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

<table>
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<th>Worksheet author(s)</th>
<th>Date Submitted for review: September 30th 2009. Data reviewed, search strategy re-run: no further revisions are needed.</th>
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<td>Tommaso Pellis, MD</td>
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<tr>
<td>Peter Kohl, MD, PhD</td>
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**Clinical question.**

"In adult cardiac arrest (prehospital [OHCA], in-hospital [IHCA]) (P), does the use of alternative methods of manual CPR (eg. cough CPR, precordial thump, fist-pacing) (I) compared with standard CPR (C), improve any outcomes (eg. ROSC, survival) (O)?"

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

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

**Conflict of interest specific to this question**

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

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


Database searched: PubMed, Cochrane Library, Embase, and AHA EndNote Master Library.

Moreover, cross-references from articles and reviews, and forward search using SCOPUS and Google scholar have been performed.

A total of 169 references were retrieved.

Details of search reported below.

**PubMed**

(("Resuscitation"[Mesh]) OR ("Cardiopulmonary Resuscitation"[Mesh]) OR (cardiopulmonary resuscitation) OR ("Heart Arrest"[Mesh]) OR (cardiac arrest)) AND ((manual external pacing) OR (manual pacing) OR (percussion pacing) OR (fist pacing) OR (chest thump) OR (precardial thump) OR (thump) OR (cough cpr) OR (chest blow))

**Cochrane**

Same search on Cochrane Library (including Cochrane database for systematic reviews and Cochrane Central Register of Controlled Trials)

**Embase**

Same search strategy

**EndNote**

Same search on AHA EndNote Master Library

Search strategy re-run on September 15th 2009

**State inclusion and exclusion criteria**

Exclusion criteria: not pertinent studies, reviews, studies focusing on commotio cordis, and endocardial thumping.

Inclusion criteria: peer-review studies only; two reviews have been retained for orientation, details on the mechanisms of action and cross-referencing; because of the lack of data with higher levels of evidence well documented case reports have been also reviewed.

**Number of articles/sources meeting criteria for further review:**

57 studies met criteria for further review. Of these fifteen LOE 4 (no controls), and eight LOE 5 (3 not in cardiac arrest/emergency condition; 4 animal studies, 1 computational model); thirty one case reports (LOE 4; one is also an animal study) and two LOE 5 case reports (all not pulseless/consciousness affecting); and two reviews.
## Summary of evidence

### Legend

**References pertinent to Precordial Thump**

**References pertinent to Fist-Pacing**

**References pertinent to Cough CPR**

### Evidence Supporting Clinical Question

<table>
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<th>Level of evidence</th>
<th>Good</th>
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**Level of evidence**

- A = Return of spontaneous circulation
- B = Survival of event
- C = Survival to hospital discharge
- D = In tact neurological survival
- E = Other endpoint

### 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 = In tact neurological survival
- E = Other endpoint

**Review**

[ Kohl et al. 2005] E
[ Kohl et al. 2006] E

### Evidence Opposing Clinical Question

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<td>[Miller et al. 1985] B</td>
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<td>[Haman et al. 2008] B</td>
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A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint  

*Italicics = Animal studies*
REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

"In adult cardiac arrest (prehospital [OHCA], in-hospital [IHCA]) (P), does the use of alternative methods of manual CPR (eg. cough CPR, precordial thump, fist-pacing) (I) compared with standard CPR (C), improve any outcomes (eg. ROSC, survival) (O)?"

DISCUSSION:
There are no randomized (LOE 1), controlled (LOE 2) or retrospective controlled studies (LOE 3) comparing the use of alternative methods of manual CPR to standard CPR. Due to the nature of the intervention it is unlikely that LOE 1-2 studies will be designed and conducted at all, this is particularly true for methods such as cough-CPR and precordial thump. Because of the lack of data with higher levels of evidence, all well-documented case reports have been also reviewed.

The clinical question is actually a three-parted one (i.e. cough CPR, precordial thump [PT], fist-pacing), therefore each component will be analyzed separately.

Precordial thump
Initially reported to treat asystole secondary to complete AV block, the use of PT then shifted to cardioversion of VF/VT, following first anecdotic case reports, then case series of suboptimal quality, and finally few prospective non-controlled studies.

