

## REFERENCES

1. Michieli M, Damiani D, Ermacora A, et al. P-glycoprotein (Pgp) and lung resistance related protein (LRP) expression and function in leukemic blast cells. *Br J Haematol.* 1997;96:356–365.
2. Izquierdo MA, Shoemaker R, Flens MJ, et al. Overlapping phenotypes of multidrug resistance among panels of human cancer cell lines. *Int J Cancer.* 1996;65:230–237.
3. Linn SC, Pinedo HM, van Ark Otte J, et al. Expression of drug resistance proteins in breast cancer, in relation to chemotherapy. *Int J Cancer.* 1997;71:787–795.
4. Schneider E, Horton JK, Yang CH, et al. Multidrug resistance-associated protein gene overexpression and reduced drug sensitivity of topoisomerase II in a human breast carcinoma MCF7 cell line selected for Etoposide resistance. *Cancer Res.* 1994;54:152–158.
5. Kostakoglu L, Kirath P, Ruacan S, et al. Association of tumor washout rates and accumulation of technetium-99m-MIBI with expression of P-glycoprotein in lung cancer. *J Nucl Med.* 1998;39:228–234.
6. Lampidis TJ, Castello C, del Giglio A, et al. Relevance of chemical charge of rhodamine dyes to multiple drug resistance. *Biochem Pharmacol.* 1989;38:4267–4271.

## On Effect of Coronary Artery Bypass Surgery on Brain Perfusion

**TO THE EDITOR:** In their report of 25 patients undergoing open-heart surgery, Degirmenci et al. (1) mention that neuropsychological testing was performed both 1 wk before and 4–6 wk after surgery. They report that 8 patients sustained neuropsychological deficits and that “deterioration of memory, concentration and attention abilities as well as depressive mood occurred in 5 patients. Deterioration in cognitive function was found to be associated with frontal hypoperfusion.”

For several years neuropsychological assessment has been used as a measure of neurological injury during cardiac surgical procedures. Lack of agreement among investigators on the choice and timing of neuropsychological tests, methods of analysis and definitions of deterioration and deficit has made study comparisons difficult. At a series of international meetings, key members of the research community have sought to reach a consensus on the use of neuropsychological assessment in cardiac surgery (2–5).

Unfortunately, Degirmenci et al. (1) give no indication of the neuropsychological tests they used, their method of data analysis or their definition of neuropsychological deterioration and deficit. Similarly, they give no indication of the method used to determine the presence or absence of depressive mood. Without mention of these important methodological issues, comparison of these findings with other studies is rendered impossible.

**Joseph E. Arrowsmith**  
Papworth Hospital  
Cambridge, United Kingdom

## REFERENCES

1. Degirmenci B, Durak H, Hazan E, et al. The effect of coronary artery bypass surgery on brain perfusion. *J Nucl Med.* 1998;39:587–592.
2. Blumenthal JA, Mahanna EP, Madden DJ. Methodological issues in the assessment of neuropsychologic function after cardiac surgery. *Ann Thorac Surg.* 1995;59:1345–1350.
3. Stump DA. Selection and clinical significance of neuropsychologic tests. *Ann Thorac Surg.* 1995;59:1340–1344.
4. Mahanna EP, Blumenthal JA, White WD, et al. Defining neuropsychological dysfunction after coronary bypass grafting. *Ann Thorac Surg.* 1996;61:1342–1347.
5. Murkin JM, Stump DA, Blumenthal JA, McKhann G. Defining dysfunction: group means versus incidence analysis—a statement of consensus. *Ann Thorac Surg.* 1997;64:904–905.

**REPLY:** We thank Dr. Arrowsmith for his comments about our article (1). In our study, we reported neuropsychological deficits in

8 patients after coronary artery bypass surgery. Deterioration of memory, concentration and attention abilities occurred in 5 patients; visual hallucinations were present in 1 patient; and disorientation, agitation and confusion periods were present in 2 patients. Brain SPECT imaging showed regional brain perfusion abnormalities in 6 of these patients. Neurological and neuropsychological examinations were performed 1 wk before and 4–6 wk after surgery. Brain SPECT imaging was repeated in 2 patients with cognitive deterioration and depressive mood 5 mo after surgery. This timing was consistent with the published data (2–4). Neurological examinations consisted of standard physical examinations for the central and peripheral neural systems. For neuropsychological examinations, we interviewed the patients and their family. During interviews with the patients, we asked some questions that we had already prepared using the Mini-Mental State Examination and part of the Hamilton Depression Scale to examine cognitive status and depressive mood of the patients and recorded the patients' complaints. We also interviewed the patients' immediate family to understand whether personality or mood changes had been observed. We know that there have been detailed neuropsychological tests published in the literature, including tests of premorbid cognitive function, attention, speed of information processing, verbal memory, figural memory, abstraction, visual/spatial ability, language, constructional abilities, motor abilities and mood/psychiatric disturbance. It is reported that this neuropsychological battery would likely require up to 10 h of testing per patient and is expensive to administer and score (2).

In our study, we could not perform all these detailed tests because of two reasons: most of the patients refused these tests, and the surgeons thought that forcing the patients to perform these tests might cause extra anxiety for the patients before surgery, because the published data (5) indicate that a cardiovascular stress response to psychological challenge may occur depending on the level of cognitive processing. The symptoms of neuropsychological deficit that occurred after surgery were clear, such as disorientation to place and person, decreased concentration and depressive mood features. We agree with Dr. Arrowsmith's comment that it is better to perform all the tests, but we designed our study according to patients' and clinicians' requests for ethical reasons. On the other hand, the main conclusion of our study was not that neuropsychological complications may occur after open-heart surgery, which has been already published, but the presence of regional brain perfusion abnormalities occurring after open-heart surgery and that these abnormalities may be transient.

**Berna Degirmenci**  
**Hatice Durak**  
**Eyup Hazan**  
Dokuz Eylul University, School of Medicine  
Izmir, Turkey

## REFERENCES

1. Degirmenci B, Durak H, Hazan E, et al. The effect of coronary artery bypass surgery on brain perfusion. *J Nucl Med.* 1998;39:587–591.
2. Blumenthal JA, Mahanna EP, Madden DJ, et al. Methodological issues in the assessment of neuropsychologic function after cardiac surgery. *Ann Thorac Surg.* 1995;59:1345–1350.
3. Mahanna EP, Blumenthal JA, White WD, et al. Defining neuropsychological dysfunction after coronary artery bypass grafting. *Ann Thorac Surg.* 1996;61:1342–1347.
4. Blumenthal JA, Madden DJ, Burkner EJ, et al. A preliminary study of the effects of cardiac procedures on cognitive performance. *Int J Psychosom.* 1991;38:13–16.
5. Montoya P, Brody S, Beck K, Veit R, Rau H. Differential beta- and alpha-adrenergic activation during psychological stress. *Eur J Appl Physiol.* 1997;75:256–262.