

MEDICATIONS IN CARDIAC ARREST AND BRADYCARDIA

The Task Force reviewed and updated evidence to support medications used during cardiac arrest and bradycardia, but no new recommendations were made. It was again emphasized that calcium and sodium bicarbonate should not be routinely used in pediatric cardiac arrest (ie, should not be used without specific indications).

Calculating Drug Dose [Peds-017B](#)

Consensus on Science

Eight LOE 5 studies^{472,479} concluded that length-based methods are more accurate than age-based or observer (parent or provider) estimate-based methods in the prediction of body weight. Four LOE 5 studies^{472,474,480,481} suggested that the addition of a category of body habitus to length may improve prediction of body weight.

Six LOE 5 studies^{482,487} attempted to find a formula based on drug pharmacokinetics and physiology that would allow the calculation of a pediatric dose from the adult dose.

Treatment Recommendations

In nonobese pediatric patients, initial resuscitation drug doses should be based on actual body weight (which closely approximates ideal body weight). If necessary, body weight can be estimated from body length.

In obese patients the initial doses of resuscitation drugs should be based on ideal body weight that can be estimated from length. Administration of drug doses based on actual body weight in obese patients may result in drug toxicity.

Subsequent doses of resuscitation drugs in both nonobese and obese patients should take into account observed clinical effects and toxicities. It is reasonable to titrate the dose to the desired therapeutic effect, but it should not exceed the adult dose.

Knowledge Gaps

What is the most accurate method for calculating resuscitation drug doses for children? Does the accuracy of the estimated weight used to calculate drug dose affect patient outcome? Do specific resuscitation drugs require different adjustments for estimated weight, maturity and/or body composition?

Are formulas for scaling drug doses with formulas from adult doses superior to existing weight-based methods?

Epinephrine Dose [Peds-018](#)

Consensus on Science

No studies have compared epinephrine versus placebo administration for pulseless cardiac arrest in infants and children. One LOE 5 randomized controlled adult study⁴⁸⁸ of standard drug therapy compared with no drug therapy during out-of-hospital cardiac arrest showed improved survival to hospital admission with any drug delivery but no difference in survival to hospital discharge.

Evidence from 1 LOE 1 prospective, randomized, controlled trial,⁴⁸⁹ 2 LOE 2 prospective trials,^{490,491} and 2 LOE 2 case series with concurrent controls^{492,493} showed no increase in survival to hospital discharge or improved neurologic outcome when epinephrine doses of >10 mcg/kg IV were used in out-of-hospital or in-hospital pediatric cardiac arrest. In 1 LOE 1 prospective trial⁴⁸⁹ of pediatric in-hospital cardiac arrest comparing high-dose (100 mcg/kg) with standard-dose epinephrine administered if cardiac arrest persisted after 1 standard dose of epinephrine, 24-hour survival was reduced in the high-dose epinephrine group.

Evidence extrapolated from adult prehospital or in-hospital studies, including 9 LOE 1 randomized trials,⁴⁹⁴⁻⁵⁰² 3 LOE 2 trials,⁵⁰³⁻⁵⁰⁵ and 3 LOE 3 studies,⁵⁰⁶⁻⁵⁰⁸ showed no improvement in survival to hospital discharge or neurologic outcome when doses >1 mg of epinephrine were given.

Treatment Recommendations

In infants and children with out-of-hospital or in-hospital cardiac arrest, the appropriate dose of IV epinephrine is 10 mcg/kg per dose (0.01 mg/kg) for the first and for subsequent doses. The maximum single dose is 1 mg.

Knowledge Gaps

Does epinephrine administration improve outcome from cardiac arrest in infants and children? Are there specific patients or arrest types (eg, prolonged arrest, asphyxial arrest, VF arrest) for which epinephrine is more effective?

Sodium Bicarbonate During Cardiac Arrest[Peds-028](#)

Consensus on Science

There are no randomized controlled studies in infants and children examining the use of sodium bicarbonate as part of the management of pediatric cardiac arrest. One LOE 2 multicenter retrospective in-hospital pediatric study⁵⁰⁹ found that sodium bicarbonate administered during cardiac arrest was associated with decreased survival, even after controlling for age, gender, and first documented cardiac rhythm.

Two LOE 5 randomized controlled studies have examined the value of sodium bicarbonate in the management of arrest in other populations: 1 adult out-of-hospital cardiac arrest study⁵¹⁰ and 1 study in neonates with respiratory arrest in the delivery room.⁵¹¹ Both failed to show an improvement in overall survival.

Treatment Recommendations

Routine administration of sodium bicarbonate is not recommended in the management of pediatric cardiac arrest.

Knowledge Gaps

Are there circumstances under which sodium bicarbonate administration improves outcome from pediatric cardiac arrest?

