REVIEW ARTICLES

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Indications for Dual Antiplatelet Therapy in Coil-Only Treatment of Ruptured Intracranial Aneurysms: A Narrative Review

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This narrative review synthesizes published evidence regarding antiplatelet therapy strategies used during coil embolization of ruptured intracranial aneurysms, with particular emphasis on coil-only treatment and distinctions between coil-only and device-assisted procedures. The available literature suggests that antiplatelet therapy can reduce periprocedural thromboembolic complications, particularly in selected coil-only cases; however, evidence for consistent benefit in delayed cerebral ischemia, functional outcomes, or long-term recovery remains limited and heterogeneous. Importantly, findings from stent-assisted or flow-diverter-treated cohorts should not be directly extrapolated to coil-only procedures – antiplatelet therapy in device-assisted treatment is largely driven by implant-related thrombogenicity. The current evidence base is limited by retrospective study designs, single-center cohorts, heterogeneous treatment protocols, and inconsistent endpoint definitions. At present, no standardized antiplatelet regimen can be recommended for routine use in coil-only aneurysmal subarachnoid hemorrhage. Ongoing randomized studies, including the ASTOP trial, may help clarify the benefit-risk balance and determine whether a more evidence-based, procedure-specific antiplatelet strategy can be established.

Keywords: Acetylsalicylic Acid • Antiplatelet Therapy • Intracranial Aneurysm • Neurosurgery • Subarachnoid Hemorrhage

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Introduction

Over the past 20 years, outcomes for patients treated for ruptured aneurysmal subarachnoid hemorrhage (aSAH) have substantially improved, partly due to advances in neurosurgical and endovascular treatment accessibility [1,2]. Modern management includes technologies such as coils, stents, flow diverters, WEB devices, and antiplatelet therapy. Antiplatelet therapy – a standard treatment for certain atherosclerotic diseases – aims to reduce the risk of thromboembolic events caused by microthrombi resulting from platelet activation associated with systemic and focal inflammation of cerebral vessels. Previous studies have demonstrated a preventive effect of perioperatively administered antiplatelet agents on perioperative thromboembolic complications in patients undergoing embolization for unruptured aneurysms [3,4].

For several years, the literature has described both single and dual antiplatelet strategies in patients with ruptured intracranial aneurysms who receive endovascular treatment. However, this evidence is heterogeneous and should not be interpreted as a unified therapeutic framework. A critical distinction must be made between coil-only treatment and device-assisted procedures, such as stent-assisted coiling or flow diversion. In device-assisted procedures, antiplatelet therapy is mainly required due to the thrombogenicity of the implanted device; in coil-only treatment, its role is more selective and primarily intended to reduce periprocedural thromboembolic complications. Available evidence suggests that antiplatelet therapy can reduce immediate thromboembolic events; however, its effects on delayed cerebral ischemia, hemorrhagic complications, and long-term functional outcomes remain uncertain [5].

The aim of this narrative review was to synthesize published evidence regarding antiplatelet therapy strategies used during coil embolization of ruptured intracranial aneurysms, with particular emphasis on coil-only treatment and distinctions between coil-only and device-assisted procedures.

Material and Methods

This narrative, non-systematic review focused on antiplatelet therapy in patients with aSAH undergoing coil-only endovascular treatment. Evidence from stent-assisted coiling or flow-diverter-treated cohorts was considered separately and included only when relevant for contextualizing device-related antiplatelet requirements and associated hemorrhagic or ischemic risks.

Table 1 summarizes all antiplatelet therapy regimens described in this manuscript for patients with aSAH treated via coil embolization, including treatment strategy (antiplatelet therapy vs dual antiplatelet therapy), timing of administration, agents used, dosing and duration (when available), and study-specific reported rates for key endpoints, including thromboembolic events and hemorrhagic complications.

Table 1. Summary of published antiplatelet therapy protocols.

Author	Heparin administration	Preoperative	Intraoperative	Postoperative	Key findings
Ries et al [11]	2000-3000 IU IV infusion before guiding catheter insertion	–	250 mg ASA after first coil	–	Thromboembolic events during procedure were more frequent in non-ASA group than in ASA group (14/159 aneurysms, 8.8%; *P*=0.028; Fisher's exact test)
Edwards et al [10]	IV bolus of 70-100 IU/kg 5 min before embolization, continuous infusion to ACT 250-300 s	–	650 mg ASA at end of procedure	325 mg ASA daily for 14 days	Aspirin administration in high-risk patients significantly decreased periprocedural TEEs, from 53.8% in control group to 10.6% in aspirin-treated group (*P*=0.001). No major systemic hemorrhagic complications were observed; aspirin did not increase risks of aneurysm rebleeding, symptomatic intracranial hemorrhage, or major EVD-associated hemorrhage (*P*=0.3). Asymptomatic minor (<1 cm) EVD-associated hemorrhage was more frequent in aspirin-treated group (*P*=0.02)

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Table 1 continued. Summary of published antiplatelet therapy protocols.

