Coronary artery bypass grafting (CABG) and cognitive decline: a review

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Abstract

Coronary artery bypass grafting (CABG) is a worldwide used myocardial revascularization procedure, which despite the modern advantages still has a spectrum of complications. The relatively old age of the patients who undergo CABG and their widespread atherosclerotic disease are possible reasons for vascular sequel particularly those leading to neurological dysfunction. Immediate, early and late cognitive decline is a known- and well-defined outcome of CABG. Whereas a lot of data was collected through the last years regarding to neuropsychological dysfunction after CABG, nevertheless etiology and mechanisms of this phenomenon remain unresolved and they are probably multifactorial. Meticulously preoperative assessment of those patients with a potential risk of adverse neurocognitive outcomes can help clinicians to select the mode of revascularization and to better counsel patients about the risks and benefits of surgery versus more conservative kinds of treatment.

1. Introduction

The over 1 million patients who undergo myocardial revascularization procedures worldwide are prone to vascular events, especially those leading to neurologic dysfunction. This is partly because they are relatively elderly and are more likely to have widespread atherosclerotic disease [1]. The neurological and neuropsychological outcomes of coronary artery bypass grafting (CABG) procedures range from the well-documented incidence of stroke to less clearly defined cognitive changes, which include immediate encephalopathy and early and late cognitive deficits [2]. This review analyzes epidemiological aspects of changes in post-CABG intellectual functions which comprise a multifactorial problem that has a serious social and economic impact on society.

2. Postoperative cognitive changes

2.1. Acute-immediate diffuse encephalopathy

Immediate or acute diffuse encephalopathy ranges from intermittent delirium to a more permanent confusional state and, at the most extreme, to stupor and coma. It is now recognized that this is a rather common condition, not only in cardiosurgical practice but in general surgery as well [3–5]. In a prospective study, Marcantonio et al. [3] investigated 1341 patients undergoing non-cardiac surgery. Postoperative delirium occurred in 117 (9%) cases, and delirious patients had higher rates of major complications, longer hospitalization, and higher rates of discharge to long-term care or rehabilitative facilities. The reported incidence of postoperative delirium in cardiac surgery ranges from 28% in older studies [4] and to a much lower rate in more recent ones [5,6]. The reason for these discrepancies in different studies is most probably due to the different methods of assessment and definitions of delirium as well as the heterogeneity of patient samples.

In McKhann et al.’s [6] study on 2711 patients who underwent cardiac surgery, the incidence of encephalopathy
was 6.9% and that of stroke was 2.7%. Patients with encephalopathy had a longer in-hospital stay and a higher mortality rate than those without complications. Age, past stroke, carotid bruit, hypertension, and diabetes were defined as preoperative risk factors for encephalopathy, while the only perioperative risk factor was time on cardiopulmonary bypass. The same results were shown in the study of Kilo et al. [7], in which cognitive tests were given to patients before CABG, at postoperative day 7 and at the 4-month follow-up. Various risk factors were evaluated as well. These authors also concluded that the use of cardiopulmonary bypass is the only perioperative predictor of short- and long-term cognitive brain dysfunction after CABG. Whether postoperative delirium predicts a later permanent cognitive decline remains unclear. It is reasonable to assume that patients who had already begun to lose their cognitive abilities and reserves are more prone to develop transient perioperative encephalopathy as well as later cognitive decline even if they had not suffered from significant brain damage during CABG surgery. Preoperative evaluation of an individual patient’s risk factors may substantially contribute to appropriate postoperative management, reduce the incidence of delirium and improve the overall surgical outcome. A complication as serious as acute encephalopathy can and should be predicted and treated not only as a sequela of cardiac surgery but also of other major operations on elderly patients.

3. Early and late cognitive decline

Modern achievements in surgical and anesthetic techniques have considerably lowered the rate of postoperative complications in general and cognitive decline in particular. Older patients who have more comorbidity, however, are more frequently being afforded the option of undergoing surgery and their inclusion changes the statistical picture of the benefit of these advances.

The issue of cognitive deterioration after surgery has been widely investigated and well defined. In Moller et al.’s [8] prospective study on 1218 postoperative (non-cardiac) patients with controls (no surgery), a cognitive dysfunction was reported in 26% of patients at 1 week postoperatively and in ~10% of patients at 3 months after surgery, compared to 3.4% and 2.8%, respectively, for the control group.

