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Original Article

Silk vista baby versus pipeline embolization device for unruptured distal anterior cerebral artery aneurysms: A multicenter propensity-weighted comparative study

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ABSTRACT

Background: Flow diversion is effective for unruptured distal anterior cerebral artery (DACA) aneurysms, yet comparative data between the Silk Vista Baby (SVB) and Pipeline Embolization Device (PED) in this challenging territory remain scarce.

Methods: We conducted a retrospective multicenter study using the CRETA Registry, including consecutive patients with unruptured DACA aneurysms treated with SVB or PED. The primary endpoint was complete angiographic occlusion (O'Kelly-Marotta grade D). Secondary outcomes included procedural characteristics, clinical outcome (modified Rankin Scale), and complications. Overlap weighting was applied to account for non-randomized treatment allocation. Predictors of occlusion were explored using penalized logistic regression. A sensitivity analysis using a reduced five-variable model was performed to assess model robustness.

Results: 137 patients were included (79 SVB, 58 PED). Within the PED group, devices included Pipeline Flex (n = 34), Pipeline Flex with Shield Technology (n = 14), and Pipeline Vantage with Shield Technology (n = 10). After overlap weighting, baseline characteristics were balanced; the effective sample size was 100.4. SVB procedures more often used a single device; PED frequently required multiple stents. Procedure duration was shorter with SVB. Complete occlusion was achieved in 69.6% (SVB) and 70.7% (PED) of aneurysms, with no significant difference in adjusted analysis (OR 1.32, 95% CI 0.59–2.96). Favorable clinical outcomes were observed in both groups, with acceptable and comparable complication rates. No variable, including device type, independently predicted complete occlusion, a finding confirmed in a reduced five-variable sensitivity analysis (aOR 1.04, 95% CI 0.47–2.31; p = 0.915).

Conclusions: SVB and PED demonstrated comparable angiographic efficacy and clinical safety for unruptured DACA aneurysms. Despite procedural differences, mid-term occlusion rates and outcomes were similar. Device selection in this distal territory may be guided primarily by anatomical considerations and operator preference rather than expectations of differential performance.

Introduction

Distal anterior cerebral artery (DACA) aneurysms represent one of the most technically challenging subsets of intracranial aneurysms to treat. Their location beyond the A1–A2 junction, the sharp angulations of the pericallosal and callosomarginal segments, and the small vessel caliber combine to create an unfavorable environment for endovascular navigation and device deployment.[1] Although flow diversion has progressively gained acceptance for distal aneurysms, its use in DACA lesions remains particularly demanding due to limited distal support, high microcatheter instability, and the increased precision required when deploying braided devices in vessels often measuring 1.5–2.5 mm in diameter.[2–5]

Distal flow diversion is typically performed with low-profile braided devices such as the Silk Vista Baby (SVB) and the Pipeline Embolization Device (PED), which differ considerably in design. SVB is a purpose-built, low-profile, dual-rail braided device engineered specifically for small, tortuous arteries, compatible with 0.017″ microcatheters (e.g., Headway 17), thereby facilitating distal access.[6,7] PED, conversely, is derived from large-vessel flow diversion and downscaled for smaller arteries; its higher radial force, thicker struts, and requirement for larger-caliber microcatheters (0.021″ Marksman or 0.027″ Phenom, depending on device diameter) may influence deliverability and wall apposition in narrow-caliber distal anterior cerebral arteries.[8]

While both devices have demonstrated safety and efficacy in selected distal aneurysms, no head-to-head comparison exists for unruptured DACA aneurysms, and isolated single-arm reports lack the statistical power necessary to draw meaningful comparative conclusions[9-13] Although the CRETA Registry provides the largest dedicated multicenter dataset on DACA aneurysms, and recent meta-analyses have expanded the available evidence, comparative device-specific analyses in this vascular territory have not yet been systematically performed.[14-16] Given the anatomical constraints of the DACA and the mechanical differences between SVB and PED, a direct comparison of angiographic performance, device requirements, and safety outcomes is clinically relevant. This study aims to provide the first comparative analysis of SVB versus PED for unruptured DACA aneurysms, using real-world data from the international CRETA Registry.

