

Complications of Distal Protection During Carotid Intervention: *Frequency, Prevention and Management*

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Disclosure Statement of Financial Interest

I, J. Michael Bacharach, MD, DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

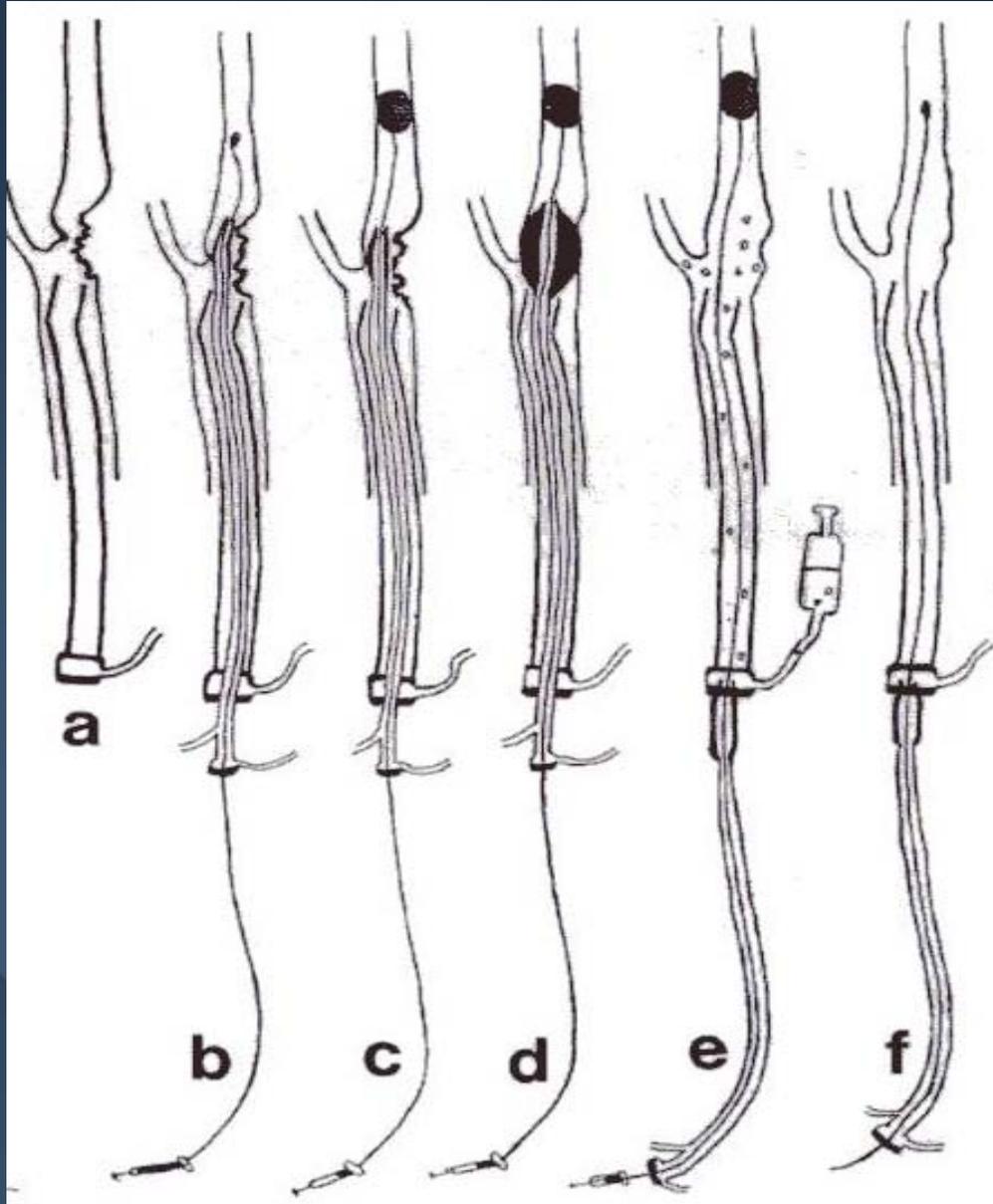
Types of EPD's

- **Distal EPD:** requires crossing the lesion with guide wire with deployment of the EPD distal to the target lesion
- **Proximal EPD:** relies on transient balloon occlusion of the CCA proximal to the lesion and in the ECA with a second balloon resulting in cessation of antegrade flow in the ICA

