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OF MEDICINE IN MARTIN
Comenius University
Bratislava



Medical Education Support Center

Pediatric BLS

BLS in special occasions

prof. Jana Plevkova MD, PhD, 2025

Paediatric Basic Life Support





Available online at www.sciencedirect.com

Resuscitation

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



European Resuscitation Council Guidelines 2021: Paediatric Life Support



*Patrick Van de Voorde^{a,b,*}, Nigel M. Turner^c, Jana Djakow^{d,e}, Nieves de Lucas^f,
Abel Martinez-Mejias^g, Dominique Biarent^h, Robert Binghamⁱ, Olivier Brissaud^j,
Florian Hoffmann^k, Groa Bjork Johannesdottir^l, Torsten Lauritsen^m, Ian Maconochieⁿ*

Out-of-hospital cardiac arrest in children - statistics

- More than 20 000 infants and children have a cardiac arrest per year in the United States.
- In 2015, EMS documented that out-of-hospital cardiac arrest (OHCA) occurred in more than 7000 infants and children.
- Approximately 11.4% of pediatric OHCA patients survived to hospital discharge, but outcomes varied by age, with survival rates of 17.1% in adolescents, 13.2% in children, and 4.9% in infants.
- In the same year, pediatric in-hospital cardiac arrest (IHCA) incidence was 12.66 events per 1000 infant and child hospital admissions, with an overall survival to hospital discharge rate of 41.1%.

Out-of-hospital cardiac arrest in children - causes

- The epidemiology, pathophysiology, and common etiologies of pediatric cardiac arrest are distinct from adult and neonatal cardiac arrest.
- Cardiac arrest in infants and children does not usually result from a primary cardiac cause; rather, it is the end result of progressive respiratory failure or shock.
- In these patients, cardiac arrest is preceded by a variable period of deterioration, which eventually results in cardiopulmonary failure, bradycardia, and cardiac arrest.
- In children with congenital heart disease, cardiac arrest is often due to a primary cardiac cause, although the etiology is distinct from adults.

Out-of-hospital cardiac arrest in children - outcomes

- Neurological outcomes remain difficult to assess across the pediatric age spectrum, with variability in reporting metrics and follow-up time across OHCA and IHCA studies. Favorable neurological outcome has been reported in up to 47% of survivors to discharge.
- Despite increases in survival from IHCA, there is more to be done to improve both survival and neurological outcomes.
- **The International Liaison Committee on Resuscitation (ILCOR) Formula for Survival emphasizes 3 essential components for good resuscitation outcomes:**
 - guidelines based on sound resuscitation science
 - effective education of the lay public and resuscitation providers
 - implementation of a well-functioning Chain of Survival

Out-of-hospital cardiac arrest in children - outcomes

- Outcomes for pediatric IHCA have improved over the past 20 years, in part because of early recognition, high-quality CPR, postarrest care, and extracorporeal CPR
- Survival rates from OHCA remain less encouraging. The annual survival to hospital discharge of pediatric OHCA ranged from 7-10 % depending on region and patient age.
- Survival of OHCA was higher in regions with more arrests that were witnessed by EMS and with higher bystander CPR rates - importance of early recognition and CPR
- As survival rates from pediatric cardiac arrest increase, there has been a shift with more focus on neurodevelopmental, physical, and emotional outcomes of survivors.
- A quarter of patients with favorable outcomes have global cognitive impairment and that 85% of older children who were reported to have favorable outcomes have selective neuropsychological deficits.