Material and methods

Study design

This study was conducted as a retrospective comparative cohort analysis using data from the international CRETA Registry, a multicenter observational database including prospectively maintained clinical, anatomical and procedural information from 39 high-volume neurointerventional centers in fourteen countries. The registry was designed to capture real-world outcomes of flow diversion in distal intracranial aneurysms through harmonized data collection and standardized definitions for radiological and clinical endpoints. All participating institutions obtained ethics approval according to local regulations, and the present analysis followed STROBE recommendations for observational research.

Patient selection

We identified all consecutive patients within the registry who underwent elective endovascular treatment of an unruptured DACA using either the SVB or the PED, including Shield variants. We included patients aged >18 years treated in the period January 2018 to December 2022. DACA aneurysms were defined as lesions arising at or beyond the A2 segment. Only patients with a pre-treatment modified Rankin Scale (mRS) score of 0 and with available angiographic follow-up were considered eligible. Device selection was at the operator's discretion and reflected anatomical considerations, device availability, as well as local institutional practice. Data variables included demographics (age and sex), clinical history (hypertension, smoking, family history of aneurysm), radiographic features of the aneurysm (morphology, maximum size, neck width, branch involvement, parent vessel size), procedural details, medications, complications, and radiological and clinical outcomes at discharge and at most recent follow-up.

Outcomes

The primary outcome was the rate of complete angiographic occlusion at last follow-up, defined as O'Kelly−Marotta (OKM) grade D. Secondary angiographic endpoints included adequate occlusion (OKM C −D), the need for retreatment, and the status of jailed branches. Secondary clinical endpoints comprised functional outcome assessed by the mRS, ischemic or hemorrhagic complications, and all-cause mortality. All outcomes were evaluated at the time of last available radiological or clinical follow-up within the registry.

Statistical analysis

Continuous variables are reported as mean ± standard deviation or median with interquartile range (IQR), as appropriate. Categorical variables are presented as counts and percentages. Unweighted between-group comparisons were performed using the Student's t test or the Mann−Whitney U test for continuous variables, and the χ^2 test or Fisher's exact test for categorical variables, as appropriate.

Because treatment allocation (SVB vs PED) was non-randomized, a propensity score−based approach was used to reduce confounding and adjust for baseline imbalances. Propensity scores were estimated using a multivariable logistic regression model including clinically relevant baseline covariates selected a priori, encompassing demographic characteristics, aneurysm morphology and size parameters, vascular anatomy, and prior endovascular treatment. To account for the time-dependent nature of flow-diverter−mediated occlusion, angiographic follow-up duration was also included in the propensity score model.

Overlap weighting was applied to generate a pseudo-population emphasizing patients with substantial propensity score overlap. Covariate balance before and after weighting was assessed using standardized mean differences (SMDs), with values <0.10 considered indicative of adequate balance.

All weighted analyses were performed on the pseudo-population generated by overlap weighting; therefore, the effective sample size was reported instead of a nominal sample size.

Comparative analyses of primary and secondary outcomes were performed in both unweighted and overlap-weighted cohorts. For binary outcomes, effect estimates are reported as odds ratios (ORs) with 95% confidence intervals (CIs). Weighted outcome analyses were conducted within a doubly robust framework combining overlap weighting with outcome regression models. Rare events did not allow for reliable adjusted modeling and were therefore summarized descriptively.

