A Literature Review on Health Economic Evaluation of Pipeline Embolization Device (PED) in Treating Intracranial Aneurysms

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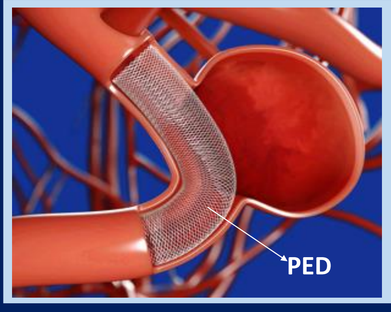
BACKGROUND| Intracranial aneurysm is a cerebrovascular disorder. It will cause ballooning of the blood vessel or a localized dilation at the weakness of a cerebral artery or vein wall. Results of a systematic review and meta-analysis of 94,912 patients with unruptured intracranial aneurysms in 83 study populations from 21 countries showed that, the combined prevalence of unruptured aneurysm was about 3.2% (95% CI: 1.9%-5.2%) in a mean age of 50 years of adults without comorbidities[1]. Hemorrhage is a serious complication of intracranial aneurysm. The morality rate and disability rate of Hemorrhage is 40% and 60%, respectively[2]. The three common types of technologies for treating aneurysm are outlined in **Figure 1** below.

FUGURE 1: THREE COMMON TYPES OF THERAPIES

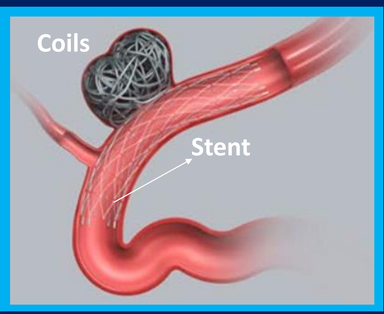


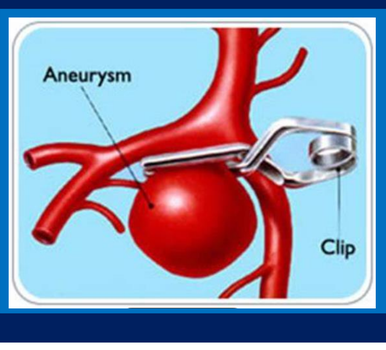
Pipeline Embolization Device (PED)

PED is a small cylindrical mesh device that is inserted into an affected artery in a less invasive endovascular procedure. It redefines treatment of intracranial aneurysms by diverting flow away from the aneurysms neck, reconstructing the parent artery and restoring its natural course.

Stent-Assisted Coiling (SAC)

Stent-assisted coiling (SAC) is an option for treating intracranial aneurysms. The coils can occlude the blood flow to the aneurysms and the stents can prevent protrusion or dislocation of coils into the parent artery as a scaffold .





Neurosurgical clipping (NC)

Neurosurgical clipping of an aneurysm requires opening of the skull (craniotomy). During the operation, a metal clip is placed over the neck of the aneurysm to occlude the blood flow to the aneurysm but to preserve it through the adjacent normal arteries.

OBJECTIVE| This literature review aims to review and summary the current literature on health economic evaluation of pipeline embolization device for treating intracranial aneurysms.

METHODS| We have performed a literature review through the Embase research engine, Cochrane library database, PubMed database and ISPOR publication database. The first search yielded 44 publications. After the abstract screening and the criteria assessment, 31 were excluded from the final review. After submitting the abstract, a health economic evaluation of PED based on the Chinese context were found from CNKI (Chinese database).

RESULTS| A total number of 13 published studies were identified from 2012 to 2022 and they were all conducted from societal or payer perspectives. Neurosurgical clipping (NC), coiling, stent-assisted coiling (SAC) and pipeline embolization device (PED) were the main technologies for treating aneurysms. Major studies (9/13) researched patients with unruptured intracranial aneurysms and only one study from America explored the patients with ruptured intracranial aneurysms. Twelve studies reported the size of aneurysms including small, medium, large and giant. Seven studies all claimed that PED was more cost-effective than SAC or coiling in patients with large and giant aneurysms and three of the studies built a model to assess the long-term health economic results. Three studies applied models for estimating the long-term economic outcome for patients with small and medium aneurysms and they all stated that PED was a cost-effective treatment compared with SAC. In terms of short-term economic evaluation, half of the studies (2/4) indicated that the procedure cost of PED is less than coiling or SAC in patients with small and medium aneurysms. Besides, one study reported that the upfront and follow-up costs after using coiling and PED techniques was mostly similar in patients with medium aneurysm.

RESULTS (cont.)| Eventually, the health economic evaluation of PED based on the Chinese context also points out that PED was more cost-effective than SAC in patients with large and giant aneurysms and it created a model for predicting long term results as well. This study also fill the gap of health economics evaluation of PED in China.

TABLE 1:SELETED CHRARCTERISTICS OF PUBLISHED STUDIES

Country	Year	Aneurysm Size	Types of therapies	CEA	Time horizon	Conclusion
Canada	2012	G&L	PED Vs SAC	×	ST	PED is cost-effective for treating complex aneurysms[3]
America	2012	M&S	PED Vs SAC	×	ST	PED has lower procedure cost compared with SAC[4]
England	2013	G&L	PED Vs SAC	√	/	PED is cost saving on some context, for example some large/ giant aneurysm[5]
America	2013	L	PED Vs Coiling	×	ST	The cost of treatment of large aneurysms with PED is economically favourable[6]
Australia	2013	L&M&S	PED Vs SAC Vs Coiling	×	ST	PED is more cost effective than SAC for treating aneurysms > 12mm[7]
Mexico	2016	G	PED Vs SAC Vs Coiling	√	LT	PED is a cost-effective strategy for the treatment of giant and wide neck intracranial aneurysms[8]
America	2017	G&L	PED Vs Coiling	√	LT	PED and coiling are both cost effective strategy compared to no treatment[9]
America	2019	S	PED Vs SAC Vs Coiling	√	LT	PED is the better option in PSA, but longer follow up studies are needed for more accurate assessment[10].
America	2019	S	PED Vs SAC	√	LT	PED is more cost effective than SAC for treating small size aneurysms[11]
America	2019	M	PED Vs Coiling	×	ST	There is no difference in admission treatment or follow up cost for PED and coiling treatments[12]
America	2020	ruptured	PED Vs Coiling Vs NC	×	ST	Treatment with PED needs more money compared to NC.[13]
America	2021	S	PED Vs SAC	×	ST	Follow up cost and total cost of PED is a little bit lower than SAC[14]
Colombia	2022	G&L&M&S	PED Vs SAC Vs NC	√	LT	PED is a cost effective treatment compared to NC; PED is a highly cost effective treatment compared with SAC in patient with S,M,L&G aneurysms[15]
China	2022	G&L	PED Vs SAC	√	LT	PED is more cost effective than SAC for treating large and giant aneurysms[16]

Abbreviation: G:giant size; L:large size; M:median size; S:small size; PED: pipeline embolization device; SAC: stent-assisted coiling; NC: neurosurgical clipping; Coiling: endovascular coiling; ST: short term; LT: long term

CONCLUSIONS| There was a high consistency in the currently available economic evaluation studies, that PED is a cost-effective technique for treating different size intracranial aneurysms.

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