

Supplementary material

Grześkowiak M, Gaczkowska AD, Bekala A, et al. People, who survived their own death — remarks for medical professionals based on the analysis of published cases worldwide. Kardiol Pol. 2021.

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Table 1. Cases of Lazarus phenomenon selected for analysis (66 patients)

Cases of Lazarus phenomenon by year of publication, country and authors (references)	Diseases before CA (origin: C-cardiac, NC-non cardiac) and place of CA if known (IH – in hospital, OH – out of hospital)	Age	Gender	Time of CPR (in min)	Rhythm during CPR before autoresuscitation	Time from stopping CPR to autoresuscitation (in min)	Monitoring of the rhythm	Back of consciousness	Survival after autoresuscitation (in days)
1982, France - Letellier N, Coulomb F, Lebec C, et al: Recovery after discontinued cardiopulmonary resuscitation. Lancet 1982; 1:1019	C - MI, Pulmonary oedema	80	M	20	A	5	ECG	Yes	35
1982, Finland - Linko K, Honkavaara P, Salmenpera M: Recovery after discontinued cardiopulmonary resuscitation. Lancet 1982; 1:106-7	C - MI	67	M	20	A	Few	No	NK	15
	C - MI,	68	F	NK	A	20	No	Yes	90
	C - MI,	84	M	10	A	5	ECG	No	1

1987, Germany - Klockgether A, Kontokollias JS, Geist J, et al: Monitoring im Rettungsdienst. Notarzt 1987; 3:85–88	NC - Multiple trauma, OH	40	F	30	A	10	NK	Yes	Discharge at 3 months
1991, USA - Rogers PL, Schlichtig R, Miro A, et al: Auto-PEEP during CPR. An “occult” cause of electromechanical dissociation? Chest 1991; 99:492–493	NC - COPD, respiratory acidosis, IH	64	M	20	PEA	15	NK	NK	1 hour
1991, Australia - Rosengarten PL, Tuxen DV, Dziukas L, et al: Circulatory arrest induced by intermittent positive pressure ventilation in a patient with severe asthma. Anaesth Intensive Care 1991; 19:118–121	NC – Acute asthma (since childhood)	36	F	25	PEA	3	ECG	Yes	After six months functioning independently at home
1991, Norway - Skulberg A: Criteria of death and time of death—do Norwegian physicians follow laws and regulations? Tidsskr Nor Laegeforen 1991; 111:3310–3311	NC - Addison’s, adrenal attack, OH	49	M	30	A	5	NK	Yes	15
	NC - Liver resection, hypothermia, OH	NK	NK	NK	PEA	15	NK	Yes	Complete recovery after 24 hours
	NC - Stroke, OH	75	F	20	A	5	NK	No	Hours
	NK, OH	NK	NK	30	A	5	No	No	<1
1993, Belgium - Martens P, Vandekerckhove Y, Mullie A: Restoration of spontaneous circulation after cessation of cardiopulmonary resuscitation. Lancet 1993; 341:841	NC - Asthma, IH	87	F	>15	NK	NK	ECG	NK	12
1993, USA - Bray JG Jr.: The Lazarus phenomenon revisited. Anesthesiology 1993;78:991	NC - haemorrhage (ruptured pulmonary artery)	75	M	23	A	5	No	No	Several
1994, USA - Quick G, Bastani B: Prolonged asystolic hyperkalemic cardiac arrest with no neurologic sequelae. Ann Emerg Med 1994; 24:305–311	C - Heart failure, renal failure IH	70	M	34	A	8	NK	Yes	21