Pediatric chain of survival

IHCA



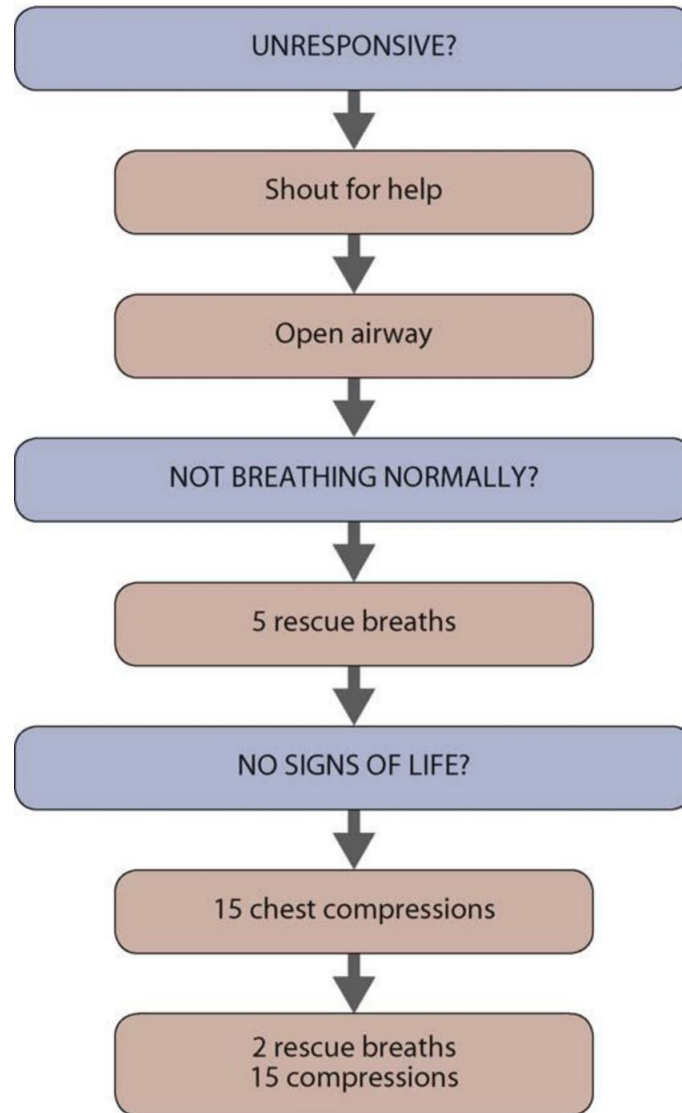
OHCA



Pediatric chain of survival

- In both the OHCA and IHCA chains, a sixth link has been added to highlight the importance of recovery, focusing on short- and long-term treatment evaluation and support for survivors and their families.
- For both chains of survival, activating the emergency response is followed immediately by initiating high-quality CPR.
- If help is nearby or a cell phone is available, activating the emergency response and starting CPR can be nearly simultaneous.
- In the out-of-hospital setting, a single rescuer who does not have access to a cell phone should begin CPR for infants/ children before calling for help because respiratory arrest is the most common cause of cardiac arrest and help may not be nearby.
- In the event of sudden witnessed collapse, rescuers should use an available automatic external defibrillator (AED), because early defibrillation can be lifesaving.

Paediatric basic life support



Call cardiac arrest team or Paediatric ALS team

Pediatric CPR guidelines

- Rapid recognition of cardiac arrest, immediate initiation of high-quality chest compressions, and delivery of effective ventilations are critical to improve outcomes from cardiac arrest.
- Lay rescuers should not delay starting CPR in a child with no “signs of life”, EMS may consider assessing the pulse as long as the CPR is not delayed more than 10 seconds.
- In infants and children, asphyxial cardiac arrest is more common than cardiac arrest from a primary cardiac event; therefore, effective ventilation is important during resuscitation of children. When CPR is initiated, the sequence is compressions-airway-breathing.
- High-quality CPR generates blood flow to vital organs and increases the likelihood of return of spontaneous circulation (ROSC).

Pediatric CPR guidelines

The 5 main components of high-quality CPR are

- (1) adequate chest compression depth
- (2) optimal chest compression rate
- (3) minimizing interruptions in CPR (ie, maximizing chest compression fraction or the proportion of time that chest compressions are provided for cardiac arrest)
- (4) allowing full chest recoil between compressions and
- (5) avoiding excessive ventilation.

