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Original Article

Endovascular management of extracranial occlusions at the hyperacute phase of stroke with tandem occlusions

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ABSTRACT

Background and purpose. – The management of cervical artery occlusions in hyperacute stroke with tandem cervical/intracranial occlusions has not yet become standardized, especially when the circle of Willis is effective.

Methods. – We retrospectively analyzed the safety and accuracy of current approaches to manage the cervical occlusion in consecutive patients with tandem occlusions addressed for intracranial mechanical thrombectomy (MT) in our department from January 2012 to May 2017. The different approaches that could be performed in a same patient during the same procedure or hospitalization were analyzed separately.

Results. – We reported 64 approaches to manage the cervical occlusion in 49 patients with tandem occlusion (14% of MT): medical treatment alone in 16/64 (25%), stenting/angioplasty in 16/64 (25%), occlusion with coils in 12/64 (19%), angioplasty alone in 9/64 (14%), stent-retriever in 8/64 (12%), and/or thromboaspiration in 3/64 (5%). Early ipsilateral embolic recurrence occurred after 9/64 (14%) of them. It was strongly associated with the presence of a cervical intraluminal thrombus ($P=0.001$) and was then lower after occlusion with coils and stent-retriever compared to medical treatment alone and thromboaspiration ($P=0.002$). Occlusion with coils had a lower rate of radiological intracranial hemorrhage at 48-hour compared to other approaches ($P=0.009$). The 3-month rates of favorable outcome ($P=0.806$) and mortality ($P=0.878$) were similar. One delayed stroke was imputable to an occlusion with coils, for a median (Q1–Q3) follow-up of 10 (3–20) months.

Conclusions. – Cervical occlusion with coils and thrombectomy with stent-retrievers may be relevant to prevent early embolic recurrence in cervical occlusions with intraluminal thrombus. Stent-retrievers should be further assessed as a first-line approach, since delayed stroke may occur following occlusion with coils.

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The management of the hyperacute stroke with cervical and intracranial tandem occlusions is still controversial. The benefit of intracranial mechanical thrombectomy (MT) in tandem occlusions is suggested in a recent meta-analysis [1]. Yet, no data are available regarding the hyperacute management of the cervical occlusion in tandem occlusions.

Some authors have reported a very low rate of early embolic recurrences and they have hypothesized that the recanalization of

the cervical occlusion may be futile or associated with excessive risk of thrombus migration and cerebral hemorrhage, particularly when a stent is used [2–4]. However, these studies did not distinguish the situations with a poor supply through the Willis circle or with an intraluminal thrombus in the cervical artery, which are known to be the major determinants of early embolic recurrences [5–7]. Case reports have suggested the feasibility of several approaches in these situations, including cervical artery mechanical thrombectomy, occlusion with coils, or angioplasty and/or stenting [8,9]. Yet, no comparative data are available regarding the safety and the accuracy of these approaches.

The aim of this study was to explore the best approaches to manage the cervical occlusion at the hyperacute phase of stroke with tandem occlusions.

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Table 1
Characteristics of the patients with tandem occlusion (n = 49).

	Total n = 49	Occlusion approach n = 12	Medical approach n = 13	Recanalization approach n = 24	P value
Age, yrs	63 (54–72)	59 (48–71)	63 (54–68)	66 (56–74)	0.321
Female, n (%)	15 (31%)	5 (42%)	2 (29%)	8 (33%)	0.334
Initial NIHSS	15 (7–20)	15 (7–18)	15 (5–18)	15 (7–21)	0.827
Anterior stroke, n (%)	41 (84%)	11 (92%)	12 (92%)	18 (75%)	0.274
Effective supply, n (%)	42 (86%)	12 (100%)	12 (92%)	18 (75%)	0.133
ASPECTS ^a	7 (5–8)	5 (4–7)	6 (5–8)	7 (6–8)	0.101
Atherosclerosis, n (%)	26 (53%)	4 (33%)	6 (46%)	16 (68%)	0.116
Dissection, n (%)	18 (37%)	7 (58%)	7 (54%)	4 (17%)	0.013
Cardioembolism, n (%)	5 (10%)	1 (8%)	0 (0%)	4 (17%)	0.349
Intracranial MT, n (%)	43 (88%)	12 (100%)	8 (61%)	23 (96%)	0.046
IV-tPA, n (%)	33 (67%)	7 (58%)	11 (85%)	15 (62%)	0.356
Time-to-IV-tPA, min	145 (120–210)	150 (117–187)	137 (105–198)	150 (137–222)	0.149
TICI > 2a, n (%)	38 (77%)	11 (92%)	8 (61%)	19 (79%)	0.150
Time-to-TICI, min	310 (270–410)	300 (220–445)	300 (230–450)	370 (300–402)	0.489
2-day ECASS > 1, n (%)	16 (33%)	0 (0)	6 (46%)	10 (42%)	0.009
Delayed stroke, n (%)	1 (2%)	1 (8%)	0 (0)	0 (0)	0.244
mRS ≤ 2 at 3 months, n (%)	28 (57%)	8 (67%)	7 (53%)	13 (54%)	0.806
Death at 3 month, n (%)	8 (16%)	1 (8%)	2 (15%)	5 (21%)	0.878
Last follow-up, months	10 (3–20)	18 (4–22)	12 (5–22)	3 (3–11)	0.048
Lost-to-follow-up, n (%)	7 (14%)	2 (17%)	0 (0)	5 (21%)	0.241