VF/VT
A systematic and standardized approach to investigate the utility of PT for VF/VT can be provided by the electrophysiology lab. In this setting the use of PT can be prospectively evaluated in patients undergoing electrophysiology studies or ICD implantation/testing. Despite very early application after the onset of arrhythmia (within 20 sec), successful cardioversion by PT of VF/VT occurred only in 1.3% of cases (3/235, all in VT) [Amir et al. 2007, Haman et al. 2008]. Earlier application of PT in “real life” setting is unlikely. There were no episodes of rhythm deterioration or adverse events (i.e. injury to sternum/ribs, ICD or lead dislodgment). Although not part of a prospective study, an additional 11 cases of VT developed in the same setting are reported by Miller et al.[Miller et al. 1985]. Again PT was neither effective nor harmful.

One might question whether ventricular arrhythmias induced in the electrophysiology lab are a genuine model of spontaneous VT/VF. However, these studies involved high-risk patients with low ejection fraction, and whenever PT failed sinus rhythm was successfully restored by electrical therapy.

When looking at “naturally” occurring ventricular arrhythmias, PT has been investigated prospectively in out-of-hospital cardiac arrest (OHCA) in only one study (good quality, LOE 4)[Pellis et al. 2009]. In victims of VF/VT, PT was not effective for VF (n=23) while in the only episode of VT late PT delivery (10 min) induced rhythm deterioration to PEA. All episodes were not EMS-witnessed, with a significant delay from collapse to intervention (4-17 min). The only other investigation on OHCA (VF/VT) is flawed by several limitations (poor quality, LOE 4) [Miller et al. 1984]: not prospective, data are not reported according to the Utstein template, time from onset of arrhythmia to intervention not reported, number of witnessed arrests not reported. Again PT was never effective in case of VF (n=23), while for patients in VT (n=27) mechanical cardioversion was successful in 3 cases (9%). This study reported an alarming proportion (44%; 12/27) of rhythm deteriorations in VT patients , attributed to the presence severe hypoxia.

In contrast, four case series of in-hospital spontaneous VT support the use of single or multiple PTs, with success rates of 16% (11/68)[Caldwell et al. 1985], 48% (13/27)[Nejima 1991], 49% (22/45)[Morgera et al. 1979], and 54% (20/37)[Volkmann et al. 1990]. PT for VF proved of little (2%)[Caldwell et al. 1985] or no effect (0/10) [Volkmann et al. 1990]. In another case series of in-hospital VT, in which it was not specified whether patients were pulseless, unconscious, or hemodynamically unstable (LOE 5), PT successfully cardioverted 56% of VTs (10/18 and 1 VF)[Befeler 1978]. Rhythm deterioration was observed only in one case (supraventricular tachycardia erroneously thumped into VF then successfully defibrillated) [Morgera et al. 1979]. No other complications were reported.

Interestingly, Volkmann et al.[Volkmann et al. 1990] reported PT success rate as a function of background VT frequency: at ≤160 bpm PT success rates was 77% (17/22), while at >160 bpm PT success was only 20% (3/15). This suggests an inverse correlation between VT rate and successful mechanical cardioversion.

When merging data from prospective non-controlled studies[Amir et al. 2007, Haman et al. 2008, Pellis et al. 2009] and case series[Befeler 1978, Caldwell et al. 1985, Miller et al. 1985, Miller et al. 1984, Morgera et al. 1979, Nejima 1991, Volkmann et al. 1990] PT was effective in restoring sinus rhythm in 19% of VTs (82/441). Only 13 cases of rhythm deterioration were reported leading to a safety profile (=no change/improved rhythm) of 97%. Thumping VF was effective in only 1.2% (4/332) with only one patient thumped into complete AV block (discharged with pacemaker).
Case reports and small case series are easily biased in favor of demonstrable outcomes (no effect usually means no case to report); nevertheless given the paucity of controlled studies all well documented case reports have been reviewed as well. Altogether 54 episodes of VT have been reported, 78% (42) of which were cardioverted by PT, while of 3 patients in VF only in one sinus rhythm was established by PT.

Deterioration of VT after PT has been associated with concomitant digitalis-induced toxicity[Sclarovsky et al. 1981] [Katz et al. 1989]. In 3 out of 4 patients PT induced acceleration of VT. The same 3 patients served as their own controls since PT effectively cardioverted VT following discontinuation of digitalis therapy in 2, and was ineffective but not harmful in the third. The forth patient went from VT to complete AV block.