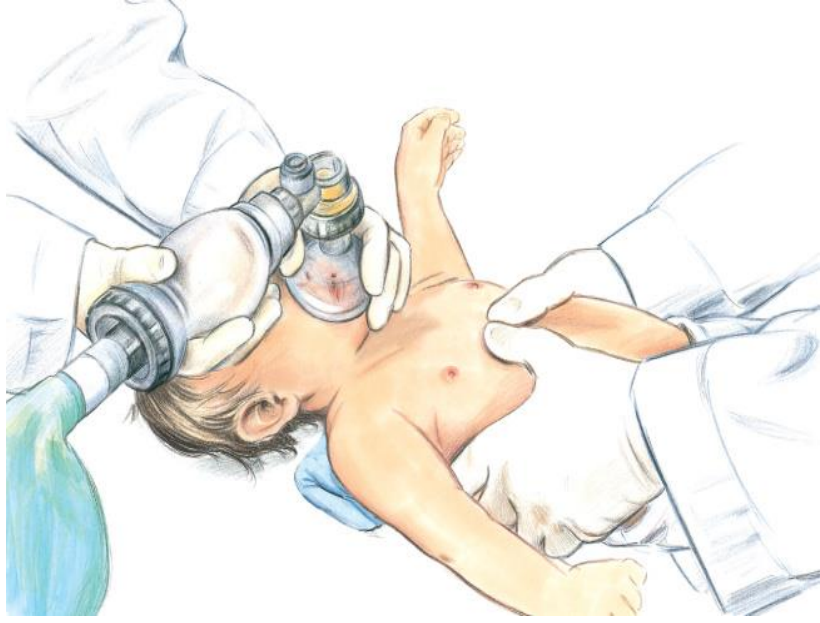
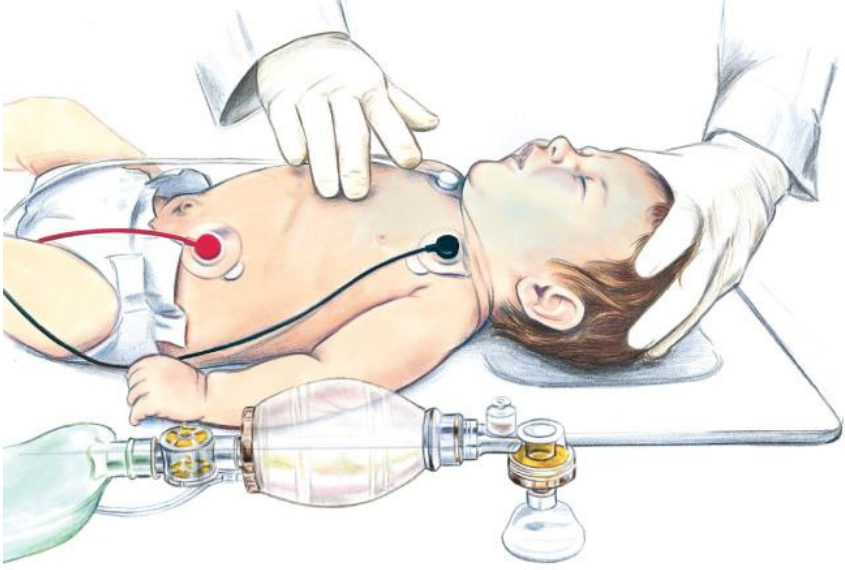
Compressions of inadequate depth and rate, incomplete chest recoil, and high ventilation rates are common during pediatric resuscitation.

Pediatric CPR guidelines

- start with 5 rescue breaths
- chest compressions : rescue breath ratio 15:2
(non-professionals 30:2)
- call 155/112 after 1 min. CPR (if only 1 rescuer)

Pediatric CPR guidelines

- Chest compressions:
 - the **lower half of the sternum**
 - at least **one third of the anterior–posterior dimension** of the chest
 - **4 cm** for an infant
 - **5 cm** for a child (no more than 6 cm)
 - after each compression, release the pressure completely (use the chest recoil)
 - rate - 100–120/min
 - infants (< 1 year) - **two finger technique**
 - **two-thumb encircling technique**
 - children aged 1-10 years - **chest compressions by 1 hand**
 - children aged over 10 years - like in adults



a



b





Rescue breath for an infant:

- open airway: neutral position of the head (gentle extension) and chin lift
- take a breath and cover the **mouth and nose of the infant** with your mouth
- **blow steadily into the infant's mouth and nose over 1 second**
- maintain head position and chin lift, take your mouth away, and watch for chest to fall



Rescue breath for a child over 1 year:

- open airway- head tilt and chin lift
- close the soft part of the nose with the index finger and thumb of your hand on forehead
- open the mouth a little but maintain the chin lift
- take a breath and place your lips **around the mouth**
- blow steadily into **mouth over 1 second** - the chest has to rise
- maintaining head tilt and chin lift, take your mouth away and watch for the chest to fall



If you have difficulty achieving an effective breath:

