Biphasic or monophasic defibrillation for adult ventricular fibrillation

Report by Rob Torok, Specialist Registrar
Checked by Jeremy Till, Staff Grade

Best evidence topic reports (BETs) summarise the evidence pertaining to particular clinical questions. They are not systematic reviews, but rather contain the best (highest level) evidence that can be practically obtained by busy practising clinicians. The search strategies used to find the best evidence are reported in detail in order to allow clinicians to update searches whenever necessary. The BETs published below were first reported at the Critical Appraisal Journal Club at the Manchester Royal Infirmary or placed on the BestBETs website.

Clinical scenario
An adult is brought into the emergency department following an out-of-hospital ventricular fibrillatory arrest. Ventricular fibrillation persists despite repeated shocks. You remember reading about biphasic defibrillation and wonder if it offers any advantages.

Three part question
In an adult in ventricular fibrillation is external biphasic shock better than monophasic shock at achieving defibrillation?

Search strategy
Medline 1966–06/03 using the OVID interface. Biphasic.mp AND (defib$.mp OR shock$.mp OR exp electric countershock) LIMIT to human AND English.

Search outcome
Altogether 337 papers were found of which seven related to out of hospital studies relevant to the original question.

Comment(s)
The studies shown in table 1 represent two independent groups of patients. The first two studies are a prospective randomised controlled trial (PRCT) and subsequent subgroup analysis of data from it. The last five studies represent ongoing investigation by a group of researchers with some overlap of patient groups between each study because of differing selection criteria and differing dates of study.

The PRCT provides good evidence for the superiority of biphasic defibrillation over monophasic. Analysis of the data from this study gives an NNT of three for successful defibrillation with first shock, and an NNT of four for successful defibrillation within the first three shocks by biphasic compared with monophasic waveforms. These out of hospital studies follow on from extensive in hospital and animal studies showing the superiority of biphasic defibrillation.

All the studies reported used the Heartstream Forerunner defibrillator with non-escalating 150 J shocks. This device uses an impedance compensating biphasic truncated exponential waveform. Laboratory and hospital based studies show the superiority of biphasic waveforms to be broadly applicable and not confined to this specific example of a biphasic waveform. Work is ongoing to refine which parameters of the waveform influence effectiveness. Evidence should be appraised for the effectiveness of the specific waveform used when selecting a defibrillator. Local considerations will determine when biphasic devices replace monophasic defibrillators.

Biphasic defibrillation is currently the best treatment for adult VF and should be used when available.


Ascorbate for alkali burns to the eye

Report by Kevin Mackway-Jones, Consultant
Checked by Janet Marsden, Senior Lecturer

Abstract

A short-cut review was carried out to establish whether ascorbate drops are useful in the management of alkali burns to the eye. Altogether 33 papers were found using the reported search, of which one presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of this best paper are tabulated. A clinical bottom line is stated.

Clinical scenario

A 22 year old man has been cleaning out an old chemical drum. He attends the emergency department with severe burning in his eyes. He says the drum was marked as NaOH 20%. You arrange for copious irrigation and oral pain relief. You contact the duty ophthalmologist who asks to start mydriatics, antibiotic ointement, and ascorbate drops. You do not have the ascorbate drops and wonder whether there is any evidence for their use.

Three part question

In [patients with alkali eye burns] do [ascorbate drops] [reduce short-term symptoms and long-term sequelae]?

Search strategy

Medline 1966- week 1 06/03 using the OVID interface. ([injury.mp OR exp “wounds and injuries” OR exp burns OR burn$.mp] AND [eye$ OR exp eye] OR [eye injury.mp OR eye injuries.mp OR exp eye injuries OR eye burn$.mp OR exp eye burns]) AND (ascorbate$.mp OR ascorbic acid.mp OR exp ascorbic acid OR vitamin C.mp)
Search outcome
Altogether 33 papers were found of which one was relevant (table 2).

Comment(s)
Ascorbate (and citrate) treatment have been extensively investigated in rabbits but there are no good human data. A randomised controlled trial is mentioned as being underway in papers in 1980, but has not been reported.

► CLINICAL BOTTOM LINE
There is no good evidence for the routine use of ascorbate in alkali burns in humans. A well designed randomised controlled trial should be performed.

