

# Neurocognitive Complications after Off-Pump and On-Pump CABG

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## Abstract

**Background-** Neurocognitive dysfunction after cardiac surgery with cardiopulmonary bypass (CPB or “pump”) is a common complication, reported in up to 53% of patients. In many patients this morbidity is only mild and transient, but in 5% of cases, it is severe.

**Method-** In this prospective study from June 2002 to July 2004, 186 cases underwent coronary artery bypass graft surgery (CABG) using CPB or off-pump CABG (OPCAB), and they were evaluated for neurocognitive complications by mini-mental status examination.

**Results-** The average age of the patients was  $56 \pm 6.2$  years, 62% were male and 38% were female. 121 operations were performed with CPB (on-pump) and 65 operations were done off-pump. Mini-mental status test was normal in 50% of off-pump CABGs and in 43% of on-pump CABGs, very mild disturbance was seen in 48% of off-pump CABGs and in 54% of on-pump CABGs ( $p$  value=0.192, NS), mild disturbance was seen in 2% of off-pump CABGs and in 3% of on-pump CABGs ( $p$  value 0.392, NS), and moderate or severe disturbance was not seen in either group.

**Conclusion-** In our study, there was no significance difference in the frequency of postoperative neurocognitive complications between off-pump and on-pump CABG patients (*Iranian Heart Journal 2009; 10 (1):27-30*).

**Key words:** coronary artery bypass graft ■ cardiopulmonary bypass ■ neurocognitive complication ■ OPCAB

Cardiopulmonary bypass (CPB) is one of the causes of brain damage during coronary artery bypass graft surgery (CABG). Neurologic complications after cardiac surgery may be categorized as: 1) neurologic deficits, and 2) neurocognitive dysfunction.

Dysfunction of the nervous system after surgery is further classified in three groups: 1) CNS complications, 2) psychological complications, and 3) peripheral neurologic complications.

Generalized neuro-psychological function including intelligence, problem solving, concentration, learning and memory are among the cognitive functions of the brain.

The presence of atheroma in the aorta and previous history of stroke are two causes of neurologic deficits. The incidence of neurocognitive disorders increases with the use of hypothermia and total circulatory arrest. Old age is a major risk factor for neurocognitive disorders.

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In this study, neurocognitive complications after off-pump and on-pump CABG are evaluated and compared. Neurocognitive complications (intelligence, problem solving, concentration, learning, memory, error free performance and dexterity) after cardiac surgery with CPB is a common complication (reported in up to 53% of patients).<sup>1</sup> CPB itself may cause brain damage during cardiac surgery, the mechanism responsible for which possibly being microemboli formation and hypoperfusion. Disorders in concentration and memory have been reported in about 50% of patients who have underwent CABG with CPB.<sup>1</sup>

### Methods

In this prospective study from June 2002 to July 2003, the patients at our center who were operated as off-pump CABG were evaluated and demographic data such as age, sex, degree of hypothermia, number of grafts, etc. were collected. For each off pump patient, two patients who were operated on pump were evaluated.

Neurocognitive complications after discharge from the ICU were evaluated (3-5 days after the operation). They were analyzed in a questionnaire as mini-mental status test and were scored as follows: (normal score: 30, very mild: 28-29; mild: 26-27; moderate: 24-25; severe dysfunction: below 24). The results were analyzed with SPSS 11 software. For ethical concerns, informed consent was received from all the patients in the study.

### Results

Totally, 133 patients were evaluated in this study. Fifty-two percent of patients were male and 42% female; patients were in the age range of 55-69 years old; 53% were operated on pump and 39% were operated with off-pump technique.

In the study population, 41% were in the normal group, 53% in the very mild and 6%

in the mild dysfunction group, according to their scores of neurocognitive disorders.

In the first row of Table I, the distribution of the neurocognitive disorders is demonstrated according to use of the pump. There was no significant difference between the two groups. ( $P=0.192$ ). Also, there was no significant difference in the incidence of neurologic complications between males and females ( $p=0.392$ ).

The frequency of neurocognitive complications in accordance with the type of complication and age are demonstrated in the third row of Table I, which shows that with increasing age, the rate of neurocognitive complications increases after CABG.

**Table I. The distribution of neurocognitive complications in the study population.**

Neurocognitive score		Normal	Very mild	Mild	Total
Type of operation ( $p=0.192$ )	On-pump	50% (32)	48% (48)	2% (7)	100% (87)
	Off-pump	37% (23)	55% (22)	8% (1)	100% (46)
Sex ( $p=0.392$ )	male	46% (38)	48% (40)	6% (5)	100% (83)
	female	34% (17)	60% (30)	6% (3)	100% (50)
Age group ( $P=0.007$ )	40-54	58% (30)	38% (20)	4% (2)	100% (52)
	55-69	34% (22)	61% (39)	5% (3)	100% (64)
	Over 70	18% (3)	65% (11)	17% (3)	100% (17)
Study population		41% (55)	53% (70)	6% (8)	100% (133)

### Discussion

In this study we evaluated the neurocognitive complications in patients who underwent CABG as on-pump and off-pump technique.

The age of the patients influenced the incidence of neurocognitive complications in off-pump and on-pump groups. With increasing age, the incidence of such complications increases ( $p=0.007$ ).

In the study of Pukas, Hernandez and Sabick, there was no significant difference in the incidence of neurologic events and postoperative stroke between off-pump and on-pump CABG patients. In one study, cognitive performances of candidates for bypass were significantly lower than those of a healthy control group.<sup>1</sup> In our study there was no significant difference for neurocognitive complications between males and females. There was no significant difference in incidence of neurocognitive complications between off-pump and on-pump surgery, similar to that reported in the study of Vedin.<sup>4</sup>

With increasing age in the on-pump group, the rate of neurocognitive complications increases.

In another study patients undergoing on-pump surgery have a significant relative reduction in prefrontal activation, which correlates with intraoperative cerebral microembolic load.<sup>2</sup> In a study of 52 patients by Stroodant et al., it was demonstrated that off-pump surgery leads to a reduction in intraoperative cerebral microembolization.<sup>3</sup>

In Vedin's study in 2006, there were no differences in postoperative cognitive function after on-pump compared to off-pump CABG.<sup>4</sup>

Although neurocognitive decline after CABG is mostly transient, memory impairment can persist for months.<sup>5</sup>

In another study, long-term cognitive function and MRI evidence of brain injury were similar after off pump and on pump coronary artery bypass grafting surgery.<sup>6</sup>

Cognitive decline after cardiac surgery is a function of underlying patient factors rather than perioperative ischemic events alone.<sup>7</sup> In one study the harmful effects of CPB were not permanent,<sup>15</sup> contrary to the results of Newman's study.<sup>16</sup>

## Conclusion

According to this study, we conclude that the use of pump has not influenced the incidence of neurocognitive disorders, and there is no significant difference for this complication between males and females. However with increasing age, the incidence of neurocognitive disorders increases, thus off pump CABG may have a beneficial role in older patients.

## Conflict of Interest

No conflicts of interest have been claimed by the authors.

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