While recognizing the limits of positive reporting bias, a total of 24 articles (previous studies and case reports combined) were used to develop a summary analysis of the safety and efficacy of PT for humans with VT or VF. Chest thump was effective in 25% of VT (124/494) with 96% safety profile (476/494 no changed/improved rhythm; 18 cases, 3.6%, of rhythm deterioration). Only 1.6% of patients in VF (5/312) were cardioverted by PT, with a safety record of 99% (310/312; 1 rhythm deterioration and 1 sternal fracture complicated by osteomyelitis).

Few considerations:

a) Although PT is often ineffective, when it is effective, it shortens the time to termination of VT/VF, particularly if defibrillation equipment is not immediately at hand or has to be prepared.

b) PT can worsen the rhythm by transforming VT to VF or asystole. This is preferentially observed in patients with pre-existing severe hypoxia or drug-induced toxicity. It occurs far less frequently than positive PT effects. If PT worsens the rhythm and there is no defibrillator immediately available, the patient continues to need standard cardiopulmonary resuscitation until defibrillation.

c) PT is unlikely to delay established resuscitative maneuvers as it requires no equipment set-up and takes only seconds to perform. This has been shown in the cath-lab studies as well as in the only prospective study on OHCA. In the latter, the comparison between patients that received PT as first resuscitative maneuver and those in whom the protocol was violated and standard CPR begun at once did not reveal any negative effect of a PT-first strategy[Pellis et al. 2009].

**Asystole**

The use of PT in patients presenting in asystole deserves a separate analysis. There is only one prospective study on OHCA victims including asystole (n=78)[Pellis et al. 2009]. PT induced ROSC only in EMS witnessed asystole (n=3/6; 50%), hence presumably secondary to conduction-disturbances, and not the by-product of late VF. Two of the three patients were discharged neurologically intact. When summarizing the entire study, which included also unwitnessed victims and other rhythms (n=144), PT contributed to overall ROSC (one in ten) and survival (one in four), in particular in witnessed early asystolic CA (one in two). The remaining available data (15 patients) derives from 5 case reports [Antonelli et al. 1986, Brandenburg 1959, Marmor et al. 1980, Patros et al. 1983, Schott 1920] and 2 poor quality case series [Caldwell et al. 1985, Cotol et al. 1980]. Again, all patients had witnessed asystolic arrest due to complete AV block. Precordial thump, not fist-pacing, was extremely successful in restoring sinus rhythm (14/15, 93%; and 1 converted into VT) with no adverse effects reported. The poor quality/low evidence and limited numbers don’t allow one to draw firm conclusions, but suggest that in case of witnessed onset of asystole a single PT might be a good strategy to successfully restore sinus rhythm. A recent animal study suggests the effectiveness of bouts of chest thumps (on average 40) in promoting ROSC when promptly delivered after post-shock asystole[Madias et al. 2009]. Induction of ventricular depolarization during asystole was significantly associated with LV pressure generated from manual thump and promoted restoration of spontaneous rhythm in all 46 instances of asystole.

**Precordial thump technique**

PT was originally described in 1920 by Schott[Schott 1920], as a sharp impact to the lower half of the sternum, delivered from a height of about 20 cm using the ulnar edge of the tightly clinched fist. Kohl et al[Kohl et al. 2005] have subsequently suggested immediate active retraction of the fist after full impact to emphasize the impulse-like nature of the stimulus. In keeping with this description the majority of authors delivered PT from 20-30 cm height [Amir et al. 2007, Caldwell et al. 1985, Haman et al. 2008, Miller et al. 1985, Miller et al. 1984, Morgera et al. 1979], yet some moved the ideal target to the junction of the middle and lower third of the patient’s sternum[Caldwell et al. 1985, Haman et al. 2008] or to the left, lower half of the sternum[Morgera et al. 1979, Volkmann et al. 1990] with the intent of improving transmission of the mechanical impulse to the heart by hitting the area just above the right ventricle.