To explore predictors of complete aneurysm occlusion at last angiographic follow-up, univariable and multivariable logistic regression analyses were performed. Complete occlusion was defined as O'Kelly −Marotta (OKM) grade D and analyzed as a binary outcome. Given the limited sample size and the low frequency of some covariates, penalized logistic regression using the Firth method was employed for multivariable modeling. Covariates were selected a priori on the basis of clinical relevance. Given the limited events-per-variable ratio in the full ten-covariate model (EPV = 4.0), a sensitivity analysis was also performed using a reduced model restricted to five clinically prioritized covariates (device type, maximum aneurysm dimension, neck width, parent artery diameter, and previous endovascular treatment), yielding an improved EPV of 8.0 (Supplementary Table S1). Results are reported as adjusted odds ratios (aORs) with 95% CIs. All statistical tests were two-sided, and a p value <0.05 was considered statistically significant. Analyses were performed using R software (version 4.5.2).

Results

Study population

A total of 137 patients with unruptured intracranial aneurysms treated with flow diversion were included in the analysis, comprising 79 aneurysms treated with SVB and 58 treated with PED. All patients had available angiographic and clinical follow-up and were included in the primary analyses. Within the PED group, devices included the Pipeline Flex (n = 34, 58.6%), the Pipeline Flex with Shield Technology (n = 14, 24.1%), and the Pipeline Vantage with Shield Technology (n = 10, 17.2%). The majority of PED devices deployed were 2.5 mm in diameter (46/58, 79.3%).

Baseline characteristics

Baseline demographic, clinical, and aneurysm-related characteristics are summarized in Table 1. Before weighting, several differences were observed between treatment groups. Patients treated with SVB more frequently presented with a daughter sac (41.8% vs 22.4%, p = 0.02) and a history of previous endovascular treatment (27.8% vs 8.6%, p = 0.01). Other demographic variables, vascular risk factors, and aneurysm size metrics, including maximum aneurysm dimension, neck width, and parent artery diameter, were comparable between groups.

After application of overlap weighting, baseline characteristics were well balanced, with no statistically significant residual differences between SVB and PED groups. This included aneurysm morphology, size parameters, incorporated branch frequency, and prior treatment status, indicating adequate covariate balance after weighting.

The effective sample size of the overlap-weighted cohort was 100.4 patients overall (SVB: 53.2; PED: 47.5), reflecting the pseudo-population generated by overlap weighting.

Procedural characteristics

Procedural characteristics are detailed in Table 2. Radial access was used in a minority of cases and did not differ significantly between SVB and PED groups (19.0% vs 15.5%, $p = 0.60$ unweighted; $p = 0.72$ overlap-weighted). The use of two or more flow diverters was infrequent in both groups (SVB: 2/79, 2.5%; PED: 4/58, 6.9%; $p = 0.23$) and was not associated with a higher rate of deployment issues. Among PED cases requiring multiple devices, only one had a recorded deployment complication, suggesting that the majority of multi-device procedures reflected planned telescoping for neck coverage rather than unplanned rescue deployment. Adjunctive coiling was infrequent and comparable between devices in both unweighted and weighted analyses.

Procedure duration was significantly shorter in the SVB group (median 35 minutes [IQR 19−45]) compared with the PED group (42 minutes [IQR 28−61]) in unweighted analysis ($p = 0.03$), a difference that remained significant after overlap-weighted adjustment ($p = 0.024$).

Table 1
Baseline characteristics.