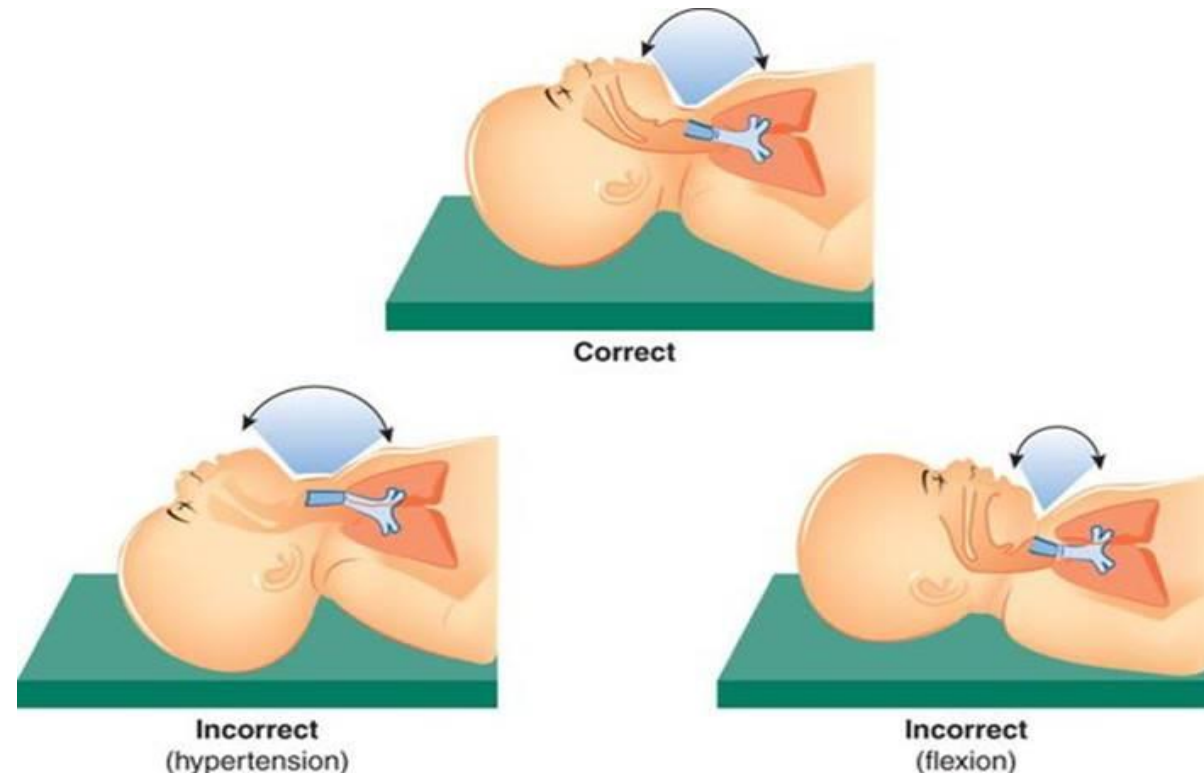
the airway may be obstructed:

- open the child's mouth and **remove any visible obstruction**.

Do not perform a blind finger sweep !!!

- ensure that there is **adequate head tilt and chin lift** but also that **the neck is not over extended**

Try repositioning the head to open the airway.





5 rescue breaths
15:2
depth of compressions 4 cm



5 rescue breaths
15:2
depth of compressions – 5 cm

AED in children

- AED in children less than 8 years old

AED can identify arrhythmias accurately and are extremely unlikely to advise a shock inappropriately → **the use in children is safe!!!**

The most common arrhythmias in children:

- **asystole, pulseless electrical activity, severe bradycardia (<60/min)**
 - non-shockable rhythms
- **ventricular fibrillation/tachycardia** - in adolescents and children with heart disease
 - shockable rhythms

AED in children

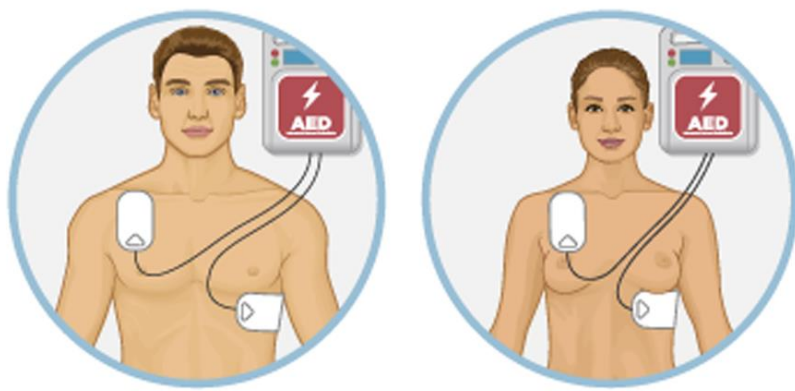
If possible, use an AED with a **paediatric attenuator** in infants and children below 8 years (energy reduced to 50-75 J)

If this is not available, use the standard AED (for all ages)



