Factors Associated With Pulseless Electric Activity Versus Ventricular Fibrillation

The Oregon Sudden Unexpected Death Study

Carmen Teodorescu, MD, PhD; Kyndaron Reinier, PhD;
(*Circulation.* **2010;122:2116-2122.**)

Reporter: Int 邱柏儒
Supervisor: VS 吳柏衡
1000307

Back ground

- A continuing Decline in the presence of SCA (sudden cardiac death) presenting as VF, but a significant rise in the prevalence of PEA.

Outlines

- Introduction
- Material & Methods
- Results
- Discussion

Introduction

- Goteborg, Sweden, 1981~1997, VF (39% →32%), PEA(6% →26%).
- Helsinki, Finland,1994~1999, VF(↓48%)
- The success rates of resuscitation from SCA a function of of the presenting arrhythmia: VF/VT (40%), PEA($\leqq$6%).

- First-responder analysis and lifetime clinical history for factors associated with PEA.
- We hypothesized that both the type as well as number of associated diseases conditions ("diseases burden") may also influence presenting arrhythmia.
- A large, ongoing, community-based study of SCA.

Methods

- The Oregon Sudden Unexpected Death Study (Oregon-SUDS) is an ongoing prospective study of out-of-hospital SCA in in Portland, Ore, metropolitan region.
- Feb 1, 2002~ Jan 31, 2007; $\geqq$18 years
- Excluded: noncardiac cause of SCA, trauma, terminal illness, drug overdoses.

- Patient's demographics, arrest circumstances, and lifetime clinical history was compared between VF/VT, PEA and asystole.

Definition

- SCA: sudden unexpected pulseless condition of likely cardiac causes; alive within 24 hrs if unwitnessed.
- Presenting arrhythmia: initial recorded rhythm by ECG rhythm strips.(64%)
- VF: pulseless condition with characteristic features on the cardiac recording .

- PEA: a pulseless condition with the appearance of an organized electric rhythm on cardiac monitoring.
- Asystole: the absence of electric activity on cardiac monitoring.
- Response time: from dispatch of emergency medical personnel to their arrival on the scene in contact with the patient. (Utstein criteria >4 mins or $\leqq$4 mins)

- Return of spontaneous circulation: return of a palpable pulse in conjunction with a SBP$\geqq$60 mmHg.
- Established CAD: MI, coronary revascularization, $\geqq$50% stenosis of CAG.
- Hyperlipidemia, DM, CRI: clinical history or drugs.
- Pulmonary diseases: history of asthma, COPD, inhaled bronchodilator or home oxygen.

- HTN, CHF, CVA, PAD, syncope, seizure, sleep apnea by clinical history.
- Disease burden: a simple sum of all preexisting clinical conditions above.
- The prevalence of conduction system disease from resting 12-lead EKG(14 months)
  - No conduction abnormality, low grade, high grade.

Statistical Analysis

- ANOVA + Tukey-Kramer post hosc test for continuous variables; Pearson $\chi 2$ test for categorical variables.
- Wilcoxon rank sum test for disease burden.
- Clinical characterisitics adjusted for age by CochranMantel-Haenszel test.
- Significant variables from univariate analysis were entered in a full multiple logistic regression model.

- To adjust for <u>arrest circumstances, witnessed status, arrest location and response time</u> were retained in the final model regardless of their significance level.
- <u>Because the age difference between patients presenting with PEA and VF/VT</u>, a logistic regression model restricted to patient aged < 75 yrs was also run to evaluated the consistency of multi-variable results.

Results

Table 1. Demographics and Outcome by Presenting Arrhythmia at Time of Cardiac Arrest, Oregon-SUDS 2002–2007 (n=1187)

	PEA (n=301) 24.9%	VF/VT (n=578) 47.8%	Asystole (n=308) 25.5%	P*	
Age, mean±SD, y	67.8±15.1	63.3±14.8	65.7±16.4	0.0002	64.9
Male, n (%)	189 (62.8)	426 (73.7)	178 (57.8)	<0.0001	67%
Female, n (%)	112 (37.2)	152 (26.3)	130 (42.2)		
Race/ethnicity, n (%)				0.01	
White	249 (84.1)	475 (88.6)	251 (84.0)		
Black	33 (11.1)	29 (5.4)	22 (7.4)		
Hispanic	5 (1.7)	12 (2.2)	7 (2.3)		
Asian	4 (1.4)	13 (2.4)	16 (5.3)		
Other†	5 (1.7)	7 (1.3)	3 (1.0)		
Missing‡	5	42	9		
Marital status, n (%)				0.07	
Married	128 (47.4)	234 (56.0)	153 (55.0)		
Never married/widowed/divorced	142 (52.6)	184 (44.0)	125 (45.0)		
Missing‡	31	160	30		
Education status, mean±SD, y (n)	12.5±3.0 (268)	12.7±2.5 (417)	12.7±2.4 (279)	0.52	

