OVERVIEW

• Case presentation
• In-hospital cardiac arrest (IHCA) and COVID19
• Recommended modifications to protocol
  • PPE
  • Airway
  • Mechanical/automated CPR devices
  • Goals of care
  • Prone position
• Beth Israel Deaconess experience
• UC San Diego experience
• Summary
• Near the beginning of the pandemic, a 61-year old man presented with a week of fevers, cough and shortness of breath and a positive COVID19 test.
• He rapidly required increasing amounts of oxygen and was intubated.
• He was managed with standard lung protective strategies and higher PEEP, sedation, paralytics and prone positioning with improved oxygenation.
On the night of hospital day 2, the patient was switched to a transport ventilator to be moved.

Outside the room he acutely desaturated with sustained hypoxia.

He became bradycardic and lost his pulse.
Code Blue

• He was pushed back into his original room, CPR was initiated and he received 1 mg of epinephrine. After 3 minutes of CPR, ROSC obtained.

• After a 31-day hospital stay he was discharged to a long-term acute care facility with a tracheostomy.

• He is now home, breathing on his own and improving.
IHCA [Data from 2008-2011 from the American Heart Association’s Get With The Guidelines-Resuscitation (GWTG-R) registry]

- Incidence = 290,000 adults
- Mean Age = 66 years
- Men account for 58% of CA
- Most often presenting rhythm = non-shockable (81%)
- Survival to hospital discharge has been increasing over last 2 decades (appx 20-25%)

### Table 1.
Comparison of Out-of-Hospital and In-Hospital Cardiac Arrest

<table>
<thead>
<tr>
<th></th>
<th>In-Hospital Cardiac Arrest</th>
<th>Out-of-Hospital Cardiac Arrest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incidence</strong></td>
<td>290 000 per year in the United States</td>
<td>350 000 per year in the United States$^a$</td>
</tr>
<tr>
<td><strong>Patient characteristics</strong></td>
<td>Mean age: 66 y Approximately 60% men</td>
<td>Median age: 65 y Approximately 60% men</td>
</tr>
<tr>
<td><strong>Presenting rhythm</strong></td>
<td>Often nonshockable (approximately 80%)</td>
<td>Often nonshockable (approximately 80%)</td>
</tr>
<tr>
<td><strong>Cause</strong></td>
<td>Primarily cardiac and respiratory</td>
<td>Primarily cardiac</td>
</tr>
<tr>
<td><strong>Prevention</strong></td>
<td>Potentially possible with recognition of deterioration and early intervention</td>
<td>Often impossible given the lack of pre-cardiac arrest monitoring</td>
</tr>
<tr>
<td><strong>Timing of basic life support</strong></td>
<td>Often instantaneously</td>
<td>Variable depending on bystander involvement</td>
</tr>
<tr>
<td><strong>Timing of advanced life support drugs</strong></td>
<td>Within 5 to 10 min</td>
<td>On average, approximately 20 min after the onset of cardiac arrest</td>
</tr>
<tr>
<td><strong>Airway management</strong></td>
<td>Approximately one-third of patients already intubated (eg, intensive care unit patients); often performed by physicians</td>
<td>Often performed by clinicians (eg, paramedics) with variable experience in advanced airway management</td>
</tr>
<tr>
<td><strong>Drugs</strong></td>
<td>Limited evidence; epinephrine and amiodarone recommended</td>
<td>Some evidence; epinephrine and amiodarone recommended</td>
</tr>
<tr>
<td><strong>Post-cardiac arrest treatment</strong></td>
<td>Limited evidence; supportive care and targeted temperature management recommended</td>
<td>Some evidence; supportive care and targeted temperature management recommended</td>
</tr>
<tr>
<td><strong>Prognostication</strong></td>
<td>Limited evidence; focuses on both neurological status and organ failure</td>
<td>Some evidence; focuses on neurological status</td>
</tr>
<tr>
<td><strong>Survival to discharge</strong></td>
<td>Approximately 25%</td>
<td>10% to 12%</td>
</tr>
</tbody>
</table>

