Angiographic and clinical outcomes from 302 direct vs indirect revascularization for Moyamoya: a large multicenter study

Background The PEDESTRIAN registry demonstrated high rates of complete long-term occlusion and good clinical outcomes among patients with intracranial aneurysms treated with the Pipeline Embolization Device. The Pipeline Flex Embolization Device with Shield Technology (PED-Shield) was introduced to minimize thromboembolic complications. In this study, we investigated the safety and effectiveness of PED-Shield among all patients treated for intracranial aneurysms at our center.

Methods This was a single-arm retrospective study of prospectively collected data of patients treated with PED-Shield at our high-volume center between January 2018-2021. The primary efficacy endpoint was complete occlusion as measured by a class 1 Raymond-Roy score at 1-year and 2-year follow-up. The primary safety endpoint was major morbidity and neurological mortality up to 1 year following operation.

Results A total of 238 patients (mean age 55.4±14.7 years; 81.1% female), 80 of whom were previously included in PEDESTRIAN, with 302 aneurysms, were analyzed. A total of 268 devices were deployed, with 94.7% (286/302) of aneurysms requiring only one device. Follow-up angiography was available for 82.8% (250/283) of the procedures after a mean time of 12.7 months. Complete occlusion was demonstrated for 75.1% (171/226) of aneurysms at 12 months and 92.5% (62/67) at 24 months. The overall rates of major morbidity and neurological mortality after 2 years were 1.7% (4/238) and 0.4% (1/238), respectively.

Conclusion Our results demonstrate high rates of complete long-term occlusion among patients treated with PED-Shield. We also observed low rates of mortality and morbidity consistent with fewer thromboembolic complications with PED-Shield.

Disclosures E. Orru: None. F. Bounni: None. M. Marosfói: None. N. Patel: None. A. Wakhloo: 1; C; Philips medical. 2; C; Stryker, Phenox. 4; C; InNeuroCo, EpiEP, Neural Analytics, ThrombX.

Abstract E-055 Figure 1

ICA luminal restoration was achieved in all cases. An average of 2 FDS were deployed telescopically to cover the dissection. Balloon angioplasty was performed in two cases to improve opening of the implant. Adjunctive carotid stents were deployed in all cases to secure the proximal end of the FDS. LVOs were addressed after ICA reconstructions by combined technique and ingestion of the stentriever in the aspiration catheter, that was advanced within the construct and positioned distally to it without issue in all cases (TICI scores: 2b-3). All patients received intra-operative epifibatide, bridged subsequently to dual antiplatelet therapy (aspirin + ticagrelor). Acute, non-occlusive in-stent thrombus was noted in 2 cases, while wire access was lost in one case, significantly increasing operative time. Hemorrhagic transformation of an acute infarct was seen in 2 (33%) patients. A good outcome (mRS 0–2 at 90 days) was achieved in 5 (83%) patients, while one died of malignant brain edema shortly after intervention. Imaging follow-up was available for 4/5 surviving patients and medical management. The unique challenges posed by utilization of high-profile catheters/stentrievers. We found excellent patency at follow-up. The average opening of the implant. Adjunctive carotid stents were deployed in all cases to secure the proximal end of the FDS. Balloon angioplasty was performed in two cases to improve opening of the implant. Adjunctive carotid stents were deployed in all cases to secure the proximal end of the FDS. LVOs were addressed after ICA reconstructions by combined technique and ingestion of the stentriever in the aspiration catheter, that was advanced within the construct and positioned distally to it without issue in all cases (TICI scores: 2b-3). All patients received intra-operative epifibatide, bridged subsequently to dual antiplatelet therapy (aspirin + ticagrelor). Acute, non-occlusive in-stent thrombus was noted in 2 cases, while wire access was lost in one case, significantly increasing operative time. Hemorrhagic transformation of an acute infarct was seen in 2 (33%) patients. A good outcome (mRS 0–2 at 90 days) was achieved in 5 (83%) patients, while one died of malignant brain edema shortly after intervention. Imaging follow-up was available for 4/5 surviving patients and medical management. The unique challenges posed by utilization of high-profile catheters/stentrievers. We found excellent patency at follow-up.

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treatment modality as different studies provide different outcomes.

**Objective** In this large case series, we compare the outcomes of direct and indirect revascularization and compare our results to the literature in order to reflect on the best revascularization modality for moyamoya.

**Methods** We conducted a multicenter retrospective study in accordance with the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines of moyamoya affected hemispheres treated with direct and indirect revascularization surgeries across 13 academic institutions predominantly in North America.

**Results** The rates of symptomatic strokes were comparable between the two cohorts (9.4% in both cohorts, OR=1.00 [0.537–1.860], p=1.000). The rate of peri-operative major (2.1% for DR vs 1.3% for IR, OR=1.681 [0.397–7.117], p=0.761), minor (2.6% for DR vs 2.1% for IR, OR=1.393 [0.550–3.529], p=0.484) was comparable between both cohorts. The rate of total follow-up strokes was higher in the IR cohort (7.3% vs 5.6%, p=0.452).

**Conclusion** Both modalities showed comparable rates of peri-operative strokes, while IR seemed to be associated with a higher rate of strokes during the follow-up period. Thus, when both modalities are indicated, one should take into consideration the superior safety profile of direct revascularization.


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**Abstract**

**E-058**

**AN ALTERNATIVE REDUCED DOSE REGIMEN OF TICAGRELOR FOR NEUROENDOVASCULAR PATIENTS**


**Introduction/Purpose** There is a growing use of ticagrelor in patients undergoing neuroendovascular procedures, especially those who demonstrate clopidogrel resistance. While multiple dosages are studied in the cardiology literature, the optimal dose for patients with neurological pathology has yet to be established. Here, we describe a single center experience involving 39 patients who underwent neuroendovascular procedures that then received an adjusted lower dose of ticagrelor.

**Materials and Methods** A retrospective chart review was performed between 2013 and 2017 for patients on dual antiplatelet therapy (DAPT) for either cervical or intracranial vascular pathologies, as well as stenting of the neurovascularity, including carotid arteries. Patients were placed on ticagrelor if their measured P2Y12 reaction units (PRU) responses to clopidogrel were outside the expected range in our center using the VerifyNow™ P2Y12 test. All patients were maintained on a dose of 45 mg twice daily except for one patient who received 22.5 mg twice daily. Responsiveness to ticagrelor were measured utilizing the VerifyNow™ P2Y12 test.

**Results** The mean number of days for follow up post treatment initiation was 532 days. A total of 39 patients were included in the analysis. Of these, 8 patients (21%) received implantation of intracranial stents (5 patients received pipeline embolization devices, 1 patient received stent-assisted coiling, and 2 patients received intra-cranial stents for atherosclerotic disease). Fourteen patients (35%) received carotid angioplasty and stenting. Seventeen patients (44%) did not receive permanent implantation of a stent. All patients on the lower dose Ticagrelor of 45 mg twice daily achieved responsiveness (i.e., PRU < 194). Hemorrhagic transformation of ischemic stroke occurred in one patient (2.5%). No other hemorrhagic complications were encountered. No thromboembolic events were recorded aside from one patient (2.5%) with intracranial atherosclerotic disease who had an ischemic event.