Resuscitation 85 (2014) 196–202

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical Paper

The incidence and significance of bacteremia in out of hospital cardiac arrest☆

Victor Coba[a,b,*], Anja Kathrin Jaehne[a], Arturo Suarez[a,c], Gilbert Abou Dagher[a], Samantha C. Brown[a], James J. Yang[d], Jacob Manteuffel[a], Emanuel P. Rivers[a,b]

[a] Department of Emergency Medicine, Henry Ford Hospital, Detroit, MI, United States
[b] Department of Surgery, Henry Ford Hospital, Detroit, MI, United States
[c] Department of Anesthesiology, Henry Ford Hospital, Detroit, MI, United States
[d] Department of Public Health Sciences, Henry Ford Hospital, Detroit, MI, United States

Introduction

- The most common etiology of cardiac arrest is presumed of myocardial origin.
- Recent retrospective studies indicate that preexisting pneumonia is frequent in patients with cardiac arrest without preceding signs of septic shock, respiratory failure or severe metabolic disorders

- Carr et al examined the characteristics of IHCA diagnosed with pre-existing pneumonia
  - The incidence of pre-existing pneumonia was 12.1% (5367 of 44,416) from a multicenter cardiac arrest registry.
- Abrupt cardiac arrest without signs of hypotension, overt shock, respiratory failure or severe metabolic derangements.

5. Carr GE, Yuen TC, McConville JF, et al. Early cardiac arrest in patients hospitalized with pneumonia: a report from the American Heart Association's Get With The Guidelines-Resuscitation Program. Chest 2012;141:1528–36.

- Little is known the prevalence of bacteremia in cardiac arrest patients arriving to the ED.

✓To examine the incidence of bacteremia in out of hospital cardiac arrest (OHCA) and identify the characteristics associated with bacteremia.

Methods

- This was a prospective observational convenient sampling study of OHCA adult patients seen at an urban academic teaching institution
- August 2007 to August 2009
- The study was designed to obtain blood cultures near time of cardiac arrest event during ACLS therapy or return of spontaneous circulation (ROSC)

- The excluded were all trauma cardiac arrest victims, pregnant patients, and patients found younger than 18 years.
- Bacteremic OHCA group
  - one blood culture tube with non-skin flora pathogens
- Non-bacteremic OHCA group
  - no bacterial growth after at least 5 days

- The **primary objective** of the study was to identify the incidence of bacteremia in OHCA adults.
- **Secondly**, *patient characteristics* and *hospital mortality* of the bacteremic OHCA compared to the non-bacteremic OHCA group

Results

- From 2007 to 2009, 250 OHCA cardiac arrest patients had 2 sets of blood cultures obtained.
- 77 (31%) met exclusion criteria
- There was 173 patients, 71 had positive blood cultures of which cultures were defined as 6 contaminants (skin flora) and included for analysis in the non-bacteremic OHCA group.

- 65 (38%) were found to be bacteremic with asystole and PEA as the most common presenting rhythms.
- Mortality in the ED was significantly higher in bacteremic OHCA (75.4%) compared to non-bacteremic OHCA (60.2%, $p < 0.05$).
- Predictive factors associated with bacteremic OHCA were lower initial arterial pH, higher lactate, WBC, BUN and creatinine.

Table 1
Demographics characteristics of patients with OHCA presenting to the emergency department and disposition from the emergency department.

Patient characteristics	Bacteremic OHCA (n = 65)	Non-bacteremic OHCA (n = 108)	p
Age, years	65.5 ± 15.1	64.6 ± 18.5	0.74
Male	55.4% (36)	59.3% (64)	0.62
Race			
African American	88% (57)	83% (90)	0.86
Caucasian	9% (6)	13% (14)	
Other	3% (2)	4% (4)	
Preexisting comorbid conditions			
Diabetes mellitus	34% (22)	31% (31)	0.81
Hypertension	52% (40)	48% (52)	0.63
Congestive heart failure	23% (15)	23% (25)	0.55
Coronary artery disease	29% (19)	31% (33)	0.98
Chronic renal failure on hemodialysis	8% (5)	6% (6)	0.78
Chronic renal failure without hemodialysis	5% (3)	13% (14)	0.07
Chronic obstructive pulmonary disease	22% (14)	29% (31)	0.28
ED survival	25% (16)	40% (43)	0.042
28 days mortality	94% (61)	93% (100)	0.75
Overall mortality	97% (63)	95% (103)	0.66

ED indicates emergency department. Continuous variables are presented as mean ± SD. Categorical variables are presented as percentages and absolute numbers (n).

Table 2
Resuscitation Profile of the Bacteremic and Non-bacteremic OHCA groups.