$^a$ Assessed by emergency medical services but not necessarily treated. $^2$
Goals

1. Identify cause of IHCA (Hs &Ts)
   • Could improve outcomes
   • Has post-CA implications if ROSC achieved

2. Prevention = first link in Chain of Survival for IHCA
   • Identify “at-risk” patients
   • Create appropriate interventional responses (i.e. rapid response teams)

MANAGEMENT

- **Chest compressions, ventilation, and early defibrillation**, when applicable – cornerstone of CA treatment
- **Quality** of chest compressions and of CPR in general associated with better outcomes
- Data supporting the efficacy of medications during in-hospital cardiac arrest are sparse.
  - For in-hospital events:
    - Early administration of epinephrine in patients with a nonshockable rhythm is associated with better outcomes.
    - Early epinephrine for patients with shockable rhythms is associated with worse outcomes.
- Airway management is key but early intubation may or may not be helpful.
  - Emerging evidence in both out-of-hospital and in-hospital cardiac arrest suggests that alternative approaches may be equally or even more effective.

CHARACTERISTICS RELATED TO OUTCOMES

- Two of the factors most strongly associated with outcomes are presenting **rhythm and duration of CA**.
- Increased age $\rightarrow$ **decreased survival** following cardiac arrest in most studies.
- Presence of preexisting medical and surgical conditions $\rightarrow$ **worse outcomes** following in-hospital cardiac arrest.
- Relationship between race and outcomes $\rightarrow$ **Black and Hispanic patients** to have **lower rates of neurological recovery and survival** following in-hospital cardiac arrest compared with white patients.
  - Data from the GWTG-R registry have shown that racial disparities in outcomes have narrowed over time, with a reported absolute survival difference between black and white patients of 4.5% in 2000 and 1.8% in 2014.
  - **Little evidence** exists for any one tool for prognostication after IHCA.

Has COVID19 changed CPR?

In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China

136 patients with COVID19 were resuscitated with only 18 (13.2%) achieving ROSC and 4 (2.9%) still alive at day 30.

Shao F et al Resuscitation April 2020
## In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China

<table>
<thead>
<tr>
<th>Aetiology, n (%)</th>
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</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>10 (7.4)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>119 (87.5)</td>
</tr>
<tr>
<td>Others</td>
<td>7 (5.1)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Location, n (%)</th>
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<tbody>
<tr>
<td>ICU</td>
<td>23 (16.9)</td>
</tr>
<tr>
<td>General ward</td>
<td>113 (83.1)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Initial rhythm, n (%)</th>
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<tbody>
<tr>
<td>VF/VT</td>
<td>8 (5.9)</td>
</tr>
<tr>
<td>PEA</td>
<td>6 (4.4)</td>
</tr>
<tr>
<td>Asystole</td>
<td>122 (89.7)</td>
</tr>
</tbody>
</table>

*Shao F et al. Resuscitation April 2020*
Cardiac arrest guidelines in COVID-19: what’s different?
Modification 1: provider protection and resource allocation

• Don’t enter the room without aerosol-appropriate PPE
  • Limited evidence from mannequin/cadaver studies, observational data from SARS

• Limit who is in the room

• Considering appropriateness of CPR
  • (more on this later)
Modification 2/3: establish a closed-circuit airway

• AHA 2019: bag-valve mask or advanced airway ok

• COVID-19 guidance focuses on achieving a closed airway circuit ASAP
  • Most experienced intubator
  • Pause compressions during airway insertion
  • Consider no bag-mask ventilation prior to intubation, or use HEPA filter and tight seal
  • Consider video laryngoscopy to increase distance between intubator and patient

• Consider leaving intubated patients on the ventilator
Modification 4: consider mechanical CPR device

• Generally NOT recommended for routine use
  • no evidence for improved outcome
  • suggestion of worse neurologic outcome in some studies\(^1\)
  • Previously suggested when manual CPR is difficult or poses risk to providers