Brodovsky SC et al, 2000, Australia
121 patients with 177 alkali burnt eyes over 11 years
Standard alkali protocol (antibiotics, intensive topical corticosteroids, ascorbate, citrate and antibiotics) v conservative protocol (antibiotics, short course of corticosteroids)
Retrospective clinical comparison
Time to re-epithelialisation
Delay in grade 2 burns. Trend for longer in 1, shorter in 3 and no difference in 4
Better in grade 3 burns. No difference in 1, 2, and 4
Uncontrolled. Very few conservatively treated patients
Conclude that ascorbate and citrate are the effective agent for grade 3 burns without considering the effect of intensive corticosteroid alone

Leucovorin (calcium folinate) in “antifreeze” poisoning

Report by Angaj Ghosh, Senior Clinical Fellow
Checked by Russell Boyd, Consultant

Abstract
A short cut review was carried out to establish whether the addition of intravenous calcium folinate to standard (ethanol) therapy reduced the visual complications of antifreeze (methanol and ethyleny glycol). Altogether 12 papers were found using the reported search, of which one animal study presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of this best paper are tabulated. A clinical bottom line is stated.

Clinical scenario
A man attends the emergency department having deliberately taken 150 ml of “antifreeze”. The can of antifreeze has conveniently been brought along and you find it consists of a mixture of methanol and ethylene glycol. The Poisons Centre is contacted. In addition to treatment with ethanol it is suggested that intravenous Leucovorin (calcium folinate) is given. You wonder if there is any evidence to support this recommendation.

Three part question
In [an adult with methanol/ethylene glycol poisoning] is [the addition of intravenous calcium folinate better than ethanol alone] at [reducing the incidence of reduced acuity and retinal oedema]? 

Search strategy
Medline 1996–06/03 using the OVID interface. [exp leucovorin OR folinic acid.mp OR Calcium folinate.mp] AND [exp methanol OR methanol.mp OR exp ethylene glycol OR ethylene glycol.mp OR antifreeze.mp] LIMIT to English.

Search outcome
Altogether 12 papers were found, none of which were relevant to humans. One paper published in two different journals described studies on monkeys and suggested that the results could be extrapolated to humans (table 3).

Comment(s)
In humans methanol toxicity is characterised by a metabolic acidosis and an ocular toxicity that occur coincident with an accumulation of formate in blood. After experimental studies on monkeys, Noker and Tephly hypothesised that folate compounds could decrease formate accumulation after methanol by stimulating formate oxidation or utilisation and suggested a possible use for folates in the treatment of certain cases of human methanol poisoning.

► CLINICAL BOTTOM LINE
There is no direct evidence of the usefulness of folates in methanol poisoning in humans. Local policy should be followed.

Vasopressin or adrenaline in cardiac resuscitation

Report by Kerstin Hogg, Clinical Research Fellow

Checked by Reddy Mahu, Clinical Fellow and Ian Crawford, Research Fellow

Abstract

A short cut review was carried out to establish whether vasopressin is more effective than adrenaline after cardiac arrest. Altogether 44 papers were found using the reported search, of which two presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of these best papers are tabulated. A clinical bottom line is stated.

Clinical scenario

A 67 year old man has been brought into the emergency department by paramedic ambulance. He was initially in ventricular fibrillation, but now has pulseless electrical activity. He collapsed 15 minutes ago and received immediate bystander basic life support. You wonder whether intravenous vasopressin would be better than adrenaline in this situation.

Three part question

In [cardiac resuscitation] is [vasopressin more effective than adrenaline] at achieving [return of spontaneous circulation and longterm survival]?

Search strategy

Medline 1966–06/03 using the OVID interface. [(exp vasopressins OR vasopressin.mp OR ADH.mp OR antidiuric hormone.mp) AND (exp epinephrine OR epinephrine.mp OR adrenaline.mp) AND (exp resuscitation OR exp cardiopulmonary resuscitation OR exp Heart arrest OR arrest.mp OR exp ventricular fibrillation OR VF.mp OR ventricular fibrillation.mp OR asystole.mp OR EMD.mp OR electromechanical dissociation.mp OR PEA.mp OR pulseless electrical activity.mp)] LIMIT to human AND English.

Search outcome

Altogether 44 papers were found, only two papers compared the effects of adrenaline and vasopressin (table 4).

Comment(s)

The total number of patients studied remains small. The only RCT looking at hospital inpatients has shown no benefit in administering vasopressin during cardiac arrest.

