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Cardiocentro Ernesto Che Guevara Santa Clara Cuba

Postoperative neurological complications in patients undergoing cardiac surgery with cardiopulmonary bypass

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ABSTRACT

Introduction: Neurological dysfunction in the postoperative period of cardiovascular surgery is one of the leading causes of disability, for the possible sequels after the onset of this complication.

Objective: To characterize the behavior of neurological complications in the postoperative period of patients undergoing cardiac surgery with cardiopulmonary bypass.

Method: A descriptive, longitudinal, retrospective study was conducted with 39 patients admitted to the surgical intensive care unit of the Cardiocentro Ernesto Che Guevara in Santa Clara, Cuba, who presented with neurological dysfunction in the immediate postoperative period, from January 2011 to December 2013.

Results: Neurological dysfunction was more frequent in males (74.3%) and the age group from 64 to 74 years. Myocardial revascularization was the most prevalent surgery. Smoking was present in 51.3% of patients and 92.3% suffered from hypertension. Most patients remained for more than 120 minutes with cardiopulmonary bypass. Type II neurological complications predominated, mainly disorientation in 35.9% of cases.

Conclusions: There was a predominance of males of advanced age, smokers, with hypertension, who underwent myocardial revascularization with prolonged cardiopulmonary bypass. Disorientation was the most common neurological complication.

Key words: Neurological dysfunction, Neurological complications, Cardiac surgery, Cardiopulmonary bypass

Complicaciones neurológicas postoperatorias en pacientes operados de cirugía cardíaca con circulación extracorpórea

RESUMEN

Introducción: La disfunción neurológica durante el postoperatorio de la cirugía car-

diovascular, constituye una de las causas principales de invalidez por las posibles secuelas, luego de la instauración de esta complicación.

Objetivo: Caracterizar el comportamiento de las complicaciones neurológicas durante el postoperatorio de pacientes operados de cirugía cardiovascular con circulación extracorpórea.

Método: Se realizó una investigación descriptiva longitudinal retrospectiva, con 39 pacientes ingresados en la sala de cuidados intensivos quirúrgicos del Cardiocentro "Ernesto Che Guevara" de Santa Clara, Cuba, que presentaron disfunción neurológica en el postoperatorio inmediato; en el período de enero de 2011 a diciembre de 2013.

Resultados: Las disfunciones neurológicas fueron más frecuentes en el sexo masculino (74,3 %) y el grupo de edad entre 64-74 años. La revascularización miocárdica fue la cirugía de más incidencia. El hábito de fumar está presente en el 51,3 % de los pacientes y el 92,3 % padecían de hipertensión arterial. La mayoría de los pacientes se mantuvieron por más de 120 minutos en circulación extracorpórea, y predominó la complicación neurológica tipo II, fundamentalmente la desorientación en el 35,9 % de los casos.

Conclusiones: Predominaron los hombres de edad avanzada, fumadores e hipertensos, sometidos a revascularización miocárdica con circulación extracorpórea prolongada. La desorientación fue la complicación neurológica más frecuente.

Palabras clave: Disfunción neurológica, Complicaciones neurológicas, Cirugía cardíaca, Circulación extracorpórea

INTRODUCTION

Cardiopulmonary bypass (CPB) is one of the technical procedures that have favored the current progress of cardiac surgery. However, regardless of its benefits, it may also cause undesirable effects on different organ systems, including neurological complication, which are among the most feared by the health teams involved in heart surgery, as they are one of the three leading causes of morbidity and mortality in these patients[1]. The progress made in recent decades in cardiac surgery with CPB has allowed a progressive reduction of overall mortality in this type of surgery; nevertheless, the incidence of neurological complications remains a challenge for the surgical teams[2].

The main function of the medical team in charge of evaluating and treating patients requiring cardiac surgery is to properly assess and prevent these complications[3]. Postoperative neurological deficit is usually the result of functional or morphological damage to neurons by factors related to surgery (embolisms or hypoperfusion), in addition to a sometimes already existing chronic cerebral atherosclerosis. In this area, and in the perioperative period, other problems that stimulate brain damage are added, such as hypo- and hyperthermia, hyperglycemia and systemic inflammatory response, among others[4].

Sixty to 80% of neurological injuries occur during the intraoperative period, and the onset of these complications extends 2 to 4 times the stay in Care Units and the Hospital, and increases mortality 5 to 10 times, in addition to the economic and social costs they cause in patients and their families[5].

