

Title: NEUROPSYCHOLOGICAL DYSFUNCTION AFTER CORONARY ARTERY SURGERY

Authors: Kevin J. Fish, M.B., Ch.B., Kenneth Helms, M.A., Frank H. Sarnquist, M.D., J. Tinklenberg, M.D., and D. Craig Miller, M.D.

Affiliation: Departments of Anesthesia, Psychiatry and Cardiac Surgery, Stanford University School of Medicine, Stanford, California and Veterans Administration Medical Center, Palo Alto, California 94304

**Introduction.** Neurological and psychological dysfunction is a major contributor to postoperative morbidity in cardiac surgery patients. The reported incidence and severity of neurological dysfunction varies considerably between studies. These differences may be attributed both to the various psychological tests used to evaluate patients and to the postoperative timing of the testing. The earlier and more extensively patients have been tested, the higher has been the incidence and severity of the observed deficits. We have conducted a prospective study of psychological dysfunction after cardiopulmonary bypass in 20 patients in an attempt to answer two questions: 1) Which psychological tests are the most sensitive in detecting cerebral dysfunction at the seventh postoperative day; and 2) What factors contributed to the observed deficits?

**Methods.** This study received Institutional Review Board approval, and all patients gave informed consent. Patients in this study were all male, between 45 and 70 years of age, and in good health except for coronary artery disease. Psychological evaluation was performed four days preoperatively; the postoperative evaluation was performed before discharge from the hospital. The psychological tests administered are listed in the Table. A standard anesthetic of fentanyl-diazepam-pancuronium was administered to all patients. Neurological function was monitored during surgery with the Neurometrik<sup>R</sup> Monitor. During cardiopulmonary bypass, a bubble oxygenator and a 25  $\mu$  arterial line filter were used, with pump flow rates of 30-50 ml/kg/min. A crystalloid prime was used in all cases. Arterial pressures were recorded continuously and the "torr minutes" under 50 (TM 50)\* calculated.

**Results.** No major neurological deficit occurred in any of these patients. Time on cardiopulmonary bypass varied from 30-207 minutes; torr minutes under 50 varied from 170-1747. The tests revealed a general decline in psychological performance after surgery but the percentage of patients showing a decline in performance on each test varied. Paired Students t tests were used to identify significant differences ( $P < .05$ ) between pre- and postoperative scores on individual tests. An overall measure of each patient's psychological deficit was determined by subtracting each post-test score from the pre-test score and summing the total of these differences. A stepwise multiple linear regression was performed to identify the minimal number of psychological tests in our battery which in combination best predicted the overall deficit (Table). Age, bypass time and TM 50 were included in the regression analysis, but were not found to be significant predictors of the overall deficit.

**Discussion.** Patients are frequently discharged on the eighth or ninth postoperative day after coronary artery surgery. Our detailed psychological examination of patients revealed a high incidence of disordered cerebral function at this time; the impact of this upon their return to normal living is not known. However, it would seem appropriate that patients and their families should be advised that their memory, reaction time and ability to perform tasks which require hand/eye coordination such as driving may be disturbed for some time after coronary artery surgery. We have identified several tests which appear particularly sensitive to identifying postoperative deficits in coronary artery surgery patients. The most sensitive predictor would appear to be the Symbol Digit test, which is also one of the simplest to score, and takes only 3 minutes to administer. It is a test of psychomotor speed, memory, planning, and hand/eye coordination. Two of the other tests, Stroop Color Word reading and Word Learning List, were used by Sotaniemi<sup>1</sup> to identify psychological dysfunction in patients undergoing heart valve surgery. We have confirmed the sensitivity of these tests in postoperative coronary artery surgery patients. No correlation was found in our study between psychological dysfunction and either age, time on bypass or hypotension during bypass.

**Conclusions.** Coronary artery surgery patients demonstrate significant psychological dysfunction one week after surgery. A combination of six tests from our overall battery were adequate to identify these deficits.

**Reference.**

1. Sotaniemi K, et al: Neuropsychological Outcome After Open Heart Surgery. Arch. Neurol. 38:2-8, 1981

Table. Psychological tests used in this study.

Tests	R <sup>2</sup>
Symbol Digit*	.53
Stroop Reading Test	---
a) Word reading*	---
b) Color reading*	---
c) Color wordreading*	.67
Word Learning List*	.77
Trails B	.79
Digit Span Backward*	.83
Benton Visual Retention*	.86
Trails A	---
Maze	---
Mental Maths	---
Digit Span Forward	---
Benton Line	---

\*Significant differences between pre- and post-test scores ( $P < .05$ ).

\*TM < 50 = (50 - {MAP < 50}) x t mins.