



Literature Reviews

Neurocognitive function and cerebral emboli: randomized study of on-pump versus off-pump coronary artery bypass surgery.

Motallebzadch R, Bland JM, Markus HS, Kaski JC, Jahangiri M. *Ann Thorac Surg* 83:475-82, 2007

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Abstract Excerpt

Neurocognitive dysfunction after coronary artery bypass graft (CABG) surgery has been well-described. This study examined if off-pump CABG, that is without the use of cardiopulmonary bypass (CPB), had a decreased incidence of cerebral emboli and decreased neurocognitive function when compared to on-pump CABG (CABG with the use of CPB). They randomized 212 patients undergoing initial cardiac surgery to receive either on-pump or off-pump CABG surgery. Exclusion criteria included previous neurological injury (e.g. stroke), significant carotid disease, previous cardiac surgery, and previous psychiatric illness. All patients had preoperative neurocognitive tests that were repeated postoperatively, at discharge, and six weeks and six months postoperatively. Intraoperatively, all patients underwent Doppler ultrasonography assessment of the middle cerebral artery. Results were read by an independent physician, blinded to the subjects/treatment groups. At hospital discharge, patients who had off-pump CABG had greater neurocognitive scores when compared with the on-pump group. There was no significant difference at six weeks or six months between the two groups. There was a significantly increased number of embolic signals by ultrasound in the on-pump group. The authors conclude that while the use of CPB was associated with increased embolic signals and decreased neurocognitive dysfunction in the immediate postoperative period, intermediate outcomes at six weeks and six months were similar between the two groups.

Reviewer's Comments

Neurocognitive dysfunction has long been described after cardiac surgery. In addition to gross stroke or diffuse neurologic dysfunction, patients have been described to have other impairments including deficits in fine motor function, memory disturbances, and speed of motor responses. Previous studies have varied greatly with respect to the qualification of such impairments with differences in tests administered, timing of administration, patient selection, etc. There exists, however, a substantial body of evidence indicating that these impairments do occur, though true quantification is difficult, with estimates of 30% - 80% of patients undergoing cardiac surgery experiencing some subtle form of neurocognitive dysfunction.

Historically, the use of CPB has been implicated in the development of these deficits. It is thought that the manipulation of a calcified aorta, including cross-clamping and cannulation, in addition to the bypass circuit itself lend to both gaseous and particulate emboli that result in neurocognitive decline. The advocates of off-pump CABG surgery hypothesize that by avoiding CPB, one can potentially avoid these complications. Data, however, proving neurological outcome benefit with the use of off-pump CABG have been conflicting.

This study was well-designed both with respect to it being a prospective, randomized trial and that coronary anatomy was not taken into account as exclusion criteria. This was important, as patients were not "selected" in or out based on surgical difficulty in pursuing one technique versus another. Preoperative characteristics were listed as similar (though no p-values were provided) and level of education was similar between the groups. Preoperative education levels affect the outcome of studies looking into central nervous system dysfunction following cardiac surgery. In this study, increased preoperative educational levels in patients were correlated with the best preservation of neurocognitive function.

That the incidence of embolic signals detected by ultrasound was significantly higher in the on-pump group should come as no surprise. The degree of manipulation of a calcified aorta during CPB essentially guarantees this result. Also, the difference in neurocognitive functioning immediately postoperatively goes along with the increased embolic events in the on-pump group. However, there was no difference between the two groups at six weeks and six months (with almost 80% follow-up). This suggests that the deficits resolve over time.

Limitations of this study include that while surgical technique was standardized, mean pressures between the two groups were not maintained at similar levels. It has been hypothesized that the nonpulsatile flow of CPB and hypotension during off-pump CABG (especially when the heart is suspended while performing distal anastomoses) may contribute to postoperative neurocognitive dysfunction. Additionally, with the exclusion criteria applied, the population studied could be considered a low-risk group (perhaps a high-risk group might demonstrate different results). Finally, length of CPB was not presented; it would have been interesting to see if length of CPB time affected test scores postoperatively.

Overall, the debate over whether off-pump CABG improves outcomes versus the use of CPB continues to go on. This study demonstrates that there may not be long-term outcome benefits associated with one technique versus the other. However, given the multifactorial nature of neurocognitive dysfunction, the answer is probably not as simple as on-pump versus off-pump and decisions on whatever technique employed need to be tailored to the individual patient.