Incidence of postoperative delirium following myocardial revascularization

A prospective study

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Previous reports assessing the incidence of postcardiotomy delirium have examined cognitive function in patients who underwent various types of cardiac surgery. The authors evaluated the incidence of postcardiotomy delirium following myocardial revascularization, specifically. Fifty-nine patients undergoing elective, first-time cardiac surgery were given a comprehensive battery of neuropsychological tests preoperatively and then six days postoperatively. According to DSM-III criteria, none of the 59 patients exhibited signs of delirium on day 6. While in the intensive care unit on postoperative day 1, four patients (6.8%) showed transient signs of confusion that resolved either spontaneously or after appropriate medical/surgical intervention.

Index terms: Cognition disorders • Delirium • Myocardial revascularization

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As early as 1964, high incidences of delirium following cardiotomy were being noted.[1,2] These observations have been verified by numerous reports, and cardiotomy is now well known to cause varying degrees of postoperative cognitive deficits.[3–16] These reports suggest delirium is a common postoperative complication, occurring in up to 70% of patients undergoing cardiotomy.[3] These data, however, should be viewed with caution because the design of these studies was limited by the heterogeneity of the patient populations; in each study patients had undergone various types of cardiac surgery. Although much less information is available about the incidence of delirium following myocardial revascularization, specifically, existing data suggest

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Table 1. Comparison between younger and older groups

	Group 1	Group 2
Sample size	34	29
Mean age (years)	53	66
Myocardial infarction within 6 weeks (%)	6	8
Previous psychiatric disorder (%)	3	4
Mean LVEDP (mm Hg)	12	15
Mean number of vessels with greater than 50% occlusion/person	2.7	2.8
Greater than 50% occlusion of left main trunk (8%)	15	8
Greater than 50% occlusion of left anterior descending artery (%)	97	92
Hypertension (%)	38	60
Diabetes mellitus (%)	15	32
Peripheral vascular disease (%)	12	40
Severe pulmonary disease (%)	9	20
Gastrointestinal disease (%)	15	8
Minor systemic illness (%)	47	75

cognitive deficits may be less common after this type of cardiac surgery than others.[17-20] To explore this possibility, we prospectively studied cognitive function with a comprehensive battery of neuropsychological tests before and after elective, first-time myocardial revascularizations.

Methods

The group studied included 59 men (aged 40 to 75 years) with median NYHA class II disease and functional class 2 angina who underwent elective, first-time myocardial revascularization between June 1983 and May 1984 at the Cleveland Clinic. Patients were recruited for this study by telephone during the week before admission; eight patients declined to participate. Patients were not excluded if they had major medical problems involving cardiovascular, peripheral vascular, endocrine, and pulmonary diseases (*Table 1*). Patients were subdivided according to age: group 1 consisted of 34 patients 40 to 60 years old, and group 2 consisted of 25 patients 61 to 75 years old (see *Table 1*).

Procedures

One psychiatrist performed all the preoperative psychiatric evaluations, which consisted of standardized assessment of diagnosis (Schedule for Affective Disorders and Schizophrenia—Lifetime Version),[21] social history, depressive state (Hamilton depression rating scales),[22] anxiety state (Hamilton anxiety rating scales),[23] and mental status. One psychometrist performed the neuropsychological assessment, which was repeated on postoperative day 6 (*Table 2*). The medical/surgical evaluation recorded past medical history, NYHA classification, functional classification of angina, and cardiac catheterization data. Hemoglobin, BUN, and CPK-BB were recorded and repeated on postoperative days 1, 3, and 6.

Preinduction medication was limited to morphine, scopolamine, and diazepam; induction medication was limited to fentanyl, thiopentol, and halothane; and intraoperative medication was limited to nitroglycerin, propranolol, nitroprusside, and hydralazine. Operative time, bypass time, lowest intraoperative body temperature, lowest hematocrit while on pump, minutes of mean systolic blood pressure less than 50 mm Hg, donor blood used, and prepump steroids used were recorded. Cardiopulmonary bypass was achieved by routine techniques using constant arterial flow, membrane oxygenation, arterial microfiltration, hemodilution, and varying degrees of hypothermia.

Results

According to DSM-III criteria,[24] none of 59 patients undergoing myocardial revascularization and prospective assessment of cognitive function exhibited signs of postoperative delirium (acute organic brain syndrome) on day 6. Likewise, there were no significant changes in depression ratings, anxiety ratings, or mental status findings. The younger cohort (group 1) showed subtle but significant (Wilcoxon Signed Rank Test) cognitive deficits postoperatively. The mean neuropsychological test scores changed as follows: Digit Symbol (mean change −3.27, $P = 0.02$), Trail Making B (mean change 15.97s, $P = 0.01$), Wechsler Memory Scale (mean change −3.35, $P = 0.01$), Figure Identification (mean change −4.10, $P = 0.003$). Subtle but significant changes were also seen in the older cohort (group 2) with the Digit Symbol (mean change −6.41, $P = 0.001$), Trail Making B (mean change 30.36s, $P = 0.01$), and Wechsler Memory Scale tests (mean change −5.61, $P = 0.002$). Spearman correlation coefficients were calculated for all of the neuropsychological test results versus anesthetic time, bypass time, body temperature during bypass, hematocrit during bypass, and perfusion pressure time below 50 mm Hg, and no correlation was significant.