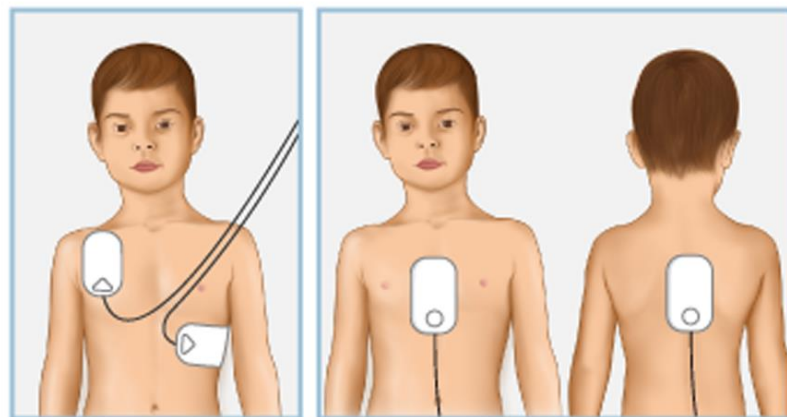
AED Pad Positions

Adult & Child > 8 years



Same pad position for both
male/female adult and older child

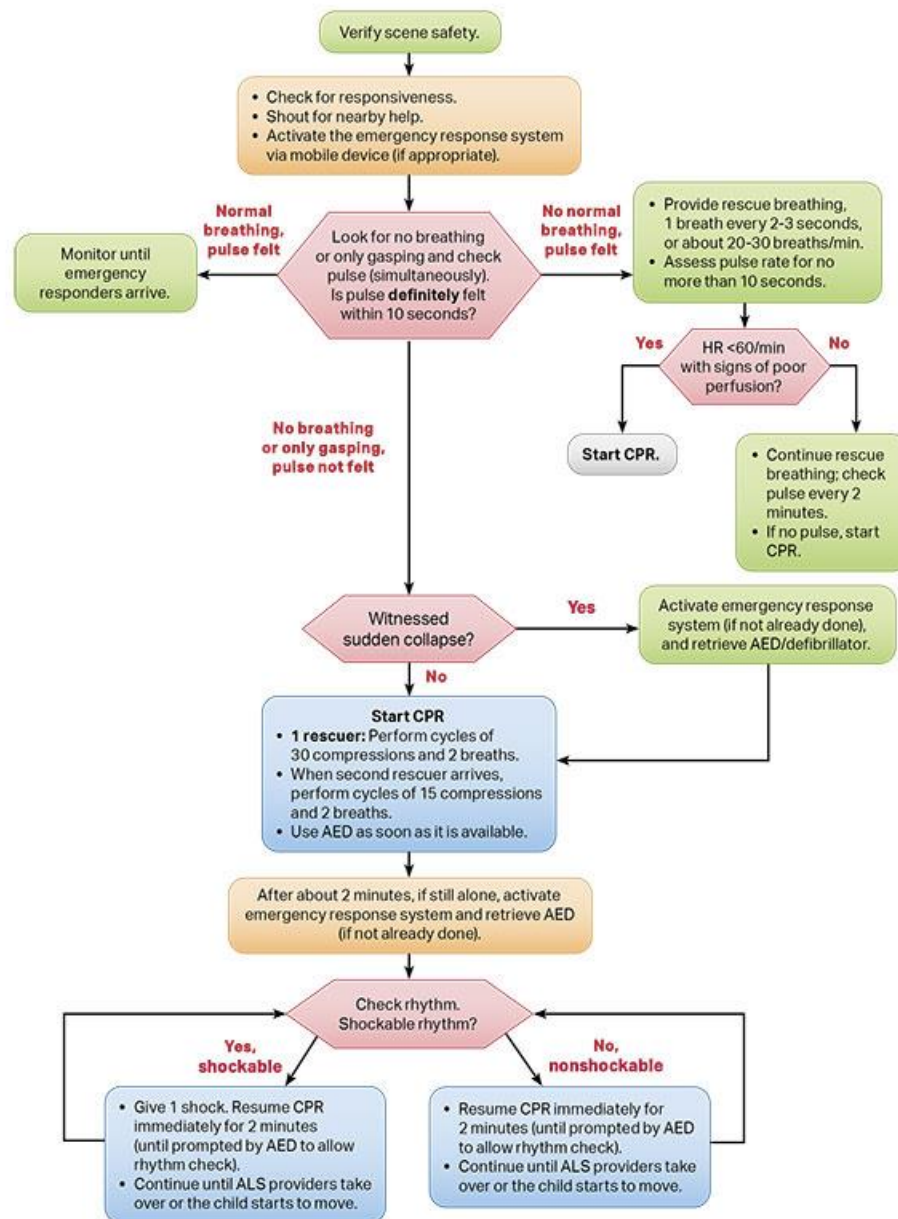
Child < 8 years



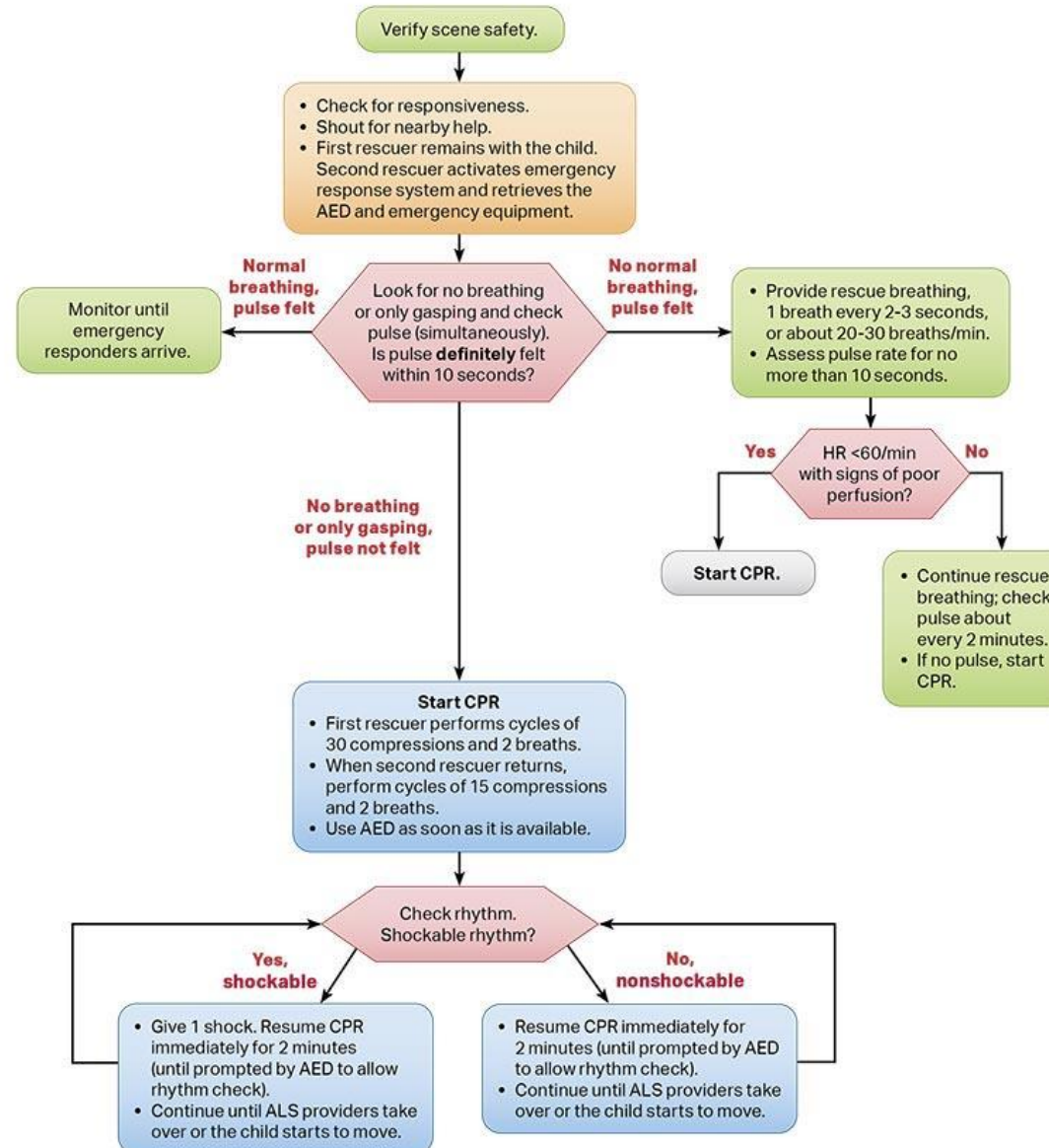
Pad position for
male/female child

Alternate position for
male/female child if
the pads would touch

Pediatric Basic Life Support Algorithm for Healthcare Providers—Single Rescuer



Pediatric Basic Life Support Algorithm for Healthcare Providers—2 or More Rescuers