Variable	SVB (n = 79)	PED (n = 58)	p (unweighted)	p (overlap-weighted)
Age, years	61 (53–67)	58.6 ± 12.5	0.32	0.64
Women, n (%)	59 (74.7)	44 (75.9)	0.87	0.92
Hypertension, n (%)	49 (62.0)	31 (53.4)	0.32	0.41
Diabetes, n (%)	13 (16.5)	5 (8.6)	0.21	0.27
Smoking (current/former), n (%)	26 (32.9)	17 (29.3)	0.71	0.71
Hyperlipidemia, n (%)	20 (24.7)	15 (25.9)	0.88	0.89
Coronary artery disease, n (%)	5 (6.3)	2 (3.4)	0.70	0.52
Previous stroke, n (%)	7 (9.0)	5 (8.6)	1.00	0.95
Baseline mRS 0–1, n (%)	73 (92.4)	57 (98.3)	0.24	0.18
Prior ruptured aneurysm, n (%)	18 (22.8)	11 (19.0)	0.67	0.66
Max aneurysm dimension, mm	4.2 (3.1–5.6)	4.3 (3.2–5.7)	0.79	0.81
Neck width, mm	3.0 (2.1–4.0)	3.0 (2.3–4.4)	0.91	0.93
Parent artery diameter, mm	1.9 (1.7–2.1)	2.0 (1.8–2.3)	0.22	0.22
Incorporated branch, n (%)	18 (22.8)	15 (25.9)	0.68	0.68
Multiple intracranial aneurysms, n (%)	15 (19.0)	19 (32.8)	0.07	0.11
Saccular morphology, n (%)	71 (89.9)	49 (84.5)	0.36	0.34
Daughter sac, n (%)	33 (41.8)	13 (22.4)	**0.02**	0.09
Previous endovascular treatment, n (%)	22 (27.8)	5 (8.6)	**0.01**	0.11

SVB, Silk Vista Baby; PED, Pipeline Embolization Device; mRS, modified Rankin Scale; IQR, interquartile range; p values for weighted comparisons were derived from overlap-weighted analyses.

Angiographic outcomes

At last angiographic follow-up, complete aneurysm occlusion (OKM grade D), was achieved in 69.6% of SVB-treated aneurysms and 70.7% of PED-treated aneurysms.

There was no significant difference between devices in unweighted analysis (OR 1.06, 95% CI 0.48–2.33; p = 0.89) or after overlap-weighted adjustment (OR 1.32, 95% CI 0.59–2.96; $p = 0.51$), indicating comparable angiographic efficacy between SVB and PED.

Clinical outcomes and complications

Favorable clinical outcome, defined as mRS 0 at last follow-up, was observed in 79.7% of SVB patients and 93.1% of PED patients. Although this difference reached borderline significance in unweighted analysis (OR 0.35, 95% CI 0.09–1.34; $p = 0.13$), it was no longer significant after overlap-weighted adjustment (OR 0.43, 95% CI 0.10–1.75; $p = 0.24$).

Thromboembolic complications occurred in 12 patients (7 SVB, 5 PED). Of these, 3 were periprocedural (within 24 hours) and 9 were delayed. The majority of thromboembolic events were clinically benign: 8/12 patients (66.7%) recovered to mRS 0 at last follow-up. Two patients retained a persistent neurological deficit (one mRS 1, one mRS 2 after initial mRS 4 at discharge), and two patients had missing follow-up mRS data. Event localization included covered-branch occlusion, in-stent thrombosis, and distal territorial infarcts in the ACA distribution.

Intracranial hemorrhage occurred in 6 patients (4 SVB, 2 PED). In the PED group, both events were clinically asymptomatic (mRS 0 at discharge and follow-up), including one minor frontal subarachnoid hemorrhage and one interhemispheric hemorrhage. In the SVB group, events included one intraprocedural distal perforation (mRS 0 at follow-up), one parenchymal hematoma at day 1 (mRS 4 persistent), one callosal hemorrhage (mRS 1 persistent), and one left parietal hemorrhage (mRS 0). Permanent morbidity attributable to hemorrhagic complications was observed in 2/137 patients (1.5%).

Rates of thromboembolic and hemorrhagic complications did not differ significantly between treatment groups in either unweighted or weighted analyses (Table 2). Retreatment was required in one patient in each group. No procedure-related mortality was observed.

Predictors of complete angiographic occlusion

Predictors of complete occlusion (OKM D vs non-D) were explored using univariable and multivariable penalized logistic regression, with results summarized in Table 3. In univariable analyses, no aneurysm-related, procedural, or device-related variable was significantly associated with complete occlusion. In multivariable analysis, no independent predictor of complete occlusion was identified. Importantly, treatment with SVB versus PED was not associated with angiographic outcome after adjustment for aneurysm morphology, size, procedural complexity, and prior endovascular treatment (adjusted OR 1.02, 95% CI 0.44–2.38; $p = 0.96$).