Author	Heparin administration	Preoperative	Intraoperative	Postoperative	Key findings
Ditz et al [20]	Post-treatment anticoagulation from day 1	–	–	100 mg ASA daily for 4-12 weeks	Antiplatelet therapy was independently associated with lower incidence of unfavorable functional outcome (OR 0.40 [95% CI: 0.19-0.87], *P*=0.021) at 3 months. Antiplatelet therapy did not reduce incidences of angiographic CVS or DCI-related infarction
Evans et al [14]	Procedure performed under systemic heparinization	–	300-1000 mg ASA (typically 500 mg) at procedure start	75 mg ASA daily	Ventriculostomy-associated hemorrhage rate was significantly higher in patients receiving intravenous aspirin (30% vs 2.5%; OR 16.7 [95% CI: 2.2-128.0], *P*<0.0001). No hematoma required surgical evacuation. No difference in favorable outcome at discharge or mortality was observed between groups
Shimamura et al [13]	Continuous infusion to ACT 200 s during procedure	200 mg ASA or 200 mg ASA and 150-300 mg clopidogrel	–	200 mg cilostazol daily for 14 days and 100 mg ASA daily from day 15 onward	TEEs decreased with increasing numbers of antiplatelet agents. No hemorrhagic complications attributable to antiplatelet therapy were observed. Postoperative symptomatic CVS tended to decrease, and outcomes tended to improve, in groups receiving multiple medications. Reduced TEEs were significantly associated with improved clinical outcomes in logistic regression analysis
Muraoka et al [12]	Continuous infusion to ACT 200-250 s during procedure	100 mg ASA and 200 mg clopidogrel	–	–	Incidence of TEEs was slightly lower in clopidogrel loading-dose group than in no-administration group (*P*=0.4). Incidence of TEEs was significantly lower in dual loading-dose group than in no-administration group (*P*=0.0396)
Hirai et al [23]	Continuous infusion to ACT 250-300 s during procedure	200 mg ASA	–	–	Study protocol only; no clinical outcome data are currently available

ACT – activated clotting time; ASA – acetylsalicylic acid; CI – confidence interval; CVS – cerebral vasospasm; DCI – delayed cerebral ischemia; EVD – external ventricular drain; IV – intravenous; OR – odds ratio; TEEs – thromboembolic events

Literature Identification and Selection Strategy

The literature search was conducted in PubMed/MEDLINE and Scopus for studies published from database inception to December 2025. Search concepts included combinations of the terms "aneurysmal subarachnoid hemorrhage", "ruptured intracranial aneurysm", "coil embolization", "standalone coiling", "stent-assisted coiling", "flow diversion", "antiplatelet therapy", "aspirin", "clopidogrel", and "cilostazol." Reference lists of relevant articles were also screened to identify additional studies.

Studies were considered eligible if they reported antiplatelet treatment strategies, timing, or outcomes in patients with ruptured intracranial aneurysms treated endovascularly. Priority was given to studies directly addressing coil-only treatment in the acute aSAH setting. Device-assisted studies were included only to contextualize implant-driven antiplatelet requirements

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and related hemorrhagic or ischemic risks. Only articles published in English were included. Because this was a narrative review rather than a formal systematic review, no prespecified risk-of-bias tool was applied; however, methodological limitations of the included studies are addressed in the Discussion.

Discussion

Antiplatelet therapy in aSAH should not be regarded as a single, homogeneous therapeutic concept. A key distinction exists between coil-only treatment and device-assisted strategies, such as stent-assisted coiling or flow diversion. In device-assisted procedures, antiplatelet therapy is mainly required due to the thrombogenicity of the implanted device; in coil-only treatment, its role is more selective and primarily intended to reduce periprocedural thromboembolic complications. Therefore, evidence derived from stent-assisted or flow-diverter-treated cohorts should not be directly extrapolated to patients treated with coils alone [6-8].

