Pulse Palpation in the Diagnosis of Cardiac Arrest

“Useful or Useless?”

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CURRENT PRACTICE

- **BASIC LIFE SUPPORT** – pulse palpation not recommended since 2000.

- **PAEDIATRIC ADVANCED LIFE SUPPORT**
  - If the appearance of the victim (absent signs of life, pallor, cyanosis) suggests absent or inadequate circulation or cardiac output, commence chest compressions immediately. Chest compression should be commenced if a pulse is not present or cannot be identified within 10 seconds …(ARC Guideline 12.2)

- **ADULT ADVANCED LIFE SUPPORT**
  - “ALS provider can check for a pulse for up to 10 seconds during the period of checking for signs of life” (ARC Guideline 11.1.10)
Pulse palpation is a clinical test to diagnose an illness (cardiac arrest)

All ‘Tests’ have false positive and false negative values
- Sensitivity of test = ability to detect underlying disease (fraction of tests which are positive when disease is present)
  \[ \text{Sensitivity} = \frac{TP}{TP + FN} \]

- Specificity of test = ability of test to exclude disease when not present (fraction of tests which are negative when disease absent)
  \[ \text{Specificity} = \frac{TN}{TN + FP} \]
MODELS OF CARDIAC ARREST

- “The Real Thing”: Patients suspected of being in cardiac arrest i.e., unknown to rescuer if in cardiac arrest or not (collapsed-arrested patients are uncommon, impracticable or impossible to study)

- Patients in therapeutic cardiac arrest (i.e., on cardiopulmonary bypass)

- Patients on extracorporeal life support (ECLS) such as extracorporeal membrane oxygenation (ECMO) or ventricular assistance devices (VAD) for cardiac arrest or cardiac failure. Non-pulsatile circulatory flow +/- endogenous cardiac pulsatile flow.
PART 1.
RELIABILITY OF PULSE PALPATION

- To determine accuracy of pulse palpation as a test to diagnose paediatric cardiac arrest
- Reliability of pulse palpation is unknown
- All previous studies biased—patients/subjects known by rescuer to have a circulation
REQUESTED DOCTORS AND NURSES, ENTERING ICU AS POTENTIAL ‘RESCUERS’, TO ATTEMPT PULSE DETECTION IN INFANTS AND CHILDREN PROVIDED WITH ECLS (BY ECMO OR VAD) FOR CARDIAC ARREST/FAILURE

- During ECLS blood flow is non-pulsatile until heart recovers to resume spontaneous ejection and establish a pulse

- Rescuers were blinded – did not know if patient had a pulse or did not have a pulse. All cardiovascular data shielded

- Rescuers free to choose any pulse location

- Rescuers asked: “Can you detect a pulse within 10 seconds?”
METHODS

- **Data collected:**
  - Rescuer Decision (‘pulse present’/ ‘pulse absent’)
  - Pulse site chosen
  - BP and pulse pressure (if any)

- Compared rescuer decision with concurred decision of investigators and bedside nurse (real diagnosis)

- **Calculated**
  - **Accuracy of test**
    - Proportion of rescuer decisions correct – (TP + TN/total)
  - **Sensitivity of test**
    - Proportion of rescuer ‘no pulse’ in actual cardiac arrest – TP/(TP + FN)
  - **Specificity of test**
    - Proportion of rescuer ‘pulse present’ not in cardiac arrest - TN/(TN + FP)
RESULTS - RESCUERS

- ‘Rescuers’
  - 108 doctors
  - 101 nurses

- Each rescuer performed test once

- Pulse palpation conducted on 16 infants and children with 12 palpations/patient
GOLD STANDARD (The Investigators)

<table>
<thead>
<tr>
<th>No True pulse</th>
<th>128 (61%)</th>
<th>Pulse Pressure mean +/- SD (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6 +/- 5</td>
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<tr>
<td>True pulse</td>
<td>81 (39%)</td>
<td>23 +/- 6 (P 0.0001)</td>
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</tbody>
</table>

P 0.0001
RESULTS – RESCUER DECISIONS

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Accuracy (%)</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>all rescuers</td>
<td>209</td>
<td>78</td>
<td>0.86</td>
<td>0.64</td>
</tr>
<tr>
<td>doctors</td>
<td>108</td>
<td>80</td>
<td>0.88</td>
<td>0.67</td>
</tr>
<tr>
<td>nurses</td>
<td>101</td>
<td>75</td>
<td>0.84</td>
<td>0.62</td>
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</tbody>
</table>
RESCUER DECISIONS

- When transduced pulse pressure = zero (n 37)
  (pulse could not possibly be present)

  Accuracy  89%
  Sensitivity  0.89
  Specificity  0.89
WHICH SITE IS BEST?