	Bacteremic OHCA (n = 65)	Non-bacteremic OHCA (n = 108)	P
Resuscitation profile			
Cardiac arrest location			
Home	49% (32)	51% (55)	0.94
Nursing home	8% (5)	9% (10)	
Public place	18% (12)	16% (17)	
Emergency Department	6% (4)	8% (9)	
Unknown	18% (12)	16% (17)	
Presenting rhythm			
Asystole	65% (42)	62% (67)	0.45
PEA	26% (7)	22% (24)	
VF	9% (6)	16% (17)	
CPR time			
Pre-hospital CPR time (m)	24.49 ± 12.4	20.6 ± 12.6	0.06
ED CPR time (m)	16.9 ± 15.7	17.2 ± 14.2	0.35
Time to ROSC (m)	13.12 ± 9.8	14.65 ± 12.8	0.66
Total CPR time (m)	40.8 ± 21.7	35.9 ± 20.4	0.15

PEA indicates pulseless electrical activity; VF, ventricular fibrillation; CPR, cardiopulmonary resuscitation; ED, emergency medicine; ROSC, return of spontaneous circulation; m, minutes. Continuous variables are presented as mean ± SD unless stated otherwise. Categorical variables are presented as percentages and absolute numbers (n).

Table 3
Bacterial species isolated from the Bacteremic OHCA group.

Bacterial species	n (%)
Other Streptococcus species	12 (18.5%)
Staphylococcus epidermidis	11 (17%)
other Staphylococcus species	9 (14%)
Corynebacterium	5 (7.7%)
Staphylococcus aureus	4 (6%)
Streptococcus pneumoniae	4 (6%)
Klebsiella pneumonia	3 (4.6%)
Enterococcus faecalis	3 (4.6%)
Propinebacterium	3 (4.6%)
Escherichia coli	3 (4.6%)
Clostridium species	3 (4.6%)
Gram positive bacilli NOS	2 (3%)
Enterococcus species	2 (3%)
Streptoccus agalactеae	2 (3%)
Clostridium cadaveris	2 (3%)
Proteus mirabilis	2 (3%)
Enterobacterium	1 (1.5%)
Enterococcus faecacium	1 (1.5%)
Actinomices	1 (1.5%)
Bacteriodes (Prevotella)	1 (1.5%)
Aerococcus viridans	1 (1.5%)

NOS indicates not otherwise specified. All bacterial species isolated were reported and on occasion more than one bacterial species were isolated noting percent summation greater than 100%. Categorical values are shown as absolute numbers and percentages (%).

Table 4
Baseline physiologic and laboratory parameters of the Bacteremic and Non-bacteremic OHCA ED survivors as well as ED disposition.

	Bacteremic ED survivors (n= 16)	Non-bacteremic ED survivors (n= 43)	P
Vital signs			
Temperature (°C)	35.9 ± 1.5	35.5 ± 1.6	0.48
HR, beats per min	104 ± 27	105 ± 28	0.90
RR, breath per min	14 ± 4	18 ± 8	0.25
Systolic BP (mmHg)	125 ± 51	136 ± 52	0.58
Diastolic BP (mmHg)	70 ± 34	79 ± 32	0.50
MAP (mmHg)	89 ± 37	98 ± 38	0.51
O_2 Saturation (%)	96% ± 6.8	95% ± 14	0.54
Shock Index	0.89 ± 0.47	0.86 ± 0.34	0.83
Vasopressors dependent (%)	93.8% (15)	74.4% (32)	0.055
Laboratory values			
White blood cells (K/μL)	14.08 ± 7.8	12.5 ± 7.7	0.49
Hemoglobin (g/dL)	11.3 ± 1.8	11.5 ± 2.4	0.69
Hematocrit (%)	34.9 ± 6.5	34.7 ± 6.7	0.91
Lactate (mmol/L)	13.4 ± 7.3	8.8 ± 5.5	0.01
Arterial pH	7.03 ± 0.2	7.17 ± 0.17	0.01
Arterial pCO_2 (mmHg)	67.3 ± 28.2	52.6 ± 23.1	0.05
Arterial pO_2 (mmHg)	133.2 ± 118	192.2 ± 114	0.16
Base excess (mmol/L)	14.8 ± 8.3	10.5 ± 6.0	0.04
Sodium (mmol/L)	144.6 ± 10.1	142.4 ± 8.4	0.41
Potassium (mmol/L)	5.2 ± 1.3	4.1 ± 2.4	0.005
Chloride (mmol/L)	104.9 ± 7.7	107 ± 8.5	0.30
Bicarbonate (mmol/L)	18.5 ± 5.3	20.1 ± 8.6	0.40
BUN (mg/dL)	48.8 ± 31.1	27.8 ± 19.6	0.02
Creatinine (mg/dL)	3.7 ± 2.2	2.4 ± 1.7	0.02
Glucose (mg/dL)	253 ± 162	249.7 ± 121	0.93
Magnesium (mg/dL)	2.7 ± 0.6	2.1 ± 0.6	0.01
Phosphorus (mg/dL)	10.3 ± 4.6	7.4 ± 3.7	0.01
Troponin I (ng/mL)	1.23 ± 1.08	3.34 ± 8.17	0.15
CK-MB (ng/mL)	7.8 ± 0.14	30.1 ± 42.36	0.13
PT (s)	22.3 ± 5.0	22.7 ± 28.8	0.93
INR	1.94 ± 0.57	2.21 ± 4.5	0.71
Hospital disposition			
ICU LOS, d	3.50 ± 5.34	5.49 ± 7.99	0.36
Hospital LOS, d	4.25 ± 7.15	6.63 ± 8.88	0.34
28 day mortality	81% (13)	81% (35)	0.65
Overall mortality	88% (14)	84% (36)	0.25
Antibiotics initiated in the ED	69% (11)	30% (13)	0.01

