5)	1.00					
No	3 (13.6)	18 (22.5)	3.00	(0.75, 12.07)	0.122			
Unsure	6 (27.3)	36 (45.0)	3.00	(1.01, 8.93)	0.048			
Awareness of thrombolysis service								
Yes	3 (13.6)	1 (1.2)	1.00			1.00		
No	19 (86.4)	79 (98.8)	12.47	(1.23,126.66)	0.033	17.12	(1.28, 229.17)	0.032†
Medical contact(s) before study hospital								
Health Clinic								
Yes	5 (22.7)	18 (22.5)	1.00					
No	17 (77.3)	62 (77.5)	1.01	(0.33, 3.13)	0.982			
GP Clinic								
Yes	0 (0.0)	21 (26.2)	1.00					
No	22(100.0)	59 (73.8)	0.00	(0.00, -)	0.998			
Basic care hospital								
Yes	2 (9.1)	7 (8.8)	1.00					
No	20 (90.9)	73 (91.2)	1.04	(0.20, 5.42)	0.960			
Traditional Medicine								
Yes	0 (0.0)	1 (1.2)	1.00					
No	22 (100.0)	79 (98.8)	0.00	(0.00, -)	1.000			
Other Stops*								
Yes	0 (0.0)	2 (2.5)	1.00					
No	22 (100.0)	78 (97.5)	$1x10^9$	(0.00, -)	0.999			
Number of stops before study hospital					0.111			
0	15 (68.2)	33 (41.2)	1.00					
1	7 (31.8)	45 (56.3)	2.92	(1.07, 7.97)	0.036			
2	0 (0.0)	2 (2.5)	$7x10^8$	(0.00, -)	0.999			

OR, Odd ratio; Adj. OR, Adjusted odd ratio; CI, Confidence interval; SD, Standard deviation; IQR, Interquartile range; LACI, Lacunar infarct; PACI, Partial anterior circulation infarct; POCI, Posterior circulation infarct; TACI, Total anterior circulation infarct; NIHSS, National Institutes of Health Stroke Scale; mRS, Modified Rankin Scale

[a] Wald test

[b] Wald test; stepwise method for multivariable analysis was employed. The *p* value of only significant variables of the multivariable analysis were presented in the table

*Other stops prior to study hospital includes HD centre and pharmacy

† denotes significant *p* value of <0.05

no significantly less decision delay. The plausible explanation to this phenomenon is the failure to apply knowledge into action even though an individual might have been exposed to stroke education previously, leading to the psychology of believing in "lightning does not strike twice". It was also worrisome to see there was no difference in the decision time in those who already had at least one cardiovascular risk factor. This finding is similar to Ashraf et al[18] and Faiz et al[15], suggesting the lack of knowledge of primary stroke prevention for patients who are at risk of stroke.

Although our study showed that the severity of stroke by NIHSS (clinicians' judgement) was associated with less decision delay, no association was found with the severity of patient-reported FAST symptoms (patients' judgement) and

Table III: Univariate and multivariate analysis of factors related to decision delay

Variable	Decision delay, n (%)		Univariate analysis			Multivariate analysis		
	No	Yes	Crude OR	95% CI	*p* value[a]	Adj. OR	95% CI	*p* value[b]
Age in years, mean (SD)	61 (12.8)	58 (12.6)	0.98	(0.95, 1.01)	0.163			
Gender								
Male	27 (57.4)	38 (69.1)	1.66	(0.73, 3.73)	0.224			
Female	20 (42.6)	17 (30.9)	1.00					
Ethnicity					0.600			
Malay	29 (61.7)	38 (69.1)	1.00					
Chinese	12 (25.5)	14 (25.5)	0.89	(0.36, 2.21)	0.802			
Indian	5 (10.7)	2 (3.6)	0.31	(0.06, 1.69)	0.174			
Others	1 (2.1)	1 (1.8)	0.76	(0.05, 12.72)	0.851			
Comorbidity								
Hypertension								
No	12 (25.5)	17 (30.9)	1.31	(0.55, 3.12)	0.549			
Yes	35 (74.5)	38 (69.1)	1.00					
Diabetes mellitus								
No	29 (61.7)	34 (61.8)	1.01	(0.45, 2.24)	0.990			
Yes	18 (38.3)	21 (38.2)	1.00					
Dyslipidaemia								
No	32 (68.1)	41 (74.5)	1.37	(0.58, 3.25)	0.472			
Yes	15 (31.9)	14 (25.5)	1.00					
Ischaemic heart disease								
No	38 (80.9)	49 (89.1)	1.93	(0.63, 5.91)	0.247			
Yes	9 (19.1)	6 (10.9)	1.00					
Atrial fibrillation								
No	45 (95.7)	55 (100.0)	$2x10^9$	(0.00, -)	0.999			
Yes	2 (4.3)	0 (0.0)	1.00					
Congestive cardiac failure								
No	46 (97.9)	54 (98.2)	1.17	(0.07, 19.30)	0.911			
Yes	1 (2.1)	1 (1.8)	1.00					
Chronic kidney disease/end stage renal failure								
No	45 (95.7)	53 (96.4)	1.18	(0.16, 8.70)	0.873			
Yes	2 (4.3)	2 (3.6)	1.00					
Previous stroke								
No	36 (76.6)	48 (87.3)	2.10	(0.74, 5.94)	0.164			
Yes	11 (23.4)	7 (12.7)	1.00					
No comorbid								
No	32 (83.0)	42 (76.4)	1.00					
Yes	8 (17.0)	13 (23.6)	1.51	(0.57, 4.03)	0.412			
Subtypes of stroke					0.587			
LACI	34 (72.3)	48 (87.3)	1.00					
PACI	7 (14.9)	4 (7.3)	0.41	(0.11, 1.49)	0.174			
POCI	3 (6.4)	3 (5.4)	0.71	(0.14, 3.72)	0.684			
TACI	3 (6.4)	0 (0.0)	0.00	(0.00, -)	0.999			
NIHSS Score, median (IQR)	6 (3.0, 10.0)	4 (2.0, 6.0)	0.86	(0.78, 0.95)	0.002	0.86	(0.78, 0.95)	0.002†
Premorbid mRS Score					0.796			
0	41 (87.2)	50 (90.9)	1.00					
1-2	3 (6.4)	2 (3.6)	0.55	(0.09, 3.43)	0.519			
3-5	3 (6.4)	3 (5.5)	0.82	(0.16, 4.28)	0.814			
Symptoms								
Limb weakness					0.703			
Mild	14 (29.8)	18 (32.7)	0.74	(0.18, 3.02)	0.669			
Severe	29 (61.7)	30 (54.6)	0.59	(0.16, 2.24)	0.439			
None	4 (8.5)	7 (12.7)	1.00					
Facial asymmetry								
Mild	10 (21.3)	10 (18.2)	0.87	(0.32, 2.34)	0.763			
Severe	4 (8.5)	7 (12.7)	1.52	(0.41, 5.66)	0.781			
None	33 (70.2)	38 (69.1)	1.00		0.532			
Dysarthria					0.892			
Mild	15 (31.9)	16 (29.1)	0.82	(0.33, 2.05)	0.672			
Severe	12 (25.5)	13 (23.6)	0.83	(0.31, 2.22)	0.715			
None	20 (42.6)	26 (47.3)	1.00					
Other symptoms					1.000			
Mild	0 (0.0)	4 (7.3)	$1x10^9$	(0.00, -)	0.999			
Severe	3 (6.4)	0 (0.0)	0.00	(0.00, -)	0.999			
None	44 (93.6)	51 (92.7)	1.00					
Perception of Stroke					0.710			
Yes	20 (42.6)	19 (34.6)	1.00					
No	18 (38.3)	24 (43.6)	1.40	(0.48, 4.09)	0.534			
Unsure	9 (19.1)	12 (21.8)	1.40	(0.59, 3.37)	0.448			
Awareness of thrombolysis service								
No	44 (93.6)	54 (98.2)	3.68	(0.37, 36.65)	0.266			
Yes	3 (6.4)	1 (1.8)	1.00					