**Mechanisms, energy requirements and timing**

Mechanical cardioversion generates an onsite (i.e. in the heart) electrical current by recruiting stretch-activated channels (mechano-electric feedback) [Kohl et al. 2006, Li et al. 2006]. If the channels activated by the mechanical impact depolarize enough excitable
ventricular tissue then an ectopic beat is generated, or the excitable gap required for re-entrant excitation may be obliterated [Kohl et al. 2005]. Zeh and Rahner [Zeh et al. 1978] suggested that an increase right ventricular pressure of 15–20 mmHg generated by PT is an important indicator of sufficiently well performed PT. The threshold for mechanical stimulation of premature ventricular beats in healthy adults is as low as 0.04 to 1.5 J [Zoll et al. 1976]. Permissive mechanical energy levels required to terminate VT or VF are higher (4-8 J), however they appear to be several orders of magnitude less than those involved in commotio cordis during competitive sports in the adult [Kohl et al. 2006, Kohl et al. 2005]. Indeed, chest impacts at energies 10 times the threshold level for mechanical action potential stimulation, did not trigger VT or VF, even if applied during the vulnerable window of the T wave [Zoll et al. 1976]. This discrepancy in permissive energy requirements may explain the rarity of negative side effects with PT in myocardium, unless it is already severely compromised by pronounced hypoxia or drug toxicity.

Since manual PT can not be synchronized with heart rhythm, there is concern about possible rhythm deterioration (VT converted to VF) induced by a mechanical stimulation during the vulnerable period (ascending T wave). Yet, this has been observed only in patients [Miller et al. 1984] and experiments [Yakaitis et al. 1973] involving severe preexisting hypoxia or drug-induced toxicity [Katz et al. 1989, Sclarovsky et al. 1981]. A possible explanation is that ischemia reduces ATP-mediated inhibition of K\textsubscript{ATP} channels, a group of channels that are also stretch-activated. This can now shift the reversal potential of the total stretch-induced current toward more negative values than would be the case with mechanical activation of cation non-selective channels only. The increased mechanosensitivity of K\textsubscript{ATP} channels (co-activation by reduces ATP and stretch) has been suggested to diminish the ability of PT to depolarize resting cells, while shortening action potential duration, hence, reducing resuscitatory potential [Li et al. 2006]. In keeping with this view, in a computer model of PT, Li et al. [Li et al. 2006] found a high efficacy (60%) of a virtual PT delivered early in the course of VT/VF, with only half the benefit (30% efficacy) when delivered under conditions of simulated myocardial ischemia. This may explain why PT appears most effective when given soon after arrest.

**Training**

Strength of PT may be an important determinant of PT success [Kohl et al. 2005]. Nevertheless the published prospective studies did not standardize the force with which PT was applied, apparently intentionally to mimic the “real life” situation [Amir et al. 2007, Haman et al. 2008]. Retrospective characterization of average impact energy was conducted only for one report [Haman et al. 2008], using a specially developed PT impact-measuring device (“thump-o-meter”), and recorded values were compatible with the apparent therapeutic range of PT.

2005 ALS guidelines recommend the use of PT only by healthcare professionals trained in the technique. Accordingly, guidelines should be extended by addition of clear procedural instructions regarding the application of PT and an effort should be made to provide consistently adequate training devices (either as stand-alone thump-o-meter type boxes, or as part of resuscitation mannequin technology). Training aids should be introduced to increase the probability of successful mechanical cardioversion.

**Conclusion**

In conclusion, with the limitations imposed by a low level of evidence provided by existing studies, PT is not effective for VF and most likely of limited use for VT. Despite a low success rate reported by prospective studies (1.4% for VT), when considering that it is the fastest resuscitation maneuver possible, its safety profile (97% better/no change), and the success reported by case series of in-hospital VT (37%), its use for witnessed onset of VT may be considered if a defibrillator is not immediately available / being prepared for use. In non-witnessed OHCA (= assumed long duration of ischemia) the potential for rhythm deterioration may be increased, and therefore PT is not recommended. PT effectiveness appears to be higher in witnessed CA, in particular in asystole, suggesting a potential utility for asystolic witnessed arrest. Hence, the use of PT should be considered to be extended to all pulseless witnessed victims of CA.

PT should be delivered as early as possible, as a sharp impact to the lower half of the sternum, from a height of about 20-30 cm using the ulnar edge of the tightly clinched fist, followed by active retraction of the fist after full impact to emphasize the impulse-like nature of the stimulus.