> CLINICAL BOTTOM LINE

Vasopressin and adrenaline are equally efficacious after cardiac arrest.


Is the central venous pressure reading equally reliable if the central line is inserted via the femoral vein

Report by Joel Desmond, RCS Research Fellow

Checked by Mahmoud Megahed, Specialist Registrar

Abstract

A short cut review was carried out to establish whether femoral central venous lines were as reliable as subclavian or jugular lines at assessing right atrial filling pressure. Altogether 141 papers were found using the reported search, of which seven presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of these best papers are tabulated. A clinical bottom line is stated.

Clinical scenario

You have been called to the resuscitation room to see a 67 year old woman who has walked out in front of a bus while shopping in town. She has an obvious closed fracture of her left arm and she is complaining of abdominal pain and central neck pain. You elicit from her husband that she has had two heart attacks in the past and the drugs in her handbag are bendrofluazide, frumil, and lisinopril. Her blood pressure is 90/52 and her pulse is 105. You are concerned that she may be hypovolaemic, but you are aware of the dangers of giving too
### Table 5

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murdoch IA et al, 1994, UK</td>
<td>12 children with cardiac pathology undergoing cardiac catheterisation while on assisted ventilation</td>
<td>Observational cohort study</td>
<td>Comparison of SVC pressure readings compared with SVC and right atrial pressures</td>
<td>SVC to IVC readings were all within 1.2 mm Hg. Right atrial pressure to IVC pressure was always less than 0.7 mm Hg apart.</td>
<td>Young children only, small group of healthy outpatients coming for cardiac catheterisation, Supine patients only, Range of readings not given</td>
</tr>
<tr>
<td>Chait HI et al, 1994, USA</td>
<td>33 paediatric cardiac-surgical patients age 2 days to 9 years</td>
<td>Observational cohort study</td>
<td>Comparison of right atrial and inferior vena caval pressure</td>
<td>22 of 31 paired patient readings were the same, 5 were within 2 mm Hg, 3 within 3 mm Hg. All spontaneously Breathing readings were within 2 mm Hg. SVC pressures were a mean of 0.71 mm Hg higher than RA pressure.</td>
<td>Study contained only children with congenital cardiac abnormalities</td>
</tr>
<tr>
<td>Reda Z et al, 1995, USA</td>
<td>44 children in ICU with mechanical ventilation</td>
<td>Observational cohort study</td>
<td>SVC pressure compared with IVC pressure</td>
<td>Mean difference 0.93, max difference 3 mm Hg, unaffected by high PEEP or mean airway pressures</td>
<td>The diagnosis of abdominal distension was entirely subjective, No attempt was made to measure intra-abdominal pressure</td>
</tr>
<tr>
<td>Young M et al, 1995, Australia</td>
<td>39 children with both SVC and IVC central venous catheters in place in a paediatric ICU</td>
<td>Observational cohort study</td>
<td>SVC compared with IVC pressure</td>
<td>Mean difference 0.33 mm Hg, 22 of 39 pressure readings were equal. 33 of 39 pressures were within 1 mm Hg. 37 of 39 pressures were within 2 mm Hg.</td>
<td>Position of femoral lines not verified radiologically and short lines used. 3 children spontaneously breathing. 36 ventilated</td>
</tr>
<tr>
<td>Yazigi A et al, 1996, Lebanon</td>
<td>30 patients post-coronary arterial bypass grafts</td>
<td>Observational cohort study</td>
<td>SVC pressure compared with IVC pressure before intubation, after extubation</td>
<td>Mean difference was 0.79 mm Hg 0.68 (SD) mm Hg, Mean difference was 0.6 mm Hg 0.93(SD) mm Hg</td>
<td>Common iliac vein rather than IVC measurement</td>
</tr>
<tr>
<td>Joynt GM et al, 1996, Hong Kong</td>
<td>19 critically ill patients mechanically ventilated in ICU</td>
<td>Observational cohort study</td>
<td>SVC pressure compared with IVC pressure Causes of increased difference</td>
<td>Mean difference is 0.45 mm Hg (CI 0.30 to 0.60) Small tendency for increased PEEP and mean airway pressure to increase observed difference</td>
<td>Patients all supine and ventilated, Non-standard—40–70 cm multi-lumen catheters used, Interestingly an intra-abdominal pressure change of 2–22 cm H₉₀ did not significantly change the differences observed</td>
</tr>
<tr>
<td>Nahum E et al, 1996, Israel</td>
<td>9 children in a paediatric ICU</td>
<td>Observational cohort study</td>
<td>Right atrial pressure compared with IVC or common iliac vein pressure</td>
<td>Mean difference 0.22 mm Hg 1.52 (SD) mm Hg 99.2% of readings were less than 2 mm Hg apart</td>
<td>This is a study in children only, 1 patient was excluded due to unreliable venous waveform of the right atrial catheter, 7 patients had congenital heart defects</td>
</tr>
<tr>
<td>Hs KM et al, 1998, Hong Kong</td>
<td>20 patients who were mechanically ventilated in ICU</td>
<td>Observational cohort study</td>
<td>SVC pressure and common iliac vein pressure (CIVP)</td>
<td>Mean difference 0.1 mm Hg 1.06 (SD) mm Hg</td>
<td>Patients all supine and ventilated</td>
</tr>
<tr>
<td>Walsh JT et al, 2000, UK</td>
<td>60 adult patients undergoing right heart studies or angioplasty</td>
<td>Observational cohort study</td>
<td>Difference between end expiratory right atrial pressure and SVC or IVC measurement</td>
<td>SVC mean difference 0.08 mm Hg (CI 0.0 to 0.18) IVC mean difference 0.23 mm Hg (CI 0.12 to 0.38)</td>
<td>The variability to acute changes were not assessed. Range of right atrial pressures found were not reported. Inadequate recordings obtained at all recording sites for 5 patients</td>
</tr>
</tbody>
</table>