Evidence for Antiplatelet Therapy in Coil-Only aSAH

Within the coil-only setting, the most consistent signal in favor of antiplatelet therapy relates to the prevention of periprocedural thromboembolic events rather than delayed ischemic complications or long-term functional recovery. A systematic review and meta-analysis by Takase et al demonstrated that antiplatelet therapy used during standalone coiling of ruptured aneurysms was associated with a significant reduction in immediate thromboembolic events, whereas no significant differences were observed in hemorrhagic complications, delayed cerebral ischemia, or overall clinical outcomes [9]. These findings are broadly consistent with those of Edwards et al, who reported that selective aspirin administration in high-risk ruptured aneurysms significantly reduced pericoiling thromboembolic events without increasing major systemic hemorrhage, aneurysm rebleeding, symptomatic intracranial hemorrhage, or major external-ventricular-drain (EVD)-related hemorrhage, although minor asymptomatic EVD-associated bleeding was more frequent [10]. An earlier work by Ries et al also supported the hypothesis that intraprocedural aspirin can reduce thromboembolic complications during aneurysm embolization, although that study was not strictly limited to a coil-only ruptured aneurysm population [11].

Evidence for Dual Antiplatelet Therapy or Multiple-Agent Regimens in Coil-Only aSAH

Evidence supporting dual antiplatelet therapy or more intensive antiplatelet regimens in true coil-only aSAH is limited and mainly derived from retrospective, single-center cohorts. Muraoka et al reported that antiplatelet loading before acute-phase coil embolization led to fewer thromboembolic complications; the most favorable results were observed in patients receiving a dual-loading strategy [12]. Similarly, Shimamura et al described lower thromboembolic complication rates and improved clinical outcomes with the use of multiple preprocedural antiplatelet agents; no hemorrhagic complications were noted in their series [13]. However, these studies reflect local practice patterns, relatively small sample sizes, and nonrandomized treatment allocation. Additionally, the regimens were not uniform and were not restricted to a single dual antiplatelet therapy scheme, limiting external generalizability. These findings should be interpreted as hypothesis-generating, rather than as evidence supporting a universal dual antiplatelet therapy standard for coil-only aSAH [12,13].

Hemorrhagic Risk Associated With Antiplatelet Therapy

Hemorrhagic risk associated with antiplatelet therapy strongly depends on the treatment context. In coil-only series, the primary concern has been ventriculostomy-associated hemorrhage. Evans et al demonstrated a significantly higher rate of ventriculostomy-associated hemorrhage among patients receiving intraprocedural intravenous aspirin; however, most hemorrhages were small, none required surgical evacuation, and neither discharge outcomes nor mortality differed between groups [14]. Edwards et al reported a similar pattern, with no increase in major hemorrhagic complications but a higher frequency of minor EVD-related bleeding [10]. In contrast, the clearest hemorrhagic signal in the literature arises from device-assisted treatment requiring dual antiplatelet therapy. Studies by Kung et al and Hudson et al demonstrated higher rates of ventriculostomy- or shunt-related hemorrhage in patients receiving dual antiplatelet therapy, although many of these events were radiographic rather than clinically significant [15-17]. Therefore, hemorrhagic risk in aSAH should not be considered a generic effect of antiplatelet therapy but rather interpreted in relation to whether therapy was used selectively in coil-only treatment or was required due to adjunctive stent or flow-diverter implantation [8,14-18].

Comparison Between Coil-Only and Device-Assisted Strategies

When interpreted thematically, coil-only and device-assisted strategies address fundamentally different clinical questions. In coil-only treatment, antiplatelet therapy is optional and mainly utilized to reduce periprocedural thromboembolic risk. In stent-assisted coiling and flow diversion, however, dual antiplatelet therapy is generally unavoidable because protection against device-related thrombosis becomes the primary objective. This distinction explains why device-assisted studies may report acceptable overall safety or lower postprocedural infarction rates while simultaneously demonstrating higher rates of

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ventriculostomy-related hemorrhage than coil-only treatment. For example, Lee et al reported lower rates of postprocedural cerebral infarction after stent-assisted coiling with periprocedural dual antiplatelet therapy than after coil-only treatment, along with a significantly higher rate of ventriculostomy-related hemorrhage [8]. Such findings are clinically important but should be regarded as device-specific evidence, rather than direct support for routine antiplatelet therapy in coil-only aSAH.