**Fist Pacing**

Fist pacing, which differs somewhat from PT, is used to pace the asystolic heart. Lower energy impacts, such as the passive fall of the fist from a similar height (i.e. 20-30 cm), should be targeted to the lower left sternal edge. A key difference is that it is no longer a single fist blow, as for PT, but a series of less forceful impacts, that should be delivered at a rate of approximately 50–70 min\(^{-1}\).

Energy requirements have been estimated by Zeh and Rahner [Zeh et al. 1978] as 15-20 mmHg increases in intracavitary right ventricular pressure. However, most investigators emphasize that both site and force need to be individually optimized in each patient by means of efficacy control [Dowdle 1996, Eich et al. 2007, Zeh et al. 1978]. The mechanically applied force must be strong enough to generate electrical stimuli triggering myocardial contractions with an arterial pulse. The force can be reduced until a threshold is found analogously to the minimal effective pacing current with electrical pacing. A palpable central or peripheral pulse must confirm mechanical coupling. The generated pressure waveform may alternatively be recorded by appropriate cardiovascular monitoring (i.e. pulse oximetry or invasive arterial pressure measuring). Fist pacing generates forward blood flow similar to electrical transthoracic, transvenous or atrial pacing, as demonstrated by pulmonary artery catheter or echo-Doppler [Chan et al. 2002, Tucker et al. 1995]. Its efficacy has been demonstrated in pediatric patients as well (3 months and 3-yr-old, 15 kg; left lower
edge of the sternum at a rate of 80 beats min$^{-1}$[Albano et al. 1967, Eich et al. 2005]. Fist pacing should be used as a bridge to
temporary electrical (external or transvenous) pacing or as a temporary measure in case of pacemaker failure.

There are no prospective studies on fist pacing. The largest case series (n=100) reports a 90% efficacy of fist pacing in treating
witnessed onset of complete AV block with ventricular standstill or life-threatening bradycardia (consciousness-affecting). In 31
patients manual pacing was continued for > 3 min (including 2 cases >30 min). While 86% survived the resuscitation phase, 62%
were discharged from hospital alive. Altoghether the 3 existing case series provide a fist-pace efficacy of 93% (129/139 patients; all
in asystole due to complete AV block except for 1 extreme sinus bradycardia and 1 classified as primary asystole)[Klumbies et al.
1988, Zeh et al. 1978, Zoll et al. 1976]. Furthermore, successful manual pacing over-stimulation of the intrinsic cardiac rhythm in
19 healthy volunteers was demonstrated by Zeh et al.[Zeh et al. 1978].

13 case reports provide information on additional 22 patients (18 in asystole secondary to complete AV block, 4 in primary
asystole) for which fist-pacing was always successful[Albano et al. 1967, Chan et al. 2002, Chester 1988, Don Michael et al. 1963,
1970, Zurcher 1972]. In one particular case fist pacing was continued successfully for 2 hours and 45 min[Albano et al. 1967]. In a
patient initially undergoing manual pacing, then electrical external, and finally transvenous pacing, hemodynamic data, following
patient stabilisation, allowed to infer cardiac output assuming that SVR and CVP remained constant throughout the three pacing
modalities. Stroke volumes were comparable with all three methods[Chan et al. 2002].
No adverse events have been reported.

Cough-CPR

There are no prospective studies on cough-CPR. Cough-CPR has been reported only in a limited number of patients (n=17) and
mainly in the catheterization lab setting while a defibrillator or pacing was prepared[Criley et al. 1976, Keeble et al. 2008, Miller et
al. 1994, Niemann et al. 1980]. This alternative method of manual CPR is capable of producing: pulsatile arterial pressure[Criley et
blood flow[Niemann et al. 1980], and can maintain consciousness during CA[Criley et al. 1976, Keeble et al. 2008, Miller et al.

When patients are instructed to cough before or immediately after onset of CA (VF or asystole/severe bradycardia) forceful cough
can generate high systolic arterial pressure (maximum reported 200 mmHg[Keeble et al. 2008], average of reported cases 146
mmHg) and diastolic aortic pressure (in a case of 62 s of cough-CPR mean diastolic pressure 63 mmHg[Miller et al. 1994]). Not all
patients are able to effectively cough (3/8 in one case series did it effectively)[Criley et al. 1976]. In the cath lab, where manual CPR
is difficult to perform, cough-CPR generated better systolic arterial pressure than conventional CPR (140 vs. 61 mmHg)[Criley et al.
1976]. In one case the same coronary care unit patient served as self-control: during a first episode of VF did not promptly cough
and lost consciousness after 15 s, whereas when VF recurred a second time he self-sustained consciousness by cough-CPR for 92 s
before being defibrillated with success[Niemann et al. 1980].