OR, Odd Ratio; Adj. OR, Adjusted Odd Ratio; CI, Confidence Interval; SD, Standard Deviation; IQR, Interquartile Range; LACI, Lacunar infarct; PACI, partial anterior circulation infarct; POCI, Posterior circulation infarct; TACI, Total anterior circulation infarct; NIHSS, National Institutes of Health Stroke Scale; mRS, Modified Rankin Scale.

[a] Wald test

[b] Wald test; Stepwise method for multivariable analysis was employed. The *p* value of only significant variables of the multivariable analysis were presented in the table

† denotes significant *p* value of <0.05

less decision delay. This reflects the poor level of awareness and knowledge for stroke among our study population, and this does not differ among different age groups, genders or ethnicity. In this report, the level of stroke awareness among our patients concurred with earlier findings by Carroll et al, who reported only 40% of stroke patients were able to identify their diagnosis.[14] Moreover, these stroke symptoms were attributed by patients to other non-stroke causes, over which patients perceive control, causing a significant decision delay.[18] With the advent of intravenous thrombolysis and mechanical thrombectomy in acute stroke, it is crucial that patients should take the shortest time straight to an acute stroke-ready hospital. Another novel finding in our study indicated only a small number of patients came to hospital using EMS. Majority of patients sought help from the nearest family members, friends or relatives. The impact of EMS in reducing prehospital delay is inconsistent across different studies[12,19], partly because it depends on the local geographical factor and medical infrastructures.

Patients' awareness and knowledge for stroke is one of the biggest obstacles to shorten prehospital delay, but it is believed there is more to it. Previous studies have shown even good knowledge of stroke symptoms is insufficient as there was a significant discrepancy between awareness and action taken following stroke.[12,14,20] In our study, less than half of the patients were unable to recognise FAST as stroke. However, patients who have correctly identified stroke do not have significant shorter prehospital or decision delay. The mnemonic FAST has been a sensitive tool for detecting stroke in prehospital setting.[21-22] Although over the years, public health campaigns have been held to publicise this knowledge, the impact on prehospital delay was minimal, most probably due to the limited behavioural impact of these health campaigns.[23-24] Therefore, future research is needed to formulate more sustainable, multi-levelled, practicable health education strategies, for example school education[25], mass media[26] and behavioural intervention programs.[27]

The limitation of our study is being single-centred cross-sectional study, which focused only in a suburban area. The study population did not reflect true incidence of stroke owing to the sampling method and exclusion of patients with severe stroke who were unable to accept the interviews. We focussed in evaluating stroke patients' first-person perception and experience, instead of third-person perspective i.e. bystanders or caregivers, hence we excluded patients who were not fit to be interviewed. The small sample size and non-probability sampling method in this study might introduce selection bias, particularly in the findings on ethnicity and awareness of thrombolysis therapy. Other biases that may occur include recall bias by study subjects in estimating response time and the perception bias in responding towards open-ended interview questions. A multi-centred analysis with a larger sample size using the probability sampling method is recommended in the future to overcome these limitations for a more generalisable and representative results.

CONCLUSION

Our research provides evidence that there was a substantial lack of knowledge and lacklustre response to stroke among our studied populations. Various strategies are required in the future not only to disseminate knowledge of stroke, but also to modulate the public behaviour and rectify the misperception for stroke as these represent the main obstacles towards early hospital presentation and stroke-directed treatment.

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DISCLOSURE

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