1996, Austria - Voelckel W, Kroesen G: Unexpected return of cardiac action after termination of cardiopulmonary resuscitation. Resuscitation 1996; 32:27-29	NC - Hyperkalaemia, OH	55	M	30	A	7	ECG	NK	3
1996, Portugal - Gomes E, Araujo R, Abrunhosa R, et al: Two successful cases of spontaneous recovery after cessation of CPR. Resuscitation 1996; 31:S40	C – MI IH	66	M	30	VF	<5	NO	Yes	Recovered
1997, Germany - Mutzbauer TS, Stahl W, Lindner KH: Compression-decompression (ACD)-CPR. Prehospital and Disaster Medicine 1997; 12:S21	C – MI OH	35	M	88	A	<5	NK	No	1
1997, Switzerland - Fumeaux T, Borgeat A, Cuenoud PF, et al: Survival after cardiac arrest and severe acidosis (pH 6.54). Intensive Care Med 1997; 23:594	C – MI OH	54	F	50	PEA	1	No	Yes	93
1998, Germany - Frolich MA: Spontaneous recovery after discontinuation of intraoperative cardiopulmonary resuscitation: Case report. Anesthesiology 1998; 89:1252–1253	C – MI IH	67	F	43	A	5	ECG	Yes	9
1998, Germany - Maleck WH, Piper SN, Triem J, et al: Unexpected return of spontaneous circulation after cessation of resuscitation (Lazarus phenomenon). Resuscitation 1998; 39:125-128	NC - Pancreatitis, cerebral infarction	80	M	30 (total of 3 CA)	PEA	5	ECG, Invasive blood pressure	No	2
1999, United Arab Emirates - MacGillivray RG: Spontaneous Recovery after Discontinuation of Cardiopulmonary Resuscitation. Anesthesiology 1999; 91:585-586	NC – CPOD IH	76	M	30	A	5	ECG	No	1

1999, UK - Bradbury N: Letter to editor, Lazarus phenomenon: another case? Resuscitation 1999; 41:87	C - Ischaemic heart disease, MI	59	F	6 loops + 3min	PEA	2	ECG/BP	No	30 minutes
2001, USA - Ben-David B, Stonebraker VC, Hershman R, et al: Survival after failed intraoperative resuscitation: a case of "Lazarus Syndrome". Anesth Analg 2001; 92:690-692.	NC - Hypertension, haemorrhage (probably abdominal aortic aneurysm), IH	66	M	18	A	10	ECG	Yes	13
2001, UK - Walker A, McClelland H, Brenchley J: The Lazarus phenomenon following recreational drug use. Emergency Medicine Journal 2001; 18:74-75	NC - Heroin and ecstasy user, OH	27	M	25	A	1	ECG, BP	Yes	Discharged after 31
2001, USA - Abdullah RS: Restoration of Circulation After Cessation of Positive Pressure Ventilation in a Case of „Lazarus Syndrome". Anesth Analg 2001; 93:241	NC - Septic shock, renal failure, embolism of mesenteric artery, IH	93	F	6	No	5	ECG	No	NK
2002, UK - Adhiyaman V, Sundaram R: The Lazarus phenomenon. The Journal of the Royal College of Physicians of Edinburgh 2002; 32:9-13	C - COPD, MI	NK	NK	15	PEA	NK	No	NK	NK
2002, Japan - Maeda H, Fujita MQ, Zhu BL, et al: Death following spontaneous recovery from cardiopulmonary arrest in a hospital mortuary: 'Lazarus phenomenon' in a case of alleged medical negligence. Forensic Sci Int 2002; 127:82-87	NC - Congenital deafness, dumbness, chronic gastritis OH	65	M	35	A	20	ECG	No	5
2003, Germany - Dück MH, Paul M, Wixforth J, et al: Das Lazarus-Phänomen Spontane Kreislaufstabilisierung nach erfolgloser intraoperativer Reanimation bei	NC - Ruptured aortic aneurysm /DDD/ IH	81	M	25	A	2	ECG Invasive BP SpO ₂ ETCO ₂	Yes	31