Table 2
Procedural and clinical outcomes.

Outcome	SVB	PED	OR (unw) [95% CI]	p (unw)	OR (overlap-weighted) [95% CI]	p (overlap-weighted)
Radial access, n (%)	15 (19.0)	9 (15.5)	—	0.60	—	0.72
≥2 flow diverters, n (%)	2 (2.5)	4 (6.9)	—	0.23	—	0.11
Adjunctive coiling, n (%)	4 (5.0)	5 (8.6)	—	0.48	—	0.48
Procedure length, min	35 (19–45)	42 (28–61)	—	0.03	—	0.024
Complete occlusion at FU (OKM D vs non-D)	55 (69.6)	41 (70.7)	1.06 (0.48–2.33)	0.89	1.32 (0.59–2.96)	0.51
Favorable clinical outcome (mRS 0 vs >0)	63 (79.7)	54 (93.1)	0.35 (0.09–1.34)	0.13	0.43 (0.10–1.75)	0.24
Thromboembolic complications, n (%)	7 (8.9)	5 (8.6)	—	0.95	—	0.94
Intracranial hemorrhage, n (%)	4 (5.1)	2 (3.4)	—	0.61	—	0.61
Retreatment, n (%)	1 (1.3)	1 (1.7)	—	0.88	—	0.88

SVB, Silk Vista Baby; PED, Pipeline Embolization Device; OR, odds ratio; CI, confidence interval; mRS, modified Rankin Scale; FU, follow-up; OKM, O'Kelly–Marotta; ORs and p values for weighted analyses were derived from overlap weighting

Table 3
Predictors of complete occlusion (OKM D vs non-D).

Predictor	OR (univ) [95% CI]	p	aOR (multiv) [95% CI]	p
SVB (vs PED)	1.00 (0.47–2.15)	1.000	1.02 (0.44–2.38)	0.961
Adjunctive coiling	2.25 (0.34–15.00)	0.404	2.40 (0.29–20.15)	0.420
≥2 flow diverters	4.95 (0.20–120.83)	0.326	6.93 (0.28–171.02)	0.237
Max aneurysm dimension	1.05 (0.91–1.22)	0.484	1.08 (0.84–1.38)	0.558
Neck width	0.95 (0.75–1.20)	0.662	0.79 (0.55–1.14)	0.203
Parent artery diameter	1.87 (0.77–4.57)	0.166	2.10 (0.80–5.53)	0.132
Incorporated branch	0.84 (0.35–2.00)	0.693	0.89 (0.34–2.34)	0.809
Daughter sac	0.81 (0.37–1.79)	0.603	0.97 (0.37–2.57)	0.958
Previous endovascular treatment	1.36 (0.50–3.69)	0.542	1.79 (0.60–5.37)	0.298
Saccular morphology	1.55 (0.71–3.36)	0.270	1.53 (0.61–3.86)	0.364

OR, odds ratio; aOR, adjusted odds ratio; CI, confidence interval; OKM, O'Kelly–Marotta; SVB, Silk Vista Baby; PED, Pipeline Embolization Device.

A sensitivity analysis using a reduced five-variable Firth model (device type, maximum aneurysm dimension, neck width, parent artery diameter, and previous endovascular treatment; EPV = 8.0) confirmed that no covariate, including device type (aOR 1.04, 95% CI 0.47–2.31; $p = 0.915$), was independently associated with complete occlusion (Supplementary Table S1), supporting the robustness of the primary findings despite the limited events-per-variable ratio of the full model.

