



Off-hour effect is not significant in endovascular treatment for anterior circulation large vessel occlusion in a multicentre registry

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To cite: Zha M, Yang Q, Liu S, *et al.* Off-hour effect is not significant in endovascular treatment for anterior circulation large vessel occlusion in a multicentre registry. *Stroke & Vascular Neurology* 2021;**6**: e000949. doi:10.1136/svn-2021-000949

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/svn-2021-000949>).

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Received 17 February 2021
Accepted 22 June 2021
Published Online First
8 July 2021



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ABSTRACT

Background and purpose Whether the off-hour effect has an impact on workflow and outcomes of endovascular treatment (EVT) for anterior circulation large vessel occlusion (AC-LVO) remains uncertain. This study aimed to compare the characteristics and outcomes of patients who presented or were treated during off-hour versus on-hour in a multi-center registry.

Methods AC-LVO patients from 21 centres were categorised into the off-hour group and the on-hour group. Off-hour (weekends, holidays, and 18:00–7:59 on weekdays) and on-hour (8:00–17:59 on weekdays except for holidays) were defined according to arrival and groin-puncture time points, respectively. Subgroup comparisons between patients both arrived and treated during off-hour (true off-hour) and on-hour (true on-hour) were performed. The primary outcome was the 90-day modified Rankin Scale (mRS) score. Secondary outcomes included favourable outcome (mRS 0–2 at 90 days), EVT-related time metrics, and other clinical outcomes. Ordinary and binary logistic regression and linear regression were taken to adjust for confounding factors.

Results Of all 698 patients enrolled, 435 (62.3%) and 456 (65.3%) patients were categorised into the off-hour arrival and off-hour puncture group, respectively. Shorter onset to door time (adjusted β coefficient: -21.56 ; 95% CI -39.96 to -3.16 ; $p=0.022$) was noted in the off-hour arrival group. Ordinal and dichotomous mRS scores at 90 days were comparable between the off-hour group and the on-hour group regardless of off-hour definitions. Other time metrics and outcomes were comparable between the two groups. Of 595 patients both presented and were treated during off-hour or on-hour, 394 patients were categorised into the true off-hour group and 201 into the true on-hour group. Time metrics and clinical outcomes were similar between the true off-hour and the true on-hour group.

Conclusions The off-hour effect was not significant regarding clinical outcomes and in-hospital workflow in AC-LVO patients receiving EVT in this Chinese multicentre registry.

INTRODUCTION

Patients presenting or getting treated outside working hours (off-hour) are prevalent in clinical practice.^{1–3} Patients with different

diseases admitted to hospitals during off-hour are associated with higher risks of mortality than patients admitted during regular working hours (on-hour).⁴ The off-hour effect might be partly explained by the absence of timely attending, delayed interventions, lower hospital staffing levels and lower quality of medical resources.^{5–9} Theoretically, the off-hour effect might be more significant in conditions that are more sensitive to the rapid availability of specialised medical care.⁷

Endovascular treatment (EVT) has been established as the golden standard of treating acute ischaemic stroke with anterior circulation large vessel occlusion (AC-LVO).¹⁰ The effectiveness of EVT is time dependent,¹¹ and fast reperfusion leads to improved functional outcomes.¹² Investigations on the off-hour effect on EVT workflow and clinical outcomes are limited, and the existing results have been conflicting.^{1 13–18} The definition of off-hour varies in different studies.¹⁹ Some studies define the off-hour group according to arrival time,^{2 13–15 17 20–23} and some according to groin-puncture time.^{1 3 16 18 24–26} Whether the effect will change or not when grouped by different reference time point remains uncertain. Moreover, investigation on this issue in the Chinese population is scarce. Thus, we performed a retrospective study to explore the potential off-hour effect on EVT in AC-LVO patients in a multicentre registry.