	PEA (n=301)	VF/VT (n=578)	Asystole (n=308)	P*	
Return of spontaneous circulation, n (%)	94 (31.2)	282 (48.8)	54 (17.5)	<0.0001	36%
Survival to hospital discharge, n (%)	17 (5.7)	133 (24.9)	1 (0.3)	<0.0001	13%
Missing‡	5	44	5		
Witnessed status, n (%)					
Witnessed	179 (59.7)	414 (72.2)	128 (41.5)	<0.0001	61%
Witnessed by EMS	30 (10.0)	33 (5.8)	7 (2.3)		6%
Not witnessed	91 (30.3)	126 (22.0)	173 (56.2)		33%
Missing‡	1	5	0		
Arrest location, n (%)				<0.0001	
Home	174 (67.2)	249 (56.5)	192 (74.7)		
Public building/outside	36 (13.9)	126 (28.6)	25 (9.7)		
Care facility/ambulance/outpatient clinic	41 (15.8)	40 (9.1)	37 (14.4)		
Vehicle/other	8 (3.1)	26 (5.9)	3 (1.2)		
Missing‡	42	137	51		
Response time, mean±SD, min (n)	6.9±3.2 (287)	6.6±3.2 (517)	6.9±3.1 (281)	0.41	
Response time >4 min, n (%)	212 (73.9)	363 (70.2)	209 (74.4)	0.35	73%

No significant difference in mean response time based on presenting arrhythmia: P=0.74, mean ranges from 6.4 to 7.0 minutes.

Comparison of preexisting clinical conditions

Table 2. Comparison of Preexisting Clinical Conditions by Presenting Arrhythmia at Time of Cardiac Arrest, Oregon-SUDS 2002–2007 (n=829)

Categories	PEA (n=218)	VF/VT (n=401)	Asystole (n=210)	P*	Age-Adjusted P†
Documented CAD	72 (33.0)	216 (53.9)	75 (35.7)	<0.0001	<0.0001
Hyperlipidemia	59 (27.1)	170 (42.4)	75 (35.7)	0.0007	0.0001
Syncope	26 (11.9)	19 (4.7)	15 (7.1)	0.004	0.006
Pulmonary disease	76 (34.9)	89 (22.2)	73 (34.8)	0.0003	0.0007
Seizure	17 (7.8)	16 (4.0)	14 (6.7)	0.11	0.03
Hypertension	125 (57.3)	227 (56.6)	115 (54.8)	0.86	0.85
Congestive heart failure	54 (24.8)	109 (27.2)	62 (29.5)	0.54	0.20
Cerebral vascular accident	34 (15.6)	46 (11.5)	23 (11.0)	0.25	0.58
Peripheral vascular disease	24 (11.0)	64 (16.0)	20 (9.5)	0.05	0.01
Sleep apnea	15 (6.9)	30 (7.5)	13 (6.2)	0.84	0.81
Diabetes mellitus	72 (33.0)	142 (35.4)	77 (36.7)	0.72	0.49
Liver disease	3 (1.4)	2 (0.5)	5 (2.4)	0.11	0.12
Chronic renal disease	36 (16.5)	62 (15.5)	32 (15.2)	0.92	0.99
Disease burden‡	2.0 (1.0–4.0)	3.0 (1.0–4.0)	3.0 (1.0–4.0)	0.38	0.15

Prevalence of cardiac conduction system disease on the resting ECG between three group:

Table 3. Prevalence of Cardiac Conduction System Disease on 12-Lead ECG by Presenting Arrhythmia, Oregon-SUDS 2002–2007 (n=391)

Type of Conduction Abnormality	PEA (n=114)	VF/VT (n=171)	Asystole (n=106)	P*
No conduction system abnormality	78 (68.4)	116 (67.8)	69 (65.1)	0.48
Low-grade conduction abnormality	14 (12.3)	20 (11.7)	20 (18.9)	
First-degree AV block	5 (4.4)	7 (4.1)	9 (8.5)	
LAFB	8 (7.0)	7 (4.1)	6 (5.7)	
LPFB	0 (0.0)	0 (0.0)	3 (2.8)	
IRBBB/ILBBB	1 (0.9)	6 (3.5)	2 (1.9)	
High-grade conduction abnormality	22 (19.3)	35 (20.5)	17 (16.0)	
LBBB	3 (2.6)	8 (4.7)	1 (0.9)	
RBBB	7 (6.1)	3 (1.7)	1 (0.9)	
IVCD	8 (7.0)	22 (12.9)	12 (11.3)	
Bifascicular block	4 (3.5)	2 (1.2)	3 (2.8)	

