**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

**Worksheet author(s)**

Allan de Caen  

**Date Submitted for review:** Feb 2, 2010

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**Clinical question.**

In pediatric patients with cardiac arrest (pre-hospital [OHCA] or in-hospital [IHCA]) (P), does the use of calcium (I) compared with no calcium (C), improve outcome (O) (eg. ROSC, survival to hospital discharge, survival with favorable neurologic outcome)?

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**Is this question addressing an intervention/therapy, prognosis or diagnosis?** Intervention

**State if this is a proposed new topic or revision of existing worksheet:** New topic

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**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

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**Search strategy (including electronic databases searched).**

**PubMed**

(Heart Arrest"[Mesh] OR "Cardiopulmonary Resuscitation"[Mesh]) AND ("Calcium Chloride"[Mesh] OR "Calcium"[Mesh] OR "Calcium Gluconate"[Mesh])

283 hits

after thinning, 16 papers

**EMBASE**

(heart arrest or cardiopulmonary resuscitation) AND (calcium OR calcium ion OR calcium chloride OR calcium glucoheptonate)

0 hits to supplement PubMed search

**Cochrane calcium search**

1. calcium
2. heart arrest
3. cardiopulmonary resuscitation
4. cardiopulmonary arrest
5. 2 or 3 or 4
6. 1 and 5

4 hits; none applicable

1 pulled after contact with author

5 pulled by hand search of references

Nothing picked up on web of science search using major papers (clinical RCTs)

The above search strategies were re-run Oct 1, 2009. 1 additional study was found (Meert, 2009)

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**State inclusion and exclusion criteria**

Inclusion criteria: all studies (adult and pediatric, human and animal); reviews reviewed for ‘missed references’, all languages

Exclusion criteria: case reports and editorials

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**Number of articles/sources meeting criteria for further review:** 12 articles; 3 LOE 2, 1 LOE 4, 9 LOE 5
## Summary of evidence

### Evidence Supporting Clinical Question

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<th>Level of evidence</th>
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<td>A = Return of spontaneous circulation</td>
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<td>B = Survival of event</td>
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<td>C = Survival to hospital discharge</td>
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<tr>
<td>D = Intact neurological survival</td>
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<td>E = Other endpoint</td>
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<td>Italics = Animal studies</td>
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### Evidence Neutral to Clinical question

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**Level of evidence**

- **A**: Return of spontaneous circulation
- **B**: Survival of event
- **C**: Survival to hospital discharge
- **D**: Intact neurological survival
- **E**: Other endpoint

*Italicics = Animal studies*

### Evidence Opposing Clinical Question

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<th>Steuven, 1985 1) ABC Steuven, 1985 2) ABC</th>
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<td>Harrison 1983 ABC Niemann, 1985 A Ornato 1985 C</td>
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**Level of evidence**

- **A**: Return of spontaneous circulation
- **B**: Survival of event
- **C**: Survival to hospital discharge
- **D**: Intact neurological survival
- **E**: Other endpoint

*Italicics = Animal studies*
The use of calcium in cardiopulmonary resuscitation was first described in the early 1900’s. Kay and Blalock reported the first pediatric case series in 1951. Significant limitations exist in the quality of their reported data, as well as the relevance of their patient population to most pediatric cardiac arrest victims. The events described were intraoperative, and involved witnessed cardiopulmonary arrests in patients with open sternums. All patients received open cardiac massage, and were treated with what would currently be considered very large dosages of epinephrine (~100 mcg epinephrine/ kg), and via the intracardiac route. It is unclear what patients had what rhythms during the events. Several of the patients reported were profoundly hypotensive on the basis of hemorrhage, and were not in true cardiopulmonary arrest. At least two of the cases that were reported had had significant hemorrhage, requiring pre-’arrest’ blood transfusion. It is unclear whether their cardiopulmonary arrests were actually hypocalcemic in nature. If so, there might have been a greater tendency for these patients to respond to resuscitation with calcium, as opposed to other etiologies of cardiopulmonary arrest.

