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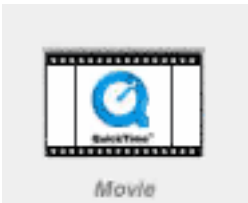
Introduction

Bypass surgery is a highly technical procedure performed to treat patients with cerebrovascular diseases. However, intraoperative technical complications in cerebral revascularization have not been studied extensively.

Methods

We analyzed all 430 intracranial bypass procedures performed between 1997 and 2017 by a single surgeon (M.T.L.). Intraoperative technical complications were recorded prospectively and confirmed by manual review of the operative report.

Data on patient demographics, diagnosis, bypass type, and graft type were collected. Descriptive statistics were used to compare bypass patency, post-operative complications, and return to OR rates.



Example of an intraoperative complication (damaged vessel)

Results

There were 37 (8.6%) intraoperative technical complications among 430 consecutive cases:

- 25 graft occlusions (5.8%)
- 6 graft injuries (1.4%)
- 3 graft twists/kinks (0.7%)
- 3 technical suture mistakes (0.7%)

Patients presenting with moyamoya disease (15/132; 11.4%) and aneurysms (18/175; 10.3%) had higher technical complication rates than those with occlusive diseases (4/120; 3.3%; *P*=0.035).

We observed higher complication rates for cases with radial artery grafts (6/36; 16.7%) than those with saphenous vein grafts (0/44; 0.0%) or none (20/285; 7.0%; *P*=0.003).

There were no differences in complication rates for number of anastomosis sites, high flow vs. low flow, or between EC-IC and IC-IC bypasses.

At last follow-up (average: 10 months; range: 0-17 years):12 occluded bypasses (2.8%) in the series, 3 of which experienced intraoperative complications.

6 cases with intraoperative complications (16.2%) had post-operative complications (vasospasm, stroke, and hydrocephalus), and two cases (5.4%) returned to the OR.

Results

Complication	Salvage maneuver
Platelet plug (“white plug”)	• Squeeze and disperse with forceps
Adherent thrombus and platelets (“red plug”)	• Suture line thrombectomy • Thrombectomy through donor arteriotomy • Complete reanastomosis
Proximal anastomosis occlusion	• Mid-graft arteriotomy with retrograde bleeding only • Fogarty catheter thrombectomy or revision
Distal anastomosis occlusion	• Mid-graft arteriotomy with antegrade bleeding only • Fogarty catheter thrombectomy or revision
Mid-graft occlusion	• Unkink or untwist graft
Failed revisions	• Alternative bypass or temporalis muscle onlay graft
Delayed ischemia	• Rescue bypass (new EC-IC interpositional bypass)

The vast majority of cases (89.2%; 33/37) were salvaged intraoperatively via reanastomosis with local anticoagulants.



Example of a salvage maneuver (damaged vessel repair)

Conclusion

In experienced hands, most intraoperative technical complications can be managed successfully with bypass salvage maneuvers. Advance preparation for technical complications as well as close inspection of patency using intraoperative video angiography are crucial to successful bypasses.