without major neurological deficits, despite very long resuscitation times (1). It remains unclear so far, whether these patients profit from mechanical chest compression devices (mCCD) and guidelines for use and pediatrics (age < 8 years) are missing. Our aim is to test three newly developed mCCD plungers adapted for pediatric use for non-inferiority to manual chest compression (manual CC) with regard to flow generation in an asphyxiated cardiac arrest infant piglet model.

Materials and Methods: 21 male domestic piglets weighing 10–15 kg were pseudo-randomized to a sequence of three mCCD plungers (two different sizes diameter of 40 and 55 mm and one plunger with active-compression-decompression (ACD)) and manual CC in a cross-over study design. Hemodynamics were assessed by carotid blood flow (CBF) relative to baseline and mean arterial pressure (MAP). Non-inferiority in CBF was tested for each plunger against manual CC with a defined test margin of −3.9% representing 1/3 of mean CBF during manual CC.

Results: CBF during mechanical resuscitation corresponded to approximately 10% of the baseline flow as well as MAP equals across all groups. While non-ACD plungers with 40 mm (Bonferroni-corrected 96.66% CI [−4.0 4.0]) and 55 mm (CI [−4.5 6.4]) were inferior to manual CC, the ACD plunger showed non-inferiority (CI [−0.8 6.8]).

Conclusions: Three new pediatric-specific plungers were successfully tested in the model. However, only the plunger with ACD method was non-inferior to manual CC (proposed as the corresponding gold standard). Therefore, we would recommend to continue the development of ACD and recommend more research diminishing the general deficit and lack of mechanical compression devices for pediatric resuscitation.

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285

Influence of aortal occlusion during non-trauma resuscitation on gas exchange in a pig model with chest compression synchronized ventilation

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Purpose of the study: A major goal of resuscitation is to oxygenate heart and brain to prevent hypoxic damage 1). Even with optimised chest compressions and ventilation, patients often show poor gas exchange. We investigated the influence of abdominal aortal occlusion on gas exchange with Chest Compression Synchronized Ventilation (CCSV) and mechanical chest compressions in a pigmodel.

Materials and methods: The study was performed on 9 pigs under general anaesthesia with endotracheal intubation. A balloon catheter was placed in the aorta at the level of diaphragm via femoral access. Ventricular fibrillation (t = 0 min) was induced. At t = 3 min mechanical chest compressions (CorpulsCPR®) were started, at t = 5 min CCSV (Weinmann MedumatStandard2®) initiated 2,3). Animals were randomised into REBOA (n = 4) and NO-REBOA (n = 5). At t = 7 min inflation of balloon. Blood gas samples at t-2 min (baseline), t = 4 min, t = 10 min and t = 14 min.

Results

Arterial blood gas analysis	Time (min)	NO-REBOAn = 5 (mean ± SD)	REBOAn = 4 (mean ± SD)	T-test p-value
pH	t = baseline	7,46 ± 0,03	7,50 ± 0,05	0,167
	t = 4	7,33 ± 0,04	7,39 ± 0,09	0,231
	t = 10	7,32 ± 0,10	7,43 ± 0,15	0,221
	t = 14	7,22 ± 0,09	7,37 ± 0,07	0,028
PaCO2	t = baseline	41,2 ± 4,1	36,3 ± 3,4	0,102
	t = 4	56,0 ± 7,0	50,3 ± 9,0	0,314
	t = 10	48,2 ± 14,4	35,0 ± 15,8	0,228
	t = 14	57,0 ± 13,5	37,3 ± 5,9	0,018
PaO2	t = baseline	105,3 ± 20,7	113,5 ± 12,9	0,518
	t = 4	42,1 ± 8,1	47,1 ± 18,0	0,589
	t = 10	298,2 ± 92,9	446,3 ± 21,6	0,031
	t = 14	288,2 ± 107,6	349,3 ± 157,6	0,511

At t = baseline and t = 4 min no differences between the groups. REBOA group showed higher values of PaO_2 and normal $PaCO_2$ and pH values after blocking the balloon compared to NO-REBOA-group.

Conclusions: Aortal occlusion during mechanical chest compressions and Chest Compression Synchronized Ventilation in a pigmodel improved gas exchange and kept acid-base-state in normal range.

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286

Longitudinal variations of prolonged grief, anxiety, and depression among bereaved family members after a close persons' death from sudden cardiac arrest – a two-year follow-up study

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Purpose: Deaths from sudden cardiac arrest (CA) are common. Despite the traumatic nature of a CA event, little is known of bereaved family members' grief reactions and psychological distress. Therefore, the aim was to explore longitudinal variations of prolonged grief, anxiety and depression in bereaved family members.

Method: This longitudinal survey included 58 bereaved family members who completed a questionnaire 6, 12, and 24 months after the sudden CA and death. The questionnaire included the Prolonged Grief Disorder-13 (PG-13) and the Hospital Anxiety and Depression Scale (HADS). To explore longitudinal variations, repeated measures ANOVA was used.

