

Neurologic Complications in the Immediate Postoperative Period After Cardiac Surgery. Role of Brain Magnetic Resonance Imaging

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Introduction and objectives. Neurologic complications still cause significant morbidity and mortality in the immediate postoperative period following cardiac surgery. Our understanding of the pathogenesis, prevention, and management of these lesions is constantly developing.

Material and method. We describe neurologic complications and their course in a cardiac surgery cohort and analyze the value of brain magnetic resonance imaging (MRI), using T₁-weighted, T₂-weighted, and FLAIR sequences, in patients with postoperative stroke or encephalopathy in whom CT scanning revealed no abnormalities explaining their clinical condition.

Results. In 688 patients studied postoperatively, we observed 57 neurologic complications (8.3%): 25 strokes, 24 encephalopathies, 5 seizure disorders, 2 brain deaths, and 1 intracranial hemorrhage. Initial CT scanning failed to show significant findings in 70%. 18 patients underwent brain MRI. In all but 1 of the 11 with stroke, MRI showed areas of acute or subacute infarction (i.e., hyperintensity in FLAIR or T₂-weighted sequences) in different locations, mainly in a watershed distribution. In 3 of the 4 patients with mild-to-moderate encephalopathy, MRI showed lesions similar to those previously described for stroke. In the remaining 3 patients, who had severe encephalopathy, MRI showed diffuse cortical necrosis.

Conclusions. The incidence of neurologic complications in the postoperative period following cardiac surgery is significant. In a high percentage of patients, brain CT scanning may not show pathologic findings. In selected patients, MRI could help identify areas of infarction not detected by CT. These images could improve clinicians' understanding of the pathogenic, pathophysiologic, clinical,

and prognostic characteristics of such neurologic complications.

Key words: Neurologic complications. Cardiac surgery. Stroke. Brain magnetic resonance imaging. Brain CT scan.

Complicaciones neurológicas en el postoperatorio inmediato de la cirugía cardíaca. Aportación de la resonancia magnética cerebral

Introducción y objetivos. Las complicaciones neurológicas (CN) causan una importante morbimortalidad en el postoperatorio inmediato de la cirugía cardíaca. La comprensión de la etiopatogenia, la prevención y el tratamiento de éstas están en constante evolución.

Material y método. Se describen las CN y su evolución en una serie quirúrgica, y se analizan las aportaciones de la resonancia magnética cerebral (RMC) con secuencias T₁, T₂ y la supresión de líquido cefalorraquídeo, en los pacientes que presentan ictus o encefalopatía posquirúrgica y tomografía computarizada (TC) craneal sin hallazgos que justifiquen la situación clínica.

Resultados. Se estudió a 688 postoperados; se observaron 57 CN (8,3%): 25 ictus, 24 encefalopatías, 5 pacientes con crisis convulsivas, 2 muertes cerebrales y una hemorragia intracerebral. La TC craneal inicial no mostró hallazgos relevantes en el 70% de las ocasiones. Se realizó RMC en 18 pacientes, 11 de ellos con ictus: excepto en un estudio, en la RMC encontramos áreas de infarto agudo o subagudo (hiperintensitas en la secuencia T₂ y FLAIR) en diferentes localizaciones. También se realizó en 4 pacientes con encefalopatía leve-moderada y mostró en 3 de ellos lesiones similares a las descritas en los ictus. En los restantes 3 casos con encefalopatía severa, la RMC mostró áreas con múltiples infartos corticales.

Conclusiones. Las CN tras cirugía cardíaca se presentan con una incidencia no despreciable. La TC craneal puede no presentar hallazgos patológicos en un alto porcentaje. En pacientes seleccionados, la RMC puede

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ABBREVIATIONS

ACC: aortic cross-clamp.
 CPB: cardiopulmonary bypass.
 CT: computed tomography.
 FLAIR: fluid-attenuated inversion recovery.
 ICU: intensive care unit.
 MRI: magnetic resonance imaging.
 NC: neurological complications.

presentar lesiones, y demostrar áreas isquémicas no detectadas en la TC que ayudan a comprender a los clínicos la etiopatogenia, la fisiopatología, la clínica y la evolución de estas complicaciones.