• COVID-19 interim guidance:
  • “In settings with protocols and expertise in place for their use, consider replacing manual chest compressions with mechanical CPR devices to reduce the number of rescuers required for adults and adolescents who meet the manufacturers height and weight criteria.”\(^2\)

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Goals of Care

• Considering appropriateness of CPR
  • Should this be emphasized for COVID-19?
  • Initial concerns re: need for resource allocation have not been realized in most of the US
  • Very limited data on COVID-19 cardiac arrest outcomes to-date
  • Poor outcomes reported from overwhelmed center with patients arrested on improvised, poorly monitored wards
The prone patient
**Prone Patients at the Time of Arrest**

- For patients with suspected or confirmed COVID-19 who are in a prone position without an advanced airway, attempt to place in the supine position for continued resuscitation.
- Although the effectiveness of CPR in the prone position is not completely known, for those patients who are in the prone position with an advanced airway, it may be reasonable to avoid turning the patient to the supine position, unless able to do so without risk of equipment disconnections and aerosolization. If unable to safely transition the patient to a supine position, place the defibrillator pads in the anterior-posterior position and provide CPR with the patient remaining prone with hands in the standard position over the T7/10 vertebral bodies.18

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**Circulation**

**CONSSENSUS REPORTS**

**Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates With Suspected or Confirmed COVID-19**

From the Emergency Cardiovascular Care Committee and Get With The Guidelines-Resuscitation Adult and Pediatric Task Forces of the American Heart Association

In Collaboration With the American Academy of Pediatrics, American Association for Respiratory Care, American College of Emergency Physicians, The Society of Critical Care Anesthesiologists, and American Society of Anesthesiologists

Supporting Organizations: American Association of Critical Care Nurses and National Association of EMS Physicians

Letter to the Editor

A need for prone position CPR guidance for intubated and non-intubated patients during the COVID-19 pandemic

Cardiopulmonary resuscitation in COVID-19 patients

Cardiopulmonary Resuscitation in the Prone Position: A Good Option for Patients With COVID-19

Ludwin, Kobi MSc, EMT-P; Szarpak, Lukasz PhD; Ruetzler, k
Böttiger, Bernd W. PhD, MD; Jaguszewski, Milosz PhD, MD;

Author Information

Anesthesia & Analgesia: September 2020 - Volume 131 - Issue

Letter | Open Access | Published: 26 May 2020

Prone ventilation of critically ill adults with COVID-19: how to perform CPR in cardiac arrest?

Wioletta Mędrycka-Dąbrowska, Katarzyna Lewandowska, Daniel Ślezak & Sebastian Dąbrowski

Critical Care 24, Article number: 258 (2020) | Cite this article
A Little History Behind Prone CPR

- Initially proposed by E.L. McNeil in 1989

RE-EVALUATION OF CARDIOPULMONARY RESUSCITATION

EDWARD L. McNEIL
Bedford, NY 10506-0507 (U.S.A.)
(Accepted January 26th, 1989)

- A modification of apneic ventilation from 1932!!
  Nielsen H. En oplvningsmetode (method of resuscitation).
  Ugesk f Laeger 1932;94:1201–3.

- A few case reports and 1 review article in the literature
  in the subsequent 14 years until...

- The Mazer et al study from 2003

Reverse CPR: a pilot study of CPR in the prone position

Sean P. Mazer, Myron Weisfeldt, Diane Bai, Carol Cardinale, Rohit Arora,
Cecilia Ma, Robert R. Sciacca, David Chong, LeRoy E. Rabbani

Figure 2 The Holger Nielsen method of resuscitation.
A (Very) Quick Look at the Mazer Article

**Patients:** Cardiac Arrest w/o ROSC after 30min of Standard CPR (N=6)

**Intervention:** Standard CPR for 15min followed by Reverse CPR for 15min

**Control:** Standard CPR (Crossover Trial)

**Outcome:** Increase in SBP or MAP
Details:
24 manuscripts (453 papers identified!)
4 original research studies
20 case reports/series with a total of 25 prone patients undergoing CPR...
  20/25 patients arrested in the OR (all neuro or ortho cases)
  14 pediatric patients
  20/25 patients had post-resuscitation survival
  5 respiratory cases, but only 1 in an adult with ARDS from pneumonia...
If You Must...