Discussion

In this comparative analysis of 137 patients with unruptured distal anterior cerebral artery aneurysms treated with flow diversion, we found no significant differences in angiographic or clinical outcomes between the SVB and the PED, even after rigorous adjustment for baseline imbalances using a doubly robust propensity-weighted framework. Importantly, penalized multivariable regression failed to identify any independent aneurysm-, procedural-, or device-related predictor of complete occlusion, including device type itself. This null finding was confirmed in a reduced five-variable sensitivity analysis with improved events-per-variable ratio (EPV 8.0), mitigating concerns about potential overfitting in the full model. These findings suggest that, in the distal ACA territory, angiographic success is primarily driven by the feasibility of achieving a stable flow-diverting construct — defined here as a device demonstrating satisfactory expansion, adequate wall apposition across the aneurysm neck and landing zones, unimpeded anterograde parent-artery flow, and absence of intraprocedural technical failure — rather than by specific device-related characteristics. This definition reflects the immediate post-deployment assessment; longer-term construct stability, including endothelialization and potential braid remodeling, was not systematically evaluated.

From a broader perspective, our findings are consistent with prior single-center series and pooled analyses of DACA aneurysms treated with flow diversion. In the large-volume experience and systematic review by Cagnazzo et al., adequate occlusion (OKM C–D) was achieved in approximately 79% of DACA aneurysms, with procedure-related complications around 7–8% and low permanent morbidity.[2] More recently, the CRETA registry reported similarly favorable angiographic and clinical outcomes in a larger multicenter cohort of unruptured DACA aneurysms, reinforcing the safety and efficacy of flow diversion in this demanding territory.[14] These results are further supported by a dedicated meta-analysis of DACA aneurysms by Vilardo et al., which found pooled adequate and complete occlusion rates of 89% and 77%, respectively, with procedure-related complications of 7% and virtually no procedure-related mortality.[16] In this context, the occlusion and complication rates observed in our comparative cohort appear highly concordant with the best available evidence for DACA flow diversion. Our data also align well with the emerging literature on distal cerebral aneurysms more broadly. In a recent meta-analysis of 445 distal cerebral aneurysms located at or beyond the A2, M2, and P2 segments, Günkan et al. reported adequate and complete occlusion rates of 90% and 79%, respectively, with retreatment in only 1.6% of cases and procedure-related morbidity and mortality of 1.5% and 0.6%.[15] These pooled estimates, which include both low-profile and standard flow diverters, suggest that once a stable construct is achieved, distal flow diversion can provide durable aneurysm exclusion with low retreatment requirements —findings that closely mirror the very low retreatment rate observed in our series.

A notable finding of this study is the absence of any independent predictor of complete occlusion in penalized multivariable analysis. Even factors traditionally associated with flow-diversion efficacy—such as aneurysm size, neck width, use of multiple devices, or adjunctive coiling —did not demonstrate a significant association with angiographic outcome. This result likely reflects the unique biomechanical and anatomical constraints of the distal ACA, where vessel caliber, tortuosity, and distal support may homogenize outcomes once successful device deployment is achieved. From a methodological standpoint, the use of penalized regression reduces the risk that these null findings are attributable to small-sample bias, reinforcing the robustness of this observation.

Procedural behavior differed between devices in a manner consistent with their design and delivery systems.[6–8] SVB was deployed as a single device in the vast majority of procedures, whereas PED more frequently required multiple devices. These differences likely reflect the distinct deliverability profiles and microcatheter requirements of the two systems; the need for multiple stents in the PED cohort might be related to the intrinsic stent composition and different unsheathing modality compared to SVB particularly in small vessels of the ACA district as well as operators experience with the device, but did not translate into different angiographic outcomes at follow-up, suggesting that once a stable and well-apposed construct is achieved, both stents provide comparable flow-diversion performance in the distal ACA. When focusing on low-profile flow diverters specifically, the meta-analysis by Elek et al. reported favorable neurological outcomes in 94% of patients treated with devices such as SVB, FRED Jr and p48 in parent vessels ≤3.5 mm, with complete or near-complete occlusion in roughly 80% of aneurysms and acceptable overall complication rates, particularly in unruptured cases.[5] Similarly, the single-center experience of Vasconcellos de Oliveira Souza et al. with SVB "beyond the circle of Willis" showed adequate occlusion in about 70% of aneurysms, a symptomatic ischemic event rate around 5%, no hemorrhagic complications, and excellent functional outcomes in the vast majority of patients.[17] Taken together, these data corroborate the notion that low-profile devices such as SVB can be safely navigated into very distal, small-caliber vessels with angiographic and clinical results that are in line with, or only slightly below, those reported for more proximal locations. Our observation that SVB was almost always deployed as a single device, yet achieved occlusion and safety profiles comparable to PED, is consistent with this broader low-profile FD literature.

