Association Between Onset-to-Arrival Time and Functional Outcome at Discharge in Acute Ischaemic Stroke

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Background & Purpose

- It has been suggested that the onset-to-arrival time is an important factor that influences the functional outcome in patients with an ischaemic stroke.
- Few studies have investigated this association between early hospital arrival and a good clinical outcome post-stroke, particularly for patients not receiving reperfusion therapy.
- The aim of this study is to investigate if early hospital arrival is associated with good clinical outcomes post-stroke (mRs ≤ 1). Additionally, we explore whether early hospital arrival influences key quality indicators of stroke care.

Methods

- Data were extracted from the nationwide, registry-based Sentinel Stroke National Audit Programme (SSNAP).
- Inclusion Criteria: (1) All patients aged > 16 years; (2) Patients admitted to participating hospitals in England, Wales and Northern Ireland; (3)Patients admitted between 1/Apr/2013 and 31/Mar/2017, inclusive; (4) Diagnosis of Ischaemic stroke; (5) Known (precise or best estimate) time of onset.
- Exclusion Criteria: (1) Haemorrhagic strokes or undetermined stroke type; (2) In-hospital strokes; (3) Wake-up strokes; (4) Onset before 1/Apr/2013.
- We used a multilevel logistic regression analysis to adjust for potential demographic (age, sex, ethnicity), and clinical (pre-stroke functional status, comorbidities, stroke severity, arrival by ambulance and acute treatment with reperfusion therapy) patient-level confounders as well as differences between hospitals.

Results

- From a total of 324,367 patients registered in SSNAP, 165,301(50.96%) patients met the inclusion/exclusion criteria, and were included in the analysis.
- Excluded cases:
 - 23,210 (7.16%) Haemorrhagic strokes
 - 18,138 (5.59%) In-hospital strokes
 - 79,350 (24.46%) Unknown time of stroke onset
 - 37,253 (11.48%) Wake-up strokes
 - 1,115 (0.34%) Unknown stroke type

Baseline Patient Characteristics

- Among the 165,301 eligible patients:
 - Mean age was 74.17 ± 13.73
 - 85,427 (51.68%) were male
 - 14,6179 (88.43%) were white
 - Median NIHSS at arrival was 4 (IQR: 2-10)
 - 84,080 (50.86%) were minor strokes (NIHSS ≤4)
 - 56,694 (34.30%) were moderate strokes (NIHSS 5-15)
 - 24,527 (14.84%) were severe strokes (NIHSS ≥16)
 - 89,766 (54.31%) arrived within the first 3 hours after onset, and 15,692 (9.49%) arrived 24 hours post-stroke
 - 140,063 (84.73%) were transported by ambulance

Patient Characteristics by Onset-to-Arrival Time (Table 1)

- Patients with shorter onset-to-arrival times were older, had a higher median NIHSS score and a higher prevalence of moderate strokes.
- The prevalence of previous strokes, atrial fibrillation and heart failure decreased with longer onset-to-arrival times, while the prevalence of hypertension and diabetes mellitus increased with longer times.
- The proportion of patients arriving by ambulance decreased with longer onset-to-arrival times.

Onset-to-Arrival Time and Functional Outcome at Discharge (Table 2)

- After adjustment, patients arriving within 1.5 hours and between 1.5 and 3 hours after stroke onset had better odds of having a good functional outcome at discharge (OR 1.21 [95%CI 1.15-1.27] and 1.08 [95%CI 1.03-1.13], respectively).
- Similar results were observed in a sensitivity analysis excluding patients receiving reperfusion therapy.

Onset-to-Arrival Time and Quality Indicators (Table 2)

- Shorter onset-to-arrival times where associated with increasing odds of meeting the following Quality of Care Indicators: Brain scan within 1h of arrival, Stroke admission within 4h of arrival, Dysphagia screen within 4h of arrival, Stroke physician and nurse assessment within 24h of arrival; Odds of attaining these quality indicators decreased with longer onset-to-arrival times.
- Other indicators showed a less clear pattern of association.

Conclusions

- Early hospital arrival after ischaemic stroke onset is associated with good functional outcome at discharge, even after adjusting for potential confounders. It is possible that this is linked to better quality of care.
- Further research is needed to better define the association between onset-to-arrival times and quality of care.

