

Table 2 – Association between cardiac index during targeted temperature management (TTM) and mortality assessed by univariable and multivariable cox regression models. the cumulated dose of epinephrine, norepinephrine and dopamine during the first 36 h are reported.

	Hazard ratios for 180-day mortality			
	Univariable HR (95%CL)	p-value	Multivariable ^a HR (95%CL)	p-value
Cardiac index during TTM (L/min/m ²)	0.84 (0.54–1.31)	0.44	1.03 (0.57–1.83)	0.93
Age at arrest (year)	1.05 (1.02–1.07)	0.0003	1.04 (1.00–1.07)	0.03
Time to ROSC (min)	1.02 (1.01–1.03)	<0.0001	1.02 (1.00–1.03)	0.03
Witnessed arrest (yes/no)	0.25 (0.12–0.49)	<0.0001	0.27 (0.10–0.68)	0.006
Bystander CPR (yes/no)	1.11 (0.56–2.24)	0.76	0.60 (0.20–1.45)	0.26
Shockable primary rhythm (yes/no)	0.24 (0.12–0.48)	<0.0001	0.28 (0.11–0.69)	0.006
Lactate level at admission (mmol/L)	1.08 (1.02–1.14)	0.01	1.05 (0.97–1.14)	0.23
TTM at 36 °C (yes/no)	0.67 (0.38–1.18)	0.17	0.76 (0.35–1.68)	0.49
Vasopressor load during TTM (µg/kg/min)	1.07 (0.91–1.25)	0.42	1.04 (0.86–1.25)	0.69

Abbreviations. TTM: targeted temperature management, CL: confidence limit, CPR: cardiopulmonary resuscitation, HR: Hazard ratio, ROSC: return of spontaneous circulation. Bold values signify statistical significance at the 5 percent level.

^a Adjusted for age, time to ROSC, witnessed arrest, cardiopulmonary resuscitation by bystander, shockable primary rhythm, lactate level at admission, randomization group (TTM at 33 °C or 36 °C) and inotropic vasopressor load.

Coronary artery disease and cardiac index

Left anterior descending coronary artery disease was present in 48 (32%) patients, left circumflex coronary artery disease was present in 26 patients (17%), left main coronary artery disease was present in 2 (1%) patients and right coronary artery disease was present in 36 (24%) patients. However, affected coronary artery was not associated with low cardiac output (Table 1). Furthermore, number of coronary stenoses was also not associated with low cardiac output (Table 1). PCI was performed in 81 (54%) patients and treatment with PCI was not associated with overall mortality or non-neurological death ($p=0.78$).

Cardiac index and lactate

As illustrated in Fig. 4, we stratified patients into four groups according to cardiac index (low or normal) and lactate during TTM (above/below 2 mmol/L). Patients with low cardiac index combined with increased lactate had the highest mortality, whereas patients with low cardiac index and normal lactate had the lowest mortality (Fig. 4).

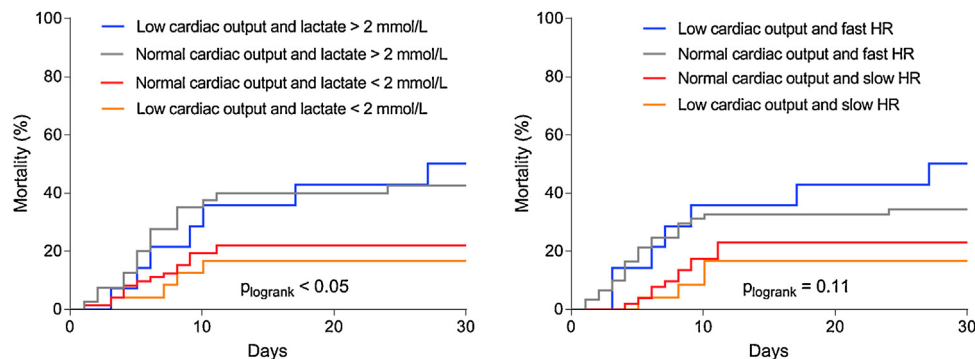


Fig. 4 – 30-days mortality of study population. In the left graph, patients were stratified by low cardiac output (lowest quartile in each TTM-group) and lactate above or below 2 mmol/L. In the right graph, patients were stratified by low cardiac output and mean heart rate above (fast) or below (slow) the median during TTM.

Discussion

We report, that low cardiac index during TTM is not associated with overall mortality or death from cerebral or non-neurological cause. However, lactate is increased as a sign of hypoperfusion, the mortality is high in both normal and low cardiac index-states. If lactate is normal, low cardiac index during TTM seems benign and not associated with mortality. Low cardiac index is possibly a symptom of hemodynamic instability only in a subgroup of OHCA-patients but is not in general a marker of organ hypoperfusion since neither lactate or mortality was associated with low cardiac output.

Cardiac index in OHCA-patients undergoing TTM have been investigated previously. One of the first studies was performed by Bernard et al. in 2002, who reported that cardiac index was 2.5–3.0 L/min/m² in the normothermia group and 2.0–2.5 L/min/m² in the hypothermia group.³⁰ In 47 selected patients from a large cohort, Oksanen et al. reported that low cardiac index (<1.5 L/min/m²) after cardiac arrest was not associated with neurological outcome.²⁰ In another selected group of 333 patients with PAC-measurements from a registry of 8736 cardiac arrest-patients, Trzeciak et al. reported that

