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ORIGINAL SCIENTIFIC PAPER

Ischaemic electrocardiogram patterns and its association with survival in out-of-hospital cardiac arrest patients without ST-segment elevation myocardial infarction: a COACT trials' post-hoc subgroup analysis

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Introduction

- Out-of-hospital cardiac arrest (OHCA) is a leading cause of death.
- Ischaemic heart disease is the most common cause of cardiac arrest and accounts for approximately 70% of cases
- urgent coronary angiography was not beneficial in OHCA patients without STEMI. (COACT trial, TOMAHAWK trial) — analizy dotyczyły pacjentów stabilnych hemodynamicznie po OHCA tj. bez wstrząsu po OHCA !!!
- Repolarization abnormalities such as ST-depression and T-wave inversion on the post-resuscitation ECG are frequently encountered

Aims

- to compare angiographic outcomes, myocardial damage, left ventricular function, and survival in patients presenting with or without ischaemic ECG patterns on the first post-resuscitation ECG recorded in-hospital.

Methods

- a post-hoc analysis of the **COACT trial**.
- The COACT trial was a multicentre, randomized controlled trial that investigated the benefit of immediate coronary angiography compared with delayed coronary angiography in successfully resuscitated patients without STEMI on the post-resuscitation ECG. This study found no benefit of immediate coronary angiography on 90-day survival and 1-year survival.
- Ischaemia was defined as ST-depression of ≥ 0.1 mV in ≥ 2 contiguous leads or T-wave inversion in ≥ 2 contiguous leads, or both.
- As part of the COACT trial protocol, all patients were randomized to immediate or delayed coronary angiography.

Table 1 Baseline characteristics

	Ischaemia on ECG (N = 340)	No ischaemia on ECG (N = 170)	P-value
Age (years)	66 ± 12	63 ± 15	0.003
Sex (male)	274 (80.6)	126 (74.1)	0.09
<i>Medical history</i>			
Hypertension	163 (48.4)	78 (46.2)	0.64
Myocardial infarction	101 (29.7)	35 (20.6)	0.03
CABG	46 (13.6)	15 (8.8)	0.12
PCI	74 (21.9)	25 (14.7)	0.054
Coronary artery disease	134 (39.4)	47 (27.6)	0.009
CVA	23 (6.8)	8 (4.7)	0.36
Diabetes mellitus	64 (18.9)	29 (17.1)	0.62
Smoker	75 (24.0)	36 (22.8)	0.78
Hypercholesterolaemia	95 (28.1)	38 (22.6)	0.19
Peripheral artery disease	24 (7.1)	10 (5.9)	0.61
<i>Arrest characteristics</i>			
Witnessed arrest	269 (79.1)	129 (75.9)	0.41
Time from arrest to BLS (min)	2 (1–5)	2 (1–5)	0.20
Time from arrest to ROSC (min)	15 (10–21)	13 (7–20)	0.07
Time from arrest to ECG at ED (min)	53 (39–71)	49 (27–70)	0.20
Glasgow Coma Scale at admission	3 (3–3)	3 (3–3)	0.97
<i>Laboratory results</i>			
pH	7.21 ± 0.14	7.23 ± 0.12	0.07
Bicarbonate (mmol/L)	19.1 ± 4.5	19.5 ± 4.2	0.45
Base excess	−7.8 ± 6.4	−7.2 ± 5.4	0.30
Troponin-T (µg/L)	0.058 (0.032–0.111)	0.034 (0.022–0.075)	<0.001
Creatinine-MB (µg/L)	6.9 (4.1–22.9)	4.9 (3.0–8.7)	0.001
Creatinine kinase (IU/L)	164 (119–243)	162 (105–284)	0.85
Lactate (mmol/L)	5.2 (3.2–8.8)	4.5 (2.8–8.2)	0.20
Creatinine (µmol/L)	103 (88–118)	99 (86–115)	0.10
Randomization to immediate CAG	168 (49.4)	94 (55.3)	0.21

BLS, basic life support; CABG, coronary artery bypass grafting; CAG, coronary angiography; CVA, cerebrovascular accident; PCI, percutaneous coronary intervention; ROSC, return of spontaneous circulation.

