The Relevance of Postoperative Cognitive Decline in Daily Living: Results of a 1-Year Follow-up

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Objectives: **Postoperative cognitive decline (POCD) has a perceivable influence on daily living and is noticed more often by close relatives than by patients themselves 3 months after aortic valve replacement. This study aimed to elucidate the longitudinal course of the subjective awareness of POCD.**

Design: **Follow-up of a prospective observational study.**

Setting: **A single cardiothoracic center in Germany.**

Participants: **The study included 108 patients scheduled for elective aortic valve replacement surgery and 85 close relatives of the patients.**

Interventions: **In addition to conducting a neuropsychologic examination, the authors previously interviewed 82 patients with a Cognitive Failure Questionnaire for self-assessment (s-CFQ), and 62 relatives with the Cognitive Failure Questionnaire for others (f-CFQ) before and 3 months after surgery. Up until 12 months after surgery, the authors continuously interviewed additional patients (baseline and 3 months after surgery), thereby enlarging the original sample, and included the entire group (108 patients, 85 relatives) for the 12-month follow-up.**

Results: **The analysis showed that relatives ($p = 0.026$) and patients experienced patients' cognitive decline 3 months after surgery ($p = 0.009$). All changes still were observed in questions related to memory and attention. After 1 year, the s-CFQ no longer differed between baseline and postoperative assessment. Mean scores in the f-CFQ still were above baseline, barely missing statistical significance ($p = 0.051$). In patients with "change to worse" in the f-CFQ at 1-year follow-up, declining cognitive results in nonverbal learning ($p = 0.021$) could be observed 3 months postoperatively. Only a decrease in 3-month f-CFQ correlated with a decline in specific neuropsychologic tests 3 months after surgery.**

Conclusions: **Contrary to the authors' previous results, the impact of POCD on daily living functions also was recognized by the patients themselves. The long-term influence and the associations between subjective deficits and psychometric cognitive measures seemed to be assessed more reliably by close relatives.**

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KEY WORDS: ***aortic valve replacement, postoperative cognitive deficits, assessment by others, 1-year follow-up***

SOON AFTER ON-PUMP cardiac surgeries began in the 1950s, neurologic and neuropsychologic complications (in particular, cognitive deficits) were postulated as postoperative side effects.[1] It has been shown that postoperative cognitive decline (POCD) is related to multiple factors, such as age, cerebrovascular risk factors, or intraoperative microembolism, and that surgical strategies and the use of filter devices may reduce these side effects.[2-4] Neuropsychologic testing can identify POCD on an objective level, and findings from one of the most important longitudinal studies by Newman et al could establish the persistence of these measurable deficits over months and years after surgery.[5]

Although clinicians often are confronted with subjective complaints about cognitive deficits from patients or close relatives, the influence of declining psychometric results on daily living has remained unclear for a long time. Several studies have indicated an increase of self-reported memory complaints after cardiac surgeries,[6-8] but the reliability of self-reported cognitive deficits remains questionable. A previous study from the authors' research group assessed cognitive failures as recognized by patients and close relatives before and 3 months after aortic valve replacement on a quantitative level and demonstrated a perceivable impact of POCD on daily living functions. The main findings included that slight deficits were noticed more often by close relatives (eg, spouses) than by the patients themselves, and only correlations between spouses' estimations and patients' psychometric measures were demonstrated. These data led to the conclusion that assessment of POCD by others was more reliable than self-assessment.[9]

To date, only 1 other study has focused on external assessment. Bergh et al[8] reported on a decline in memory functions after coronary artery bypass grafting and angioplasty perceived by patients and spouses. Unfortunately, the data were collected retrospectively 1 to 2 years after intervention; thus, there was no baseline status determined or neuropsychologic tests performed to objectively quantify cognitive decline. Hence, it still remained unclear whether POCD, objectified by neuropsychologic testing, could have a verifiable long-term influence on daily living as perceived by close relatives or patients themselves.

The authors now report on their findings of the 1-year follow-up, aiming to elucidate the longitudinal course of postoperative subjective complaints after aortic valve replacement compared with baseline levels and the objective cognitive measures 3 months after surgery. In light of the previous findings, the authors expected relatives to be a more reliable source of information than patients on cognitive decline even 1 year after surgery.

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PATIENTS AND METHODS

Enrollment

The study design has been described previously.[9] Referring to differences in neuropsychologic pretests to post-tests from other studies,[6,7,10] in the original study, medium effect sizes (r = 0.3-0.4) were expected. With a chosen significance level of $\alpha = 0.05$, between 40 and 60 patients would be needed to reach a power level of 0.85. A dropout rate of 20% to 30% was anticipated due to experiences in such clinical studies.

In the original study, 82 patients and 62 relatives were enrolled for the evaluation of short-term POCD. While arranging the 1-year follow-up, the authors continued recruiting patients, increasing the sample by 26 patients. Finally, 108 patients who were scheduled for elective aortic valve replacement surgery were included in this study and underwent 1-year follow-up.