METHODS

Patient selection

This study was a retrospective analysis of the acute anterior circulation ischaemic stroke registry (ACTUAL). Between January 2014 and June 2016, 698 consecutive AC-LVO patients were enrolled from 21 comprehensive stroke centres in China. Detailed descriptions on this registry have been published

previously.²⁷ Patients were enrolled after fulfilling the inclusion criteria: (1) age ≥ 18 years; (2) were diagnosed as acute ischaemic stroke; (3) had angiographically proven (CT angiography/magnetic resonance angiography/digital subtraction angiography) AC-LVO; (4) underwent EVT. Patients treated with intra-arterial thrombolysis alone or diagnosed with a concomitant aneurysm, arteriovenous malformation or posterior circulation occlusion were excluded to maintain the homogeneity. The ACTUAL study was approved by the ethics committee of each participating centre.

Treatment protocol

Neurointerventional teams in all participating centres were capable of providing potential EVTs across the 7-day week including nights and national holidays. All enrolled patients were treated following contemporary guidelines. Patients received intravenous thrombolysis within 4.5 hours since stroke onset after excluding contradictions. Thrombectomy was performed with a stent-like retriever (Solitaire, Covidien, Irvine, California, USA) in most patients via a transfemoral approach, with other devices permitted. Rescue therapies including balloon angioplasty, stenting, intraarterial thrombolysis and intraarterial tirofiban administration were performed at the discretions of neurointerventionalists.

Definitions and group divisions

Off-hour was defined as weekends, Chinese national holidays and 18:00–7:59 on weekdays. On-hour was defined as regular working hours between 8:00 and 17:59 on weekdays except for holidays.²¹ Patients were categorised into the off-hour group and the on-hour group, and off-hour was defined according to arrival time (arrival mode) and groin-puncture time (puncture mode), respectively. Some patients presented during off-hour but were treated during on-hour, and some vice versa. The true off-hour group was defined when patients arrived and treated both during off-hour. Patients who arrived and got punctured both during on-hour were defined as the true on-hour group. Comparisons between the true off-hour group and the true on-hour group were performed to explore the off-hour effect thoroughly.

Data collection

Demographics, medical histories, baseline National Institutes of Health Stroke Scale (NIHSS) score, baseline Alberta Stroke Program Early CT Score (ASPECTS), time metrics, and clinical outcomes were collected. Time metrics were calculated according to medical records and automatic time stamps on images and digital subtraction angiography documents. Onset to door time (OTD) was defined as the time interval from stroke symptom onset to emergency department arrival. Door to imaging (DTI) time was defined as the time interval between patient arrival and imaging results acquired. Onset to puncture (OTP) time and door to puncture (DTP) were defined as the time interval from symptom onset to groin-puncture

and patient-arrival to groin-puncture, respectively. Puncture to reperfusion (PTR) was referred to the time interval between groin-puncture and successful reperfusion. If reperfusion failed, PTR was regarded as the time interval from groin-puncture to the ending of EVT. Time from symptom onset to reperfusion (OTR) was also calculated.

Clinical outcomes

Reperfusion status was evaluated according to the modified Thrombolysis In Cerebral Infarction (mTICI) Scale, and successful reperfusion was defined as a mTICI score of 2b-3.²⁸ Post-EVT intracranial haemorrhages (ICH) were recorded and analysed. Symptomatic ICH (sICH) and asymptomatic ICH (aICH) were evaluated according to the Heidelberg criteria.²⁹ Collateral flow grading was estimated through the American Society of Interventional and Therapeutic Neuroradiology/Society of Interventional Radiology (ASITN/SIR) grading system.³⁰ All angiographic data were sent to a core laboratory in Jinling Hospital. The size of ICH, collateral flow grading and preprocedure and postprocedure mTICI were evaluated blindly by two physicians/interventionists with advice from the third experienced physician/interventionist in case of disagreement.²⁷ Modified Rankin Scale (mRS) scores at 90 days were followed up by the outpatient clinic or telephone. The primary outcome was 90-day mRS score. Secondary outcomes included favourable outcome (mRS 0–2 at 90 days), successful reperfusion, time metrics, sICH, aICH, mortality in hospital and mortality at 90 days.