The study of the use of calcium in treating ventricular fibrillatory (VF) cardiac arrest is limited. A single small retrospective study of pre-hospital adult cardiac arrest victims carried out by Harrison in 1983 included patients in VF and failed to demonstrate any benefit from the use of calcium chloride.

In a study investigating the treatment of pulseless electrical activity (PEA) in a canine model of asphyxial cardiac arrest, the use of calcium chloride failed to show benefit over saline placebo in the restoration of a spontaneous circulation (ROSC) (Redding 1983). Two retrospective studies of pre-hospital adult cardiac arrest from the 1980s examined the use of intravenous or intracardiac calcium chloride in the treatment of PEA, but failed to demonstrate any survival benefit (Harrison 1983, Steuven 1983). A small prospective randomized and blinded trial compared calcium chloride to saline placebo for adult pre-hospital PEA cardiac arrest that was refractory to epinephrine and NaHC03 therapy (n=90) (Steuven 1; 1985). There was no difference between groups in the rate of survival to hospital admission, although post-hoc analysis of presenting rhythms suggested that those patients with QRS durations > 0.12 might benefit from treatment with calcium chloride (increased likelihood of ROSC). Unfortunately, only one out of the 90 patients in the entire study survived to hospital discharge.

Two retrospective studies from the 1980s of pre-hospital adult asystolic cardiac arrest failed to demonstrate any survival benefit to the use of intravenous/ intracardiac calcium chloride (Harrison 1983, Steuven 1983). One small (n=73) prospective randomized blinded trial has been performed comparing the use of calcium chloride to saline placebo in the treatment of adult pre-hospital asystolic cardiac arrest (Steuven 1985). While there was a trend to a treatment advantage in calcium’s ability to establish ROSC, there were unfortunately no survivors to hospital discharge in either treatment or control group.

These relatively small studies of the use of calcium chloride in asystolic and PEA cardiac arrest prompted 1980’s treatment guidelines to limit the use of calcium therapy in cardiac arrest to those patients with documented hypocalemia, calcium channel blocker overdose, hypermagnesemia, and hyperkalemia. Despite these on-going recommendations in the 2000 AHA Guidelines, a recent study of the National Registry of CPR database shows that the use of calcium chloride in pediatric in-patient cardiac arrest resuscitation continues to be common (45% of events), especially in pediatric tertiary care institutions (Srinivasan 2008). In a U.S. multi-centre retrospective cohort study (Meert, 2009), 51.9% of a select group of pediatric in-patients experiencing cardiac arrest received intravenous calcium during the course of cardiac resuscitation.

The NRCPR paper showed that the use of calcium in cardiac arrest care was found to be more common with longer durations of CPR (>15 min), and was used concurrently with other ALS medications. Despite this, its use (in comparison to those not receiving calcium during CPR) was associated with decreased survival to hospital discharge, and is not associated with favorable neurologic outcome (despite adjustment for confounding factors). Using Srinivasan’s data, the NRCPR paper suggested a potential for harm, with an adjusted odds ratio favoring survival of 0.6 when calcium was used for in-hospital pediatric cardiac arrest. The Meert study
suggested worsened hospital survival with the use of calcium during cardiac arrest, with an odds ratio of increased hospital mortality of 2.26.

A retrospective study of 91 pediatric cardiopulmonary arrests in the ICU setting (de Mos, 2006) showed via multivariable logistic regression analysis that the administration of one or more calcium boluses during resuscitation was an independent predictor of hospital mortality. The study does not demonstrate causality, although interestingly, neither the duration of resuscitation or the number of doses of epinephrine given were independent predictors of mortality, while calcium use was.