**Notes:**
- SVC: Superior Vena Cava
- IVC: Inferior Vena Cava
- PEEP: Positive End-Expiratory Pressure
- RA: Right Atrium
- CVP: Central Venous Pressure

**Measurements:**
- Intra-abdominal pressure
- Right atrial pressure
- SVC pressure
- IVC pressure
- Mean airway pressures

**Diagnosis:**
- Abdominal distension

**Studies:**
- Observational cohort study

**Instruments:**
- Femoral venous catheters
- Iliac catheters

**Methods:**
- Simultaneous monitoring of SVC and common iliac vein pressures
- Central venous catheters

**Results:**
- Mean difference
- Max difference
- SD
- CI

**Implications:**
- Analysis of intra-abdominal pressure
- Monitoring of right atrial and SVC pressures

**Additional:**
- Age range
- Range of measurements
- Patient numbers

**Study Limitations:**
- Patient selection
- Equipment variations

**Conclusion:**
- Clinical correlation with hemodynamic data
- Evaluation of surgical interventions

**References:**
- Murdoch IA, et al. (1994) UK
- Chait HI, et al. (1994) USA
- Reda Z, et al. (1995) USA
- Joynt GM, et al. (1996) Hong Kong
- Nahum E, et al. (1996) Israel
- Hs KM, et al. (1998) Hong Kong
- Walsh JT, et al. (2000) UK
much fluid to a patient with probable heart failure. You elect to insert a central line for central venous pressure monitoring but she has a neck collar on and so you wonder if placing this via the femoral vein would affect your readings.

**Three part question**
In [patients requiring central venous pressure monitoring] is [a femoral vein central line as good as a jugular or subclavian line] at [reliability assessing right atrial filling pressure]? 

**Search strategy**
Medline 1966–06/03 using the OVID interface. [(exp Central Venous Pressure OR Central Venous pressure.mp) AND (exp Vena Cava, Inferior OR vena cava.mp)] LIMIT to human.

**Search outcome**
Altogether 141 papers of which nine were found to be relevant. These papers are shown in table 5.

**Comment(s)**
There is extensive and consistent evidence that right atrial pressure in pediatric cardiac surgical patients. This has been proved in ventilated and spontaneously breathing adults and children. The readings of supine patients. This has been proved in ventilated and critically ill mechanically ventilated patients.

**CLINICAL BOTTOM LINE**
Inferior vena cava or common iliac venous pressure can be used reliably to measure right atrial pressure and may be regarded as equivalent to readings of superior vena cava pressure.