A prospective study reports of 6 conscious patients with in-hospital VT who were instructed to cough: in all cough was effective in
terminating VT (all discharged alive)[Criley et al. 1985].
No adverse events related to cough-CPR have been reported.

Patients can be instructed to effectively perform cough-CPR prior to high risk procedures or immediately after CA (maximum
reported 10 s) as a bridge to defibrillation or pacing. This is only a temporary maneuver that has not been reported for more than 92
s, hence should not be routinely considered as an alternative conventional resuscitative measures or patient preparation for high-risk
procedures.

Cough can terminate VT.

Acknowledgements:
Citation List


PEDIATRIC Case report; LOE 4, fair quality, supporting, E.
Fist pacing to treat asystolic cardiac arrest:
1. Asystole followed procainamide administration, fist pacing allowed effective mechanical coupling for 2 hrs 45 min; the patient died of refractory asystole 12 hrs later
2. Complete AV block cosciousness-affecting with juctional rhythm of 24 bpm, fist pacing restored consciousness; the manoeuvre was succesfully repeated several times to oviiate to severe bradycardia/asystole over the ensuing 3 hrs; discharged alive.
3. 3 months old with supposed intracranial hypertension due to cerebral hemorrhage and repeated episodes of loss of consciousness was treated with fist-paching (only 3-4 fists delivered) to treat an asystolic episode.

No comment about industry funding


LOE 4, good quality, opposing, AB.
PT was delivered to 80 patients who during their electrophysiological studies and/or ICD implantation developed a hemodynamically unstable VT/VF. A senior cardiologist (4 in the study) provided, 10-20 seconds from the onset of the ventricular tachyarrhythmia or during the detection and charging time of ICD, a single PT to the mid sternum from a height of 20-25 cm . Force was not standardized in order to mimic the “real life” situation. In all but one patient (79/80) with monomorphic VT PT was unsuccessful; the remaining pts were successfully defibrillated. No rhythm deterioration or adverse event (i.e. injury to sternum/ribs or ICD) occurred.

No comment about industry funding


Case report; LOE 4, fair quality, supportive, B
Complete AV block and 15 sec of ventricular asystole were successfully treated by PT in the cardiology dept.

No comment about industry funding


Case report; LOE 4, fair quality, supportive, B
In a 75 year-old lady with in-hospital witnessed collapse, a precordial thump cardioverts VT (ECG tracings produced).

No comment about industry funding


LOE 5, quality fair, supportive E (cardioversion).
32 in-hospital pts experiencing 37 episodes of VT. Settings: cath lab or CCU. Not mentioned whether pulseless, conscious or blood pressure. PT was repeated several times before concluding it was ineffective. Of 18 episodes of VT (16 pts) 10 (56%) were treated successfully by PT. I VF cardioverted by PT. 8 episodes of VT did not respond to PT but successfully treat with electrical cardioversion (6) or lidocaine (2). No harm or rhythm deterioration.

No comment about industry funding


Case report; LOE 4, fair quality, supportive, AC
The case of two patients with history of AMI and ventricular aneurism is presented. Patients developed in-hospital VT (total 3 episodes) that responded to a precordial thump when delivered over the area of paradoxical pulsation.

No comment about industry funding

Case report; assumed LOE 4, fair quality, supportive, A
A 64 yrs old man was administered to hospital with severe chest pain which suddenly had begun 40 minutes before. Pulse was regular at 68 beats per minute, blood-pressure was 150/80mm Hg, heart tones were normal and the chest was clear. He was given oxygen and morphine (15 mg intramuscularly and 10 mg intravenously). During further examination the patient suddenly became limp and finally lost consciousness. No pulse was palpable, heart tones were absent and he was apnoeic (unfortunately there was no ECG rhythm reported). Three quick, heavy blows with the clenched fist were applied to the left side of the chest while the radial pulse was palpated. After the third blow a strong but very irregular pulse was felt which soon became regular. About ten seconds after circulation was restored the patient regained full consciousness. There are no further complications mentioned. It is suggested that chest blows should be tried as simple treatment in case of cardiac arrest while equipment for resuscitation is being obtained.