Statistical analyses

Multiple imputations with chain equations were performed to account for missing values (glucose level: 7.02%; atrial fibrillation: 0.14%; ASPECTS: 3.72%; ASITN/SIR grade: 0.86%; DTI time: 1.29%; PTR: 1.00%; OTR: 0.86%). Categorical variables were expressed as numbers (percentages). Continuous variables were displayed as means (SD) or medians (IQR) according to the normality of data distributions. Univariate analysis was performed between the off-hour group and the on-hour group by using t-test, Mann-Whitney U test, χ^2 test or Fisher exact test as appropriate.

The on-hour group was set as the reference in multivariable regressions. Ordinary logistic regression (shift analysis) was taken to analyse differences in the 90-day mRS score between the off-hour group and the on-hour group. Linear regression and binary logistic regression were taken to compare time metrics and binary clinical outcomes between the two groups, respectively.² In different off-hour modes, time metrics were adjusted for baseline variables with statistical trends ($p < 0.1$ on univariate analyses). Other clinical outcomes were adjusted for baseline variables with statistical trends, OTD time and other time metrics with statistical trends. A two-sided $p < 0.05$ was considered statistically significant. Analyses were performed using the SPSS software package, V.22.0 (IBM) and R V.3.6.3 (R Core Team (2020)). R: a language

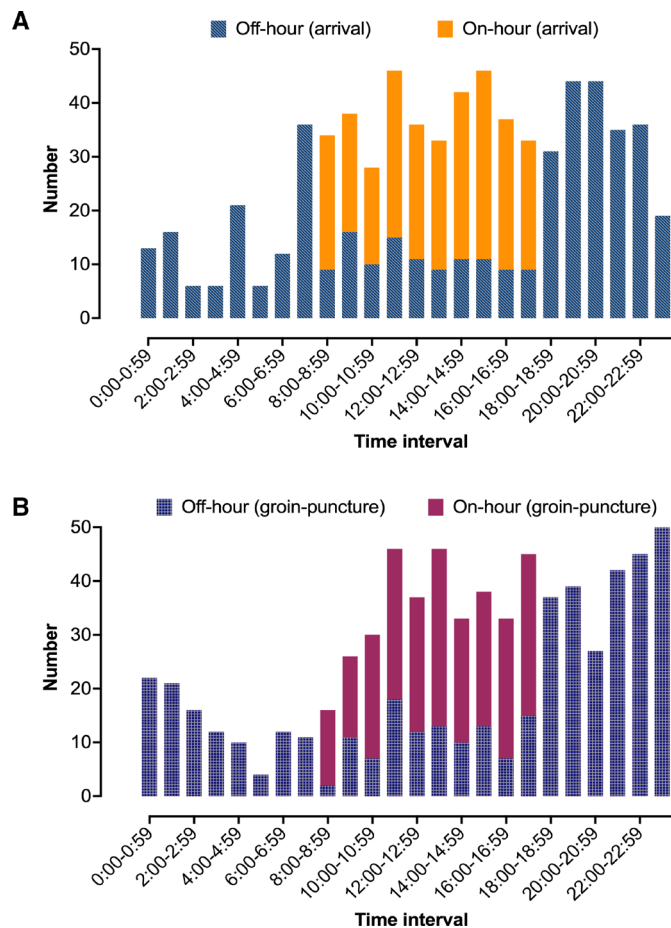


Figure 1 Distributions of arrival and groin-puncture times across all days: (A) arrival mode; (B) puncture mode.