Comparison of Cardiac History in Syncope Patients

- Older in PEA than VF/VT and asystole.
- No significant difference were identified in gender distribution or clinical history of cardiomyopathy, Af, aortic stenosis and CHF. (P≧0.10)

Causes of syncope

	PEA(26)	VF/VT(19)	Asystole(15)
Permanent pacemaker	2	0	1
Paryoxysmal supraventricular tachycardia	1	0	1
VT	0	3	1
AV block	1	0	1
No hx of cardiac disease	6	4	0
others	1 Torsades 1 vasovagal	1 long QT 3 implanted defibillator	
Unknown causes	14	8	11

Multivariate Analysis of PEA versus VF/VT

Table 4. Multivariable Odds Estimates of Factors Associated With PEA vs VF/VT, Oregon-SUDS 2002–2007 (n=538)

	OR (95% CI)*
Age (per year increase)	1.02 (1.01–1.04)
White	1.0 (reference)
Black	2.64 (1.29–5.38)
Hispanic	0.32 (0.05–2.13)
Asian	0.88 (0.20–3.98)
Other race	1.02 (0.23–4.59)
CAD	0.35 (0.23–0.53)
Hyperlipidemia	0.59 (0.38–0.90)
History of syncope	2.64 (1.31–5.32)
Male without pulmonary disease	1.00 (reference)
Female without pulmonary disease	1.68 (1.01–2.82)
Male with pulmonary disease	3.17 (1.86–5.42)
Female with pulmonary disease	2.11 (1.10–4.04)

CI indicates confidence interval.
*Adjusted for witnessed status, arrest location, and response time.

Similar results was found in a model restricted to cases aged < 75 yrs, and restricted to witnessed cases.
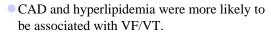
Multivariable Analyses of PEA Versus Asystole

Table 5. Multivariable Odds Estimates of Factors Associated With PEA vs Asystole, Oregon-SUDS 2002–2007 (n=393)

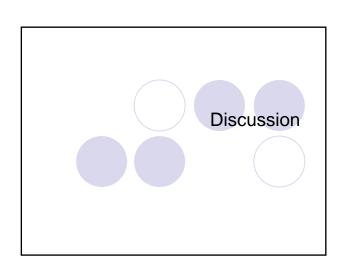|	OR (95% CI)*
Age (per year increase)	1.01 (1.00–1.03)
White	1.0 (reference)
Black	1.30 (0.65–2.63)
Hispanic	1.11 (0.15–8.38)
Asian	0.26 (0.07–1.03)
Other race	1.10 (0.17–7.05)
Hyperlipidemia	0.61 (0.39–0.97)
History of syncope	2.27 (1.08–4.78)

CI indicates confidence interval.
*Adjusted for witnessed status, arrest location, and response time.

Conclusion

- CAD and hyperlipidemia were more likely to be associated with VF/VT.
- Age, black, female gender and pulmonary disease, a history of syncope was a significant correlate to PEA.

Discussion

Discussion

- 1. What's the causes of the phenomenon of ↑ PEA with ↓ VF/VT?
  - Unlikely to be a function of response time for resuscitation.
    - Sweden: shortening of the response time correlated with decreased VF prevalence and increased PEA prevalence.
    - The present study observed no significant difference in response time between VF/VT, PEA and Asystole.
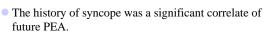
- Age & Woman
  - Longer response times in woman may explain their increased likelihood of presenting with PEA.
  - The present study showed No gender–related difference in response time.
- Black

- The history of syncope was a significant correlate of future PEA.
  - The Framingham Heart Study: the strongest predictor of overall mortality in patients with syncope was heart disease.
  - The present study showed patients with PEA may have had a propensity for syncope.
  - No differences in the prevalence of conduction system disease on the 12-lead EKG.

- CAD and male gender are considered risk factors for occurrence of VF.
  - Morality due to CAD has been halved.
  - Recently observed decline in CAD could lead to a decline in incidence of VF?
    - Milwaukee. Wis; the decreased VF/VT incidence was found not to be related to any patient or EMS dependent factors.
    - The present study showed association between VF/VT with CAD and hyperlipidemia.

- We had hypothesized that occurrence of PEA may be a function of these patients having a higher prevalence of comorbidities or extracardiac conditions.
  - No significant differences in disease burden between the 3 forms of presenting arrhythmias.

- Previous clinical reports have focused largely on the SCA event, attributing manifestation of PEA to a variety of factors:
  - Hypoxia, hypovolemia, electrolyte imbalance, tamponade, pneumothorax, thromboembolism.
  - Preexisting clinical conditions from the lifetime clinical history + first responder data.

Thank you for your attentions!