Note should be made that few of the studies described are in pediatric animal models or human pediatric studies. Some of them (Redding 1963, 1983) are in animal asphyxial models (more analogous to most pediatric cardiopulmonary arrests), but the others were VF-induced cardiac arrest with post-countershock PEA/ asystole. How relevant these studies are to primary asphyxial cardiac arrest models/ clinical scenarios is unclear. The only prospective RCTs performed investigating calcium therapy in cardiac arrest were the Steuven studies (1985) of refractory pre-hospital adult cardiac arrest. While both were negative studies, the actual conclusions drawn by the authors in both studies were that larger studies should be performed to confirm their results. Follow up studies were never undertaken.

Discussion at the ILCOR meetings in Ghent (Spring 2008) and New Orleans (Fall 2008) reinforced concerns regarding potential for harm with the use of calcium in cardiac arrest, stemming from both the Srinivasan and de Mos studies. Based upon this discussion, the CoSTR statement that originally was (essentially) unchanged from the C2005 statement was modified, as well as the cautionary addendum to even calcium use in the settings of documented hypocalcemia, calcium channel blocker overdose, hypermagnesemia, or hyperkalemia.

Acknowledgements:
Nil

Citation List


An observational study of ionized calcium levels in an adult canine model of VF-induced cardiac arrest.

Main findings
1) There was no change in ionized calcium levels over the course of prolonged cardiac arrest (~30 min of CPR).
2) 3/4 animals that were treated with calcium chloride (standard ACLS doses) developed severe hypercalcemia, raising concerns that calcium treatment might be harmful as a result.

Limitations:
1) The study differs from other animal models (or clinical studies) in that the subjects were resuscitated aggressively with mechanical devices (THUMPER) with or without simultaneous compression and ventilation CPR.
2) A continuous high dose intravenous epinephrine infusion (5 mcg/ kg/ min) ran from the start of resuscitation of all animals as well (the equivalent of 10 mcg/ kg of epinephrine being given every 2 minutes).
3) Use of a non-asphyxial model
4) non-pediatric model

LOE: 5
Quality: Good
Supportive/Neutral/Opposing: background paper addressing presence of hypocalcemia during cardiac arrest: not addressing worksheet question directly


An RCT in an adult canine model of induced VF-cardiac arrest, examining the effects of calcium and epinephrine on ROSC and post-resuscitation hemodynamics. After 2 min of VF the animals were countershocked into PEA. CPR was then provided via a Thumper device (12 breaths/ min, 60 CC/ min). After 2 min of CPR, blinded investigators treated animals with either epinephrine (~50 mcg/ kg IV), calcium chloride (~30 mg/ kg) or dextrose control. The drug was dosed every 2
minutes until ROSC was achieved. After 15 minutes of ROSC, the animal had VF reinduced, and then (in the same study format as above) post-countershock PEA was treated with one of the two remaining drugs (still blinded). Finally, after the re-establishment of ROSC for 15 min, the animal had VF once more induced, and then post-countershock PEA was treated with the final agent.

Main findings:
1) ROSC was less likely to be achieved with the use of a single dose of calcium chloride than with epinephrine (no apparent difference in regards this response when comparing a single dose of calcium to a single dose of placebo).
2) During post-resuscitation recovery, MAP remained lower in the calcium group than in the epinephrine group, but equivalent to those in the placebo group.

Limitations:
1) Use of the animal as its own control, while attractive statistically, overlooks the entity of post-resuscitation myocardial dysfunction. With many of the calcium treated animals being treated later in the study (round 2 or round 3 of resuscitation), that post-resuscitation myocardial dysfunction might have impaired resuscitation or hemodynamics in calcium treated animals, worsening their potential outcome.
2) not a pediatric model
3) non-asphyxial arrest (lesser relevance to pediatrics)

LOE: 5
Quality: Fair
Supportive/Neutral/Opposing: Opposing


An observational study of the change in ionized calcium levels with prolonged cardiac arrest in a closed chest CPR adult canine model (n=9). After 71/2 minutes of VF-cardiac arrest, CPR and ACLS care was provided for countershock-induced asystole or PEA.

Main findings:
1) With increasing duration of cardiac arrest, ionized calcium levels progressively fell.
2) There was no correlation between ionized calcium level and arterial pH, but there was an indirect correlation with lactate levels. Total calcium levels did not change.