### Table 6

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beyer JE et al, 1990, USA</td>
<td>25 children aged 3–7 who were given morphine or methadone postoperatively had their pain levels assessed using the CHEOPS, Oucher and the analogue chromatic continuous scales.</td>
<td>RCT to assess the effects of giving morphine or methadone postoperatively. All patients had their pain level assessed.</td>
<td>Looked at the postoperative pain scores 2 hourly for 36 hours and the correlation</td>
<td>The Oucher scale and the ACCS were strongly correlated. CHEOPS was only correlated with the Oucher 4 of 26 times and with ACCS 2 of 26 times.</td>
<td>Sample size not justified, only 25 and at each time point not everyone was assessed, ranges from 6–25. Done postoperatively so may not be applicable generally. Preoperative measurement was done 1 to 4 days before, not consistent might forget technique. Order was consistent with CHEOPS then Oucher and then ACCS to prevent the nurses being influenced by the self report scores.</td>
</tr>
<tr>
<td>Sutters KA et al, 1995, Netherlands</td>
<td>87 children postnephrectomy. Children were given either IM ketorolac or IM saline. All children had their level of pain assessed using CHEOPS and the Oucher scale, if they were able.</td>
<td>RCT for treatment group. All patients had their level of pain assessed.</td>
<td>Changes in these scores over time</td>
<td>The Oucher proved statistically more sensitive to changes in pain levels over time. Not all children could complete the Oucher scale postoperatively.</td>
<td>Does not include ages of children even though it states that the CHEOPS has thus been shown to be less reliable in older children. Does not say why children couldn’t complete the Oucher. Does not say whether the 2 assessments were done by independent people.</td>
</tr>
<tr>
<td>Jacobson S et al, 1997, UK</td>
<td>56 children aged 5–17. One group received IV morphine plus placebo and the other oral morphine plus placebo. Both groups were assessed for their pain using the CHEOPS, Oucher scale, Faces scale and a five point clinical assessment scale.</td>
<td>RCT (with respect to allocation to morphine treatment group). All patients were pain scaled.</td>
<td>Relation between the pain scales presented by use of a Pearson’s correlation and linear regression coefficient.</td>
<td>All pain scales correlated significantly.</td>
<td>Little information about the pain scales. Does not say if they used the Oucher picture or numerical scale. Does not tell you if any were unable to use the Oucher scale. There was a single investigator for assessing pain and this may have introduced bias. Does not tell you the order of presentation of the pain scales and if this was random. Uses the CHEOPS in an older age range than it was designed for.</td>
</tr>
</tbody>
</table>
Oucher or CHEOPS for pain assessment in children

Report by Fiona Lyon, Senior House Officer
Checked by Debbie Dawson, Clinical Research Nurse

Abstract
A short cut review was carried out to establish which of the Oucher or CHEOPS pain assessments were best for assessing pain in children. Altogether 12 papers were found using the reported search, of which three presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of these best papers are tabulated. A clinical bottom line is stated.

Clinical scenario
A 3 year old child comes into casualty and you need to assess their pain. Would it be better to use the Oucher scale, a self report measure, or CHEOPS, a behavioural pain measure, as at this age using either seems equally valid.

Three part question
In [children] is the [Oucher better than CHEOPS] at [assessing pain]?

Search strategy
Medline 1966-week 1 06/03 using OVID. Cinahl 1982- week 1 06/03 using OVID. {oucher.mp. AND cheops.mp.} AND [pain.mp. OR exp pain/] LIMIT to human and English language)

Search outcome
Altogether 12 papers were found. Three of these addressed the subject indirectly, while testing efficacy of analgesia, they are reviewed in table 6.

Comment(s)
The underlying question is whether pain behaviour tools (such as CHEOPS) or self report tools (such as Oucher) are more useable and valid in the assessment of pain in children capable of assessment by both methods. None of the papers addressed the question directly. There seems to be some disagreement as to whether the CHEOPS score correlates to the Oucher score or not. Jacobson et al states that they are correlated, but this may be unreliable as CHEOPS was used in an older age range than was intended. Sutters et al state that CHEOPS is less reliable in older children, though they do not support this with any evidence. The Beyer study uses the two scales in the correct age range but the study is small and conducted postoperatively and general applicability is therefore moot. Further studies using a larger sample of patients in a wide range of clinical situations are needed.

► CLINICAL BOTTOM LINE
There is no evidence to show whether Oucher or CHEOPS is better at assessing pain in children. Local policy should be followed.