

Validation of surgical strategies for coronary artery bypass grafting to reduce ischemic brain lesions using diffusion-weighted magnetic resonance imaging

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BACKGROUND: It is well known that neurologic complications such as stroke or cognitive dysfunction may occur after coronary artery bypass graft surgery with extracorporeal circulation. An early diagnosis of cerebral impairment can be achieved with diffusion-weighted magnetic resonance imaging (DWI)^{1,2}. New ischemic brain lesions, the vascular distribution as well as the differentiation between embolic or hemodynamical related infarction can be characterized with this technique. Therefore, DWI is helpful to monitor new developments in cardiopulmonary bypass procedures.

OBJECTIVE: To minimize embolic disease in pts. with cardiopulmonary bypass, heparin-coated circuits were compared to conventional non heparin-coated devices. The endpoint was early postoperative burden of ischemic brain lesions detected by DWI.

METHODS: In this study, thirty-one patients (mean ± SD = 66,2 ± 8,3 [46-79] years, 5 females) receiving coronary artery bypass grafting with (a) conventional, non heparin-coated (N = 11 pts) and (b) heparin-coated (N = 20 pts) cardiopulmonary bypass systems were examined with DWI (b-values = 0, 800, 1600 and 2400 s/mm²) and conventional brain MRI. Scans were acquired prior to cardiac surgery and 114 ± 21 hours (range: 93 – 173 hours) after intervention. Images were evaluated regarding number, size, and location of fresh lesions by an experienced neuroradiologist. Before surgery, each patient underwent color-duplex-ultrasound to exclude significant carotid artery disease.

RESULTS: Mean bypass time was 68 ± 14 min (range: 39-95 min). No major neurological complications were clinically observed in either group. 39 new ischemic lesions were found in 14 (45 %) patients; in particular 16 lesions occurred in the control group (1,45 lesions per pt) and 23 in the group with heparin-coated circuits (1,15 lesions per pt). Multiple infarctions were evident in 8 patients, among these 3 were caused by a fragmented embolus. Lesion volume ranged from 12 to 380 mm³ (N = 36), 380 to 1.000 mm³ (N = 2) and one was 2300 mm³. Prevalence of infarctions according to the vascular territories are listed in table 1. One lesion was suspected to be flow related and not of embolic origin.

Table 1: Vascular distribution of new lesions after coronary artery bypass grafting.

	left hemisphere					right hemisphere				
	ACA	ACM	ACP	watershed	cerebellum	ACA	ACM	ACP	watershed	cerebellum
embolic	0	11	0	2	4	1	14	3	1	2
hemodyn.	0	0	0	1	0	0	0	0	0	0

ACA=Anterior cerebral artery; ACM=Middle cerebral artery; ACP=Posterior cerebral artery

CONCLUSION: The use of heparin-coated cardiopulmonary bypass systems might help to lower the postoperative cerebrovascular event rate as shown by the lower frequency of brain embolism. DWI proved as a reliable endpoint to characterize amount and location of tissue damage.

LITERATURE:

1. Floyd T, Shah P, Price C et al. Clinically silent cerebral ischemic events after cardiac surgery: their incidence, regional vascular occurrence, and procedural dependence [In Process Citation]. *Ann Thorac Surg.* 2006;81:2160-6
2. Knipp S, Matatko N, Wilhelm H et al. Evaluation of brain injury after coronary artery bypass grafting. A prospective study using neuropsychological assessment and diffusion-weighted magnetic resonance imaging. *Eur J Cardiothorac Surg.* 2004;25:791-800.