Limitations
1) non-pediatric
2) non-asphyxial

LOE: 5
Quality: Good
Supportive/Neutral/Opposing: background paper addressing presence of hypocalcemia during cardiac arrest: not addressing worksheet question directly


A retrospective study of 91 pediatric cardiopulmonary arrests in the ICU setting.

Multivariable logistic regression analysis showed that the administration of one or more calcium boluses during resuscitation was an independent predictor of hospital mortality. The study does not demonstrate causality, although interestingly, neither the duration of resuscitation or the number of doses of epinephrine given were independent predictors of mortality while calcium use was. The number needed to harm associated with calcium use was .

Limitations
1) Retrospective
2) Mixed asphyxial and non-asphyxial arrests (no subgroup analysis)
3) Unclear as to different associated rhythms
4) Calcium levels treated or achieved are not described (hypercalcemia actually achieved?)

LOE: 2
Quality: Good
Supportive/Neutral/Opposing: Opposing


A prospective observational study of ionized calcium levels in adult OHCA (n=32; 16 cardiac, 16 non-cardiac in etiology). Blood work was analyzed on ED-presentation, and at 30 and 60 minutes after presentation. No patient received calcium during the course of resuscitation.

Main findings:
1) All patients presented to the ED with ionized hypocalcemia (average 1.09 mmol/L; clinically relevant?)
2) Ionized calcium levels progressively fell during the course of CPR. Only 2 patients ever developed severe ionized hypocalcemia (<0.8 mmol/L)
3) There was no association between ionized calcium levels and serum lactate or pyruvate levels.
4) Of 32 patients, 18 achieved ROSC, 6 survived to hospital discharge, all being vegetative at that time.
5) Hypocalcemia may be more a marker of poor outcome as opposed to a therapeutic target

Limitations
1) Mixed model of asphyxial and non-asphyxial victims
2) non-pediatric
3) levels of hypocalcemia never reached what is commonly viewed as being clinically relevant
4) no comment as to associated rhythm

LOE: 5
Quality: Fair
Supportive/Neutral/Opposing: background paper addressing presence of hypocalcemia during cardiac arrest: not addressing worksheet question directly


A prospective observational study of the change in arterial and mixed venous blood ionized calcium levels in adult humans OHCA (asphyxial or non-asphyxial; n=22; trauma excluded). Calcium levels were measured ~5 minutes and 30 minutes after ED-presentation. No calcium was given during resuscitation of any patient.

Main findings:
1) There was a drop in ionized calcium levels in both arterial and mixed venous blood between the two points in time, with no difference in arterial and mixed venous ionized calcium levels
2) Ionized calcium levels were lower at time-2 in both those reaching ROSC (n=11; average duration of CPR ~8 min) and those not achieving ROSC (n=11; CPR continued to an average of 49 min in non-survivors, at which time attempts at resuscitation were discontinued)
3) Total calcium levels did not change over time in either group.
4) Ionized calcium levels were lower at time-2 in patients not achieving ROSC (it would appear that most patients in the ROSC group would have re-established a perfusing rhythm by that time based upon the average duration of CPR) and in those patients with longer periods of CPR/ unwitnessed cardiac arrest
5) Note should be made that the average ionized calcium levels did not drop to <1 mmol/ L in either group over the course of resuscitation; it is unclear whether any of the patients developed severe ionized hypocalcemia (<0.8 mmol/ L) during the course of CPR.

Limitations
1) Mixed model of asphyxial and non-asphyxial victims
2) non-pediatric
3) levels of hypocalcemia never reached what is commonly viewed as being clinically relevant
4) It is unclear what percentage of those achieving ROSC survived to hospital discharge (or beyond), so one is unable to predict whether there is any association between ionized calcium levels during cardiac arrest and longer term outcome.
5) unclear as to associated rhythms

LOE: 5
Quality: Fair
Supportive/Neutral/Opposing: background paper addressing presence of hypocalcemia during cardiac arrest: not addressing worksheet question directly


A prospective observational study of ionized calcium levels in adult OHCA victims (trauma victims excluded), upon admission to the ED and over the ensuing 60 minutes of resuscitation.

