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Effect of shunt placement on stroke risk in symptomatic patients undergoing carotid endarterectomy with patch angioplasty

Analysis of NSQIP 2016-2019

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Disclosures

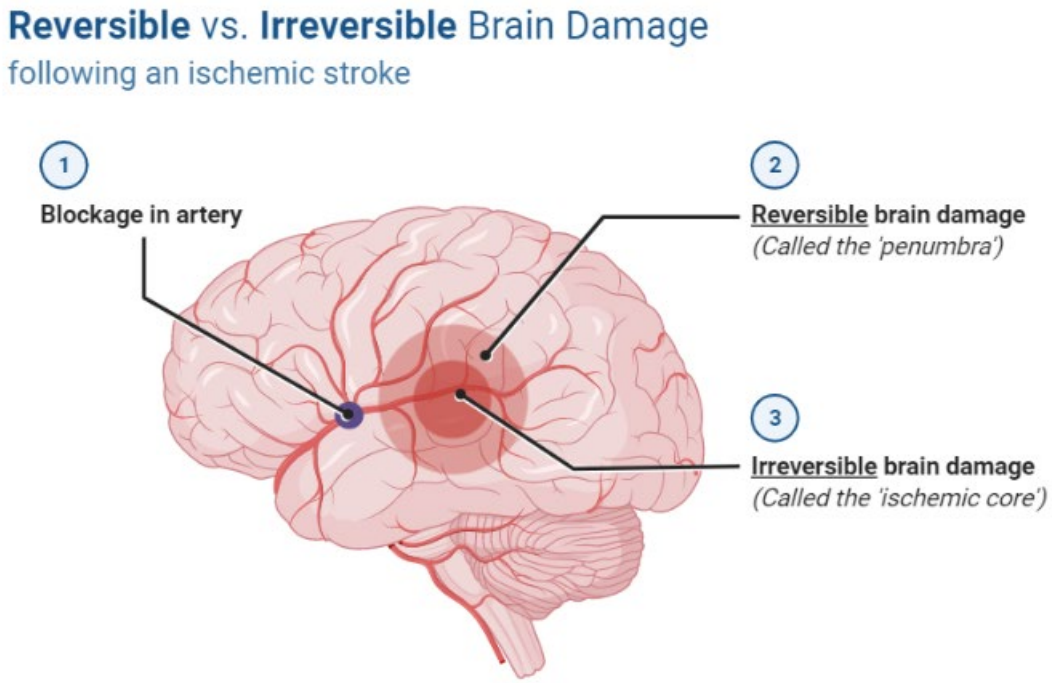
All authors have no relevant disclosures to report.

Introduction

In symptomatic patients with moderate-to-severe ICA stenosis, carotid endarterectomy (CEA) reduces risk of stroke.[1-4]

The ischemic penumbra is the area between irreversible infarction and normal perfused brain tissue.

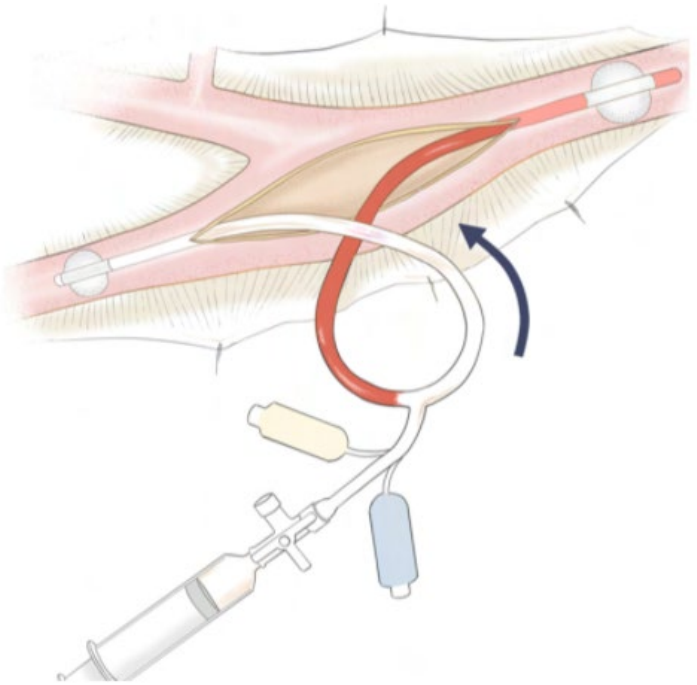
The ischemic penumbra can potentially be salvaged with reperfusion but is otherwise at risk of progression to irreversible infarction.