einem Patienten mit Herzschrittmacher. Anaesthetist 2003; 52:413-418									
2004, Italy - De Salvia A, Guardo A, Orrico M, et al: A new case of Lazarus Phenomenon? Forensic Sci Int 2004; 146S:S13-S15	C - MI, OH	81	F	13	A	Few	ECG, BP	No	20 hours
2004, Spain - Casielles Garcia JL, Gonzalez Latorre MV, Fernandez Amigo N, et al: Lazarus phenomenon: spontaneous resuscitation. Rev Esp Anesthesiol Reanim 2004; 51:390-394	NC - Duodenal perforation, haemorrhage IH	94	F	40	PEA	3	ECG	NK	21
2005, USA - Jain S, DeGeorgia M: Brain Death-Associated Reflexes and Automatism. Neurocritical Care 2005; 3:122-126	NC - Dyspnea, hypoxia	41	M	15	A	23	ECHO	No	5
2005, Germany - Puschel K, Lach H, Wirtz S, et al: Ein weiterer Fall von "Lazarus-Phänomen"? Notfall Rettungsmedizin 2005; 8:528-532	C - MI OH	83	F	17	A	33	NK	No	4 hours
2005, Saudi Arabia - Al-Ansari MA, Abouchaleh NM, Hijazi MH: Return of spontaneous circulation after cessation of cardiopulmonary resuscitation in a case of digoxin over dosage. Clinical Intensive Care 2005; 16:179-181	NC - Poisoning by digoxin	63	F	12	A	10	ECG	Yes	12
2006, Spain - Torbado A, Pellejero S, Uriz J, et al: No neurological impairment after a case of Lazarus phenomenon. Eur J Anaesthesiol 2006; 23:214	C - Cardiomyopathy, dyspnoea OH	83	M	60	PEA	7	ECG, SpO ₂	Yes	NK
2006, Austria - Monticelli F, Bauer N, Meyer HJ: Lazarus phenomenon: current resuscitation standards and questions for the	C - MI, OH	78	M	25	A	Few	NK	No	19 hours

expert witness. Rechtsmedizin 2006; 16:57–63									
2007, Germany - Klein A, Lach H, Püschel K: Ein weiterer Fall von „Scheintod“ - Diskussion über Richtlinien zur Todesfeststellung im Rettungswesen. Notfall & Hausarztmedizin 2007; 33:330-335	NC - drug intoxication (attempted suicide) OH	52	F	No CPR	A	NK	NK	NK	Discharge with days
2007, Finland - Kamarainen A, Virkkunen I, Holopainen L, et al: Spontaneous defibrillation after cessation of resuscitation in out-of-hospital cardiac arrest: A case of Lazarus phenomenon. Resuscitation 2007; 75:543-546	NC - Hepatitis C, alcohol abuse. OH	47	M	26	A	15	NK	Open eyes, spontaneous inappropriate verbal response	3 months
2007, Germany - Wiese CHR, Stojanovic T, Klockgether-Radke A, et al: Intraoperative „Lazarus-Phänomen“? Spontane Kreislaufstabilisierung bei einem Patienten mit Herzschrittmacher. Anaesthesist 2007; 56:1231–1236	NC - Ruptured aortic aneurysm /DDD/ IH	85	M	No CPR	PEA	6	ECG, Invasive BP SpO ₂ , ETCO ₂	No	2
2010, Germany - Tiesmeier J, Brandt O, Emmerich M: Unexpected return of vital signs after cessation of prehospital resuscitation–Lazarus phenomenon. MMW Fortschritte der Medizin 2010; 152:33–36	NK OH	NK	NK	36	A	2	ECG	No	25 minutes
2010, Denmark - Krarup NH, Kaltoft A, Lenler-Petersen P: Risen from the dead: A case of the Lazarus phenomenon — With considerations on the termination of treatment	NK Coronary artery bypass, stroke,	84	M	15	PEA	5	ECG	Yes	After 1 year was doing well

