

Low-Profile Visualized Intraluminal Support (LVIS Jr) Stent in the Treatment of Ruptured and Unruptured Aneurysms: Focus on Complex Stenting

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Introduction

Stent-assisted coiling has been shown to be an effective treatment modality for wide-neck intracranial aneurysms. The LVIS Jr stent (Microvention) represents a braided, re-sheathable microstent deployable via an 017 microcatheter. Complex stenting using the LVIS Jr stent is not well reported in the literature.

Demographics and clinical data of patients treated with the LVIS Jr stent in this series.

Age Sex	Presenting Symptoms	Ruptured Y/N	Medical History	Stent in Aorta Prior Y/N	Location	Aneurysm Height (mm)	Distal Neck	Parent Vessel Type (Phantom/Real)	Stent Configuration and Technique	Intraop Completion	Immediate mRROC	Complications	LOS (Days) (ICU/Hospital)	Dispo	F/U Time (mo)	F/U mRROC	In-Stent Stenosis Y/N	Change in mRS
52M	Rocan	Y	HTN, Smoking	N	Basilar Tip	8.6	2.0	1.0/1.0	Y, coil through	None	1	Seizure (within 24h)	1/5	Home	3	1	N	0
72M	Headache	Y	HTN	Y	LICA	8.5	1.1	1.0/2.5	Trans-circulation, coil through	None	2	Viscospasm	11/16	Home	1	1	N	1
63M	Seizure	Y	Unknown	Y	Accomm	7.7	1.3	2.0/1.8	Single, unable to complete coil through	None	3a	Seizure, EVD malfunction	4/4	Death	N/A	N/A	N/A	6
68F	Incidental	N	HTN	N/A	Accomm	6.8	1.4	1.0/1.6, 1.0/1.8	Trans-circulation, coil through	None	2	Coil compaction, stroke	4/6	Home	2	2	Y	0
40F	Rocan	Y	Smoking	N	ICA	8.4	1.4	1.0/1.5	Trans-circulation, coil through	None	2	None	2/2	Home	N/A	N/A	N/A	N/A
75F	Incidental	N	HTN, DM, COPD	N/A	R	5.8	1.4	2.0/2.3	N/A	None	N/A	Stroke	1/1	Home	N/A	N/A	N/A	N/A
83M	Incidental	N	HTN, Smoking, DM	N/A	Basilar Tip	8.7	1.6	1.0/2.5	Single, coil through	None	1	None	1/1	Home	3	1	N	0
49M	Rocan	Y	HTN, COPD	N	Accomm	6.6	1.5	1.0/2.2	Single, coil through	None	1	None	3/3	Home	N/A	N/A	N/A	N/A
43M	Headache	Y	Smoking	Y	LMCA	2.8	1.6	2.0/2.8	Single, coil through	None	2	Viscospasm	12/17	Home	3	1	N	0
69M	Incidental	N	HTN, Smoking, COPD	N/A	Accomm	9.8	1.6	1.0/1.1	Single, coil through	None	2	None	1/5	Home	1	1	N	0
42F	Incidental	N	Smoking	N/A	ICA	3.6	2.9	2.0/2.6	Single, acute after coil	None	2	None	1/1	Home	4	1	N	0
68F	Incidental	N	Smoking	N/A	Basilar Tip	7.1	1.9	2.0/1.2	Single, coil through	None	1	None	1/1	Home	1	1	N	0
57F	Headache	N	HTN, Smoking	N/A	RMCA	8.4	2.6	2.0/1.9	Single, coil through	None	2	None	2/5	Home	4	1	N	0
47F	Rocan	Y	Smoking	N	Accomm	6.3	2.3	1.0/1.6	Single, coil through	None	1	None	1/2	Home	3	1	N	0
80F	Headache	N	HTN, Smoking, CAD	N/A	ICA	11.5	1.8	1.0/1.2	Single, coil through	None	2	None	2/5	Home	1	1	N	0
79M	Headache	N	HTN, Smoking, CAD	N/A	Accomm	8.5	1.1	1.0/1.8	Single, coil through	None	1	None	3/5	Home	3	1	N	0
65M	Incidental	N	HTN, Smoking, family h/o rupture	N/A	Accomm	11.8	1.8	1.0/2.3	Single, coil through	None	1	None	1/1	Home	N/A	N/A	N/A	N/A
54M	Incidental	N	HTN, Smoking, CAD	N/A	Accomm	7.8	1.7	1.0/1.2	Single, coil through	None	3a	None	1/1	Home	N/A	N/A	N/A	N/A
70M	Incidental	N	HTN, Smoking	N/A	Accomm	3	1.5	1.0/1.4	Single, coil through	None	2	Agitation causing aspiration	2/4	Home	1	1	N	0
46F	Headache	N	HTN, Smoking, CAD, family h/o rupture	N/A	LMCA	7.2	1.3	1.0/1.2	Single, coil through	Intraop rupture	1	Stroke, viscospasm	19/18	Home	3	1	N	0