and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

RESULTS

Overview

Of all 698 patients enrolled in the ACTUAL registry, the median (IQR) age was 66 (57–74) years old, and men accounted for 60.6% (423/698). The median (IQR) admission NIHSS score and ASPECTS were 16.0 (12.0–21.0) and 9.0 (8.0–10.0), respectively. Two hundred and twenty-nine (32.8%) patients received intravenous thrombolysis. The median OTD, DTI, DTP, PTR, OTP and OTR time metrics were 125.0, 23.0, 125.0, 100.0, 271.5 and 380.5 min, respectively. Four hundred and thirty-five (62.3%) patients were categorised into the off-hour group and 263 (37.7%) patients into the on-hour group in the arrival mode. Four hundred and fifty-six (65.3%) patients were categorised into the off-hour group and 242 (34.7%) patients were into the on-hour group in the puncture mode. Arrival and puncture times across all days are illustrated in [figure 1](#). Patients who arrived or were treated in the afternoon/evening were more prevalent than those in the morning in both modes. A total of 579 (83.0%) patients reached successful reperfusion. Two

hundred and eighteen (31.2%) patients were diagnosed as aICH and 108 (15.5%) as sICH. The median (IQR) mRS score at 90 days was 3 (1–6). At 90 days, 304 (43.6%) patients had favourable outcomes.

Baseline characteristics

[Table 1](#) shows comparisons on the baseline characteristics and clinical outcomes between the off-hour group and the on-hour group in different modes. Male sex was much more prevalent in the off-hour arrival group (64.8% vs 53.6%, $p=0.003$). Admission glucose level was significantly higher in the off-hour puncture group (median: 6.8 mmol/L vs 6.4 mmol/L, $p=0.024$). No other statistical difference in baseline characteristics was noted between the off-hour group and the on-hour group.

Clinical outcomes

In univariate analysis, mRS scores at 90 days were comparable between the off-hour arrival group and the on-hour arrival group (median: 3 vs 3; $p=0.624$). The OTD time was significantly shorter in the off-hour arrival group (120.0 min vs 140.0 min, $p=0.047$). Other EVT-related time metrics and clinical outcomes including successful reperfusion, favourable outcome, sICH, aICH, mortality in hospital and mortality at 90 days were comparable between the two groups ([table 1](#)). In the puncture mode, there was no significant difference concerning all clinical outcomes between the off-hour and on-hour presentations. [Figure 2](#) illustrates distributions of mRS scores in different modes.

In multivariable analyses, OTD was significantly shorter in the off-hour arrival group after adjusting for covariates (adjusted β coefficient: -21.56 min; 95% CI -39.96 to -3.16 min; $p=0.022$). Ordinary logistic regression indicated that the 90-day mRS scores remained comparable between the two groups in arrival mode (common OR: 0.98; 95% CI 0.74 to 1.29; $p=0.881$) and puncture mode (common OR: 0.96; 95% CI 0.72 to 1.28; $p=0.792$). No significant difference was found regarding other time metrics and clinical outcomes between the off-hour group and the on-hour group in both arrival and puncture modes ([table 2](#)).

Subgroup analysis

Of 595 patients who presented and were treated during the same period (both during off-hour or during on-hour), 394 patients were categorised into the true off-hour group and 201 into the true on-hour group. Baseline characteristics between the two groups were shown in online supplemental table 1. A trend towards a longer DTP time metric was witnessed in the true off-hour group (median: 125.0 min vs 116.0 min; adjusted β coefficient: 12.17 min; 95% CI -1.20 to 25.55; $p=0.074$). No significant difference in other time metrics and clinical outcomes was noted between the two groups ([table 3](#)). The summary of this research is illustrated in [figure 3](#).