Introduction

Compared to asymptomatic patients, those with a history of stroke are at increased risk of cross-clamp intolerance and postoperative cerebrovascular events.[5-7]

Placement of an **intraluminal shunt** during CEA can be used to limit interruption to cerebral perfusion and in theory, may protect the ischemic penumbra in patients with a history of stroke.



Methods

Does shunt placement affect postoperative stroke risk in symptomatic patients undergoing CEA?

Database: National Surgical Quality Improvement Program (NSQIP) 2016-2019

Inclusion: CEA with patch angioplasty, history of stroke or transient ischemia attack (TIA)/amaurosis fugax (AF)/temporary monocular blindness (TMB)

Exclusion: asymptomatic patients, CEA with primary closure or eversion CEA

Results

Shunts were placed in 40.4% of the 4,925 cases included.

Shunt use was more common in Hispanic patients, during non-elective or emergent surgery, and under general anesthesia.

Variable N (%) or median [IQR]	CEA 2,937 (59.6)	CEA + Shunt 1,988 (40.4)	P
Age, years	71 [64-78]	72 [65-78]	.080
Gender, female	1,104 (37.6)	765 (38.5)	.527
Race, non-White	660 (22.5)	459 (23.1)	.612
Ethnicity, Hispanic	113 (4.4)	47 (2.7)	**.005**
Non-elective surgery	1,108 (37.8)	807 (40.6)	**.042**
Emergency case	207 (7.0)	183 (9.2)	**.006**
Body mass index, kg/m^2	27.8 [24.4-31.9]	27.7 [24.3-31.4]	.129
Obesity (BMI >30 kg/m^2)	1,020 (34.7)	662 (33.3)	.299

Results

Patients who were shunted were more often current smokers and had preoperative bleeding disorders (includes inherited coagulopathy and therapeutic anticoagulation not reversed prior to surgery).

Variable N (%) or median [IQR]	CEA 2,937 (59.6)	CEA + Shunt 1,988 (40.4)	P
Functional status, dependent	132 (4.5)	87 (4.4)	.844
Current smoker	842 (28.7)	627 (31.5)	**.031**
Dyspnea, at rest or on exertion	293 (10.0)	229 (11.5)	.084
COPD	281 (9.6)	214 (10.8)	.170
Congestive heart failure	50 (1.7)	28 (1.4)	.418
Hypertension requiring medication	2,355 (80.2)	1,579 (79.4)	.515
Diabetes requiring medication	937 (31.9)	614 (30.90	.450
Currently on dialysis	31 (1.1)	20 (1.0)	.866
Disseminated cancer	14 (.5)	14 (.7)	.297
Open wound or infection	43 (1.5)	27 (1.4)	.758
Steroid use for chronic condition	101 (3.4)	62 (3.1)	.538
>10% body weight loss in last 6 months	25 (.9)	11 (.6)	.229
Bleeding disorder	673 (22.9)	544 (27.4)	**<.001**
Transfusion <72 hours pre-op	19 (.6)	8 (.4)	.254

Results

Patients who were shunted were more likely to have contralateral ICA occlusion.

Variable N (%) or median [IQR]	CEA 2,937 (59.6)	CEA + Shunt 1,988 (40.4)	*P*
Baseline Doppler US or angiogram, ipsilateral			.091
Total occlusion (100%)	44 (1.5)	33 (1.7)	
Severe stenosis (80%-99%)	1,605 (56.0)	1,156 (59.2)	
Moderate stenosis (50%-79%)	1,158 (40.4)	733 (37.5)	
Mild or no stenosis (<50%)	61 (2.1)	31 (1.6)	
Baseline Doppler US or angiogram, contralateral			**.001**
Total occlusion (100%)	67 (2.5)	81 (4.5)	
Severe stenosis (80%-99%)	186 (7.0)	153 (8.5)	
Moderate stenosis (50%-79%)	793 (30.0)	542 (29.9)	
Mild or no stenosis (<50%)	1,594 (60.4)	1034 (57.1)	

Results

Patients who were shunted were more likely to undergo general anesthesia.

Operative time was slightly shorter in shunted patients.

There were differences in rates of acute occlusion/technical defects requiring revision, restenosis, or distal embolization with shunt placement.