following cardiac arrest in a prehospital setting. Resuscitation 2010; 81:1598-1599	abdominal aortic aneurysm OH								
2011, Spain - Rodriguez Aguado O, Suarez Portilla FJ, Novalbos Ruiz JP, et al: Lazarus phenomenon in an out-of-hospital emergency attended by a home emergency service. Emergencias 2011; 23:43-46	NC - COPD, liver cirrhosis hypertension, smoker, drinker, OH	83	M	90	A	10	ECG	No	12
2011, Canada - Duff JP, Joffe AR, Sevcik W, et al: Autoresuscitation after pediatric Cardiac Arrest. Is hyperventilation a cause? Pediatr Emerg Care 2011; 27:208-209	NC - Medulloblastoma, shock, neutropenia	3	M	25	A	1	ECG, ETCO ₂	NK	40 minutes
	NC - Found apnoeic and pulseless, OH	9 month	F	NK	A	30 s	ECG USG	Severe brain injury	several
2011, USA - Cummings BM, Noviski N: Letter to editor, Autoresuscitation in a child: The young Lazarus. Resuscitation 2011; 82:134	NC - microcephaly, spastic quadriplegia, home mechanical ventilation, pneumonia	10	F	40	PEA	2	BP	No	Absence of brain stem reflexes - withdraw care
2012, Greece - Ekmektzoglou KA, Koudouna E, Bassiakou E, et al: An intraoperative case of spontaneous restoration of circulation from asystole: a case of Lazarus phenomenon. Case Reports in Emergency Medicine 2012; Article ID 380905.	NC - after self-shooting, femoral artery rupture IH	53	M	46	A	2	ECG, Invasive BP SpO ₂ , ETCO ₂	No	34
2012, Malaysia - Low DW, Looi I, Manocha AB, et al: Rising From The Dead! <i>The Medical Journal of Malaysia</i> 2012; 67:538-539	C – MI, chronic smoker, hypertension, OH	65	M	55	A	40	ECG, BP	No	13
2013, USA - Huang Y, Kim S, Dharia A, et al: Delayed recovery of spontaneous circulation following cessation of	Hip trauma, COPD, hypertension, hypothyroidism	89	F	18	A	5	ECG	No	370 minutes

cardiopulmonary resuscitation in an older patient: a case report. Journal of Medical Case Reports 2013; 7:65	lymphedema, lung resection IH									
2013, Singapore - Thong S-Y, Ng S-Y: Case report - Lazarus syndrome after prolonged resuscitation. Journal of Anesthesiology & Clinical Science 2013; 2:14	NC - Head injury, IH	62	M	40	PEA A	5	ECG	NK	34 hours	
2014, Denmark - Schierbeck LL, Katja C: Lazarusfænomen. Ugeskrift for Læger 2014; 176:2-3	NC -hyperkalaemia IH	NK	NK	22	A	3	ECG	Yes	Full recovery (minor impairments)	
2014, Turkey - Adanali M, Güvenç TS, Kale MY, et al: Lazarus phenomenon in a patient with Duchenne muscular dystrophy and dilated cardiomyopathy. Journal of Acute Medicine 2014; 4:99-102	NC - Duchenne dystrophy	21	M	30	A	10	ECG	Yes	57	
2015, Denmark - Hannig KE, Hauritz RW, Grove EL: Autoresuscitation: A Case and Discussion of the Lazarus Phenomenon. Case Reports in Medicine 2015; Article ID 724174	NK, Hypertension, atherosclerosis, COPD, abdominal aortic aneurism, coronary artery bypass	67	M	47	PEA	5	ECG ECHO	Yes	1	
2015, USA - Tretter JT, Redunsky GS, Rogers DJ, et al: A pediatric case of autoresuscitation. Pediatr Emerg Care 2015; 31:138-139	ischemic encephalopathy cardiomyopathy	11 month	F	35	NK	15	No	No	4,5 months	
2016, Australia - Yong SA, D'Souza S, Philpot S, et al: The Alfred Hospital experience of resumption of cardiac activity after withdrawal of life-sustaining therapy. Anaesth Intensive Care 2016; 44:605-606	NC – Multiple trauma	NK 40-50	M	No CPR	NK	1 min 42 sec	ECG	No	108 seconds	
	NC - End-stage pulmonary fibrosis IH	57	F	No CPR	NK	3 min	ECG	No	3 minutes	