Table 1 Demographics and clinical outcomes between the off-hour group and the on-hour group

Variable	Defined off-hour with arrival time (arrival mode)		P value	Defined off-hour with groin-puncture time (puncture mode)		P value
	Off-hour n=435	On-hour n=263		Off-hour n=456	On-hour n=242	
Age, year, median (IQR)	65.0 (57.0–73.0)	66.0 (56.0–75.0)	0.587	65.0 (57.0–73.0)	66.0 (56.0–75.0)	0.831
Male, n (%)	282 (64.8)	141 (53.6)	0.003	285 (62.5)	138 (57.0)	0.159
SBP, mm Hg, median (IQR)	145.0 (130.0–160.0)	146.0 (129.0–160.0)	0.624	145.0 (130.0–160.8)	145.0 (127.5–160.0)	0.474
DBP, mm Hg, median (IQR)	82.0 (76.0–92.0)	83.0 (74.0–93.0)	0.697	83.0 (76.0–92.0)	80.0 (72.0–93.0)	0.079
Glucose, mmol/L, median (IQR)	6.8 (5.8–8.6)	6.5 (5.5–8.6)	0.082	6.8 (5.8–8.6)	6.4 (5.5–8.4)	0.024
Medical history, n (%)						
Atrial fibrillation	177 (40.7)	111 (42.2)	0.693	189 (41.4)	99 (40.9)	0.891
Hypertension	278 (63.9)	164 (62.4)	0.680	290 (63.6)	152 (62.8)	0.837
Diabetes	80 (18.4)	48 (18.3)	0.963	85 (18.6)	43 (17.8)	0.777
Current smoking, n (%)	123 (28.3)	61 (23.2)	0.140	131 (28.7)	53 (21.9)	0.051
ASPECTS, median (IQR)	9.0 (8.0–10.0)	9.0 (8.0–10.0)	0.932	9.0 (8.0–10.0)	9.0 (8.0–10.0)	0.925
Baseline NIHSS, median (IQR)	16.0 (12.0–20.0)	17.0 (12.0–21.0)	0.154	16.0 (12.0–20.0)	17.0 (12.0–21.0)	0.071
Intravenous thrombolysis, n (%)	153 (35.2)	76 (28.9)	0.087	158 (34.6)	71 (29.3)	0.155
Local anaesthesia, n (%)	358 (82.3)	202 (76.8)	0.077	373 (81.8)	187 (77.3)	0.153
Stroke aetiology, n (%)			0.669			0.950
LAA	191 (43.9)	118 (44.9)		202 (44.3)	107 (44.2)	
CE	216 (49.7)	124 (47.1)		223 (48.9)	117 (48.3)	
Others	28 (6.4)	21 (8.0)		31 (6.8)	18 (7.4)	
ICA occlusion, n (%)	174 (40.0)	107 (40.7)	0.858	187 (41.0)	94 (38.8)	0.579
MCA occlusion, n (%)	257 (59.1)	154 (58.6)	0.891	264 (57.9)	147 (60.7)	0.467
ASITN/SIR 0–1, n (%)	221 (50.8)	117 (44.5)	0.106	226 (49.6)	112 (46.3)	0.409
Onset to door, min, median (IQR)	120.0 (60.0–212.0)	140.0 (64.0–240.0)	0.047	125.0 (60.0–220.0)	127.0 (63.5–232.5)	0.542
Door to imaging, min, median (IQR)	23.0 (12.0–33.0)	24.0 (13.0–32.0)	0.940	23.0 (12.0–34.0)	24.0 (15.0–32.0)	0.885
Door to puncture, min, median (IQR)	128.0 (84.0–177.0)	125.0 (80.0–172.0)	0.597	130.0 (86.3–177.0)	120.0 (75.0–165.0)	0.161
Puncture to reperfusion, min, median (IQR)	100.0 (72.0–145.0)	101.0 (77.0–138.0)	0.858	99.5 (70.0–140.8)	103.0 (79.8–143.5)	0.235
Onset to puncture, min, median (IQR)	266.0 (201.0–345.0)	285.0 (210.0–360.0)	0.098	273.5 (204.3–349.5)	270.5 (210.0–360.0)	0.711
Onset to reperfusion, min, median (IQR)	380.0 (299.0–470.0)	383.0 (310.0–488.0)	0.393	382.0 (299.0–470.0)	380.5 (313.0–488.5)	0.656
Successful reperfusion, n (%)	361 (83.0)	218 (82.9)	0.973	378 (82.9)	201 (83.1)	0.957
Symptomatic ICH, n (%)	69 (15.9)	39 (14.8)	0.715	74 (16.2)	34 (14.0)	0.449
Asymptomatic ICH, n (%)	140 (32.2)	78 (29.7)	0.485	144 (31.6)	74 (30.6)	0.786
Mortality in hospital, n (%)	104 (23.9)	59 (22.4)	0.655	110 (24.1)	53 (21.9)	0.509
mRS score at 90 days, median (IQR)	3 (1–6)	3 (1–6)	0.624	3 (1–6)	3 (2–6)	0.549
Favourable outcome, n (%)	190 (43.7)	114 (43.3)	0.932	200 (43.9)	104 (43.0)	0.823
Mortality at 90 days, n (%)	109 (25.1)	68 (25.9)	0.814	116 (25.4)	61 (25.2)	0.947

