

# Cardiac arrest – an epidemiologic perspective on pharmacotherapy and post-resuscitation care

AKADEMISK AVHANDLING

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet kommer att offentligen försvaras i Arvid Carlsson, Academicum, Medicinaregatan 3, Göteborg, fredagen den 24 september, klockan 9.00.

av **Andreas Lundin, Leg. Läkare**

Fakultetsopponent:

**Docent/Överläkare Sten Walther**

Institutionen för hälsa, medicin och vård,  
Linköpings universitet, Linköping

## Avhandlingen baseras på följande delarbeten

- I. Lundin A, Rylander C, Karlsson T, Herlitz J, Lundgren P. Adrenaline, ROSC and survival in patients resuscitated from in-hospital cardiac arrest.  
*Resuscitation. 2019 Jul;140:64-71*
- II. Lundin A, Karlsson T, Herlitz J, Lundgren P, Rylander C. *The association between duration of mechanical ventilation and survival in post cardiac arrest patients.*  
*Resuscitation. 2020 Mar 1;148:145-151.*
- III. Lundin A, Dell'anna AM, Peluso L, Nobile L, Annoni F, Creteur J, Rylander C, Taccone FS. Venous-arterial CO<sub>2</sub> difference and respiratory quotient after cardiac arrest: an observational cohort study.  
*Journal of Critical Care, 2020 Dec, 62:131-137*
- IV. Lundin A, Lundgren P, Herlitz J, Taccone FS, Rylander C. Can carbon dioxide-based parameters predict early death in post cardiac arrest patient?  
*Manuscript*

**SAHLGRENKA AKADEMIN  
INSTITUTIONEN FÖR KLINISKA VETENSKAPER**



## Abstract

**Background:** Despite significant research and progress, cardiac arrest remains a condition with a high mortality rate, and few interventions have been demonstrated to improve outcomes in this patient group. Despite incorporation of adrenaline use in the treatment guidelines over several decades, its potential benefit remains uncertain. After initial resuscitation, patients are often admitted to the intensive care unit (ICU). Mortality approaches 50% in comatose post-cardiac arrest patients, leaving clinicians to face often difficult decisions concerning prognostication and duration of intensive care efforts in this patient population.

**Aims:** The aims of this thesis were: To study the relationship between adrenaline treatment, return of spontaneous circulation (ROSC), and survival in patients with in-hospital cardiac arrest (paper I). To explore the inter hospital variation in the duration of mechanical ventilation ( $MV_{DUR}$ ) in post cardiac arrest patients and any association between  $MV_{DUR}$  and survival following a cardiac arrest (Paper II). To characterize levels of blood lactate, veno-arterial carbon dioxide difference ( $p\Delta CO_2$ ) and the ratio of veno-arterial carbon dioxide content difference to arterio-venous oxygen content difference (RQ) in post cardiac arrest patients and assess whether these parameters are associated with and are able to predict mortality during the post resuscitation phase (paper III and IV).

**Methods:** Data were collected from the Swedish Registry of Cardiopulmonary Resuscitation (papers I and II) and The Swedish Intensive Care Registry (paper II). In paper I, we compared ROSC and 30-day survival in patients that received, or did not receive, adrenaline during resuscitation. In paper II, hospitals were divided into quartiles (hospital groups 1–4) according to their median duration of mechanical ventilation in patients who did not survive to hospital discharge. The primary outcome was the association between the variable ‘hospital group’ and 30-day survival. In papers III and IV, we measured and evaluated the prognostic implications of RQ and  $p\Delta CO_2$  in two cohorts of post-cardiac arrest patients. In paper III, data were collected retrospectively from an institutional registry at Erasme University, Belgium, and RQ and  $p\Delta CO_2$  were assessed from central venous and arterial blood gases once during the initial 24 h after admission. Outcomes were ICU mortality and unfavourable neurologic outcome at 3 months. Paper IV was a prospective study in patients admitted to Sahlgrenska University Hospital. We measured RQ,  $p\Delta CO_2$ , and lactate prospectively during the initial 72 h after admission and explored whether RQ or  $p\Delta CO_2$  can identify patients who experienced either early mortality (at 96 h) or mortality during follow up.

**Results:** In paper I, the relationship between adrenaline treatment and ROSC was dependent on initial rhythm and duration of cardiopulmonary resuscitation (CPR), with patients presenting a shockable rhythm and treated with adrenaline having a lower frequency of ROSC when stratified by CPR duration. In patients with a non-shockable rhythm, the ROSC rate was higher in adrenaline-treated patients when stratification included CPR duration. Survival at 30 days was lower for adrenaline-treated patients regardless of initial rhythm both before and after stratification for CPR duration. In paper II, the median duration of mechanical ventilation in non-survivors ranged from 17 h in hospital group 1 to 56 h in group 4. The hospital group was associated with 30-day survival; however, division of patients according to initial rhythm revealed that the association was only significant for patients with an initially non-shockable rhythm. In paper III, RQ was associated with ICU mortality, whereas  $p\Delta CO_2$  was negatively associated with both ICU mortality and neurologic outcome. In paper IV, survivors and non-survivors at 96 h showed similar levels of RQ and  $p\Delta CO_2$  during the initial 72 h after ROSC and neither parameter could predict early mortality or mortality during follow up. By contrast, lactate levels were higher in patients with early mortality and predicted mortality in post-cardiac arrest patients.

**Conclusions:** The relationship between adrenaline and ROSC is affected by duration of CPR and initial rhythm. The role of adrenaline in patients with IHCA and a shockable rhythm should be investigated further as it may be associated with inferior short- and long-term outcome. Short duration of intensive care efforts in post cardiac arrest patients is associated with lower survival in patients with an initial non-shockable rhythm. During post resuscitation care, lactate levels is a better at prognosticating mortality compared with RQ and  $p\Delta CO_2$ .

**Keywords:** Cardiac arrest, Resuscitation, Post Cardiac arrest care

ISBN: 978-91-8009-402-3 (PRINT)

ISBN: 978-91-8009-403-0 (PDF)