Main findings:
1) There was a significant negative correlation between transport time (and consequently duration of arrest) and ionized hypocalcemia.
2) Ionized calcium levels continued to fall during resuscitation
3) In survivors, calcium levels would rise with or without calcium therapy to lab-normal levels by 60 min after ED admission.
4) Some patients developed likely significant hypercalcemia with standard ACLS dosages of CaCl
5) In this non-randomized study, there was no association between calcium therapy or lowest level of ionized calcium, and likelihood of ROSC.

Limitations
1) No information is given re: any association between hypocalcemia and survival to hospital discharge.
2) Even the lowest ionized calcium levels in this study would not generally be judged clinically significant (~0.09-1.0 mmol/ l).
3) non-pediatric
4) mixed population of asphyxial and non-asphyxial cardiac arrest?
5) unclear as to different associated rhythms

LOE: 5
Quality: Fair
Supportive/Neutral/Opposing: background paper addressing presence of hypocalcemia during cardiac arrest: not addressing worksheet question directly


A retrospective study of adult OHCA over a 24 month period, looking for an association between patient outcome and pre-hospital intravenous or intracardiac calcium chloride use (along with other 'standard' ACLS drugs). Calcium chloride (400-1000 g) was given for all non-shockable arrests, and VF/ pulseless-VT that was resistant to initial defibrillation.

Main findings:
1) Of the 480 sequential cardiac arrest patients that received calcium chloride therapy, only those with PEA (n=119) achieved ROSC (n=27)
2) There were only 14 survivors to ED-admission, and 3 long term survivors.

Limitations
1) retrospective and uncontrolled
2) variable dosage and route of Calcium delivery
3) although there were long term survivors, their neurologic status is not stated
4) non-pediatric
5) mixed asphyxial and non-asphyxial? Other patient demographics (witnessed arrest, down-time) are not stated
5) unclear how equivalent the ACLS care was amongst patient groups (amount of epinephrine given, other drugs)

LOE: 5
Quality: Poor
Supportive/Neutral/Opposing: Opposing


There are significant limitations to the use of the series as supportive literature in the evidence releasing of this topic:

1) They are all intra-operative witnessed cardiac arrests in patients with open sternums. All patients received open cardiac massage
2) Most patients received very large concurrent dosages of epinephrine (equivalent of ~100 mcg epinephrine/ kg)
3) Most drug dosing (including calcium chloride) was delivered by direct intracardiac route
4) As these patient were not monitored for rhythm at the time, it is unclear what rhythm was involved with each case, let alone whether each patient was truly in cardiac arrest (at least 2 of the cases were hypotensive but may not have been truly arrested)
5) At least 2 of the cases had significant associated hemorrhage and required large pre-arrest blood transfusion, so it is unclear whether this was more profound hypocalcemic arrest, that might have responded much more dramatically to treatment with calcium

LOE: 4
Quality: Poor
Supportive/Neutral/Opposing: Supporting


Interestingly, regression model (variables available before and during the arrest) did not select the use of Calcium as an association with worse outcome. In model 2 (variables available up to 12 hours post-arrest), the use of calcium intra-arrest was associated with increased hospital mortality, with an Odds ratio of 2.26.

Limitations:
1) Mixed asphyxial and non-asphyxial arrests (no subgroup analysis)
2) Calcium levels treated or achieved are not described (hypercalcemia actually achieved?)
3) This retrospective study suggests at least an association of mortality with calcium use during cardiac arrest, but still leaves open the question of causality

LOE: 2
Quality: Good
Supportive/Neutral/Opposing: Opposing


A small (n=10) observational study in an adult canine model studying drug therapy (including calcium use) of post-countershock asystole/PEA. Two minutes after induction of VF, animals were countershocked into PEA or asystole and then transvenously or transcutaneously paced (successful electrical capture but without associated contraction). A further 2 minutes later, CPR was started and animals were dosed with calcium chloride. Animals were treated 2 min later with epinephrine, with a significant improvement in CPP, and with ROSC in 8/10 animals.