As the awakening from anesthesia occurs, it is vital to assess the presence of focal neurological deficits, or delays in this awakening after the normal time[6].

The aim of the study was to characterize the behavior of neurological complications during the postoperative period. To that end, and in order to devise future strategies to improve the quality of our work, we considered the relationship with the personal medical history, the type of surgery performed and the degree of impairment of neurological function.

METHOD

Population and type of study

A retrospective, descriptive, longitudinal study was conducted in the Surgical Intensive Care Unit of the Cardiocentro Ernesto Che Guevara in Santa Clara, Cuba. Of the 576 patients who underwent cardiac surgery with CPB, a nonrandom sample consisting of 39 patients who presented immediate postoperative neurological dysfunction, from January 2011 to December 2013, was selected. Late complications were excluded.

Data collection

The data were obtained from the medical records of each patient, the hospital admissions records of the Hospital Statistics Department, the Intensive Care Unit admission records, and the operating room perfusion models.

Variables

The variables age, sex, type of heart surgery performed (all with CPB), toxic habits, personal medical history, duration of CPB (more than 120 minutes was regarded as a prolonged perfusion) and neurological complications were assessed.

Classification of neurological dysfunction and universally accepted frequency of occurrence for the postoperative period of cardiovascular surgery[7]:

- Major or type I neurological dysfunction includes stupor, isolated coma, transient ischemic attack, cerebrovascular accident, brain death, spinal injuries.
- Minor or type II neurological dysfunction includes delirium, mental confusion, drowsiness, disorientation, psychomotor agitation, cognitive alterations[8].

Statistical Analysis

Data were collected and entered into a database in Excel; then they were processed through the SPSS version 19.0 statistical package for Windows.

The results were summarized in tables. The description of the data was carried out by calculating the absolute and relative frequencies as percentages. Descriptive statistics such as mean and standard deviation for quantitative variables, nonparametric tests such as chi-square test for independence for determining the relationship between qualitative variables and chi-square goodness-of-fit test for comparing proportions were calculated. Also, the corresponding statistic (χ^2) and its associated significance (p) were determined.

RESULTS

Table 1 shows the distribution of patients by age group and sex. The largest number of patient belongs to the age group of 64-74 years with 17 (43.6%), while 74.3% are male (29 patients). The overall mean age was 61.7 ± 8.6 years, with a mean of 59.8 ± 9.1 for women and 62.4 ± 8.5 for men.

Myocardial revascularization was the most frequent surgery in males, with 10 patients (34.5%) (**Table 2**), and in the overall result with 12 patients (30.8%), very significant statistical differences were found between them (p=0.006). Aortic valve replacement followed with 20.5%. Both situations are in correspondence with the predominance of elderly in the study sample.

Table 1. Distribution of patients by age and sex. Cardiocentro Ernesto Che Guevara. Villa Clara, Cuba, 2011-2013.

Age groups	Male		Female		Total	
	Nº	%	Nº	%	Nº	%
42 - 52	5	17,2	2	20,0	7	17,9
53 - 63	9	31,0	4	40,0	13	33,3
64 - 74	13	44,8	4	40,0	17	43,6
75 - 85	2	6,9	0	0	2	5,1
Total	29	74,3	10	25,7	39	100
Mean age	62,4± 8,5		59,8 ± 9,1		61,7 ± 8,6	

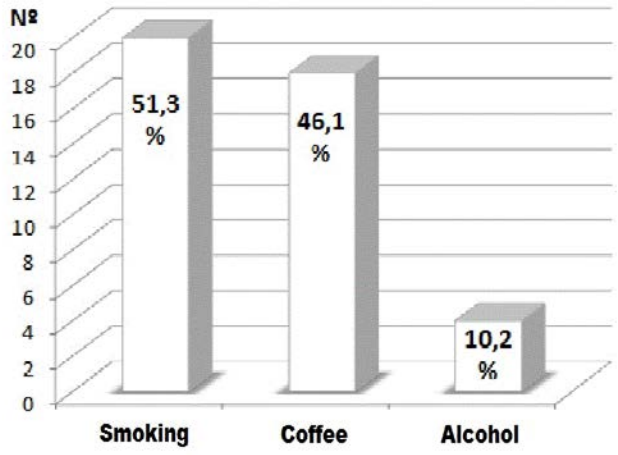
Source: Medical records

Table 2. Distribución de pacientes, según tipo de cirugía y sexo.