We found that in prone patients, the largest LV cross-sectional area is located 0 to 2 vertebral segments below the line crossing both the inferior angles of the scapula in at least 86% of patients.
Other recommended changes to workflow

<table>
<thead>
<tr>
<th>CPR Revision</th>
<th>Potential Problems</th>
<th>Solutions</th>
</tr>
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<tbody>
<tr>
<td>Mechanical chest</td>
<td>Communicating instructions to pause or resume CPR by external team</td>
<td>Telecommunications</td>
</tr>
<tr>
<td>compressions</td>
<td>Communicating the presence or absence of a pulse by internal team</td>
<td>Videoconferencing</td>
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<td></td>
<td></td>
<td>Handheld laminated cards</td>
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<tr>
<td>External medication delivery</td>
<td>Increased dead space and delay in delivery</td>
<td>Low-volume, microbore tubing</td>
</tr>
<tr>
<td></td>
<td>Inadvertent disconnection of intravenous tubing</td>
<td>Periodic monitoring of intravenous connections by internal team</td>
</tr>
<tr>
<td>External laboratory draws</td>
<td>Dilution of laboratory sample</td>
<td>Low-volume, microbore tubing</td>
</tr>
<tr>
<td></td>
<td>Theoretical risk of viral transmission in blood</td>
<td>Measurement of tubing volume to determine wasted blood before drawing laboratory sample</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Protective equipment (gloves, mask) while drawing laboratory samples</td>
</tr>
<tr>
<td>External defibrillation</td>
<td>Communicating “all clear” by external team</td>
<td>Telecommunications</td>
</tr>
<tr>
<td></td>
<td>Communicating acknowledgement of “all clear” by internal team</td>
<td>Videoconferencing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handheld laminated cards</td>
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<tr>
<td>External ventilator</td>
<td>Communicating confirmation of endotracheal intubation by external team to proceduralist</td>
<td>Telecommunications</td>
</tr>
<tr>
<td>management</td>
<td></td>
<td>Videoconferencing</td>
</tr>
</tbody>
</table>

Cheruku S et al J Cardiothoracic Vasc Anesth Oct 2020
BIDMC Code Blue Modifications

- Safety officer to insure proper PPE at the door
- Limit who goes in
  - Baby monitors for communication with pharmacy/other personnel
- LUCAS device to minimize those needed for CPR
  - Multiple trainings, interns delegated to bring to codes
- Early intubation
  - No BVM beforehand
BIDMC outcomes/causes (during surge March-May)

- 9 IHCA in COVID+ patients
- ROSC in 5/9
- Survival to hospital discharge in 2/9
- Survival to 30 days in 2/9
- Likely causes:
  - Pulmonary embolism-1
  - Dislodged endotracheal tube-3
  - Aspiration event-2
  - VT-1
  - Bradycardia/suspected mucous plug -2
UC San Diego experience

• Unit charge nurse is responsible for managing traffic in and out of room.
• An adequate supply of PPE is readily available.
• Only the minimum number of staff in room at a time.
• Intubate early if possible.
• Use 2 hand seal and HEPA filter for ventilation if possible.
UCSD experience

- Over 495 patients have been admitted with COVID19
- 6 have experienced an IHCA (all 6 with ROSC, 1 survived to discharge)
  - Hypoxia coded on arrival from OSH
  - LVAD and VF arrest
  - Hypoxia when switched to transport ventilator
  - Septic shock from perforated diverticulitis
  - On ECMO, hypoxia during vent change
  - Autoimmune encephalitis developed complete heart block and PEA arrest
Key take away points

• Minimal published data on IHCA in patients with COVID19
• Minimize staff exposure – utilize a traffic cop/safety officer
• With adequate PPE, risk of transmission is low – encourage/enforce use of PPE
• Early intubation
• Offer CPR to those who may benefit