Postoperative cognitive impairment is traditionally divided into early and late types. Early cognitive dysfunction appears in the first few days or weeks after surgery and is basically characterized by memory difficulties and decreased visual attention [9]. The reported incidence of early cognitive disturbance varies, ranging from 33% [10] to 83% [11]. Again, different assessment techniques and heterogeneous patients groups could explain the discrepancy.

Much attention has been given to the influence of the type of surgery (i.e., cardiac vs. non-cardiac) on postoperative cognitive function. Investigators who have prospectively examined neuropsychological dysfunction after CABG procedures and after total knee or hip replacements found a similar incidence of cognitive decline in both groups at 1 week and 6 months after surgery. The most frequently disturbed cognitive feature was memory [12]. The lack of an additive effect of cardiac surgery on early cognitive impairment after surgery was supported by the findings of Vingerhoets et al.’s [9] study on patients who underwent major vascular or thoracic surgery and cardiac revascularization: there was no significant association between the type of surgery and cognitive impairment.

Another way to check the influence of CABG on subsequent intellectual deterioration is to compare surgical and non-surgical groups of patients. Thus, in the study of Selnes et al. [13], patients who underwent CABG and matched non-surgical controls were followed at 3 and 12 months. The prospective longitudinal neuropsychological performance of post-CABG patients did not differ from that of comparable non-surgical control subjects at both time points after baseline evaluation. The authors concluded that the previously reported cognitive decline during the early postoperative period after CABG is transient and reversible. In the editorial discussion which immediately followed this paper, however, it was correctly pointed out that 16% of patients were lost to follow-up in one group and 17% in another group. It is, therefore, possible that patients lost to follow-up had the worst neuropsychological outcome. Another weakness is that they did not mention whether the control group with coronary artery disease had undergone coronary angiography, an examination that may also cause cognitive impairment in patients with severe atherosclerosis.

It is important to address the two types of CABG, with (on-pump) and without (off-pump) cardiopulmonary bypass. Stroobant et al. [14] studied patients undergoing these two types of CABG and a comparison of their results revealed no short-term differences between the groups, while long-term cognitive outcome was more favorable for the off-pump group.

Several studies assessed long-term cognitive changes over a few months up to several years after surgery. In one study [15], 261 patients who underwent CABG performed neurocognitive tests preoperatively, before discharge, and 6 weeks, 6 months, and 5 years after CABG surgery. The incidence of cognitive decline was 53% at discharge, 36% at 6 weeks, 24% at 6 months, and 42% at 5 years. The suggested pattern of postoperative cognitive decline consists of a relatively high prevalence of early deterioration with short-term improvement within a first few months and consequent secondary decline. Late postoperative dementia was predicted by early cognitive deterioration [15].

Particularly interesting results were obtained in the study of Müllges et al. [16] who investigated 52 patients who underwent CABG surgery with a non-complicated perioperative period. After a median follow-up of 55 months, no patient showed a decline in neuropsychological test per-
formance compared to baseline. The unique feature of these patients was in the implementation of aggressive postoperative vascular risk factor control: smoking cessation, balancing blood pressure and lowering cholesterol and glucose blood levels. The authors hypothesized that the stringency of vascular risk factor control may contribute to the favorable cognitive outcome after CABG, and recommended future prospective studies with larger cohorts to confirm this hypothesis.

4. Conclusion

Despite the large amount of current data on the potential risk and possible mechanisms of cognitive dysfunction following CABG, much is still unknown, basically due to large discrepancies in patient selection, relatively small sample sizes with no controls, different methods of assessment of cognitive decline and other factors. The etiology of neuropsychological dysfunction after CABG remains unresolved, and it is probably multifactorial. It is important to note that those patients with preoperatively defined serious risk for cognitive dysfunction after CABG could also undergo an alternative procedure. Percutaneous coronary angioplasty with stenting and minimally invasive approaches to cardiac surgery are other recently developed revascularization procedures. That is why the identification of patients at potential risk of adverse neurocognitive outcomes can help clinicians to select the mode of revascularization and to better counsel patients about the risks and benefits of surgery versus other kinds of treatment.

References