Clinical outcomes were excellent across the cohort. Functional independence at last follow-up was observed in >85% of patients in both groups, and ischemic complication rates were acceptable and similar.

Among the 12 thromboembolic events, the majority (9/12) were delayed rather than periprocedural, and most patients (8/12) recovered to mRS 0 at follow-up, with permanent morbidity in only 2 cases. Hemorrhagic complications were rare and confined to the SVB cohort in this series. Given the extremely low number of events, the apparent clustering of hemorrhagic complications in the SVB group is most likely due to chance rather than a device-related mechanism. Of note, both hemorrhagic events in the PED group were clinically asymptomatic, whereas in the SVB group, permanent morbidity was observed in 2 of 4 cases. Retreatment was exceptionally uncommon in both arms; however, this finding should be interpreted with caution, as the technical difficulty and procedural risk of re-navigating the distal ACA may lead operators to adopt a more conservative retreatment threshold compared with more accessible vascular territories, potentially contributing to an underestimation of residual aneurysm persistence.

Within the PED group, the antithrombotic phosphorylcholine coating of the Shield variants may theoretically influence thromboembolic event rates; however, the small subgroup sizes (Pipeline Flex, $n = 34$; Shield, $n = 14$; Vantage, $n = 10$) did not allow meaningful statistical comparison. Descriptively, complete occlusion rates ranged from 60.0% to 78.1% across PED subtypes without a clear pattern, but dedicated device-stratified studies are needed to evaluate this potential effect.

A relevant aspect of this study is the explicit consideration of follow-up time. Imaging follow-up intervals were similar between SVB and PED, whereas clinical follow-up was slightly longer in the PED cohort most probably due to the earlier FDA approval for 2.5 mm PED (2019) compared to SVB (2020–2021). By incorporating follow-up duration into the adjusted models and performing a sensitivity analysis restricted to patients with at least 12 months of angiographic follow-up, we aimed to mitigate time-dependent bias in the estimation of occlusion rates. The consistency of results across these analyses supports the robustness of our main findings, while acknowledging that longer-term surveillance is still needed.

The biological equivalence observed between the two devices is notable given their mechanical differences. SVB, designed for vessels as small as 1.5–3.5 mm, offers enhanced navigability in sharply angled segments, whereas PED provides greater radial force and a different braid architecture.[4,7] Our data suggest that in the specific context of unruptured DACA aneurysms, the dominant determinant of success is the ability to deliver a suitable flow-diverting construct rather than the particular device design. These findings reinforce the concept that in DACA aneurysms, procedural feasibility — particularly stable distal access and device deployment — may outweigh device-specific architectural differences in determining angiographic success.[13-15] Importantly, stent size — including 2.25 mm SVB devices — did not appear to influence occlusion performance, suggesting that vessel compatibility rather than device diameter drives outcomes in this territory. Nevertheless, subtle differences in endothelialization, in-stent stenosis, and branch preservation may not be fully captured by the present sample size and follow-up duration. Finally, it is worth noting that complete occlusion rates in our DACA cohort remain somewhat lower than those historically reported for internal carotid artery aneurysms treated with flow diversion, where occlusion rates frequently approach 80–95% at mid- to long-term follow-up.[18] This discrepancy likely reflects the intrinsic anatomical and technical complexity of the pericallosal–callosomarginal segments, rather than a device-specific limitation, and underscores that in the DACA territory the primary determinant of success is the ability to safely deliver and adequately appose a flow-diverting construct, irrespective of whether SVB or PED is used.