2016, India - Sukhyanti K, ShriKrishan C, Anu K, et al: Lazarus phenomenon revisited: a case of delayed return of spontaneous circulation after carbon dioxide embolism under laparoscopic cholecystectomy. <i>Anaesthesia, Pain & Intensive Care</i> 2016; 20:338-340	NC – during laparoscopic cholecystectomy (probable CO ₂ embolism) IH	25	F	40	A	5-7 min	ECG SpO ₂ BP EtCO ₂	No	4 hours
2016, USA - Meeker JW, Kelkar AH, Loc BL, et al: A Case Report of Delayed Return of Spontaneous Circulation: Lazarus Phenomenon. <i>The American Journal of Medicine</i> 2016; 129:e343-e344	Quadriplegia after fracture, haemodialysis	69	F	25	PEA	10	ECG USG	NK	Discharge with minimal neurologic function
2016, Germany - Haggmann H, Oelmann K, Stangl R, et al: Is increased positive end-expiratory pressure the culprit? Autoresuscitation in a 44-year-old man after prolonged cardiopulmonary resuscitation: a case report. <i>Journal of Medical Case Reports</i> 2016; 10:364	C - Viral myocarditis	44	M	80	PEA	5	ECG	No	3
2017, Turkey - Guven AT, Petridis G, Ozkal SS, et al: Lazarus Phenomenon in Medicolegal Prospective: A case report. <i>The Bulletin of Legal Medicine</i> 2017; 22:224-227	Alzheimer disease, OH	69	M	40	A	180	180	No	10
2017, Finland - Kusima M, Salo A, Puolakka J, et al: Delayed return of spontaneous circulation (the Lazarus phenomenon) after cessation of out-of-hospital cardiopulmonary resuscitation. <i>Resuscitation</i> 2017; 118:107-111	NK	97	F	16	A	3	No	No	2 minutes
	NC - Haemorrhage	30	F	31	PEA	6	BP	Yes	88 minutes
	NC - Carbon monoxide	63	M	12	PEA	3	EtCO ₂	Yes	> 1
	NK	91	F	16	PEA	3	No	No	15 minutes
	NC - Aortic dissection	61	F	18	PEA	8	No	No	3 minutes

2017, UK - Spowage-Delaney B, Edmunds CT, Cooper JG: The Lazarus phenomenon: spontaneous cardioversion after termination of resuscitation in a Scottish hospital. BMJ Case Reports 2017; 2017:bcr-2017-219203	C – MI, hypertension, type 2 diabetes	66	M	45	PEA	5	ECG BP	Yes	9
2018, Singapore - Ding WY, Meah M, Mann P: Unassisted return of spontaneous circulation after ventricular fibrillation. J Cardiovasc Electrophysiol 2018; 29:199-200	C - ventricular dysfunction, chronic kidney disease, digoxin overdose, hyperkalaemia	97	M	No CPR DN AR	A, VF	NK	ECG	No	20 hours
2018, N. Ireland - Mullen S, Roberts Z, Tuthill D, et al: Lazarus Syndrome – Challenges Created by Pediatric Autoresuscitation. Pediatr Emerg Care 2018; Sep11:doi:10.1097/PEC.0000000000001593	NC - suspected choking Ex-preterm born at 24 week	18 months	M	NK	PEA	6	ECG EtCO ₂	Yes	Survived, (unable to communicate or swallow)

Abbreviations: CA, cardiac arrest; MI, myocardial infarction; NK, not known; COPD, chronic obstructive pulmonary disease; A, asystole; PEA, pulseless electrical activity; VF, ventricular fibrillation