Case report; LOE 4, fair quality, supportive, A.
Setting: CCU. Population: 12 patients with VT (not specified whether pulseless). Intervention: 1 or PTs to the lower half of the left side of the sternum. Results: in 38% of patients (7/12) sinus rhythm was successfully restored by PT. No harm or rhythm deterioration.


LOE 4, fair quality, supportive, BC.
Prospective study. In-hospital and OOH-CA victims were first treated by PT (instructed to cough if still conscious). PT was administered to the lower sternum (2/3 of the way down) from a height of 15-20 cm. The force of the precordial thump was not measured. Whenever possible electrocardiograms were registered (12).
Results (out of 5000 pts): 68 VT and 248 VF pts (of which 86 OOH) were treated by PT.
Responded (altogether 8 pts were pulseless):  
- 5 VF (2%; OOH 2/86 = 2.3%; In-H 3/162 =2%; discharged alive 5/5)  
- 11 VT (17%; discharged alive 4/11, 36%)  
- 2 Asystole (discharged alive 2/2)  
- Cough-CPR for VT in 6 pts (discharged alive 6/6; 1 also treated for recurrent VT with PT)
In several pts multiple PTs required for recurrent or different arrhythmias
Adverse events: complete heart block after PT in a pt in VF (discharged alive).


Case report; LOE 4, good quality, supportive, B.
In a 55 year old female resuscitated from asystolic cardiac arrest, ventricular asystole with persisting electrocardiographic "p" wave activity was induced upon positioning of a pulmonary artery catheter. Manual external pacing (cardiac percussion) was commenced over the lower end of the sternum at a rate of 52 beats/min and electrical capture was evident electrocardiographically. Manual pacing was maintained for 4 min while an external transthoracic pacing device was prepared. This in turn was eventually substituted by transvenous cardiac pacing. Hemodynamic data, following patient stabilisation with transeptal pacing, allowed to infer cardiac output assuming the SVR and CVP remained constant throughout the three pacing modalities. Mechanical pacing resulted in higher blood pressure and cardiac output (60 and 77% of baseline, respectively) than external chest compressions (24 and 38%; assuming chest compression generate 30% of baseline cardiac output). No harm.


Case report; LOE 4, fair quality, supportive, E
High degree AV block in the OR after spinal anesthesia succesfully managed with fist pacing for over 30 sec.
No comment about industry funding

Case report; LOE 4, fair quality, supportive, E; 
Over a 13 years period a patient repeatedly self-administers PT to interrupt numerous episodes of VT, even when monitored in-hospital (ECG produced). 
No comment about industry funding


Case report; LOE 4, fair quality, supportive, E; 
The authors present a case of VT succesfully terminated by PT. The ECG is produced. 
No comment about industry funding


Case report; LOE 4, poor quality, supporting, A. 
PT administered to 6 pts in VT and 8 pts in complete AV block with ventricular standstill. In all pts restored ROSC. Only few ECG strips are presented. 
No comment about industry funding


LOE 4, good quality, supportive, AB.
In settings of cath lab 8 pts developed VF after dye injection. Pts were instructed to repeatedly cough immediately after injection. Three of these pts remained conscious and were able to continue cough after onset of VF. Cough-CPR generated systolic AP of 139.7 mm Hg vs. only 60.7 mm Hg by conventional CPR (sub-optimal due to the position). Consciousness was maintained until defibrillation (24, 29, 36 sec). Cough-CPR maintained flow, consciousness and promoted ROSC in an additional pt in asystole for 20 sec. No adverse effects of cough-CPR. 
No comment about industry funding


Case report; LOE 4, fair quality, supportive, E 
Case report about a 68 yrs old man after myocardial infarction. He developed an Adam-Stokes attack with ventricular asystole. Percussion pacing with 60 beats per minute was applied for 1 1/2 hour until an intravenous pacemaker was ready. An effective cardiac output was achieved. It is suggested to discuss percussion pacing in case of resuscitation procedures. 
No comment about industry funding