Main findings:
1) There was no demonstrable improvement in coronary perfusion pressure (CPP) or subsequent ROSC with the use of calcium.

Limitations
1) non-pediatric
2) non-asphyxial arrest, specifically post-countershock arrest

LOE: 5

An observational study in an adult canine model of VF cardiac arrest. After 7.5 min of VF, animals were countershocked and closed chest CPR initiated along with epinephrine therapy.

Main findings:
1) Animals that had prolonged (and ultimately unsuccessful) resuscitation had a progressive fall in ionized calcium levels to a clinically significant level (<= 0.85 mmol/ l). 9/10 of these animals had post-countershock PEA or asystole
2) Ionized hypocalcemia did not develop in successfully resuscitated animals, with ROSC being achieved within 5-10 minutes of initiating ACLS care.

Limitations
1) post-countershock model (non-asphyxial)
2) non-pediatric

LOE: 5
Quality: Fair
Supportive/Neutral/Opposing: background paper addressing presence of hypocalcemia during cardiac arrest: not addressing worksheet question directly


A prospective cohort study of adult OHCA (n=83) demonstrated that countershock appeared to be superior to epinephrine, CaCl, and atropine for treating asystole.

Limitations
1) non-pediatric
2) mixed population of asphyxial and non-asphyxial
3) Although the collection of data was prospective, there was no attempt made to randomize therapies. Analysis of rhythms and correlations with drug interventions was decided post-hoc

LOE: 5
Quality: Poor
Supportive/Neutral/Opposing: Opposing


In this canine model of asphyxial cardiac arrest, calcium therapy for PEA cardiac arrest was no more effective at achieving ROSC than saline control.

Limitations
1) Only 10 animals were included in each study group.
2) Interestingly, animals that received calcium chloride had a more significant rise in heart rate than atropine or saline control, although no better achievement of ROSC.
3) Unclear whether or how randomization occurred
4) non-pediatric model

LOE: 5
Quality: Fair
Supportive/Neutral/Opposing: Opposing

An adult canine model of *asphyxial* cardiac arrest. After 6-8 minutes of ETT calm ping, LV activity (strain gauge) ceased. A further 5 minutes of CPA elapsed before CPR was instituted with 5:1 CV ratio (Vent rate 20 bpm). One minute after initiating CPR, animals were randomized to receive one of a number of drugs (epinephrine, phenylephrine, isoproterenol, metaraminol, methoxamine, mephentermine, or 10% calcium chloride; no control group).

**Main findings:**
1) Calcium was intermediate in effectiveness (achieving ROSC to 20 min), but significantly inferior to epinephrine.
2) VF-followed CaCl use in an equivalent frequency to those animals receiving epinephrine (2-3/10 animals in each group had this complication).

**Limitations**
1) Uncontrolled
2) Unclear whether or how randomization occurred
3) non-pediatric model
4) which rhythm: PEA, asystole?

**LOE:** 5
**Quality:** Fair
**Supportive/Neutral/Opposing:** Opposing


**Limitations:**
1) Mixed asphyxial and non-asphyxial arrests (no subgroup analysis)
2) Calcium levels treated or achieved are not described (hypercalcemia actually achieved?)
3) This retrospective study suggests at least an association of mortality with calcium use during cardiac arrest, but still leaves open the question of causality

**LOE:** 2
**Quality:** Good
**Supportive/Neutral/Opposing:** Opposing


**Retrospective cohort study of adult OHCA victims (excluding trauma and poisoning) presenting with PEA or asystole that were treated by an urban EMS service with/without calcium chloride.** Calcium was used as a *rescue* therapy after failure to respond to other ACLS drugs.