Clinically, these findings support the notion that in unruptured DACA aneurysms, device selection should be guided primarily by anatomical feasibility and operator experience rather than expectations of superior angiographic performance. Once a flow-diverting construct can be safely delivered and adequately apposed, both low-profile and standard devices appear capable of achieving comparable aneurysm exclusion.

This study has limitations. Its retrospective design remains susceptible to selection bias and residual confounding despite the use of propensity-score weighting and doubly robust adjustment. Device selection was at the operator's discretion and likely influenced by factors not fully captured in the registry, such as precise vessel diameter, degree of tortuosity, microcatheter support, and antiplatelet regimen. Importantly, the study is susceptible to center-level confounding, as device preference varied across sites: SVB was used at 21 centers and PED at 14, with only 8 centers contributing cases treated with both devices. This clustering limits the separability of device-related effects from center-related practice patterns and operator experience. Specific per-procedure microcatheter data were not recorded in the registry. Sample size, while representing the largest comparative dataset for DACA flow diversion to date, remains small and limits the statistical power for detecting rare complications such as delayed hemorrhage and retreatment. Imaging assessments were performed locally without core laboratory verification. The registry did not systematically capture data on delayed flow-diverter braid deformation, a phenomenon of emerging clinical interest particularly relevant in small-caliber tortuous vessels; future studies should specifically monitor for this complication. To address potential timing-related differences in occlusion maturation, we performed a sensitivity analysis restricted to patients with ≥12-month angiographic follow-up. Results were unchanged, supporting the robustness of the primary findings and suggesting that follow-up heterogeneity did not materially bias the comparative evaluation of the two devices. Lastly, although flow diversion has become an established treatment for intracranial aneurysms, longer follow-up periods are necessary to assess the durability of aneurysm occlusion and the long-term safety profile of these devices. Although no independent predictors of occlusion were identified, the study may still be underpowered to detect subtle device-specific differences or rare adverse events, which would require larger cohorts and longer follow-up.

Within these constraints, our findings support the concept that both SVB and PED can be used safely and effectively for appropriately selected unruptured DACA aneurysms. The absence of measurable differences in occlusion and complication rates suggests that device choice in this territory may reasonably be guided by anatomical feasibility, microcatheter strategy, and operator experience rather than expectations of differential efficacy. Overall, these results emphasize that in unruptured DACA aneurysms, the ability to achieve a stable, well-apposed construct is the main driver of success.

Conclusion

In this multicenter comparative analysis of unruptured DACA aneurysms, the SVB and the PED demonstrated similar angiographic and clinical performance, with nearly identical complete occlusion rates, acceptable and comparable ischemic complication rates, and excellent functional outcomes in both groups. Larger cohorts with longer follow-up and standardized imaging assessment will be essential to confirm these findings and further explore potential device-specific differences in long-term durability and rare adverse events. Future studies with standardized imaging, core-laboratory adjudication, and extended follow-up will be essential to determine long-term device-specific durability.

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Ethical approval

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Statement for studies in humans

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committees of all participating centers and with the 1964 Declaration of Helsinki and its later amendments. Ethics approval was obtained at each participating institution according to local regulations. Given the retrospective, observational design of the study using anonymized registry data, the requirement for individual informed consent was waived by the respective ethics committees/institutional review boards.

Statement for animals

Not applicable.

Informed consent

The requirement for written informed consent was waived by the local ethics committees/institutional review boards due to the retrospective nature of the study and the use of anonymized data.

Data sharing statement

The data that support the findings of this study are available from the corresponding author upon agreeing to a data sharing agreement.

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Declaration of competing interest

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.neurad.2026.101553.

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