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Association between delirium and cognitive change after cardiac surgery

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Abstract

Background. Previous studies provide inconsistent data on whether postoperative delirium (POD) is a risk factor for postoperative cognitive decline (POCD). We thus investigated the relationship between POD and cognitive change after cardiac surgery and assessed the relationship between preoperative cognitive domain scores and POD.

Methods. Postoperative delirium was assessed with the Confusion Assessment Method (CAM) adapted for the intensive care unit and the conventional CAM accompanied by chart review. Cognitive function was assessed with a neuropsychological test battery before elective cardiac surgery and 1 month and 1 yr afterwards. Cognitive change was calculated using the Reliable Change Index (RCI). Multiple linear regression was used to adjust for confounding.

Results. Of the 184 patients who completed baseline assessment, 23 (12.5%) developed POD. At 1 month, the decline in cognitive performance was worse in patients with POD [median composite RCI −1.00, interquartile range (IQR) −1.67 to 0.28] than in patients without POD (RCI −0.04, IQR −0.70 to 0.63, $P=0.02$). At 1 yr, both groups showed cognitive improvement on average compared with baseline (POD patients median composite RCI 0.25, IQR −0.42 to 1.31, *vs* non-POD patients RCI 0.92, IQR 0.18–1.53; $P=0.08$). Correction for differences in age and level of education did not change the results. Patients with POD performed less well than patients without POD on the preoperative Trailmaking test part A ($P=0.03$).

Conclusions. Postoperative delirium is independently associated with cognitive decline 1 month after surgery, but cognitive performance generally recovers in 1 yr. Patients with a predisposition to POD can be identified before surgery by worse performance in an attention task.

Clinical trial registration. NCT00293592.

Key words: cardiac surgical procedures; cognition; delirium; neuropsychological tests

Transient postoperative cognitive decline (POCD) and postoperative delirium (POD) are relatively common complications after surgery. Patients undergoing cardiac surgery are at high risk for both conditions because they are relatively old and often have multiple co-morbidities, including hypertension, diabetes, and previous ischaemic stroke.[1–5] Impaired preoperative overall cognitive function and low level of education[2] increase the risks of both POD and POCD, but the predisposing cognitive profile for both conditions has not yet been fully elucidated. There is limited information on the predictive value of impairment in specific cognitive domains.

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Editor's key points

- Postoperative delirium and postoperative cognitive dysfunction (POCD) are common complications of cardiac surgery.
- It is unknown whether they have a similar aetiology and pathophysiology.
- The authors performed a secondary analysis of the Dexamethasone for Cardiac Surgery (DECS) study database to investigate associations between the two.
- Among patients who developed postoperative delirium, POCD at 3 months was more common.

There is inconsistency in the literature on whether POD increases the risk of POCD.[6] Two recent studies demonstrated an association between POD and subsequent POCD in elderly patients undergoing orthopaedic surgery[7] and cardiac surgery.[8] Both studies used the Mini-Mental State Examination as a global measure of cognitive function.[9] There is, however, longstanding consensus that a battery of neuropsychological tests is required to detect POCD reliably after cardiac surgery.[10] Furthermore, it is currently unclear how postoperative cognitive function evolves over time with respect to the magnitude of the change, changes in overall cognitive function, and changes in different cognitive domains.

The primary aim of this study was to examine the relationship between POD and POCD at 1 month after cardiac surgery, assessed with a battery of neuropsychological tests and based on a comparison with preoperative neuropsychological test performance. Secondarily, we examined whether POD is associated with POCD at 1 yr, whether POD differentially affects specific cognitive domain scores over time, and which preoperative cognitive profile predisposes cardiac surgery patients to develop POD.