Table 1. Patient Characteristics by Onset-to-Door Time								
	≤ 1.5h	>1.5-3h	>3-4.5h	>4.5-6h	>6-12h	>12-24h	>24h	P _{trend}
Age, mean (SD)	74 (14)	76 (14)	75 (14)	75 (14)	74 (13)	72 (14)	71 (14)	<0.001
Male, n (%)	25,046 (51)	20,464 (50)	8,187 (50)	4,948 (51)	9,463 (53)	8,608 (55)	8,711 (51)	<0.001
Ethnicity								
White, n (%)	43,628 (89)	36,437 (89)	14,481 (89)	8,661 (89)	15,759 (88)	13,728 (87)	13,485 (86)	<0.001
Black, n (%)	515 (1)	406 (1)	219 (1)	120 (1)	254 (1)	258 (2)	276 (2)	<0.001
Other, n (%)	2,104 (4)	1,457 (4)	708 (4)	404 (4)	882 (5)	825 (5)	802 (5)	<0.001
Not Stated, n (%)	2,774 (6)	2,445 (6)	956 (6)	570 (6)	1,054 (6)	964 (6)	1,129 (7)	<0.001
mRs ≤ 2 pre-stroke, n (%)	40,028 (82)	32,430 (80)	13,067 (80)	7,901 (81)	15,055 (84)	13,720 (87)	13,922 (89)	<0.001
Comorbidities								
Previous Stroke, n (%)	13,694 (28)	11,883 (29)	4,661 (29)	2,695 (28)	4,767 (27)	3,840 (24)	3,517 (22)	<0.001
Hypertension, n (%)	25,916 (53)	22,104 (54)	9,077 (56)	5,446 (56)	10,040 (56)	8,782 (56)	8,726 (56)	<0.001
Diabetes Mellitus, n (%)	8,588 (18)	8,104 (20)	3,531 (22)	2,128 (22)	4,083 (23)	3,598 (23)	3,567 (23)	<0.001
Atrial Fibrillation, n (%)	11,332 (23)	9,117 (22)	3,403 (21)	1,929 (20)	3,224 (18)	2,404 (15)	2,070 (13)	<0.001
Heart Failure, n (%)	2,900 (6)	2,335 (6)	908 (6)	495 (5)	882 (5)	697 (4)	630 (4)	<0.001
NIHSS, median (IQR)	7 (3-15)	5 (2-11)	4 (2-9)	4 (2-8)	3 (1-6)	3 (1- 6)	2 (1-4)	<0.001
Stroke Severity								
Minor, n (%)	16,924 (35)	18,820 (46)	8,832 (54)	5,647 (58)	11,212 (63)	10,602 (67)	12,043 (77)	<0.001
Moderate, n (%)	19,888 (41)	15,388 (38)	5,557 (34)	3,156 (32)	5,428 (30)	4,138 (26)	3,139 (20)	<0.001
Severe, n (%)	12,209 (25)	6,537 (16)	1,975 (12)	952 (10)	1,309 (7)	1,035 (7)	510 (3)	<0.001
Arrival by Ambulance, n (%)	45,054 (92)	37,762 (93)	14,444 (88)	8,209 (84)	14,538 (81)	11,473 (73)	8,583 (55)	<0.001
Intravenous rtPA, n (%)	20,885 (43)	11,633 (29)	1,888 (12)	95 (1)	18 (0)	0 (0)	0 (0)	<0.001
Thrombectomy, n (%)	352 (2)	153 (1)	59 (1)	24 (1)	11 (0)	8 (0)	2 (0)	<0.001
mRs indicates modified Rankin Scale, NIHSS National Institute of Health Stroke Scale, rtPA recombinant tissue plasminogen activator All values have been rounded to the nearest integer								

Table 2. Association between Onset-to-Arrival time, Clinical Outcome at Discharge and Quality Indicators. (Fixed effects)						
	≤ 1.5h OR(95%CI)*	>1.5-3h OR(95%CI)*	>3-4.5h OR(95%CI)*	>4.5-6h OR(95%CI)*	>6-12h OR(95%CI)*	>12-24h OR(95%CI)*
mRS ≤ 1 at discharge	1.21 (1.15-1.27)	1.08 (1.03-1.13)	1.03 (0.95-1.14)	1.05 (0.95-1.17)	0.96 (0.88-1.05)	1.03 (0.95-1.13)
Brain scan within 1 h of arrival	2.79 (2.52-3.10)	2.32 (2.11-2.55)	1.82 (1.64-2.03)	1.71 (1.52-1.93)	1.29 (1.73-1.41)	1.38 (1.25-1.52)
Stroke unit admission 4h of arrival	1.71 (1.59-1.84)	1.60 (1.49-1.71)	1.47 (1.35-1.59)	1.24 (1.13-1.35)	1.06 (0.98-1.15)	1.00 (0.99-1.17)
Dysphagia screen within 4h of arrival	1.87 (1.72-2.04)	1.70 (1.57-1.84)	1.54 (1.40 1.69)	1.25 (1.13-1.39)	1.13 (1.03-1.23)	1.06 (0.97-1.15)
Stroke physician within 24h of arrival	1.30 (1.17-1.45)	1.27 (1.14-1.41)	1.26 (1.11-1.42)	1.13 (0.98-1.29)	0.98 (0.88-1.10)	0.99 (0.88-1.10)
Stroke nurse within 24h of arrival	1.51 (1.28-1.78)	1.42 (1.21-1.67)	1.31 (1.09-1.57)	1.42 (1.15-1.75)	1.22 (1.03-1.44)	1.22 (1.03-1.45)
Physiotherapy assessment within 72h of arrival	1.29 (1.10-1.53)	1.30 (1.11-1.53)	1.14 (0.95-1.36)	1.13 (0.92-1.39)	1.31 (1.09-1.57)	1.27 (1.05-1.52)
Occupational therapy assessment within 72h of arrival	1.05 (0.91-1.20)	1.08 (0.94-1.23)	1.12 (0.96-1.30)	1.05 (0.89-1.25)	1.07 (0.92-1.24)	1.00 (0.86-1.17)
Communication assessment by SALT within 72h of arrival	1.17 (0.99-1.40)	1.16 (0.98-1.38)	1.20 (0.99-1.46)	1.25 (0.99-1.55)	1.25 (1.03-1.52)	1.16 (0.95-1.41)
Swallowing assessment by SALT within 72h of arrival	1.40 (1.17-1.67)	1.49 (1.25-1.77)	1.17 (0.96-1.43)	1.58 (1.26-1.98)	1.42 (1.17-1.72)	1.23 (1.01-1.49)
* Compared to patients arriving >24h. mRS indicates modified Rankin scale; SALT, speech and language therapist Odds ratios are adjusted for patient-level confounders: age, sex, ethnicity, functional status pre-stroke, comorbidities (previous stroke or transient ischaemic attack, hypertension, diabetes mellitus, atrial fibrillation, heart failure), stroke severity (NIHSS score), use of ambulance service, and reperfusion therapy (rt-PA thrombolysis, thrombectomy)						