Variable N (%) or median [IQR]	CEA 2,937 (59.6)	CEA + Shunt 1,988 (40.4)	P
Principal anesthesia technique, general	2,541 (86.5)	1,931 (97.2)	**<.001**
Operative time, minutes	118 [90-151]	114 [90-143]	**.005**
Acute occlusion/technical defects requiring revision	12 (.4)	14 (.7)	.160
Restenosis	15 (.5)	6 (.3)	.270
Distal embolization	11 (.4)	5 (.3)	.457

Results

Thirty-day mortality, readmission, reoperation rates were similar between shunted and non-shunted groups.

Stroke rate was 3.2% in shunted compared to 2.7% in non-shunted patients ($P = .289$).

Cranial nerve injury rate was higher in shunted (4.0%) compared to non-shunted patients (2.4%) ($P = .002$).

Variable N (%) or median [IQR]	CEA 2,937 (59.6)	CEA + Shunt 1,988 (40.4)	P
Mortality, same-admission	11 (.4)	9 (.5)	.672
Mortality, 30-day	25 (.9)	22 (1.1)	.366
Readmission, 30-day	235 (8.0)	161 (8.1)	.902
Unplanned reoperation, 30-day	105 (3.6)	65 (3.3)	.565
Total length of stay, days	2 [1-5]	2 [1-5]	.285
Stroke	78 (2.7)	63 (3.2)	.289
TIA/AF/TMB	20 (.7)	20 (1.0)	.212
Cranial nerve injury	71 (2.4)	79 (4.0)	**.002**

Results

After stratifying patients by severity of preoperative symptomology and neurological deficit, there was still no effect of shunt placement on postoperative stroke risk.

Modified Rankin Scale (mRS)

Score	Definition
0	No symptoms
1	No significant disability
2	Slight disability
3	Moderate disability
4	Moderately severe disability
5	Severe disability
6	Dead

Category	CEA	CEA + Shunt	OR	95% CI	P
mRS 0-2	24/873 (2.7)	26/633 (4.1)	1.515	.862-2.665	.146
mRS 3-5	12/248 (4.8)	8/186 (4.3)	.884	.354-2.208	.792
History of TIA/AF/TMB	32/1,553 (2.1)	19/995 (1.9)	.925	.522-1.620	.791
History of stroke	46/1,384 (3.3)	44/949 (4.4)	1.349	.885-2.056	.163

Results

Multivariate analysis was performed to account for effect of preoperative demographics and comorbidities, severity of preoperative symptoms, presence of contralateral ICA occlusion, pre-procedural medication, general anesthesia, and operative time.

Outcomes	Variable	aOR	95% CI	*P*
Stroke, 30 days	History of stroke (*vs* TIA/AF/TMB)	1.68	1.15-2.45	**.007**
	Non-elective surgery	1.89	1.30-272	**<.001**
Cranial nerve injury	Race, non-White	1.51	1.02-2.24	**.038**
	Operative time (every 30-minute increase)	1.35	1.23-1.48	**<.001**
	Shunt placement	1.92	1.35-2.73	**<.001**

After adjusting for confounders, history of stroke and non-elective surgery were risk factors for postoperative stroke, and non-white race, increasing operative time, and shunt placement were risk factors for cranial nerve injury.

Summary of Findings

In this retrospective study of NSQIP 2012-2019 including 4,925 CEA cases performed in patients with symptomatic carotid stenosis:

1. Shunts were placed in 40% of cases, and more so in patients with history of stroke (*vs* TIA/AF/TMB), contralateral ICA occlusion, and under general anesthesia.

2. History of stroke (*vs* TIA/AF/TMB) and non-elective surgery, but not contralateral ICA occlusion, were associated with increased risk of postoperative stroke.

3. Shunt placement was associated with increased risk of cranial nerve injury without reduction in postoperative stroke risk.

Conclusion

Symptomatic status should dictate shunt placement during CEA.

Three randomized trials[8-10] and a pooled analysis[11] of the 686 participants in these studies found no difference in 30-day stroke risk with routine compared to never shunting.

A Vascular Quality Initiative (VQI) study of 28,457 CEA cases compared routine shunting, never shunting, and selective shunting based on awake monitoring, EEG, or stump pressures, and found no difference in risk-adjusted in-hospital stroke or death.[12]

Surgeons should perform the operation they are most familiar with.

Limitations of this study:
- Retrospective design
- Outcomes limited to 30 days
- Indication for shunting not known → could not differentiate between routine and selective approaches

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