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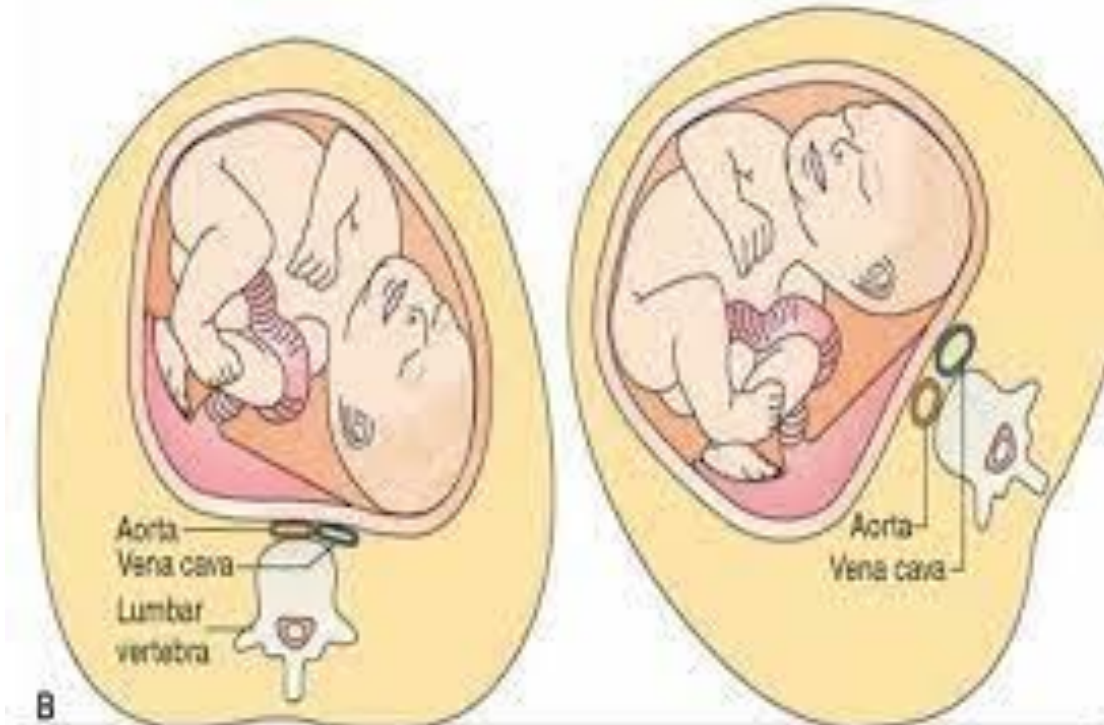
European Resuscitation Council Guidelines 2021: Cardiac arrest in special circumstances



*Carsten Lott^{a,*}, Anatolij Truhlař^{b,c}, Annette Alfonzo^d, Alessandro Barelli^e,
Violeta González-Salvado^f, Jochen Hinkelbein^g, Jerry P. Nolan^{h,i},
Peter Paal^j, Gavin D. Perkins^{k,l}, Karl-Christian Thies^m, Joyce Yeung^{k,l},
David A. Zidemanⁿ, Jasmeet Soar^o, the ERC Special Circumstances
Writing Group Collaborators¹*

CPR in pregnant women

- algorithm BLS is the same 30:2/ AED
- after 20th week of pregnancy – **the gravid uterus compresses the inferior vena cava when a pregnant woman is in a supine position, leading to decreased venous return centrally**
(supine hypotensive syndrome, inferior vena cava compression syndrome)



Aorto- caval compression reduces efficacy of chest compression during CPR

- **Perform 15-30° left lateral tilt** → to relieve aorto- caval compression → to increase cardiac output
- **Left uterine displacement** using 2-hands technique or 1-hand technique



Left Uterine Displacement
One handed Technique



Left uterine Displacement
- 2 Handed Technique



Figure 4. Patient in a 30° left-lateral tilt using a firm wedge to support pelvis and thorax.