Table 2 Angiographic outcomes

	Ischaemia on ECG (N = 340)	No ischaemia on ECG (N = 170)	Odds ratio (95% CI) ^a
Coronary angiography performed	276 (81.2)	139 (81.8)	0.96 (0.60–1.55)
Urgent coronary angiography due to deterioration (in the delayed group)	31 (9.1)	4 (2.4)	4.16 (1.45–12.00)
STEMI	12/324 (3.7)	1/167 (0.6)	6.39 (0.82–49.53)
Cardiogenic shock	1/324 (0.3)	0 (0.0)	N.A.
Recurrent ventricular arrhythmias	7/324 (2.2)	3/166 (1.8)	1.20 (0.31–4.70)
Other	11/324 (3.4)	3/167 (1.8)	1.92 (0.53–6.98)
Significant coronary artery disease (>70%)	186 (67.4)	80 (57.6)	1.52 (1.01–2.32)
Coronary artery disease severity			
One-vessel disease	70 (25.4)	44 (31.7)	Reference
Two-vessel disease	60 (21.7)	22 (15.8)	1.71 (0.93–3.18)
Three-vessel disease	56 (20.3)	14 (10.1)	2.51 (1.28–5.04)
Acute unstable lesion	40 (14.5)	22 (15.8)	0.90 (0.51–1.59)
Acute thrombotic occlusion	16 (5.8)	5 (3.6)	1.65 (0.59–4.60)
Chronic total occlusion	108 (39.1)	38 (27.3)	1.71 (1.10–2.67)
PCI	95 (27.9)	49 (28.8)	0.96 (0.63–1.48)
CABG	25 (7.4)	13 (7.6)	0.96 (0.48–1.92)
Conservative treatment	222 (65.3)	109 (64.1)	1.05 (0.71–1.55)

CABG, coronary artery bypass grafting; CI, confidence interval; NA, not applicable; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction.

^aOdds ratios are reported as effect estimates with 95% confidence intervals. No ischaemia was used as the reference group.

Table 3 Clinical outcomes

	Ischaemia on ECG (N = 340)	No ischaemia on ECG (N = 170)	Effect size (+95% CI) ^a
Survival at 90 days follow-up	212 (62.4)	125 (73.5)	1.51 (1.08–2.12)
Targeted temperature management	314 (92.4)	162 (95.3)	0.60 (0.26–1.35)
Median target temperature	34 (33–36)	34 (33–36)	
Geometric mean (95% CI)	34 (34–34)	34 (34–34)	1.00 (0.99–1.01)
Left ventricular ejection fraction ^b	44.7 ± 12.5	49.9 ± 13.3	−5.13 (−8.84 to −1.42)
Noradrenaline administered	303 (89.1)	137 (80.6)	1.97 (1.18–3.29)
Duration of administration (days)	1.9 (1.2–2.9)	1.6 (1.1–2.3)	
Geometric mean (95% CI)	1.7 (1.5–1.9)	1.5 (1.3–1.8)	1.09 (0.90–1.32)
Dobutamine administered	93 (27.4)	42 (24.7)	1.15 (0.75–1.75)
Duration of administration (days)	1.2 (0.7–1.6)	1.3 (0.8–1.8)	
Geometric mean (95% CI)	1.0 (0.8–1.2)	1.1 (0.8–1.5)	0.91 (0.63–1.30)
Use of assist device	4 (1.2)	3 (1.8)	0.66 (0.15–3.00)
Acute kidney injury ^c			
Stage 0			Reference
Stage 1	16/307 (5.2)	4/156 (2.6)	2.06 (0.68–6.28)
Stage 2	5/307 (1.6)	4/156 (2.6)	0.64 (0.17–2.43)
Stage 3	14/307 (4.6)	8/156 (5.1)	0.90 (0.37–2.20)
Need for renal replacement therapy	11 (3.2)	5 (2.9)	1.10 (0.38–3.23)
Recurrence of ventricular tachycardia needing defibrillation	20 (5.9)	13 (7.6)	0.76 (0.37–1.56)
ICD implanted	124 (36.5)	81 (47.6)	0.63 (0.43–0.92)
Maximum troponin value (µg/L)	0.595 (0.243–1.430)	0.359 (0.159–0.845)	
Geometric mean (95% CI)	0.863 (0.660–1.129)	0.413 (0.296–0.574)	1.58 (1.13–2.20)
Maximum creatinine kinase MB (µg/L)	39.1 (18.8–122.9)	21.8 (12.7–47.5)	
Geometric mean (95% CI)	46.4 (38.2–56.3)	26.4 (21.1–33.1)	1.80 (1.39–2.32)
Maximum creatinine kinase (IU/L)	800 (379–2087)	899 (361–1555)	
Geometric mean (95% CI)	917 (773–1088)	876 (690–1111)	1.06 (0.86–1.31)
Maximum lactate (mmol/L)	4.9 (2.8–8.4)	4.5 (2.8–8.0)	
Geometric mean (95% CI)	5.0 (4.51–5.50)	4.5 (3.9–5.2)	1.05 (0.92–1.19)
Duration of ICU hospitalization	4 (2–6)	3 (2–6)	
Geometric mean (95% CI)	4 (4–5)	4 (3–4)	1.11 (0.97–1.29)
Duration of hospital admission	12 (6–19)	16 (7–22)	
Geometric mean (95% CI)	11 (9–12)	13 (11–15)	0.83 (0.69–0.99)