ASITN/SIR, American Society of Interventional and Therapeutic Neuroradiology/Society of Interventional Radiology; ASPECTS, Alberta Stroke Program Early CT Score; CE, cardioembolism; DBP, diastolic blood pressure; ICA, intracranial artery; ICH, intracranial haemorrhage; LAA, large-artery atherosclerosis; MCA, middle cerebral artery; mRS, modified Rankin Scale; NIHSS, National Institute of Health Stroke Scale; SBP, systolic blood pressure.

DISCUSSIONS

This multicentre study demonstrated that the prehospital time metric (OTD time) was shorter in patients presented

during the off-hour period. However, off-hour arrival/treatment did not influence in-hospital workflow and clinical outcomes.

Table 2 Analyses on the off-hour effect regarding time metrics and clinical outcomes

Variable	Defined off-hour with arrival time (arrival mode)			Defined off-hour with puncture time (puncture mode)		
	Unadjusted β coefficient/OR (95% CI)	Adjusted β coefficient/OR (95% CI) *	Adjusted <i>p</i> value	Unadjusted β coefficient/ OR (95% CI)	Adjusted β coefficient/OR (95% CI) †	Adjusted <i>p</i> value
Onset to door time	-20.91 (-39.52 to -2.30)	-21.56 (-39.96 to -3.16)	0.022	-3.41 (-22.43 to 15.60)	-3.20 (-22.40 to 16.00)	0.744
Door to imaging time	-0.97 (-4.86 to 2.91)	-0.82 (-4.76 to 3.12)	0.682	-1.51 (-5.46 to 2.44)	-1.28 (-5.27 to 2.71)	0.529
Door to puncture time	6.06 (-7.53 to 19.65)	6.95 (-6.70 to 20.60)	0.318	4.21 (-9.63 to 18.05)	2.26 (-11.64 to 16.16)	0.749
Puncture to reperfusion	2.74 (-6.65 to 12.13)	3.50 (-5.88 to 12.87)	0.464	-3.58 (-13.14 to 5.98)	-4.899 (-14.54 to 4.74)	0.319
Onset to puncture time	-14.85 (-35.30 to 5.60)	-14.61 (-35.12 to 5.89)	0.162	0.80 (-20.06 to 21.65)	-0.94 (-21.95 to 20.07)	0.930
Onset to reperfusion time	-12.21 (-35.20 to 10.78)	-11.36 (-34.44 to 11.72)	0.334	-4.75 (-28.17 to 18.67)	-7.75 (-31.36 to 15.86)	0.520
Successful reperfusion	1.01 (0.67 to 1.51)	0.96 (0.63 to 1.46)	0.838	0.99 (0.65 to 1.50)	0.96 (0.63 to 1.47)	0.853
Symptomatic ICH	1.08 (0.71 to 1.66)	1.14 (0.73 to 1.76)	0.569	1.18 (0.76 to 1.84)	1.18 (0.75 to 1.85)	0.473
Asymptomatic ICH	1.13 (0.81 to 1.57)	1.13 (0.80 to 1.59)	0.480	1.05 (0.75 to 1.47)	1.10 (0.78 to 1.55)	0.587
Mortality in hospital	1.09 (0.76 to 1.56)	1.14 (0.78 to 1.67)	0.494	1.13 (0.78 to 1.65)	1.23 (0.82 to 1.86)	0.316
90-day mRS score (shift analysis)	0.94 (0.71 to 1.22)	0.98 (0.74 to 1.29)	0.881	0.92 (0.70 to 1.21)	0.96 (0.72 to 1.28)	0.792
Favourable outcome	1.01 (0.74 to 1.38)	0.96 (0.70 to 1.33)	0.808	1.04 (0.76 to 1.42)	1.00 (0.70 to 1.42)	0.994
Mortality at 90 days	0.96 (0.68 to 1.36)	1.01 (0.70 to 1.46)	0.964	1.01 (0.71 to 1.45)	1.07 (0.72 to 1.59)	0.722