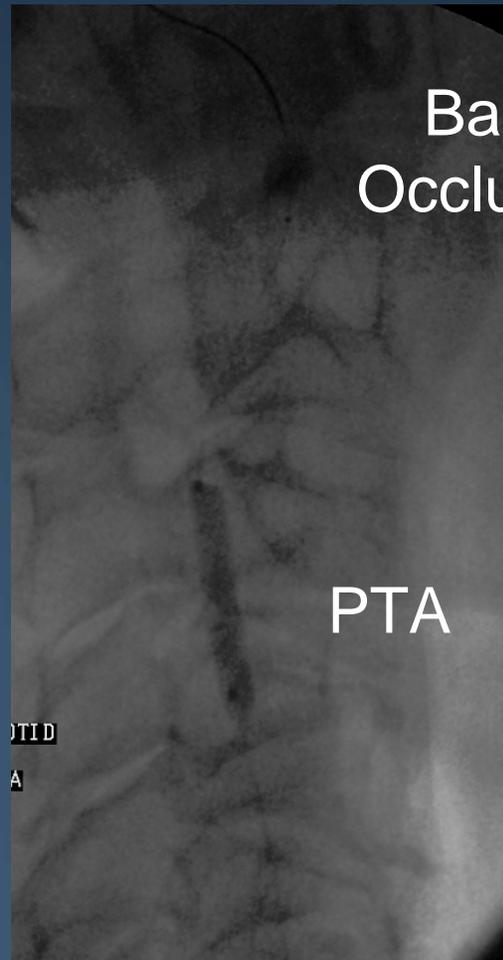
Proximal Occlusion



Distal Occlusion

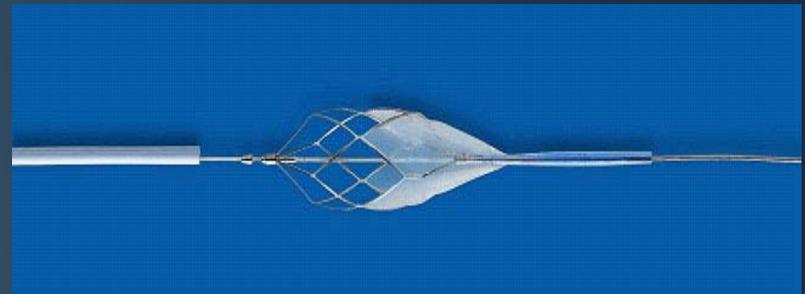


Percu-surge protection device w/ balloon inflated



Distal EPD

- Type I – transient balloon-mediated occlusion of the distal cervical portion of the ICA (ie. percusurge)
- Type II – deployment of filter device in the distal ICA; following stent deployment re-capture of the filter and removal



Goal of EPD's

- All EPD's share a common goal:
 - Prevention of embolic debris from entering the intracranial circulation during carotid angioplasty and stenting



Mode of Failure

- **Inability to deliver or properly deploy the device in a safe location**
- **Device-induced injury or embolization**
- **Device-induced carotid occlusion resulting in cerebral ischemia**
- **Incomplete capture or retrieval of embolic debris**
- **Entanglement of EPD within the stent**

Technical Features that Potentially Increase the Risk of EPD Failure

- Large device profile
- Excessive vessel tortuosity
- Diffuse atherosclerotic plaque
- Inaccurate sizing of device
- Incomplete capture
- Instability of guide or sheath delivery system