Results: The bereaved family members had a mean age of 63.5 years (range = 53–72) and were adult children (n = 27, 47%), spouses (n = 22, 38%) or significant others (n = 9, 15%) of the person who died from sudden CA. A majority were women (n = 36, 62%) and had no university degree (n = 35, 60%). Most of the cardiac arrests took place out-of-hospital (n = 38, 84%), and a third of the family members had been present during resuscitation (n = 21, 36%). Family members improved significantly during the two year follow-up in symptoms of prolonged grief (mean 23.8, 22.4, and 19.8, $F(57, 2) = 12.99$, $p < 0.001$), anxiety (mean 5.3, 4.4, and 4.0, $F(57, 2) = 7.39$, $p < 0.001$), and depression (3.6, 3.0, and 2.4, $F(57, 2) = 6.49$, $p = 0.002$).

Conclusion: Despite that the average symptom level of prolonged grief, anxiety, and depression decreased during the two-year follow up, this was not true for all bereaved family members. Therefore, health care professionals need to identify those with a complex grief process and in need of support.

287

Association of lactate and lactate clearance with favourable neurological outcome in cardiac arrest patients managed with extracorporeal cardiopulmonary resuscitation

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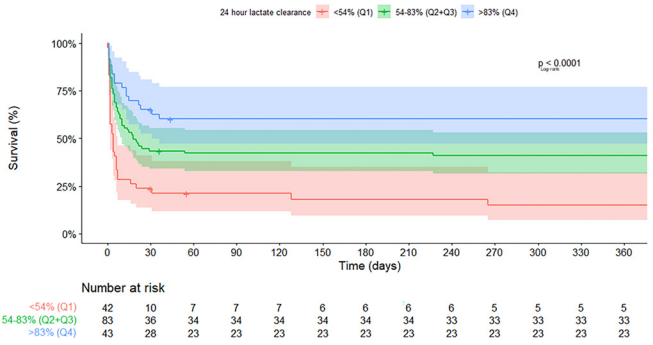
Introduction: Global tissue injury because of prolonged whole-body ischemia is unavoidable in refractory cardiac arrest despite management with extracorporeal cardiopulmonary resuscitation (ECPR). The purpose of this study was to investigate whether the degree of ischemia measured by serial lactate levels and lactate clearance is associated with survival with favourable neurological outcome.

Methods and materials: A retrospective cohort of 303 adult refractory cardiac arrest patients (out-of-hospital cardiac arrest = 254, in-hospital cardiac arrest = 49) managed with ECPR was included (Denmark n = 210, Berlin = 93). We analysed 1) lactate levels prior to ECPR initiation, 2) 24 hours after initiation, and 3) lactate clearance (((pre-ECPR lactate - 24 hour lactate)/pre-ECPR lactate)×100%). We separated the biomarkers into quartiles for further analyses. The primary outcome was favourable neurological outcome (Cerebral Performance Category (CPC) 1–2) at hospital discharge. Unfavourable neurological outcome was defined as CPC 3–5. Probability of survival was visualized using Kaplan-Meier curves.

Results: Median age of included patients was 56 years (1. quartile to 3. quartile (Q1-Q3): 47–64 years) and 80% were male. Most had cardiac cause of arrest (95%), 65% had a primary shockable rhythm, and median low flow time was 96 minutes (65–120 minutes). Favourable neurological outcome was significantly associated with quartiles of lactate level pre-ECPR (34% (Q1) vs. 23% (Q2+Q3) vs. 8% (Q4), $p < 0.001$), 24 hours after ECPR initiation (55% vs. 42% vs. 8%, $p < 0.001$), and 24-hour lactate clearance (17% vs. 37% vs. 56%, $p < 0.001$). Similarly, probability of 1-year survival was low (<25%) in patients with 24-hour lactate clearance less than 54% (Q1) and high (60%) in patients with a 24-hour lactate clearance >83% (Q4) (Figure).



Conclusion: Lactate and lactate clearance were both associated with survival with favourable neurological at hospital discharge in this large international ECPR cohort study of in- and out-of-hospital cardiac arrest patients.

288

Initial rhythm is not associated with self-reported health and psychological distress in cardiac arrest survivors – a Swedish nationwide register-based study

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Purpose: Non-shockable initial rhythm is associated with a poorer prognosis compared to shockable initial rhythm at cardiac arrest (CA). However, the association between initial rhythm and patient-reported outcomes is still unclear. Therefore, the aim was to examine if initial rhythm is associated with self-reported health and psychological distress in CA survivors.

Materials and methods: This nationwide register study used data from the Swedish Register for Cardiopulmonary Resuscitation, collected 3–6 months post CA in survivors 18 years or older. Self-reported health was measured by the EQ VAS and psychological distress by the Hospital Anxiety and Depression Scale. The associations between initial rhythm, self-reported health, and psychological distress were examined with multiple linear regression analysis, adjusted for gender, age, aetiology (cardiac vs. non-cardiac), cerebral performance category (CPC), time to CPR, time to defibrillation, and location (in-hospital vs. out-of-hospital).

Results: The final sample included 1783 survivors, 29% women and 71% men, with a mean age of 66.3 (SD 13.3) years. In the unadjusted analyses, survivors with non-shockable initial rhythms reported significantly poorer self-reported health ($p < 0.001$) and higher levels of anxiety ($p = 0.034$), and depression ($p = 0.017$) compared to survivors with shockable initial rhythms. However, these differences did not remain in the adjusted regression analyses, showing that gender, age, location, CPC, and time to defibrillation overall were the