Reference: patients who presented or get treated during the on-hour period.

*Time metrics were adjusted for gender, glucose level, intravenous thrombolysis and local anaesthesia. Other clinical outcomes were adjusted for gender, glucose level, intravenous thrombolysis, local anaesthesia, onset to door time and onset to puncture time.

†Time metrics were adjusted for diastolic blood pressure, glucose level, current smoking and baseline National Institute of Health Stroke Scale (NIHSS) score. Other clinical outcomes were adjusted for diastolic blood pressure, glucose level, current smoking, baseline NIHSS score and onset to door time.

ICH, intracranial haemorrhage; mRS, modified Rankin Scale.;

Table 3 Time metrics and clinical outcomes between the true off-hour group and the true on-hour group

Variable	Overall n=595	True off-hour n=394	True on-hour n=201	Adjusted β coefficient/OR (95% CI)*	P value
Onset to door, min, median (IQR)	131.0 (60.0–230.0)	124.5 (60.0–218.2)	146.0 (73.5–240.0)	-15.56 (-35.78 to 4.65)	0.131
Door to imaging, min, median (IQR)	22.0 (12.0–32.0)	22.0 (11.8–32.2)	23.0 (12.0–30.5)	-0.37 (-4.30 to 3.56)	0.855
Door to puncture, min, median (IQR)	120.0 (76.0–164.0)	125.0 (80.0–170.2)	116.0 (67.0–150.0)	12.17 (-1.20 to 25.55)	0.074
Puncture to reperfusion, min, median (IQR)	100.0 (74.0–143.0)	100.0 (71.0–144.2)	103.0 (78.5–140.5)	-0.57 (-10.93 to 9.79)	0.914
Onset to puncture, min, median (IQR)	270.0 (203.0–348.0)	265.5 (200.0–345.0)	271.0 (210.0–359.0)	-3.39 (-24.78 to 17.99)	0.755
Onset to reperfusion, min, median (IQR)	374.0 (300.0–470.0)	374.5 (294.0–463.8)	372.0 (312.0–485.5)	-5.10 (-29.14 to 18.94)	0.677
Successful reperfusion, n (%)	494 (83.0)	327 (83.0)	167 (83.1)	0.96 (0.60 to 1.54)	0.878
Symptomatic ICH, n (%)	95 (16.0)	65 (16.5)	30 (14.9)	1.20 (0.73 to 1.95)	0.474
Asymptomatic ICH, n (%)	186 (31.3)	126 (32.0)	60 (29.9)	1.13 (0.77 to 1.65)	0.525
Mortality in hospital, n (%)	141 (23.7)	96 (24.4)	45 (22.4)	1.28 (0.82 to 2.00)	0.281
90-day mRS score, median (IQR)	3.0 (1.0–6.0)	3.0 (1.0–6.0)	3.0 (2.0–6.0)	0.97 (0.71 to 1.32)	0.848
Favourable outcome, n (%)	252 (42.4)	169 (42.9)	83 (41.3)	0.95 (0.65 to 1.40)	0.790
Mortality at 90 days, n (%)	154 (25.9)	101 (25.6)	53 (26.4)	1.09 (0.71 to 1.67)	0.692

Reference: patients who presented or get treated during the on-hour period.