- Reliability with site of palpation:
  - 60% rescuers chose brachial artery
  - 33% rescuers chose femoral artery
  - 2.5% chose radial artery

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<td>Brachial</td>
<td>78%</td>
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<tr>
<td>Femoral</td>
<td>77%</td>
<td>0.85</td>
<td>0.56</td>
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DISCUSSION

- **78% Accuracy**
  - Implies that 22% diagnosed incorrectly

- **0.86 Sensitivity**
  - Implies that in 14% occasions, rescuers would withhold ECC from patient in cardiac arrest - therefore no chance of survival

- **0.64 Specificity**
  - Implies rescuers would give ECC in 36% occasions when patient not in cardiac arrest
DISCUSSION

- Results similar to those of Erbele et al
  - Reliability of pulse palpation for detection of cardiac arrest in adults
  - 206 laypersons and ambulance officers, 16 patients undergoing CABG (unknown to rescuers whether on/off cardiopulmonary bypass)
    - Sensitivity 90%
    - Specificity 55%
    - Accuracy 65%

- Pulse check deleted from BLS resuscitation guidelines for lay-persons

- Since 2000, lay-person rescuers advised to give ECC to collapsed infant or child with no signs of life
CONCLUSIONS

- Pulse palpation to diagnose cardiac arrest in infants and children is unreliable

- Pulse palpation should not be recommended to healthcare personnel as a test to diagnose paediatric cardiac arrest

- Influence of time spent palpating unknown

PART 2.
DOES PULSE PALPATION ACCURACY IMPROVE WITH TIME SPENT?
METHOD

- 117 rescuers recruited (65 nurses, 52 doctors)
- 11 children (ECMO or VAD)
- “Tell me if a pulse is present or absent at the site of a brachial artery – I will time you”
- 87 rescuers tested when pulse really present
- 30 rescuers tested when pulse really absent
# RESULTS

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<th>Pulse pressure +/- SD (mmHg)</th>
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<tr>
<td>No True pulse</td>
<td>30 (26%)</td>
<td>8 +/- 7</td>
</tr>
<tr>
<td>True pulse</td>
<td>87 (74%)</td>
<td>23 +/- 11 (P&lt; 0.00001)</td>
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# RESULTS – RESCUER DECISIONS

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Correct pulse determination at specific times
(pulse present or absent)

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>% Correct</th>
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<tbody>
<tr>
<td>0-5</td>
<td>94</td>
</tr>
<tr>
<td>6-10</td>
<td>87</td>
</tr>
<tr>
<td>11-15</td>
<td>67</td>
</tr>
<tr>
<td>16-20</td>
<td>71</td>
</tr>
<tr>
<td>21-30</td>
<td>55</td>
</tr>
<tr>
<td>&gt;30</td>
<td>61</td>
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Correct pulse determination accumulative time
(pulse present or absent)

% correct

0 10 20 30 40 50 60 70 80 90 100

<5 <10 <15 <20 <30 unlimited

time (seconds)

Correct pulse determination accumulative time
HOW LONG TO DIAGNOSE?

- Time to make any decision
  
  18 +/- 15 seconds

- Time to make correct decision
  
  16 +/- 14 seconds

- Time to make wrong decision:
  
  24 +/- 16 seconds
HOW LONG TO DIAGNOSE CARDIAC ARREST?

- Time to decide “no pulse” when really absent – i.e., time to detect real cardiac arrest

25 +/- 13 seconds
CONCLUSIONS

- Pulse palpation is unreliable to diagnose cardiac arrest
- Pulse palpation is time-wasteful

i.e., rescuers take too much time and make the wrong decisions (it is beyond human capability to confirm or exclude cardiac arrest based on pulse palpation alone)
RECOMMENDATION

- If the patient is not breathing normally, is not responsive and not moving – i.e., looks dying or dead (but recently discovered)

GIVE CPR!