¹Patient had an uncomplicated course but represented shortly after discharge with rupture of another aneurysm, causing permanent morbidity.

²Early recanalization was observed on follow-up imaging, since treated with pipeline embolization device.

³Postoperative course was complicated by seizures and clotting of EVD requiring replacement while on dual-antiplatelet agents. After the last ICP crisis, family elected to forgo head imaging and opted for comfort care only.

⁴A stent was placed from R ICA to R PCA (patient has a fetal PCA). While crossing the first stent to attempt a Y construct, the first stent migrated to near the aneurysm neck. The stent was retrieved, and the procedure was aborted.

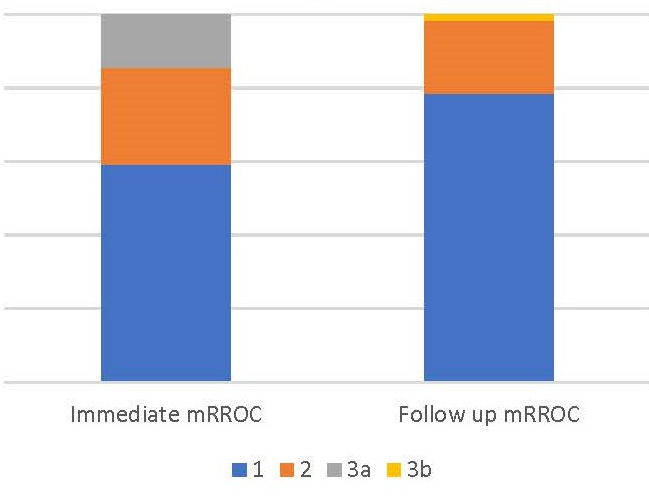
Abbreviations: Accomm = anterior communicating artery; AMS = altered mental status; CAD = coronary artery disease; CVA = cerebrovascular accident; EVD = external ventricular drain; h/o = history of; HTN = hypertension; ICA = internal carotid artery; ICH = intracerebral hemorrhage; LOS = length of stay; MCA = middle cerebral artery; mRS = modified Rankin scale; N = no; N/A = not applicable; PCA = posterior cerebral artery; Pcomm = posterior communicating artery; Rocan = Recanalization of previously treated aneurysm; mRROC = modified Raymond-Roy occlusion classification; SAH = subarachnoid hemorrhage; Y = yes

Methods

A retrospective analysis of patients who underwent stenting for intracranial aneurysms using LVIS Jr at a single institution was performed. Clinical and radiographic data were analyzed. A literature review was performed and data from similar series were analyzed.

mRROC for available pooled cohorts including the current series.

n = 65, p = 0.011



Results

Twenty patients were included. Seven aneurysms were ruptured, with three treated in the acute period. Complex stenting was attempted in six patients (two Y-stenting, one X-stenting, one H-stenting, and two trans-circulation stenting), and successfully accomplished in 4 cases. One Y-stenting case was aborted due to stent migration (and retrieval), and one X-stenting case was converted to conventional stent-assisted coiling. In the entire series, clinical complications included one intraoperative rupture, one minor stroke, and one ruptured femoral artery pseudoaneurysm. The latter was the only clinical complication that occurred in a case of complex stenting. Complete occlusion immediately post-procedure was achieved in 42% of aneurysms. This improved to 86% at 3-month follow-up. One case of in-stent stenosis was observed in follow-up. 87% of patients had favorable clinical outcomes.