Table 2. Neuropsychological tests

Test	Brief explanation
Weschler Memory Scale	verbal learning, associative learning, immediate recall, memory for simple figures that are easily encoded
Digit span forward and reverse	immediate verbal recall
Shipley-Hartford vocabulary abstraction	general assessment of verbal ability, verbal abstraction, logic, problem solving
Trail making A and B	scanning, speed, efficiency, attention, ability to handle sets, frontal and general brain integration
Bender Gestalt	visual-perceptual, visual-constructive, short-term visual-spatial memory, right occipital-parietal functioning, integrated brain functioning
Wais digit symbol	attention, orientation, psychomotor speed, motor persistence
Conceptual level analogy	general measure of cortical integrity and verbal problem solving
Figure identification	spatial visualization, right hemispheric, for familiar stimuli
Figure rotation	spatial orientation, right hemispheric, for novel stimuli
Graham Kendall memory for designs	immediate recall of geometric designs; right occipital, temporal, and parietal function

Although no patient showed signs of delirium when neuropsychological testing was done on day 6, 4 of 59 patients displayed transient signs of delirium, based on mental status exams, during their stay in the surgical intensive care unit. One patient in group 1 spontaneously exhibited confusion without medical or surgical complications. A second group 1 patient became delirious and paranoid after a perioperative myocardial infarction that resulted in pulmonary edema. Two patients in group 2 exhibited transient signs of delirium during their stay in the surgical intensive care unit. A 75-year-old with a cardiac ejection fraction of less than 50% was believed to have become confused for several reasons: intraoperative blood loss, hyperglycemia, intraoperative anesthetics, and the postoperative use of chloral hydrate. The second patient in group 2 became delirious during his stay in the intensive care unit, because of hypoxia subsequent to pulmonary edema.

Discussion

None of 59 patients who underwent elective myocardial revascularization exhibited signs of delirium on postoperative day 6. At this time, comprehensive neuropsychological tests, including Digit Symbol, Trail Making B, Wechsler Memory Scale, and Figure Identification, showed subtle but significant cognitive deficits (*Table 2*). These measures of cognitive function generally assess for attention deficit and arousal. The scores suggested that patients had some minor difficulty concentrating postoperatively. Our data suggest anesthetic time, bypass time, body temperature during bypass, hematocrit during bypass, and perfusion pressures do not account for these attention deficits. Although we are unable to speculate with any degree of certainty, we wonder whether the nonspecific stress of any major hospitalization would not impair one's ability to concentrate. Based on the bedside mental status exam, 4 of 59 patients showed transient evidence of delirium while in the intensive care unit; repeat examination of mental status at the bedside on postoperative day 6 showed no evidence of delirium in any patient. These transient deliria were accounted for primarily by perioperative changes in cardiopulmonary function.

Postoperative delirium following myocardial revascularization has been reported to occur in 6.5%,[17] 14%,[18] 33%,[19] and 28%[20] of patients, whereas incidences reported to follow other types of cardiac surgery, i.e., valve replacement and repair, congenital defects, etc., have ranged from 13% to 70% (see *Table 3*). These data, along with our current report, suggest myocardial revascularization is accompanied by less postoperative risk of delirium than other cardiac surgeries. All four patients in our study who were delirious in the intensive care unit became lucid by postoperative day 6. The data presented here support the notion that the risk of delirium following elective, first-time myocardial revascularization, regardless of age and general medical health, approaches that seen in general surgical pa-

Table 3. Incidence of delirium following open heart surgery

Year	Authors	Delerium %
1964	Blachy and Starr[1]	57
1964	Egerton and Kay[2]	41
1965	Kornfeld et al[3]	70
1966	Weiss[4]	46
1967	Burgess et al[5]	28
1967	Gilberstadt and Sako[6]	13
1968	Lazarus and Hagens[7]	33
1968	Edington[8]	19
1969	Kimball[9]	33
1969	Rubinstein and Thomas[10]	19
1970	Heller et al[11]	24
1970	Tufo et al[12]	43
1971	Layne and Yudofsky[13]	14
1971	Freyhan et al[14]	51
1974	Kornfeld et al[15]	25
1979	Summers[16]	23

tients.[25] Although it is uncertain why the incidence of delirium following myocardial revascularization is decreasing, we believe refinement of surgical technique, as well as improved monitoring of intra- and perioperative hemodynamic function, may account for it.

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