Pre-Admission Blood Pressure and Outcome in a Large Telestroke Cohort

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Introduction

- 55% of Americans live within 60 miles of a primary stroke center.
- Telestroke (TS) units shorten treatment delivery times (e.g. rt-PA) and reduce permanent neurologic sequelae.[1,2]
- TS units provide tele-consults with neurovascular specialists experienced in medical and surgical treatment of acute ischemic stroke (AIS).
- Maintenance of systolic blood pressure (SBP) > 140mmHg is recommended in AIS management.
  - SBP < 140mmHg is independently predictive of poor neurologic outcome.[3]
- We analyzed all patients with AIS symptoms transported to Thomas Jefferson University Hospital (TJUH), via JeffSTAT EMS ground vehicles or helicopters, to verify efficiency of the TS system and the prognostic value of vital sign-monitoring throughout the transportation process.

Study Design

- Cohort:
  - AIS patients presenting to Telestroke (TS) hospital network of over 40 regional medical institutions within PA and NJ from 2011-2016 (n=2,928).
- Data points:
  - HRR*, BP, MAP* were collected: (1) at presentation to TS unit, (2) during transportation and (3) at arrival to TJUH
  - NIHSS was collected: (1) at presentation to TS unit, (2) at arrival to TJUH
  - DTN*, IV rt-PA status, CTA-CTP*, MT* status, TICI*
- Outcome Variables:
  1. Influence of SBP variations during transportation on clinical outcome, measured by modified Rankin Score (mRS) on discharge, latest follow-up, and mortality rate.
  2. Number of patients who received MT and/or rt-PA.
- Covariates and Comorbidities (risk-adjusted):
  - Age and gender
  - Risk factors of hypertension (HTN), diabetes mellitus (DM), and smoking
  - Hospital course: MT, TICI score, recanalization device, IV rt-PA, NIHSS pre-treatment.
- Statistical Analysis:
  - Regression diagnostics were performed for all analyses.
  - Study sample of 1,354 patients → 80% power to detect a difference in mortality as small as 7.6%, at an α-level of 0.05.
  - All probability values were the result of two-sided tests.
  - Stata version 13 (StataCorp, College Station, TX) was used for statistical analysis.

*Abbrev: heart rate & rhythm (HRR), mean arterial pressure (MAP), door-to-needle time (DTN), Computed Tomography Angiography-Perfusion (CTA-CTP), mechanical thrombectomy (MT), Thrombolysis in Cerebral Infarction (TICI) scale

Outcomes

Gender	**n**	**%**
Female	644	47.6
Male	709	52.4
Total	**1353**	**100**

	Mean	**SD**	**Min**	**Max**
Age	66.6	15.4	16	111
NIHSS pre-intervention	8.67	8.38	0	38

Treatment	**n**	**%**
Standard medical protocol	717	53.0
IV rt-PA	595	23.7
IV rt-PA & Medical	273	46
MT	93	3.4
MT & IV rt-PA	46	49

IV rt-PA (no MT)	**Mean**	**SD**	**Min**	**Max**
pre-treatment NIHSS	8.37	8.3	0	38
DTN (min)	96	46.0	0	200
outcome mRS (60.7% < 2)	2.11	2.02		
Mortality rate	0.1	0.4		

MT (includes rt-PA)	**Mean**	**SD**	**Min**	**Max**
pre-treatment NIHSS	12.8	7.88	0	32
TICI score	2.99	1.6	0	3
outcome mRS (37.6% < 2)	2.9	1.66		
Mortality rate	0.17	0.97		

	Before transportation		During transportation		After transportation	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
MAP (mmHg)	103.4	16.51	103.02	18.36	101.3	17.37
SBP	148.39	25.39	148.51	26.5	145.3	24.36

	mRS			**Mortality**		
	OR	**CI 95%**	**p-value**	**OR**	**CI 95%**	**p-value**
SBP_1	0.007	0.004-0.003	0.71	0.99	0.98-1.01	0.41
MAP_1	0.002	0.01-0.004	0.56	0.98	0.97-1.00	0.09
SBP_2	0.000	0.004-0.003	0.84	0.99	0.98-1.00	0.24
MAP_2	0.000	0.01-0.005	0.89	0.99	0.98-1.01	0.28
SBP_3	0.000	0.002-0.004	0.61	0.99	0.98-1.01	0.61
MAP_3	0.002	0.0051-0.0053	0.96	0.99	0.98-1.00	0.18

SBP during transport	**< 140 mmHg**		**140-185 mmHg**		**> 185 mmHg**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
pre-intervention NIHSS	8.41	8.65	8.53	8.40	8.41	7.03
Treated with IV rt-PA	22.3%		22.0%		16.4%	
Treated with MT	8.1%		5.7%		1.8%	
Outcome mRS ≤ 2	61.7%		59.0%		54.5%	
Correlations	**OR**	**CI 95%**	**OR**	**CI 95%**	**OR**	**CI 95%**
Latest mRS	1.167	-0.04-0.96 (p=0.422)	0.29	-0.38-0.96 (p=0.397)	0.28	-0.39-0.97 (p=0.410)
Mortality	1.167	0.21-6.38 (p=0.858)	0.89	0.52-1.55 (p=0.705)	0.98	0.61-1.58 (p=0.945)

Discussion

- Patients who received MT had higher NIHSS on admission, prior to treatment.
- Patients with SBP > 185 mmHg during transportation were least likely to receive IV rt-PA, MT, and had less good clinical outcomes (mRS ≤ 2).
  - However, reasons for exclusion from IV rt-PA treatment is not entirely known due to retrospective nature of study.
- Efficient TS network protocol increases the number of stroke patients treated and yields better outcomes by decreasing DTN.
  - Less than ⅓ of patients (27.3%) received IV rt-PA within DTN ≤ 60 min.
  - 55.63% (153/275) of patients treated with IV rt-PA, via TS consultation, had a good clinical outcome on latest follow-up (mRS ≤ 2).
  - These results are better than previously published (TEMPiS and REACH), and other European TS studies.

Limitations:

- Study design is limited by its retrospective nature.
- We did not consider pre-existing HTN; we could have collected relative BP.[4]
- Though studies report high BP and increases in BP to be associated with worse outcomes, there is no data supporting causation.[5-7]
- Cutoff limit of SBP values used in management of stroke lack evidence and are extrapolated from cardiac literature.
  - More randomized clinical trials are needed to elucidate the relationship between SBP during acute phase of ischemic stroke and clinical outcome.

Conclusion

- TS service enables rapid assessment and reduced DTN. This study displayed better clinical outcomes at latest follow-up when compared to current international TS studies.
- SBP was not associated with higher mortality and morbidity.
- Future studies should address limitations of this study to confirm these findings.

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