Studies with complex stenting using LVIS Jr.

Series	# Cases	% Complex Stenting	Stent Config/ Technique	% Ruptured	#Treated In-Stent Phase	Anterior/ Posterior	Mean Aneurysm Size (mm)	Mean Proximal Parent Vessel Diameter (mm)	Mean Distal Parent Vessel Diameter (mm)	Intraoperative Complication	Hospital Complication	% Immediate Aneurysmal Occlusion	Median Angiographic Follow-Up Time (months)	% Aneurysmal Occlusion at Last FU	% In-Stent Stenosis at Last FU
Current series	20	50%	2 Y-stent 3 X-stent 2 Transcirc 3 H-stent	35%	4	1/3	7.4(2.9)	2.4(0.6)	2.1(0.5)	1 stroke (2%) 1 embolization (5%)	1 stroke (5%) 1 embolization (5%) 1 EVD malfunction (5%)	42%	3	86%	7%
Grevel, 2014	2	100%	2 Y-stent	0%	N/A	0/2	8.7(0.5)	N/A	N/A	None	None	0%	N/A	N/A	N/A
McIntosh, 2014	22	50%	8 Y-stent 3 X-stent 2 Transcirc	18%	4	14/6	5.6(2.7)	2.4(0.6)	2.0(0.4)	2 strokes (9%) 1 embolization (5%) 1 EVD malfunction (5%)	1 stroke (5%) 1 embolization (5%) 1 EVD malfunction (5%)	73%	6	82%	9%
Behme, 2015	34	12%	11 Y-stent	35%	12	26/8	N/A	N/A	N/A	2 strokes (6%) 1 embolization (3%)	1 stroke (3%)	50%	N/A (mean 4.4, 2-12)	73%	6%
Shankar, 2017	100	19%	19 Y-stent 1 X-stent	13%	11	69/31	8.3(7.7)	N/A	N/A	14 strokes (14%) 1 stroke (1%) 1 embolization (1%) 1 EVD malfunction (1%)	1 stroke (1%) 1 embolization (1%) 1 EVD malfunction (1%) 1 EVD malfunction (1%)	52%	12	68%	14%
Grossberg, 2017	85	12%	7 Y-stent 1 X-stent 2 Transcirc	20%	17	65/22	6.1(3.4)	N/A	N/A	1 stroke (1%) 1 embolization (1%) 1 EVD malfunction (1%)	1 stroke (1%) 1 embolization (1%) 1 EVD malfunction (1%)	42%	N/A (median 4.4, 1-12)	71%	0%
Wu, 2017	90	4%	4 Y-stent	26%	4	79/11	5.8(3.0)	2.3(0.6)	2.4(0.5)	2 strokes (2%) 1 embolization (1%) 1 EVD malfunction (1%)	1 stroke (1%) 1 embolization (1%) 1 EVD malfunction (1%)	91%	18	92%	2%
Santillan, 2018	33	26%	8 Y-stent 3 X-stent	29%	1	11/4	6.4(N/A)	2.3(0.3)	2.1(0.4)	2 strokes (6%) 1 embolization (3%) 1 EVD malfunction (3%)	1 stroke (3%) 1 embolization (3%) 1 EVD malfunction (3%)	60%	9	72%	10%

Outcomes compared to other series

Outcome Variables	Our Series	Other Series with Complex Stenting	p-value
% Immediate aneurysmal occlusion	42% (n=19)	61% (n=368)	0.15
% Aneurysmal occlusion at follow up	86% (n=14)	76% (n=298)	0.53
% In-stent thrombosis at follow up	7% (n=14)	8% (n=322)	1.00
% Favorable clinical outcome	87% (n=15)	96% (n=348)	0.14

Conclusions

The LVIS Jr stent offers a safe and effective modality to assist in the treatment of intracranial aneurysms. Complex stenting using the LVIS Jr stent was found to be technically safe and feasible in this series.

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