Type of surgery	Male		Female		Total	
	Nº	%	Nº	%	Nº	%
Myocardial revascularization	10	34,5	2	20,0	12	30,8
Aortic valve replacement	6	20,7	2	20,0	8	20,5
Mitral valve replacement	4	13,8	3	30,0	7	17,9
Aortic and mitral valve replacement	4	13,8	2	20,0	6	15,4
Myocardial revascularization and aortic valve replacement	4	13,8	0	0	4	10,3
Myocardial revascularization and mitral valve replacement	1	3,4	1	10,0	2	5,1
Total	29	100	10	100	39	100

χ^2=21,5 p=0.006

Figure 1 shows the distribution of patients according to their toxic habits. There is a higher incidence of smoking with 20 patients (51.3%), followed by coffee consumption (46.1%) and, to a lesser extent, alcohol consumption (10.2%). Statistical differences were highly significant (p=0.004).

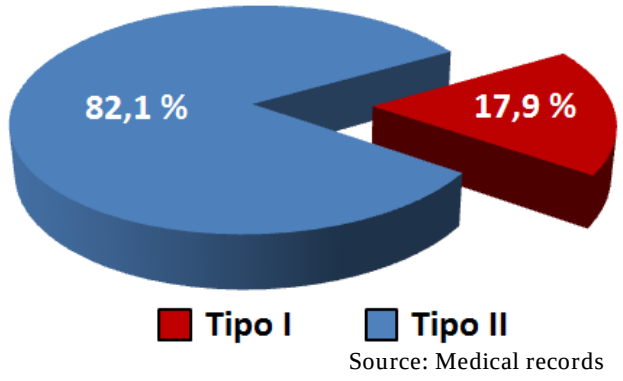


χ^2= 10,8 p=0.004
Source: Medical records

Figure 1. Toxic habits in the patients of the study.

Figure 2 shows the distribution of patients according to the type of neurological complication. Most patients had minor or type II dysfunction.

Hypertension (92.3%) was the most frequent condition in the personal medical history (**Table 3**), followed by ischemic heart disease (53.8%) and diabetes mellitus (46.1%); very significant statistical differences were also found here.



Source: Medical records

Figure 2. Distribution of patients according to the type of neurological complications.

Table 3. Distribution of patients according to their personal medical history.

Personal medical history	Nº	%
Hypertension	36	92,3
Ischemic heart disease	21	53,8
Diabetes mellitus	18	46,1
Others	4	10,2

χ^2=13,2 p=0.001

Table 4. Distribution of patients by age group, according to CPB time.

Age group	CPB time (minutes)			
	≤ 120		> 120	
	Nº	%	Nº	%
42 - 52	1	33,3	6	16,7
53 - 63	2	66,7	11	30,5
64 - 74	0	0	17	47,2
75 - 85	0	0	2	5,6
Total	3	100	36	100

χ^2=12,5 p=0.006

Table 5. General distribution of the complications in the immediate postoperative period.

Complications	Nº	%
Disorientation	14	35,9
Drowsiness	8	20,5
Psychomotor agitation	7	17,9
Delirium	3	7,7
Cerebrovascular accident	3	7,7
Stupor	2	5,1
Coma	1	2,6
Transient ischemic attack	1	2,6
Total	39	100

χ^2= 32,7 p= 0.000

Most patients remained with CPB for more than 120 minutes, that is, they had a prolonged perfusion time (**Table 4**). Of these, 17 patients (47.2%) belonged to the age group of 64-74 years.

Table 5 shows the specific complications (types I and II), which were found in the immediate postoperative period. Disorientation was the most prevalent one with 14 patients (35.9%), followed by drowsiness (20.5 %) and psychomotor agitation (17.9%). Statistical difference was highly significant (p=0.000).

DISCUSSION

One factor that has been found to increase the incidence of neurological complications is the age of the patient. Some studies[9-10] state that complications increase 4 to 5 times around 60 years of age. Atherosclerotic and atheromatous cerebrovascular lesions, and those of the great vessels, especially the aorta, and diseases such as hypertension and diabetes are more common in the elderly. This would explain the increase in neurological damage in these patients[6-9].