Technical Limitations EPD

- Retrospective review of 206 CAS procedures from 4/2001 to 9/2005
- 98 cases (48%) filter devices and 94 (46%) were distal balloon occlusion
- 2 patients (2%) manifested reversible neurologic intolerance during flow arrest
- 11 patients (11%) necessitated intraoperative switching to balloon occlusion secondary to extreme tortuosity or severe stenosis of the target lesion limiting passage of the filter

Eskandari et al. Annals Vasc. Surg
2007 Vol 21(4): 403-7

Technical Limitations EPD

- Dartmouth Group reported device specific technical difficulties during 141 CAS procedures
- EPD-related technical difficulties occurred in 15% in the balloon occlusion group and 31% of the filter group ($p < .05$)

Powell et al. JVS July 2006
44(1):56-60

Technical Complications of EPD

Filter (N=42) Balloon (N=99) p
 % %

	Filter (N=42) %	Balloon (N=99) %	p
Neuro Comp	0	10	.002
Unable to cross lesion	12	0	.001
Filter clogged	5	0	.07
ICA spasm	12	2	.002
Malposition stent	0	2	.56
Other (*delayed retrieval wire kinking)	7	1	.16

Powell et al. JVS July 2006
 44(1):56-60

EPD Complications

- Cremonesi and colleagues reported on 442 consecutive patients undergoing carotid stenting with embolic protection
- Cerebral protection device-related complications were 4 (0.9%)
 - 1 (0.2%) spiral dissection resulting in abrupt vessel closure
 - 1 (0.2%) case of trapped guide wire
 - 2 (0.5%) cases of intimal dissection
 - 6 of 40 patients (15%) developed reversible cerebral ischemic symptoms in whom occlusive protection devices were used

Stroke 2003 34(8)

Incidence of EPD Complications

Author **N** **Observed Technical Complications**
Patients

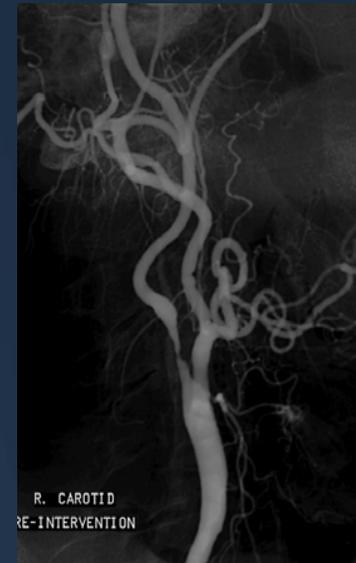
Cremonesi	442	4 (0.9%) filter devices 6 of 40 (15%) balloon occlusion
Powell	141	31% filter devices 15% balloon occlusion
Eskundari	206	11% required conversion from filter to balloon 2% balloon occlusion
Chaer	43	23% neurologic intolerance with balloon occlusion

Prevention of EPD-Related Complications

- Anatomical considerations
- Device-specific features
- Operator considerations

Anatomical

- Assessment of lesion morphology
ie. calcification, degree of stenosis
- Collateral circulation
- Anatomical limitations related to
delivery and recovery



Device Specific

- Size and deliverability
- Occlusion versus filter
- Compatability with delivery system and stent

Operator Considerations

- Adequate familiarity and experience with features of the device
- Appropriate patient selection

Management

- No specific cookbook or algorithm for dealing with complications
- Neurologic intolerance related to occlusion: restore flow
- Spasm: most cases require only time, avoid manipulation of PTA
- Maintain guide and wire position so that in the event further intervention is required, access is maintained

Spasm at EPD Site



Summary

- EPD-related technical difficulties are not uncommon
- Familiarity with different types of EPD's allows for improved response when difficulties arise
- Balloon and filter-type EPD's have complimentary advantages and disadvantages
- Assessment of individual patient anatomy and lesion characteristics is important to avoid EPD-related complications