Synthesis of Reported Clinical Outcomes

Across available studies, the most consistent benefit signal is a reduction in periprocedural thromboembolic complications, particularly in the coil-only setting [9-13]. In contrast, evidence for a reduction in delayed cerebral ischemia is less consistent. Takase et al did not find a significant reduction in delayed ischemia during their meta-analysis of standalone coiling [9]; broader meta-analyses by Cagnazzo et al and Lee et al suggested either no overall significant effect or a more favorable signal when more heterogeneous antiplatelet-treated aSAH populations were pooled [7,19]. Evidence concerning functional outcomes is also inconsistent. Ditz et al reported that postinterventional antiplatelet therapy was associated with improved 3-month functional outcomes without reducing angiographic vasospasm or delayed-cerebral-ischemia-related infarction [20]; Darkwah Oppong et al found that aspirin was independently associated with lower delayed cerebral ischemia risk and improved outcomes, whereas dual antiplatelet therapy conferred no additional benefit and was associated with a higher risk of major bleeding [21]. In contrast, Wallace et al did not demonstrate a benefit of dual antiplatelet therapy over aspirin monotherapy for delayed cerebral ischemia, symptomatic vasospasm, or favorable 6-month outcomes [22]. Taken together, the available evidence suggests that antiplatelet therapy appears most promising for periprocedural ischemic protection, whereas evidence for a consistent downstream benefit in delayed cerebral ischemia or long-term recovery remains limited and heterogeneous.

Institutional Practice Example

To avoid conflating published evidence with unpublished local practice, the following regimen is presented only as an example of institutional management and is not part of the evidence synthesis discussed above.

At our center, all patients with ruptured intracranial aneurysms managed by a coil-only strategy receive a standardized periprocedural dual antiplatelet regimen followed by postoperative aspirin monotherapy. On the day of the procedure, clopidogrel (150 mg orally) is administered at least 30 minutes before the endovascular procedure, and acetylsalicylic acid (ASA, 150 mg orally) is given 1 hour before induction of anesthesia. During the procedure, all catheters are continuously flushed with heparinized saline containing 5000 IU of heparin in 500 mL of 0.9% NaCl. Additionally, intravenous heparin (2500 IU) is administered as a bolus after placement of the first coil. Postoperatively, patients receive intravenous heparin 2500 IU every 6 hours during the first 24 hours (4 doses in total). From the first postoperative day onward, patients receive oral ASA 75 mg daily for a minimum of 3 months.

This protocol is reported solely to illustrate a uniform local management strategy in a coil-only ruptured aneurysm population; it should not be interpreted as comparative evidence or as a recommendation derived from the present review.

Strengths and Limitations of the Available Evidence

The current evidence base remains constrained by several methodological weaknesses. Most available studies are retrospective, single-center, and observational. Treatment allocation was not randomized; it often was influenced by aneurysm morphology, procedural complexity, perceived thromboembolic risk, or the need for adjunctive devices, resulting in substantial confounding by indication. Antiplatelet regimens also considerably varied with respect to agent selection, loading strategy, timing of administration, and duration of therapy. Furthermore, endpoint definitions were inconsistent across studies, particularly for thromboembolic complications, hemorrhagic complications, delayed cerebral ischemia, and functional outcomes. These limitations are especially important when comparing coil-only and device-assisted populations because the indication for antiplatelet therapy fundamentally differs between these treatment groups. Accordingly, the current literature supports cautious clinical hypotheses but does not define a standardized protocol for routine antiplatelet therapy in coil-only aSAH.

Future Directions

Key unresolved questions include whether antiplatelet therapy should be used routinely in coil-only aSAH, which patients are most likely to benefit, whether aspirin monotherapy is sufficient, and how ischemic protection can be balanced against procedure-related bleeding. The ASTOP trial [23] is particularly important in this context because it directly addresses the coil-only setting. This multicenter, randomized, double-blind, placebo-controlled trial is underway to evaluate preprocedural aspirin versus placebo before coil embolization of ruptured aneurysms; primary outcomes include intraoperative thromboembolic complications and symptomatic ischemic lesions on diffusion-weighted magnetic resonance imaging. Until randomized data of this type become available, the use of antiplatelet therapy in coil-only aSAH should remain individualized and interpreted in the context of local procedural practice and hemorrhagic risk.

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Conclusions

Available evidence suggests that antiplatelet therapy during coil-only treatment of ruptured intracranial aneurysms can reduce periprocedural thromboembolic complications in selected patients. However, the literature remains hindered by retrospective study designs, small sample sizes, protocol heterogeneity, and inconsistent reporting of hemorrhagic, ischemic, and functional endpoints. Evidence derived from stent-assisted or flow-diverter-treated cohorts should not be directly applied to coil-only procedures because the indication for antiplatelet therapy fundamentally differs in device-assisted treatment. At present, no standardized antiplatelet regimen can be recommended for routine use in coil-only aSAH; treatment decisions remain individualized and center-dependent. Ongoing randomized studies, including ASTOP, may help determine whether a more evidence-based, procedure-specific antiplatelet strategy can be established.

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