

The contribution of neuropsychology in cardiac surgery: Cognitive deficits after heart surgery can be detected only by neuropsychological assessment

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Postoperative cognitive dysfunction involves decline in several cognitive domains after surgery and is particularly common after cardiac surgery. Postoperative cognitive dysfunction refers to impairment in one or more cognitive domains including decrements in attention, orientation, memory and learning following surgery. The severity of postoperative cognitive dysfunction covers a broad range, varying from mild cognitive decline to severe dementia. A comprehensive neuropsychological assessment is necessary in diagnosis for the detection and specification of postoperative cognitive dysfunction in cardiac surgery, as it is typically quite subtle, may elude detection. The important point is that without a complete and thorough neuropsychological assessment cannot be detected easily and definitely cannot be picked up from subjective impressions. Neuropsychological assessment of cognitive functions is very important in order to ascertain the true extent of postoperative cognitive dysfunction in cardiac surgery. Given the potential effects of such cognitive dysfunction on quality of life, it is important to investigate it. The time of which neuropsychological assessment should be conducted is a critical issue.

Key words: Cardiac surgery; Cardiopulmonary bypass; Cognitive functions; Neurocognitive function; Neuropsychological assessment; Postoperative cognitive dysfunction.

La disfunción cognitiva postoperatoria implica una disminución en varios dominios cognitivos después de la cirugía y es particularmente común después de la cirugía cardíaca. La disfunción cognitiva postoperatoria se refiere al deterioro en uno o más dominios cognitivos, incluidos los decrementos en la atención, la orientación, la memoria y el aprendizaje después de la cirugía. La gravedad de la disfunción cognitiva postoperatoria cubre un amplio rango, que va desde un deterioro cognitivo leve hasta una demencia grave. Una evaluación neuropsicológica completa es necesaria en el diagnóstico para la detección y especificación de la disfunción cognitiva postoperatoria en la cirugía cardíaca, ya que normalmente es bastante sutil, puede eludir la detección. El punto importante es que sin una evaluación neuropsicológica completa no se puede detectar fácilmente, y definitivamente no se pueden recoger de las impresiones subjetivas. La evaluación neuropsicológica de las funciones cognitivas es muy importante para determinar el verdadero grado de la disfunción cognitiva postoperatoria en cirugía cardíaca. Dados los efectos potenciales de dicha disfunción cognitiva en la calidad de vida, es importante investigarla. El momento en el que se debe realizar la evaluación neuropsicológica es un tema crítico.

Palabras clave: Cirugía cardíaca; Derivación cardiopulmonar; Función cognitiva; Evaluación neuropsicológica; Disfunción cognitiva postoperatoria.

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Neuropsychological assessment following cardiac surgery

Generally, neuropsychological assessment contributes to the identification, assessment care and treatment of brain impaired patients [1]. Specifically, it provides useful information about diagnosis, treatment planning and treatment evaluation. One example common in cardiac surgery is postoperative cognitive dysfunction (POCD) that refers to impairment

in one or more cognitive domains after surgery [2]. These may include decrements in attention, orientation, memory and learning being able to improve reaching baseline levels by three months after surgery [3,4]. Additionally, POCD is associated with increased morbidity and mortality, prolonged hospitalization, increased health care costs, and may have an adverse impact on social functioning and health-related quality of life [5,6]. It is usually developed over a period of more than one week, or one month, or lasting for a long time [7]. Although it has been said that POCD is generally transient [8], it can last from a few days to several years.

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The severity of POCD covers a wide range, varying from mild cognitive decline to severe dementia [9]. It is most common after cardiac surgery with cardiopulmonary bypass [10]. The incidence of postoperative cognitive decline among cardiac surgery patients is very large in comparison with general surgery. Specifically, studies have reported rates ranging from 11% to 80% and 42% up to 3–5 years later, referred to as long-term POCD [11]. POCD after non-cardiac surgery seems to be much lower, with one week after surgery to be 25.8%, at 3 months is 9.9%, and at 2 years is 1% [10]. Studies using magnetic resonance imaging (MRI) investigating the neural bases of POCD after non cardiac surgery claimed that no strong conclusions can be drawn [12]. Time of the assessment varies from long-term follow-up assessments that have been conducted as early as one month and as late as five years after operation [13,14], POCD can be identified for at least three months and even as long as seven and a half years [6].

A comprehensive neuropsychological assessment is necessary for the detection and specification of POCD in cardiac surgery, as it is typically quite subtle and may elude detection [15]. Point being, without a complete and thorough neuropsychological assessment, POCD cannot be easily detected, and definitely cannot be picked up from subjective impressions [6]. In cardiac surgery, neuropsychological assessment is conducted in order to detect both the amount of cognitive change after surgery, as well as the patients who are at high risk for POCD. Thus, they can participate in cardiac rehabilitation programs. These programs include counseling, training, support and education for heart-healthy living.