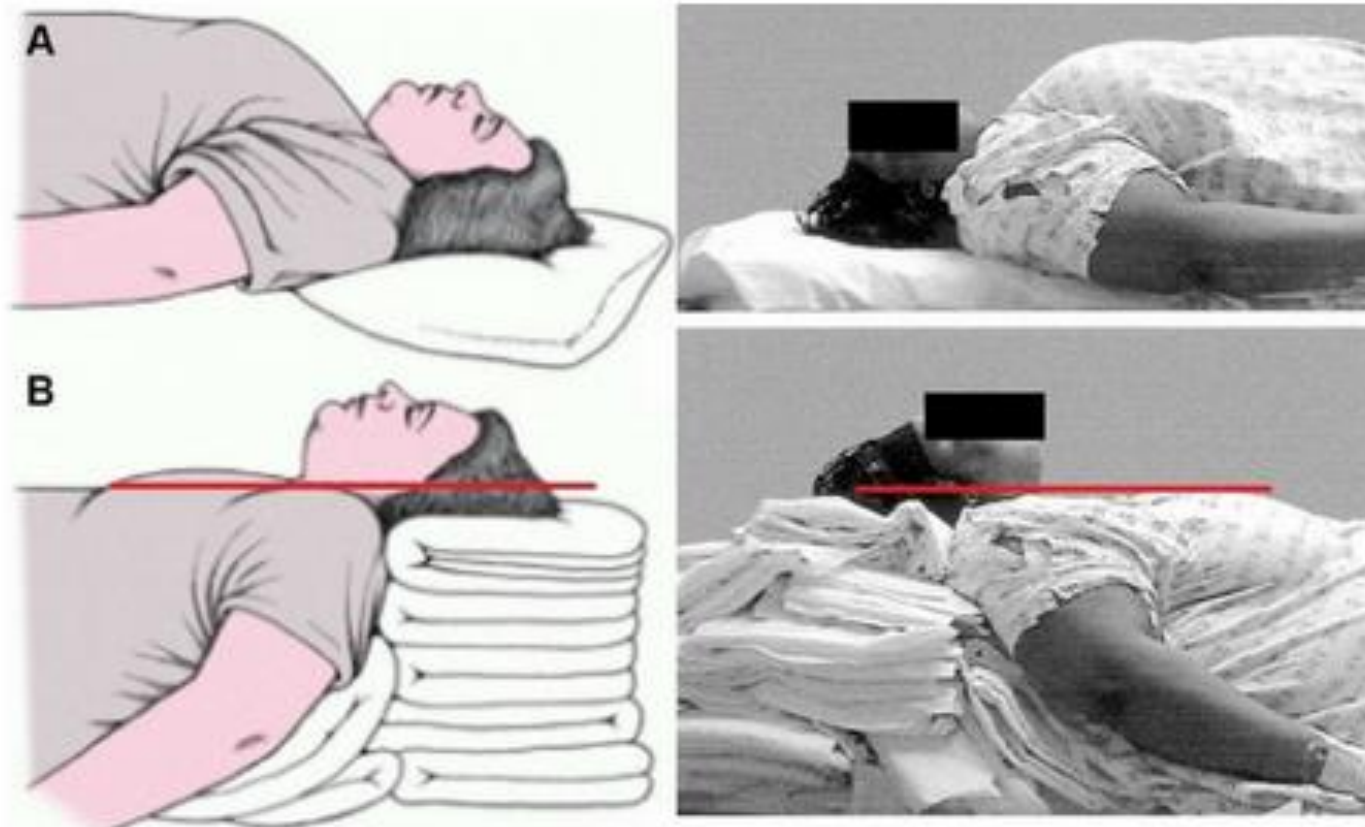


BLS in obesity

Limitations

- BLS is more difficult, because of the access to the patient and transportation
- open airway – can be problematic mainly in so called „apple shape obesity“)
- chest compressions (6 cm) more difficult as well (requires more frequent switching of the CPR providers due to exhaustion)
- shocks are less efficient due to the thickness of the chest wall
- mask-bag breathing – the technique of two providers is more effective, one seals the mask to the face and holds the head tilted, the other one squeezes the bag delivering 2 rescue breaths

Airway management is a problem even in hospital settings in anaesthesia e.g.



BLS – cardiac arrest in sport

- Most common causes of sudden unresponsiveness in sport
 - 1. collision with an opponent - head hits the front wall of the chest - most often resulting in malignant arrhythmia and loss of consciousness
 - 2. sudden onset of an arrhythmia with low or zero CO – due to genetic predisposition, substance abuse, energy drinks, ion imbalance
 - 3. head trauma – person is unconscious but breathing

BLS – cardiac arrest in sport

Risk assessment in sport facilities/staff training/AED direct access

Implementation

- Recognize collapse. Gain immediate and safe access to the Field of Play.
- Call for help and activate EMS.
- Assess for signs of life. If no signs of life:
 - Commence CPR.
 - Access an AED and defibrillate if indicated.
- If ROSC occurs, carefully observe and monitor the patient until advanced medical care arrives.
- If there is no ROSC:
 - Continue CPR and defibrillation until advanced medical care arrives
 - In a sport arena, consider moving the patient to a less exposed position and continue CPR (with minimal interruption to chest compressions).

BLS – Drowning

- **Initial rescue**
- Undertake a dynamic risk assessment considering feasibility, chances of survival and risks to the rescuer:
 - Submersion duration is the strongest predictor of outcome.
 - Salinity has an inconsistent effect on outcome.
- Assess consciousness and breathing:
 - If conscious and/or breathing normally, aim to prevent cardiac arrest.
 - If unconscious and not breathing normally, start resuscitation.

BLS – Drowning

- **Cardiac arrest management**
- Start resuscitation as soon as safe and practical to do so. If trained and able this might include initiating ventilations whilst still in the water or providing ventilations and chest compressions on a boat.
- Start resuscitation by giving 5 rescue breaths/ventilations using 100% inspired oxygen if available.
- If the person remains unconscious, without normal breathing, start chest compressions.
- Alternate 30 chest compressions to 2 ventilations.
- Apply an AED if available and follow instructions.

BLS – Dentistry

- Check patient's mouth and remove all solid materials from the oral cavity (e.g. retractor, suction tube, tampons). Prevention of foreign body airway obstruction should precede positioning.
- Recline the dental chair into a fully horizontal position. If reduced venous return or vasodilation has caused it (e.g. vasovagal syncope), CO can be restored.
- Place a stool under the backrest for stabilisation.
- Start chest compressions immediately while patient lying flat on the chair.
- Consider the over-the-head technique of CPR if access to either side of chest is limited.
- Basic equipment for standard CPR including a bag-valve-mask should be available immediately.