Palabras clave: *Complicaciones neurológicas. Cirugía cardíaca. Ictus. Resonancia magnética cerebral. Tomografía computarizada craneal.*

INTRODUCTION

Neurological complications (NC) are a major cause of morbidity and mortality during the immediate postoperative period following cardiac surgery. They add to the consumption of health care resources and lead to functional limitations in surviving patients. The understanding of their etiology, pathogenesis, prevention, and management on the part of the clinicians who treat patients who develop these complications is under constant development. A number of studies have demonstrated an incidence of ischemic stroke with motor deficit ranging between 2% and 6% among patients who have undergone myocardial revascularization, with even higher rates following valve replacement.¹⁻⁵ The proposed etiologic and pathogenic mechanisms include perioperative embolism originating in the cardiac chambers or aorta, systemic hypoperfusion or a combination of these 2 processes. Several risk factors associated with stroke have been identified, in particular, age over 75 years, diabetes, hypertension, congestive heart failure, recent myocardial infarction, prior stroke, carotid disease, chronic renal failure, low cardiac output, the need for balloon counterpulsation, prolonged ventilation, and atrial fibrillation.⁶

Aside from stroke, differing degrees of decrease in the level of consciousness (which we will refer to as encephalopathy), a more or less evident deterioration in neuropsychological function and convulsive seizures may be observed during the immediate postoperative period following cardiac surgery. Up to 10% of the patients present encephalopathy, which can range from prolonged emergence, confusion or stupor

with no focal motor deficit, to a state of prolonged cognitive deterioration.⁷ Among the etiologic factors involved in these conditions, cerebral microemboli, cerebral edema, hypoperfusion, cerebral hypoxia and the effects of pharmacological agents utilized in anesthesia and during the perioperative period have been considered.

The diagnosis and prognostic evaluation of these complications involves the use of brain neuroimaging studies. Until recently, these studies have added little to the understanding of the pathogenesis of the neurological dysfunction; cranial computed tomography (CT) is employed to rule out hemorrhagic lesions but, in stroke, it is only useful in those cases involving a large cerebral artery (which suggests an embolic event as the cause). In contrast, brain magnetic resonance imaging (MRI), a more sensitive technique, has revealed lesions in up to a third of the patients who have undergone surgery, although in some of the few studies published in the medical literature, there is no correlation between the anatomical lesion encountered and the clinical features.

In this report, we describe the NC in a surgical series and analyze the neuroimaging studies performed and discuss the value of brain MRI in patients presenting a focal motor deficit or postoperative encephalopathy in whom cranial CT failed to substantiate the clinical signs.

MATERIALS AND METHODS

We describe the NC that develop during the immediate postoperative period and their course in a series of patients who had undergone cardiac surgery—in cardiopulmonary bypass (CPB)—in our center between 1 May 2002 and 31 December 2003. We analyze the value of brain MRI, using T1-weighted, T2-weighted and fluid-attenuated inversion recovery (FLAIR) sequences in patients with postoperative stroke or encephalopathy in whom CT scanning revealed no abnormalities substantiating their clinical condition. The data was collected prospectively.

The anesthetic technique was similar in all the patients. Pulsatile CPB at a flow rate of 2.4 to 4.8 L/min/m² was established using a roller pump (Sarns® 9000). Hypothermia was maintained between 28°C and 32°C, except in those cases in which circulatory arrest was required, in which it was reduced to 18°C.

Selected information was collected from the clinical histories and from a specific database. The incidence, clinical features and presentation of the NC were analyzed. The procedure-related variables analyzed were the type of surgery and the duration of CPB, aortic cross-clamping (ACC), and circulatory arrest, when the latter was necessary. The postoperative course was also analyzed. The patients with and without NC were compared in terms of the hours of mechanical ventila-

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