

Hypothermia during percutaneous coronary intervention in comatose survivors of cardiac arrest

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ABSTRACT

Urgent invasive coronary strategy including coronary angiography and percutaneous coronary intervention (PCI) is feasible and safe in combination with mild induced hypothermia and may significantly improve survival with good neurological outcome in comatose patients after reestablishment of spontaneous circulation (ROSC). The starting hypothermia already in the prehospital setting or immediately after arrival to the catheterization laboratory to complement urgent coronary angiography and PCI seems to be a logical strategy.

Keywords: cardiac arrest, urgent coronary angiography, percutaneous coronary intervention PCI, mild induced hypothermia, outcome

Introduction

Immediate coronary angiography in patients resuscitated from sudden cardiac arrest demonstrated angiographic evidence of coronary artery disease in 80%. (1) Moreover, in patients with evidence of coronary artery disease, acute or recent coronary occlusion was demonstrated in 67%. Accordingly, acute coronary thrombotic event leading to critical narrowing or complete coronary obstruction may be viewed as the main trigger of sudden cardiac arrest. There is evidence, derived from multivariate analyses of nonrandomized trials, that urgent coronary angiography followed percutaneous coronary intervention (PCI) may improve survival. (1-3) On the other hand, in comatose survivors of cardiac arrest, postresuscitation brain injury represents an additional variable with profound influence on the outcome. Severe postresuscitation brain injury

leading to permanent vegetative state makes possible benefits of urgent PCI meaningless. Besides restarting the heart as soon as possible, only mild induced hypothermia has been shown to improve neurological outcome. (4,5) Thus, starting hypothermia already in the prehospital setting or immediately after arrival to the catheterization laboratory to complement urgent coronary angiography and PCI seems to be a logical strategy.

Urgent coronary angiography, PCI and mild induced hypothermia

There is preliminary evidence that angiographic result of primary PCI in patients with ST-elevation myocardial infarction (STEMI) after reestablishment of spontaneous circulation (ROSC) is not compromised if mild induced hypothermia is used concomitantly (table 1). Moreover, there is no excess in arrhythmias and hemodynamic instability requiring more aggressive support with inotropes, vasopressors and intraaortic balloon counterpulsation. (6) There was some

excess in pulmonary infections which, however did not compromise the outcome which was significantly better in hypothermia group. These findings were independently confirmed also by other investigators. (7) Recent literature search revealed 4 independent nonrandomized trials (6-9) and one case report (10) which cumulatively investigated 138 comatose survivors of cardiac arrest with STEMI (table 2). Coronary angiography was followed by PCI in 83%. Platelat glycoprotein (GP IIb/IIIa) were used in 64% and stenting in 93%. Patency of infarct related artery was reestablished in 93%. Survival with good neurological outcome was obtained in 63% which is very good result for these sick patients.

Accordingly, urgent coronary angiography /PCI and mild induced hypothermia should be incorporated in comprehensive postresuscitation intensive care protocol for the management of comatose survivors of cardiac arrest. (3,11) When proportion of comatose survivors of cardiac arrest undergoing urgent coronary angiography/PCI and hypothermia increased to 77%, hos-

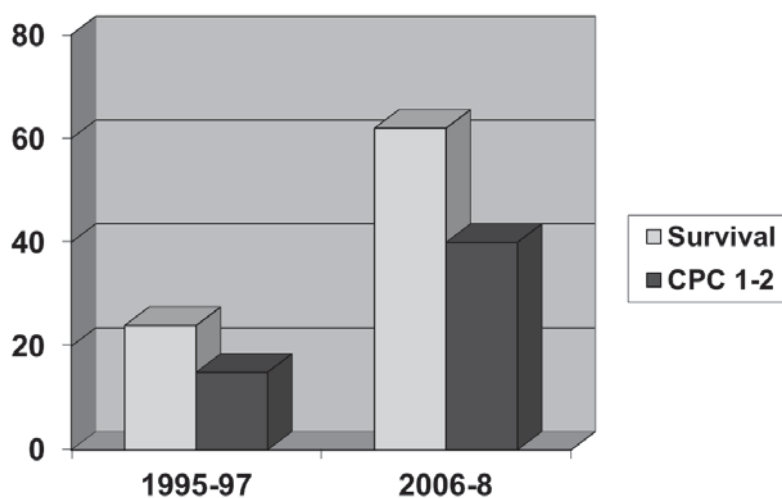
pital survival with good neurological outcome increased from 26% to 56%. (11) This is in accordance also with our observations in consecutive comatose survivors of out-of-hospital cardiac arrest in whom survival with good neurological recovery improved from 15% between 1995-1997 to 40% between 2006-2008 when treatment with urgent