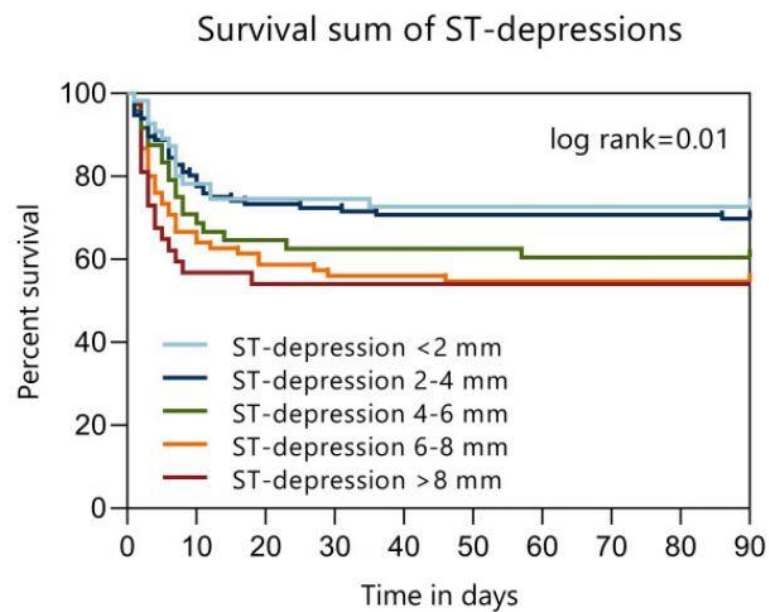
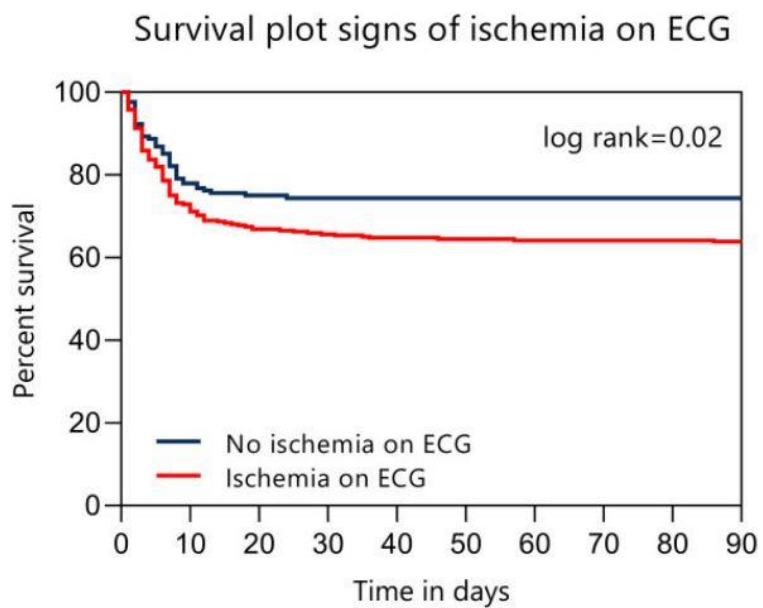


Figure 1 Kaplan–Meier estimates on 90-day survival. Patients with ischaemic electrocardiogram patterns had worse survival compared with patients without.

Table 4 Assessment of potential confounders for association between ischaemic electrocardiogram and 90-day survival

	(Adjusted) HR for ischaemic ECG	95% CI for (adjusted) HR for ischaemic ECG	P-value for (adjusted) HR for ischaemic ECG
Ischaemic ECG (unadjusted HR)	1.51	1.08–2.12	0.02
Adjusted for single confounder			
Age	1.33	0.94–1.86	0.10
Male sex	1.53	1.09–2.16	0.01
History of myocardial infarction	1.45	1.03–2.04	0.03
History of PCI	1.46	1.04–2.05	0.03
History of coronary artery disease	1.45	1.03–2.04	0.03
Time from OHCA to ROSC (min)	1.36	0.93–2.00	0.12

Results

Study has shown that patients with ischaemic ECG patterns in the absence of STEMI on the post-resuscitation ECG had more CAD, higher levels of myocardial injury, worse left ventricular function, and lower survival compared with patients without ischaemic ECG patterns.

Conclusions

In successfully resuscitated patients without signs of STEMI, ischaemic ECG patterns such as ST-depression and/or T-wave inversion were found to be associated with worse 90-day survival. Moreover, a higher sum of ST-depression was associated with worse survival. Adjusted for age and time to ROSC, ischaemic ECG patterns were no longer associated with survival. These findings suggest that ischaemic ECG patterns in survivors of OHCA with no ST-segment elevation are mostly due to myocardial ischaemia caused by prolonged resuscitation.