Neuropsychological assessment of neurocognitive function and risk factor identification are both imperative in order to ascertain the true extent of POCD [16]. Measured domains of cognitive functioning includes verbal and non-verbal memory, attention, executive functions and visuospatial ability. The tests should be selected on the basis of their psychometric properties, such as reliability and validity and should be sensitive to small changes in cognitive functioning. Typically, patients perform the tests before surgery to get a baseline standard, and one or more times after surgery.

Criterion for the diagnosis of Postoperative Cognitive Dysfunction

Criterion for the definition of postoperative cognitive dysfunction is an individual worsening in cognitive performance on at least two neuropsychological tests in the battery. With test performance being defined as significantly deteriorated if a patient's pre- to post-operative test score decrement is at least one standard deviation (SD), the SD being determined of the preoperative scores in the patient sample. Another common definition is 20 % of decrement in test score from baseline on at least 20 % of the tests. However, each criterion concerns for and against. Among possible disadvantages are that they do not deal with chance fluctuations in test scores due to measurement error (i.e., imperfect reliability of test scores) and they do not apply practice effects that often come from repeated neuropsychological testing. In addition, they do not consider the multifocal nature of the dysfunction and

the varying extent to which specific cognitive domains may be concerned. More recently, alternative statistical indices of cognitive deterioration have been put forward to overcome these problems [17]. Practice has an impact on performance and results in "true" changes in neuropsychological tests' scores following cardiac surgery. These changes could also be covered by performance changes due to practice (i.e., previous exposure to a test results in an improved performance on a subsequent assessment) and by statistical phenomena (i.e., regression to the mean). The effects of these factors on test score must be differentiated from any "true" change in test score, before an appropriate clinical decision may be made regarding the presence or absence of cognitive change after cardiac surgery [18].

The cause of POCD as well as its appearance among different types of therapies have been properly investigated by several authors. The coronary artery bypass grafting is considered to be superior compared to other therapies (angioplasty-stent, medical management), because of more complete revascularization and the low overall mortality rate. The critical point is that extracorporeal circulation may lead to cognitive impairment and effects such as mild to severe vascular cerebral stroke, renal and pulmonary complications [4]. Although it has been considered off-pump CABG to be associated with improved cognitive outcome in the early postoperative period, there are many studies that have shown no difference between both procedures [19]. Measurements of neuropsychological assessment and diffusion-weighted Magnetic Resonance Imaging (MRI) for the detection of early as well as POCD three years after surgery have been carried out. Nevertheless, no direct relationship was observed between the presence of new diffusion-weighted MRI detected lesions and cognitive decline [20]. Cognitive dysfunction can be diagnosed by neuropsychological testing while neuroimaging and electrophysiological studies playing an additional role in diagnosis [17].

Conclusions

POCD cannot be diagnosed unless a patient has undergone formal neuropsychological testing before and after surgery. However, it is uncommon beyond a research setting [21].

It is doubtful that POCD can be treated successfully and the emphasis should be on prevention [22]. The pathogenesis of postoperative cognitive decline remains unclear. No single factor responsible but a multifactorial phenomenon. In addition, there does not seem to be a single intervention that can provide adequate protection of the brain during surgery [23]. Maekawa et al. argue that patient-related risk factors such as the extent of preexisting cerebrovascular disease play an important role in the pathogenesis of both short and long-term POCD. Establish the degree of functionally significant vascular disease in the brain in the preoperative period should be an essential part of patient evaluation [24].

In order to make a proper diagnosis, a neuropsychological evaluation should be included systematically as a complete clinical evaluation of individuals with cognitive impairment.

There are so many unanswered questions regarding cardiac surgery and cognitive functions. Observational evidence about the association can be confused by study design, comorbidity and insensitive cognitive assessment tools [25]. Neuropsychological assessment may contribute to prediction of cognitive decline and future dementia. Cognitive decline existing before operation seems to be an important predictor of POCD, and patients with cognitive impairment prior to surgery are more likely to suffer from POCD. Especially, impairment in executive functions is considered to predict POCD [26].

Shortcomings could be present when quantifying the degree of cognitive change. They are related to study design, such as patient sampling, and deficit definition. Additionally, changing patient populations have influenced results reported from different health care settings [27]. The implications

are quite substantial as POCD can have an adverse impact on quality of life and social functioning. In addition, POCD is a multifactorial trouble that may have a crucial social and economic impact on society as well as cognitive function. Cognitive stability plays a significant role in quality of life and daily activities, especially in heart surgery elderly patients. Finally, it is very important that neuropsychological assessment be included in the preoperative general evaluation of cardiac surgery patients.

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