*Time metrics were adjusted for gender, glucose level, current smoking, baseline National Institute of Health Stroke Scale (NIHSS) score, intravenous thrombolysis, local anaesthesia. Other clinical outcomes were adjusted for gender, glucose level, current smoking, baseline NIHSS score, intravenous thrombolysis, local anaesthesia, onset to door time and door to puncture time.

ICH, intracranial haemorrhage; mRS, modified Rankin Scale.;

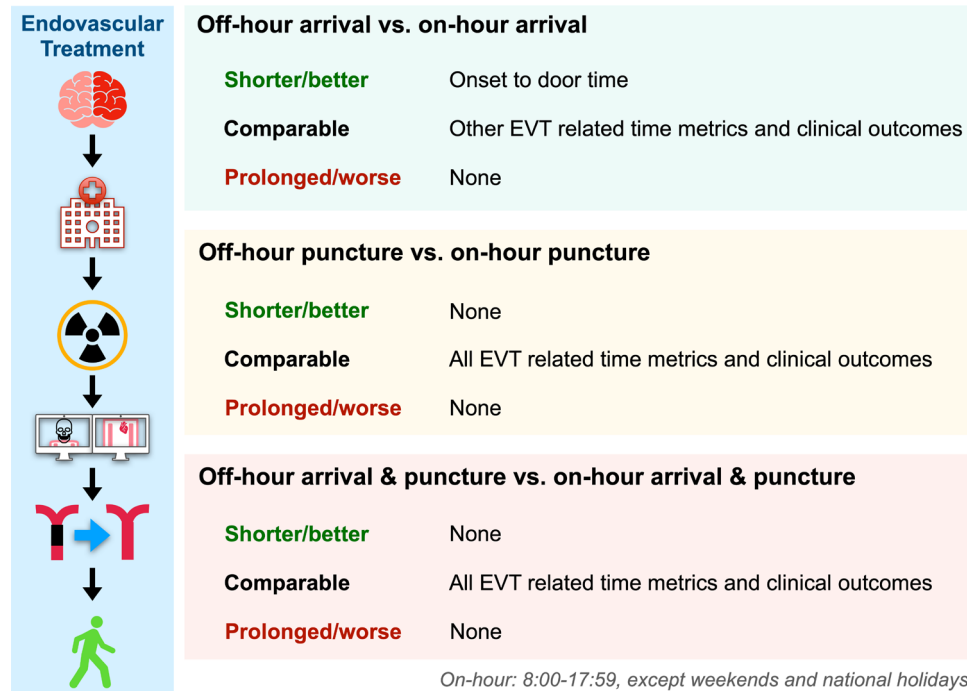


Figure 3 The central illustration of this study. EVT, endovascular treatment.

study still provided valuable information on this research area of uncertainty.

CONCLUSIONS

AC-LVO patients who arrived at hospitals outside working hours and underwent EVT were associated with shorter OTD time comparing with the on-hour population. But the potential hazardous off-hour effect was not evident regarding in-hospital workflow and clinical outcomes.

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Acknowledgements We sincerely thanked all efforts made by ACTUAL investigators.

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Funding This study was partly supported by the National Nature and Science Foundation (Grant No. 81901218, 81870946, 81530038, and 81701299).

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The central ethics committee at Jinling Hospital and the ethics committee of each participating center approved this registry.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data that support the findings of this study are available from the corresponding author on reasonable request.

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