Methods

Study design and participants

For this cohort study, we used a subset of the data from the Dexamethasone for Cardiac Surgery (DECS) trial registered in ClinicalTrials.gov (NCT00293592).[11]

This multicentre, double-blind, placebo-controlled trial randomized 4494 patients aged 18 yr or older who were undergoing cardiac surgery with cardiopulmonary bypass to a single high dose of dexamethasone, 1 mg kg^{-1} i.v. injection with a maximum of 100 mg, or placebo at the time of induction of anaesthesia. The use of intraoperative dexamethasone did not reduce the 30 day incidence of major adverse events, a composite of death, myocardial infarction (MI), stroke, renal failure, or respiratory failure, compared with placebo. The study design and the primary results have been described in detail previously.[11]

Data from the present study consist of a subset of the data from two sub-studies of the DECS study. The first was a sub-study of the influence of dexamethasone on the incidence of POD,[12] involving the 768 patients enrolled in the DECS trial at the University Medical Center Utrecht between June 2009 and November 2011, in whom more elaborate delirium data collection was conducted. The second was a pre-planned sub-study within the DECS trial of the effect of dexamethasone on the occurrence of POCD.[13] For this sub-study, 340 patients of the University Medical Center Utrecht, Utrecht, the Erasmus University Medical Center, Rotterdam, and Isala Clinics, Zwolle, provided additional consent (at the time of enrolment in the DECS study) for preoperative and follow-up testing of cognitive function. Between August 2010 and October 2011, 291 patients completed baseline assessment of their cognitive performance (of the 340 who provided informed consent, six were unable to complete the baseline neuropsychological assessments, and 43 could not do so for logistical reasons).[13] Of these 291 patients, 184 were also enrolled in the delirium sub-study. Dexamethasone appeared to have no effect on POD and POCD.[12 13]

All 184 patients who participated in and completed both sub-studies (elaborate delirium screening and cognitive function testing) were included in the present cohort to evaluate the association between postoperative delirium and cognitive change after cardiac surgery. Additional exclusion criteria for this additional sub-study were evident mental illness or significantly impaired vision, hearing, or motor skills (e.g. hemiplegia). Dexamethasone appeared to have no effect on POD and POCD.[12 13] Data on patient, clinical, and surgical characteristics were prospectively collected in the DECS trial database.[11] The Medical Ethics Committee of the University Medical Centre Utrecht approved this study, and written informed consent was obtained from all patients.

To define true cognitive decline beyond natural variation in test performance, from the cardiology outpatient clinic we recruited as control subjects a group of volunteers with documented coronary artery or valve pathology but without elective surgery. In this group, the same neuropsychological test battery and protocol was used by the same investigators as the trial participants, assessing cognition twice with an interval of 1 month.[13]

Delirium assessment

Delirium was assessed by trained research personnel using a previously validated method.[14] This included daily assessment by a research nurse using the Confusion Assessment Method (CAM) adapted for the ICU (CAM-ICU)[15] in the ICU setting, the CAM[16] when the patient was transferred to the ward, a chart review over the previous 24 h to identify key words suggestive of delirium (e.g. confused, agitated, drowsiness, disorientated, delirious),[17] the results of twice daily CAM(-ICU) assessments conducted by the bedside nurse, and the administration of antipsychotic medication. If any of these indicators were present, the patient was scored as delirious. Patients who were deemed to be unarousable as determined by a Richmond Agitation Sedation Scale (RASS)[18] score of −4 or −5 were not evaluated for delirium.[19] Patients were assessed on the first 4 days after surgery at a fixed point during the day whenever possible.

Neuropsychological assessment

Cognitive function was assessed 1 day before surgery (baseline), at 1 month after cardiac surgery, and at 1 yr follow-up. If possible, patients were assessed in the hospital by trained research personnel. In order to maximize the completeness of cognitive follow-up, patients who were unable to come to the hospital for follow-up were offered the option to have the neuropsychological tests administered at their home. Total test time was approximately 30–40 min, depending on the patient's speed of comprehension and execution.

The following tests[20] were administered: Corsi block-tapping task (spatial memory), Rey auditory verbal learning [immediate recall (short-term verbal memory) and delayed recall (intermediate-term verbal memory)], grooved pegboard (motor skills),