All patients were medically stable at inclusion. The exclusion criteria were defined as a history of stroke and psychiatric or neurologic disorders. Patients had to complete a psychometric cognitive test within 2 weeks (± 1 week) before surgery and were reassessed 3 months (± 1 week) after surgery. At the same intervals, and additionally 12 months (± 2 weeks) after surgery, patients completed a questionnaire related to cognitive failures by self assessment, and cognitive failure questionnaires for assessment by others were addressed to relatives of the patients and sent in the mail. Twenty-three relatives did not answer at least 1 questionnaire in a correct manner (eg, omitted their names) or refused or forgot to send back the questionnaires; these studies were excluded from the statistical analysis. Finally, 85 close relatives (54 female, 31 male) of the patients completed the Cognitive Failure Questionnaire for others (f-CFQ) 3 months after the surgery and at 1-year follow-up. Most of the relatives were spouses or long-term partners (87.0%); only 9 children (10.6%) and 2 siblings (2.4%) completed the questionnaires.

This study complied with the Declaration of Helsinki and was approved by the ethics committee of the Justus Liebig University Giessen. All participants gave signed informed consent.

Surgery

Ninety-two patients received biologic valves and 16 mechanical valves. Oral anticoagulation for mechanical valves included dose-adjusted usage of vitamin K antagonists.

After premedication with flunitrazepam, total intravenous general anesthesia was induced and maintained using sufentanil and propofol. No volatile anesthetics were used. After relaxation with pancuronium bromide, the trachea was intubated and controlled with normocapnic ventilation with an air/oxygen mixture. Standard monitoring was applied, including pulse oximetry, mainstream capnometry, peripheral and central body temperature sensors, and arterial and pulmonary artery catheters. Arterial blood gas, electrolyte, and glucose levels, and activated clotting time were measured repeatedly according to the authors' standard anesthesia protocol.

All procedures were performed using conventional full median sternotomy under cardiopulmonary bypass and mild hypothermia (32-34°C). The dynamic bubble trap was integrated into a standard extracorporeal circulation (ECC) tubing set containing a 40-μm heparin-coated arterial line filter. Extracorporeal perfusion was performed using a roller pump and a hollow-fiber membrane oxygenator with a venous hard-shell reservoir at a nonpulsatile flow rate of 2.4 L/min/m^2. The circuit was primed with 1,600 mL of Ringer's solution, 100 mL of mannitol 20%, 100 mL of sodium bicarbonate 8.4%, 5,000 U of heparin, and 2 mL of aprotinin.

Standard cannulation technique was performed with a wire inlay aortic arch cannula, which was placed in the ascending aorta, and with a proximal and distal wire-reinforced 2-stage venous cannula through the right atrium. After systemic heparinization (500 U/kg), ECC was initiated according to the alpha-stat concept. Additional heparin was added during cardiopulmonary bypass to maintain the activated clotting time above 400 seconds if necessary. The left ventricle was vented using an aortic root cannula. Blood cardioplegia was injected antegrade in the aortic root and retrograde in the coronary sinus to achieve and sustain cardiac arrest. After the aorta was opened through vertical incision and the aortic valve was exposed, excision and measurement of the new valve and implantation with supported sutures were performed.

After the aortotomy was closed, the aorta and left ventricular chamber were de-aired carefully using aortic root cannula and puncture of the left ventricular tip under constant lung inflation. The cross-clamp then was removed. Thereafter, the patients were weaned from ECC. After myocardial function returned and the patients reached normothermic conditions, ECC was terminated. Intraoperative echocardiography was used to assess residual air and ventricular function in every patient.

Questionnaires

Study participants completed a validated German version of the Cognitive Failure Questionnaire for self assessment (s-CFQ)[11] or the f-CFQ.[12] The questionnaires evaluate the frequency of failures in daily living related to memory, attention, action, and perception. Because memory impairment is most pronounced in POCD, the s-CFQ was modified slightly, with additional items related to memory failures, which were taken from the validated German version of the Memory Complaint Questionnaire.[13] All scores were summarized in a global sum score for both questionnaires (maximum score s-CFQ = 116, maximum score f-CFQ = 32). Furthermore, because the s-CFQ is more extensive, items were included in a factor analysis with varimax rotation.[14] Because the results did not show additional meaningful outcomes in the main analysis, only global sum scores were presented. To score depression and anxiety, the validated German version of the Hospital Anxiety and Depression Scale (HADS) was used.[15] In all questionnaires, higher scores represented worse outcomes.

Neuropsychologic Assessment

Cognitive examination was performed using a battery of well-established and validated tests 1 to 4 weeks before cardiac surgery and 3 months (± 1 week) after intervention. The tests always were administered by the same psychologist. In all domains, parallel test forms were used at follow up to account

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