ED indicates emergency department; °C indicates Celcius; HR, heart rate; RR, respiratory rate; BP, blood pressure; MAP, mean arterial pressure; O_2, oxygen. Continuous variables are presented as mean ± SD unless stated otherwise. BUN indicated blood urea nitrogen; CKMB, creatine kinase myocardial band; PT, prothrombin time; INR, international normalized ratio and LOS, length of stay. Categorical variables are presented as percentages and absolute numbers (n). Continuous variables are presented as

Discussion

- OHCA patients presenting to the ED, we found a 38% incidence of bacteremia
- The presence of bacteremia was associated with a significant decrease in ED survival compared to non-bacteremic patients.

Bacteremia: incidence and significance

- Risk factors contributing significantly to mortality in bacteremic patients were
  - increasing age
  - underlying ultimately fatal disease
  - presence of severe sepsis, shock and gram-positive pathogen infections

- The incidence of bacteremic complications OHCA was first reported by Gaussorgues et al. at 8%.
  - They hypothesized that a low flow shock state post cardiac arrest along with mesenteric ischemia
  - With gut flora bacteremia in blood cultures obtained 12 h after ROSC

- Our most common pathogens identified were not of *intestinal origin* rather Staphylococcus and Streptococcus species.
- The pathogens identified was likely related to the timing of blood culture sampling

- In this study, the incidence of bacteremia in OHCA is ***higher than*** any previously reported
- In this study, the ED medical team initiated empiric antibiotic therapy in 69% of bacteremic OHCA ED survivors.

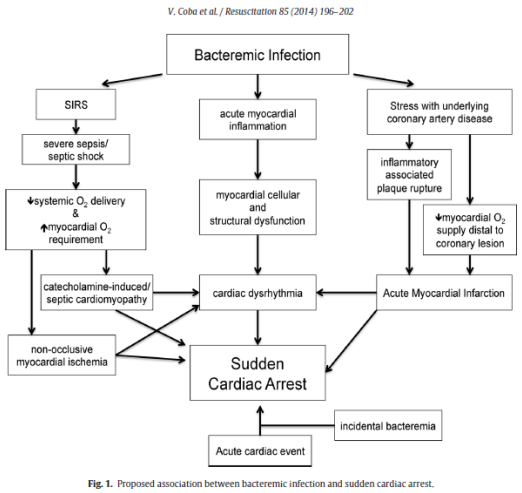

Fig. 1. Proposed association between bacteremic infection and sudden cardiac arrest.

How this paper can change management or current ACLS guideline

- Current 2012 AHA/ACLS note the importance of post-CPR for
  - therapeutic hypothermia
  - hemodynamic and ventilation optimization
  - coronary reperfusion
  - glycemic control
  - neurologic care

- This study suggests that one major precipitating factor or comorbidity associated with OHCA is unrecognized bacteremia.
- To initiate **prompt empiric antibiotic therapy** during the post cardiac arrest resuscitation period for the bacteremic OHCA.

Limitations

- The study was designed to report blood cultures results without requiring specimens from other potential sites of infection.
- The ED medical team initiated empiric antibiotic treatments for both groups.

Conclusion

- This study is the first to report over 38% incidence of bacteremia in OHCA adults.
- The bacteremic OHCA adults had severe metabolic derangements, higher lactates and lower ED survival
- Further study is needed to identify the cause and effect relationship between bacteremia and sudden cardiac arrest