**Main findings**
1) Survival to ED admission was worse in patients presenting with either rhythm if they had been treated with calcium chloride, although in this study it is hard to know whether this is a result of calcium therapy, or that the need to use calcium was just a surrogate (and not a cause) of worse patient outcome.
2) The only survivors to hospital discharge were in the groups that did not receive calcium (1/129 or 0.8% of asystolic patients and 4/81 or 5% of PEA patients).
3) Patients that presented with PEA and a sinus rhythm were more likely to achieve ROSC.
4) QRS-morphology (wide vs narrow) was not associated with likelihood of achieving ROSC.

**Limitations**
1) Retrospective
2) mixed asphyxial and non-asphyxial
3) non-pediatric
4) no distinction between primary or secondary PEA

LOE: 5
Quality: Fair
Supportive/Neutral/Opposing: Opposing

Labeled as Steuven 1985 1)

A prospective RCT in adult OHCA comparing calcium chloride use to saline control in PEA refractory to other ACLS drug therapy in the pre-hospital setting.

Main findings
1) There was no significant difference in survival to ED admission when comparing the two groups (calcium an saline control).
2) Only one patient in the study of 90 patient survived to hospital discharge
3) Widened QRS complexes were (in post-hoc analysis) more likely to achieve survival to ED admission with the use of calcium therapy.

Limitations of the study
1) calcium was used only after other ACLS drugs were unsuccessful (standardized approach), although it is unclear what the exact drug therapy was in either patient group after the single dose of calcium was given
2) it is unclear how many of the patients were primary vs secondary PEA in either group
3) unclear what the breakdown of asphyxial vs non-asphyxial arrest is between the two groups
4) although they do describe their exclusion criteria (no IV access, unable to intubate, already treated with calcium, trauma, poisoning or pediatric patients, failure to follow protocol), it is unclear how many eligible patients were excluded due to this
5) relatively small study size
6) non-pediatric

LOE: 5
Quality: Good
Supportive/Neutral/Opposing: Opposing

Labeled as Steuven 1985 2)

A prospective RCT of the use of calcium chloride vs saline control in adult OHCA victims with asystole refractory to standard ACLS drug therapy in the pre-hospital setting. After failed response to epinephrine, atropine and NaHC03, patients were randomized to receive calcium or placebo.

Main findings
1) Although there was a suggestion that there might be a benefit to calcium use re: survival to ED admission, it did not reach statistical significance. To rule out a type 2 error, it would have entailed a study recruitment of 600 patients to prove a significant response to calcium.
2) There were no survivors to hospital discharge in this study of 73 patients.

Limitations of the study
1) calcium was used only after other ACLS drugs were unsuccessful (standardized approach), although it is unclear what the exact drug therapy was in either patient group after the single dose of calcium was given
2) it is unclear how many of the patients were primary vs secondary asystole in either group
3) unclear what the breakdown of asphyxial vs non-asphyxial CPA is between the two groups
4) although they do describe their exclusion criteria (no IV access, unable to intubate, already treated with calcium, trauma, poisoning or pediatric patients, failure to follow protocol), it is unclear how many eligible patients were excluded due to this
5) relatively small study size
6) non-pediatric

LOE: 5
Quality: Good
Supportive/Neutral/Opposing: Opposing


Observational study (prospective vs retrospective?) of the time course of ionized hypocalcemia in adult OHCA (n=12) and IHCA (n=9).

Main findings
1) With increasing duration of cardiac arrest, ionized hypocalcemia dropped to a level of clinical significance.
2) There was no significant difference in the ionized calcium levels when comparing patients (OHCA) that died to those that survived.

Limitations
1) Most of the patients in this study had non-asphyxial cardiac arrest.
2) Of the 4 OHCA patients that survived to hospital discharge, 2 of them were calcium channel blocker overdoses (etiologically different and likely different in the nature of their response to the calcium therapy that they received).
3) non-pediatric

LOE: 5
Quality: Fair
Supportive/Neutral/Opposing: background paper addressing presence of hypocalcemia during cardiac arrest: not addressing worksheet question directly