Vasopressin[Peds-020A](#),[Peds-020B](#)

Consensus on Science

In 1 pediatric LOE 3 study⁵¹² vasopressin was associated with lower ROSC and a trend toward lower 24-hour and discharge survival. In 3 pediatric LOE 4^{513,–,515} and 2 adult LOE 5^{516,517} case series/reports (9 patients) vasopressin⁵¹³ or its long-acting analogue, terlipressin,^{514,515} administration was associated with ROSC in patients with refractory cardiac arrest (ie, standard therapy failed).

Extrapolated evidence from 6 LOE 5 adult studies^{518,–,523} and 1 LOE 1 adult meta-analysis⁵²⁴ showed that vasopressin used either by itself or in combination with epinephrine during cardiac arrest does not improve ROSC, hospital discharge, or neurologic outcome. Evidence from 1 LOE 5 animal study⁵²⁵ of an infant asphyxial arrest model showed no difference in ROSC when terlipressin was administered alone or in combination with epinephrine as compared with epinephrine alone.

Treatment Recommendations

There is insufficient evidence for or against the administration of vasopressin or its long-acting analogue, terlipressin, in pediatric cardiac arrest.

Knowledge Gaps

Are there patient subgroups who might benefit from vasopressin (with or without other vasopressors) for pediatric cardiac arrest? Does the use of “early” versus “late” (ie, rescue) vasopressin affect outcome in pediatric cardiac arrest? Is vasopressin effective when administered via a tracheal tube?

Calcium in Cardiac Arrest[Peds-021A](#),[Peds-021B](#)

Consensus on Science

Evidence from 3 LOE 2^{509,526,527} studies in children and 5 LOE 5 adult studies^{528,–,532} failed to document an improvement in survival to hospital admission, hospital discharge, or favorable neurologic outcome when calcium was administered during cardiopulmonary arrest in the absence of documented hypocalcemia, calcium channel blocker overdose, hypermagnesemia, or hyperkalemia. Four LOE 5 animal studies^{533,–,536} showed no improvement in ROSC when calcium, compared with epinephrine or placebo, was administered during cardiopulmonary arrest.

Two studies investigating calcium for in-hospital pediatric cardiac arrest suggested a potential for harm. One LOE 2 study examining data from the NRCPR⁵²⁶ observed an adjusted odds ratio of survival to hospital discharge of 0.6 in children who received calcium, and 1 LOE 3 multicenter study⁵⁰⁹ showed an odds ratio for increased hospital mortality of 2.24 associated with the use of calcium. One LOE 2 study of cardiac arrest in the PICU setting⁵²⁷ suggested a potential for harm with the administration of calcium during cardiac arrest; the administration of 1 or more boluses was an independent predictor of hospital mortality.

Treatment Recommendations

Routine use of calcium for infants and children with cardiopulmonary arrest is not recommended in the absence of hypocalcemia, calcium channel blocker overdose, hypermagnesemia, or hyperkalemia.

Knowledge Gaps

Are there indications for calcium administration that may be associated with improved outcome from pediatric cardiac arrest? Does the increased mortality risk associated with calcium administration reflect harm from calcium or does it simply identify patients who failed to respond to other ALS interventions and therefore were at a higher risk of death?

Atropine Versus Epinephrine for Bradycardia [Peds-052A](#)

Consensus on Science

Evidence from 1 LOE 3 study of in-hospital pediatric cardiac arrest⁵³⁷ observed an improved odds of survival to discharge for those patients who received atropine based on multivariate analysis, whereas the use of epinephrine was associated with decreased odds of survival. Another large LOE 3 study⁵³⁸ demonstrated no association between atropine administration and survival.

In 1 LOE 5 adult case series,⁵³⁹ 6 of 8 patients in cardiac arrest who did not respond to epinephrine did respond to atropine with a change to a perfusing rhythm; 3 survived to hospital discharge. An LOE 5 retrospective adult review⁵⁴⁰ observed that a small number of asystolic patients who failed to respond to epinephrine did respond to atropine, but none survived to hospital discharge.

Four LOE 5 adult studies^{541,544} showed a benefit of atropine in vagally mediated bradycardia. One small LOE 4 pediatric case series⁵⁴⁵ showed that atropine is more effective than epinephrine in increasing heart rate and blood pressure in children with post-cardiac surgical hypotension and bradycardia (Bezold-Jarisch reflex mediated bradycardia).

Four LOE 5 adult^{542,546,548} and 4 LOE 5 animal^{549,552} studies showed no benefit from atropine used to treat bradycardia or cardiac arrest. One LOE 5 animal study⁵⁵³ did show a benefit of atropine when used with epinephrine in cardiac arrest.

Treatment Recommendations

Epinephrine may be used for infants and children with bradycardia and poor perfusion that is unresponsive to ventilation and oxygenation. It is reasonable to administer atropine for bradycardia caused by increased vagal tone or cholinergic drug toxicity. There is insufficient evidence to support or refute the routine use of atropine for pediatric cardiac arrest.

Knowledge Gaps

What is the optimal dose of epinephrine for pediatric bradycardia? Is there a role for titrated doses? Does the use of epinephrine versus atropine improve outcome from pediatric bradycardia? Are there circumstances under which atropine administration improves outcome from pediatric cardiac arrest?