Effect of heparin during endovascular stroke treatment: A large single-center analysis

Mori F., Konda D., Morosetti D., Da Ros V., Gandini R., Koch G., Diomedì M., Sallustio F.
Policlinico Tor Vergata , Università degli Studi di Roma “Tor Vergata”, Roma, Italy

Introduction: effectiveness of heparin use during endovascular mechanical thrombectomy (MT) for acute ischemic stroke (AIS) has been barely investigated. Use of i.v. heparin during arterial catheterization is largely employed (1) to prevent thrombus formation over catheters, distal embolization, clot extension and arterial reocclusion. On the other hand, anticoagulation in the early phases of acute ischemic stroke is not recommended due to the risk of serious intracranial hemorrhage (ICH) (2).

Aim: to assess effectiveness and safety of heparin use during MT for AIS in a real-world setting.

Methods:

Patients
361 patients with anterior circulation AIS undergoing MT were retrospectively analyzed from our stroke registry. Based on intra-procedural use of heparin, patients were grouped in heparin (H+) and no-heparin (H-).

Outcomes
The effect of heparin use on MT effectiveness was tested by comparing rates of successful reperfusion defined as a TICI score $\geq 2b$ (3) between H+ and H- groups. Effect of heparin use on safety was tested by comparing rates of hemorrhagic complications defined according to the ECASS criteria (no hemorrhage, hemorrhagic infarction-1, hemorrhagic infarction-2, parenchymal hematoma-1, parenchymal hematoma-2) (4), and symptomatic ICH (sICH) defined as an hemorrhage associated with an increase of at least 4 points in the NIHSS.

Age, gender, NIHSS, site of occlusion, history of hypertension, diabetes, smoking, atrial fibrillation, ASPECTS on non-contrast CT (5), collaterals adequacy on pretreatment CT-Angiography (6), intravenous thrombolysis (IVT), general anesthesia, type of device for thrombectomy, procedural times were also compared between groups to control for an effect of possible confounding factors.

Results:

Table 1. Demographics and baseline characteristics

	No Heparin (n=161)	Heparin (n=200)	p
Age, years (mean±SD)	74±14	68.9±12.2	0.001
Gender (male) (%)	62(38.5)	85(42.5)	0.45
Pre-stroke mRS 0-2 (%)	156(96.8)	198(99)	0.24
Hypertension (%)	115(71.4)	147(73.5)	0.72
Diabetes (%)	24(14.9)	39(19.5)	0.26
Atrial Fibrillation (%)	72(44.7)	95(47.5)	0.67
Current Smoking (%)	25(15.5)	32(16)	1.00
Glycemia (mean±SD)	128.2±42.8	134.1±50.7	0.36
NIHSS (mean±SD;median(range))	17.1±5.01;18(2-26)	18.1±4.1;19(3-25)	0.17
Systolic BP (mean±SD)	144.9±26.4	148.3±26.8	0.47
Diastolic BP (mean±SD)	79±16.8	82.3±14.8	0.07
ASPECTS (mean±SD;median(range))	8±1.6; 8(2-10)	7.4±2.1;8(2-10)	0.009
MCA occlusion (%)	102(63.3)	123(61.5)	0.74
Terminal ICA (%)	4(2.4)	2(1)	0.41
T occlusion (%)	9(5.5)	7(3.5)	0.44
Tandem occlusion (%)	46(28.5)	68(34)	0.3
Good collaterals (%)	99(61.4)	128(64)	0.66

NIHSS= National Institute of Health Stroke Scale; BP= blood pressure; ASPECTS= Alberta Stroke Program Early CT Score; MCA= middle cerebral artery; ICA= internal carotid artery; T occlusion= combined occlusion of terminal ICA, MCA and ACA

Table 3. Safety and efficacy outcomes

	Overall			MT			IV+MT		
	H-(n=161)	H+(n=200)	p	H-(n=49)	H+(n=94)	p	H-(n=112)	H+(n=106)	p
Successful reperfusion (%)	133(82.6)	139(69.5)	0.004	41(83.6)	61(64.8)	0.02	92(82.1)	78(73.5)	0.14
24h ASPECTS (median;range)	6(0-10)	4(0-10)	<0.001	6(0-10)	5(0-10)	0.03	6(0-10)	5(0-10)	<0.001
Any ICH (%)	58(36)	74(37)	0.9	19(38.7)	34(36.1)	0.85	39(34.8)	40(37.7)	0.67
SAH	3(1.8)	2(1)	0.66	1(2)	1(1)	1.00	2(1.7)	2(1.8)	1.00
HI-1	3(1.8)	7(3.5)	0.52	2(4)	3(3.1)	1.00	1(0.8)	4(3.7)	0.2
HI-2	12(7.4)	10(5)	0.37	7(14.2)	5(5.3)	0.1	5(4.4)	5(4.7)	1.00
PH-1	15(9.3)	23(11.5)	0.6	2(4)	9(9.5)	0.33	13(11.6)	12(11.3)	1.00
PH-2	25(15.5)	32(16)	1.00	7(14.2)	14(14.8)	1.00	18(16)	14(13.2)	0.57
Symptomatic ICH (%)	16(9.9)	19(9.5)	1.00	3(6.1)	12(12.7)	0.26	7(6.2)	14(13.2)	0.1
3-month mRS≤2 (%)	66(40.9)	73(36.5)	0.38	13(26.5)	31(32.9)	0.45	53(47.3)	41(38.6)	0.21
3-month mRS≤3 (%)	74(45.9)	91(45.5)	1.00	14(28.5)	41(43.6)	0.1	60(53.5)	49(46.2)	0.34
All-cause mortality (%)	49(30.4)	63(31.5)	0.9	18(36.7)	35(37.2)	1.00	31(27.6)	26(24.5)	0.64

MT= mechanical thrombectomy; IV+MT= intravenous thrombolysis plus mechanical thrombectomy; ASPECTS= Alberta Stroke Program Early CT Score; ICH= Intracranial haemorrhage; SAH= Subarachnoid haemorrhage; HI= Hemorrhagic Infarction; PH= Parenchymal haematoma; mRS= modified Rankin Scale.

Table 4. Multivariable regression model: best predictors of successful reperfusion

Variables	OR	SE	95% CI	P
Stentriever vs Aspiration	0.45	0.15	0.22-0.89	0.02
CT ASPECTS	1.2	0.08	1.05-1.37	0.007
Heparin	0.49	0.17	0.25-0.97	0.04

OR: Odds Ratio; SE: standard error; CI: confidence interval

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Our study reveals that heparin use during endovascular procedure of MT for anterior circulation AIS is safe and does not improve clinical outcome but is associated with lower chance of reperfusion.