Although cerebral blood flow and oxygen consumption decreases with age, about 0.5% per year, the mechanism of cerebral autoregulation continues during CPB in elderly patients. However, the irrigation of gray matter decreases with age, which may predispose them, with a limited cerebrovascular reserve, to present episodes of cerebral ischemia during CPB[11].

A study by Rubio *et al*[12] in a Spanish hospital, agrees with ours in the average age; however, the majority of patients were female. Also, Smith *et al*[13] found that males accounted for 53.7%, which is consistent with our results.

Performing coronary surgery in increasingly older patients with increased systemic atheromatous involvement has led to a higher incidence of embolic neurological injuries. It is now accepted that the fragmentation of atherosclerotic plaques, during manipulation of the aorta, and the subsequent embolization to the brain is the most common cause of cerebrovascular injury in patients with coronary disease[14]. However, this statement does not agree with the results of Balaguer*et al*[15] who in a recent publication found that neurological complications occurred in only 1.7% of patients with coronary revascularization, in 3.6% of single valve replacements, in 3.3% of patients who underwent both surgeries (coronary and valve replacement) and in 6.7% of patients with multiple valve replacement. These figures are consistent with previous series indicating a greater number of neurological complications in valve replacement surgery compared with coronary revascularization[15].

Smoking is a risk factor for cardiovascular disease, and increases its harmful effect if associated with hypertension. There is evidence of the undeniable connections between both factors, and it may be said that smoking is an important risk factor for hypertensive cerebrovascular disease because it negatively affects the control and prognosis of the hypertensive patient[16].

Smoking increases coronary risk by producing two main effects: atherogenic effects (endothelial injury, decreased HDL cholesterol, platelet activation and release of free fatty acids) and thrombogenic effects (platelet activation, increased fibrinogen, release of thromboxane and decreased prostacyclin production) [17].

High blood pressure is a predictor of postoperative neurological dysfunction; hence it is important to take into consideration that cerebral autoregulation curve shifts to the right in hypertensive patients, so it is necessary to get a correct cerebral blood flow[18].

The risk of death from cerebrovascular disease triples in the hypertensive elderly patients. Old age favors the development and maintenance of systolic hypertension[19]. Newman *et al*[20], in their study of nervous system injuries associated with cardiac surgery, reported a predominance of ischemic cerebrovascular accident, and found that hypertension was the risk factor most frequently associated with cerebrovascular disease, followed by cardiovascular disease and diabetes mellitus[20].

Regarding the type of neurological complication, our study agrees with other authors who state that type II is the most common one, mainly encephalopathies and neuropsychological disorders[7-11,19-21].

In a study by Morlan*et al*[22], neurological dysfunction was found in 7.7% of cases, minor neurological dysfunction was detected in 5.3%, and major neurological dysfunction was found in 2.5% of patients who underwent CPB, as a factor favoring these processes[22].

There are not conclusive data to determine that the duration of CPB influence the neurological outcome. The effect of CPB time on cerebral perfusion is controversial. In a clinical study of the Intensive Care Department of a university hospital in Madrid, Spain, describing the immediate postoperative neurological complications and evolution of a series of patients after cardiac surgery with CPB time greater than 120 minutes, the CPB time was directly correlated with the occurrence of cerebral infarction after surgery, appearing in 49.9% of cases[23].

This study showed that in the early hours the most common neurological complications were disorientation, drowsiness and restless awakening in the early hours. The results of the Society of Thoracic Surgery indicate an incidence of 3.3% of neurological complications, mainly the stuporous state that sometimes alternates with periods of agitation and pupillary reflexes which may be slowed down.

These cases, which have been termed by some authors as post-CPB encephalopathy, have been attributed to the development of a more or less prolonged neuronal ischemia, causing a diffuse cerebral dysfunction of variable duration which may evolve into recovery and healing, or into cognitive deterioration[24].

CONCLUSIONS

Neurological dysfunction was more common in males, in the age group of 64-74 years, in smokers with a history of hypertension, ischemic heart disease and diabetes mellitus. The type of surgery which is most often responsible for this neurological disorder was myocardial revascularization, followed by aortic valve replacement. There was a predominance of type II neurological complications (disorientation, drowsiness and psychomotor agitation), in which CPB time was greater than 120 minutes.

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