Occlusion approach: cervical artery occlusion with coils; medical approach: medical treatment alone; recanalization approach: cervical artery recanalization using stenting, balloon-angioplasty, thromboaspiration, or thrombectomy with a stent-retriever. NIHSS: National Institute of Health stroke scale; ASPECTS, CT or MR Alberta Stroke Program Early CT score; IV-tPA: intravenous tissue plasminogen activator; time-to-IV-tPA: time from the onset of symptoms to IV-tPA; TICI: Thrombolysis In Cerebral Infarction scale; time-to-TICI: time from the onset of symptoms to last TICI score assessment; ECASS: European Cooperative Acute Stroke Study classification; mRS: modified Rankin Scale.

^a For anterior circulation only unless specified numbers are median (IQR).

Material and methods

Population and variables

Based on a prospective database of consecutive patients who were assigned an intracranial MT in our center between January 2012 and May 2017, we retrospectively analyzed the data of all patients with tandem occlusions defined as an intracranial thrombus that migrated from the cervical artery occlusion or sub-occlusion. We excluded patients with pure hemodynamic cervical occlusion, patients with non-embolic intracranial occlusion (stenosis or dissection) and patients for whom intracranial catheterism was impossible.

Intracranial arteries were defined as intradural arteries. Cervical arteries included in our study the intracranial/extradural segment of the internal carotid artery and the pre-PICA segment of the vertebral artery. Clinical, radiological and angiographic data were retrospectively assessed by two authors (CD, MAL) in consensus, including one neurologist who was independent of the procedures (CD). For each patient, we analyzed the usual prognostic variables in MT trials (Table 1). We also determined whether blood supply through the Willis circle was effective, based on the morphology of the supply arteries, and/or a relative delay of venous filling < 1.5 s in the vascular territory of the initial intracranial occlusion after recanalization, compared to the contralateral territory on angiography [10,11]. We also studied the presence of a cervical artery intraluminal thrombus (CAIT), defined on the angiography as a non-enhanced endoluminal irregular entity that was at least partially surrounded by the iodine-contrasting agent. It was distinguished from mural hematoma, which has regular contours, and from stenosis, which has a large implantation base on the wall of the vessel. We determined the occurrence of an ipsilateral early embolic recurrence, defined as any new ipsilateral clinical or radiological cerebral ischemia, or an arterial occlusion upstream of the initial cervical lesion at ≤ 30 days from the onset of symptoms. This variable included embolic recurrences that occurred during the endovascular procedure, but not erratic embolisms due to the intracranial MT itself. Lastly, we studied the occurrence of a delayed stroke recurrence, defined as any transient or permanent

clinical or parenchymal recurrence of cerebral ischemia at > 30 days regardless of the vascular territory. All of the patients or their relatives were informed whenever possible before or otherwise after the procedure and they provided their consent. The study was approved by the local Ethics Committee.

Management of the tandem occlusions

The technical features of the management of the tandem occlusions at the hyperacute phase of the stroke are detailed in the Supplemental Data. To summarize, the intracranial occlusion was treated with intravenous tissue plasminogen activator (IV-tPA) before 4.5 hours and/or mechanical thrombectomy (MT) before 6 hours from the onset of symptoms, according to the mean current guidelines [1,12,13]. The cervical occlusion was treated with one or several of the following approaches:

- medical treatment alone consisting of acetyl salicylic acid at 24 hours;
- stenting and/or balloon-angioplasty;
- mechanical thrombectomy using a thromboaspiration catheter or a stent-retriever;
- permanent occlusion using coils.

We analyzed separately each approach in patients who experienced different approaches during the same procedure, or during the same hospitalization. The choice of the approach was not standardized and depended for each patient on a joint assessment involving the interventional neuroradiologist and the vascular neurologist.

Study plan

We compared each type of approach that was performed to manage the cervical occlusion. The occurrences of an early embolic recurrence and of an intraluminal thrombus were analyzed after each approach even when several consecutive approaches were performed in a same patient. For the other variables, we considered only the last approach performed in a given patient. Continuous

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