PCI and hypothermia exceeded 70 and 90%, respectively (figure 1). (12,13)

Conclusion

Urgent invasive coronary strategy including coronary angiography and PCI is feasible and safe in combination with mild induced hypothermia and may significantly improve survival

with good neurological outcome in comatose patients after ROSC. Since contemporary treatment of comatose survivors of cardiac arrest is thereby becoming more complex, it should ideally be centralized to dedicated "24/7" primary PCI centers with well-equipped and skilled interventional cardiology facility and cardiac intensive care unit.



CAG,coronary angiography; CPC 1/2,cerebral performance category indicating good neurological recovery; IABP,intraaortic balloon pumping; MIH,mild induced hypothermia; PCI,primary percutaneous coronary intervention.

Figure 1. Difference between survival to hospital discharge and survival to hospital discharge with good neurological outcome between 1995-1997 and 2006-2008 at University Medical Center Ljubljana (Slovenia) when proportion of comatose survivors of cardiac arrest undergoing urgent coronary angiography/PCI and mild induced hypothermia was significantly increased.

Table 1. Comatose survivors of ventricular fibrillation and ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention (PCI) and mild induced hypothermia compared to historical controls undergoing primary PCI but no hypothermia (Adapted from 15).

	Hypothermia (n=40)	No hypothermia (n=32)	p
Post PPCI TIMI 2/3,%	90	88	.41
>70% ST resolution,%	68	59	.64
Stent thrombosis	2.5	0	1.0
Sustained VT,%	13	19	.69
Repeat VF,%	20	19	.87
Paroxysmal AF,%	18	16	.92
DC/EC,%	30	34	.89
Antiarrhythmics,%	33	53	.13
IABP,%	20	22	.92
Vasopressors,%	65	53	.44
Inotropes,%	48	59	.44
Peak arterial lactate, mmol/l	5.1+4.5	5.7+4.0	.56
Peak creatinine, mcmol/l	160+131	158+147	.95
Need for hemodialysis,%	7.5	6.5	.80
Peak CRP, mg/l	174+82	184+96	.64
Positive tracheal aspirates,%	93	72	.04
Need for antimicrobials,%	90	72	.07
Hospital survival, %	75	44	.001
Hospital survival with CPC 1/2,%	55	16	.001
6-months survival, %	68	38	.021
6-months survival with CPC 1/2	53	19	.007

AF, atrial fibrillation; CPC 1/2, cerebral performance category indicating good neurological recovery; CRP, C-reactive protein; DC, defibrillation; EC, cardioversion; IABP, intraaortic balloon pumping; PPCI TIMI- primary percutaneous coronary intervention thrombolysis in myocardial infarction; VF, ventricular fibrillation; VT, ventricular tachycardia.

Table 2. Primary percutaneous coronary intervention in comatose survivors of ventricular fibrillation and signs of ST-elevation acute myocardial infarction (STEMI) after reestablishment of spontaneous circulation.

Author	n	PPCI IIb/IIIa	GP IRA	Stentin	Patent	IABP	Survival CPC 1/2
Knafelj (15)	40	36	18	32	36	8	2
Hovdenes (17)	50	36	NA	NA	NA	23	34
Koutouzis (19)	1	1	NA	1	1	0	1
Wolfrum (16)	16	16	15	16	16	5	11
Scheffold (18)	31	25	16	NA	NA	NA	19
Together	138	114 /138 (83%)	49/77 (64%)	49/53 (93%)	53/57 (93%)	36/107 (34%)	87/138 (63%)

CPC 1/2, cerebral performance category indicating good neurological recovery; GP IIb/IIIa, platelet glycoprotein inhibitors; IABP, intraaortic balloon pumping; IRA, infarct related artery; NA, not available; PPCI, primary percutaneous coronary intervention.

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