Case report; LOE 4, quality fair, supportive, B 
A 20 year old man developed complete AV block with ventricular standstill requiring temporary invasive pacing. Due to pacing wire displacement the pt was treated by fist-pacing over the precordium for 15 min. External mechanical pacing generated QRS complexes and palpable pulse. The pt never lost consciousness and was compliant with the procedure. A detailed description of how the technique should be performed is provided. 
No comment about industry funding


PEDIATRIC, Case Report, LOE4, good quality, supportive, B. 
Three min of fist pacing, generating adequate perfusion during complete AV block, provided support until pharmacological restoration of sinus rhythm (atropine + epinephrine) in a 3-yr-old (15 kg). Percussion was provided by hitting the left lower edge of the sternum with the closed fist at a rate of approximately 80 beats min 

No comment about industry funding

Case report; LOE 4, fair quality, supportive, E
Two new cases of complete AV block with ventricular standstill in post-cardiac surgery patients are presented. A third case was previously published (Eich 2005).
Pt #1 instantly regained consciousness while plethysmographic reading of the pulse oximeter showed good electromechanical coupling. She served as self-control since each interruption of percussion pacing was associated with an immediate recurrence of loss of consciousness.
Pt #2, under general anesthesia, fist-pacing resulted in rapid restoration of an adequate mean arterial pressure, shown by invasive arterial pressure monitoring.
In both fist-pacing effectively served as bridge to electrical pacing
A review of the existing literature on the subject is also presented.
No comment about industry funding


Case report; LOE 4, fair quality, supportive, CD
2 pts developing VT/VF in CCU. ROSC stemmed by PT. Both discharged home intact.
No comment about industry funding


LOE 5, fair quality, supportive, A.
In an animal model of myocardial infarction 20 episodes of VT were induced in 5 pigs. Intervention: single CT repeated after 5 sec if not effective; then, SCTs (5 CTS in short interval); then, bimanual SCTs (5-9 CTS) up to 9 series. Efficacy: overall 95%; 6 by CT; 7 by first SCT; 6 by multiple SCTs. No harm or rhythm deterioration.
No comment about industry funding


LOE 4, good quality, opposing, B.
Setting: electrophysiology study with programmed ventricular stimulation. Population: 485 consecutive patients prospectively studied. Intervention: in case of sustained ventricular arrhythmias (VA), a precordial thump was administered immediately after the onset of unconsciousness. PT delivery: clenched fist forcefully applied from the height of 20-30 cm to the junction of the middle and lower third of the patient’s sternum; individual subjective force magnitude (typical for “real life” conditions). Retrospective characterization of average impact energy was conducted using a specially developed PT impact-measuring device (“thump-o-meter”). Results: induced VA was not tolerated in 155 patients; retrospective measurements of PT energy identified values that are compatible with the therapeutic range of PT (6.3-7.1 J and 8.8-10.4 J); PT terminated polymorphic VT in only two patients; in 153 patients (98.7%), PT was ineffective. No harm or rhythm deterioration. No delay in providing standard resuscitatory measures. The authors conclude that: efficacy of precordial thump for termination of induced non-tolerated ventricular tachyarrhythmias is very low even with application early after the onset of arrhythmia; availability of simulators for training, are currently unavailable and form desirable development targets.
No comment about industry funding


Case report; LOE 4, good quality, supportive, E
Five cases of fist-pacing are presented. Of notice 2 patients were in post-shock asystole; one in particular developed the sequence of VF-shock-asystole-successful fist-pacing 3 times. Other 3 pts experienced complete AV block complicated by asystole. ECG tracings are produced.
No comment about industry funding

Case report; LOE 4, fair quality, opposing, E;
A 70 yrs old man with a hx of an uncomplicated anterior wall myocardial infarction was admitted to hospital with chest pain and dyspnoea. The ECG showed an acute inferior myocardial infarction. On the eight day of hospitalization the patient suddenly showed a VT and became unconscious. A vigorous chest thump resulted in a complete atrioventricular block followed by a sinus rate of 140 beats per minute but no ventricular escape rhythm for eight seconds, followed by an idioventricular rhythm which deteriorated again into ventricular tachycardia (VT). A second chest thump again induced complete AV-block followed by idioventricular rhythm and finally by VT. The VT was unresponsive to lidocaine, procaainamide and electrical cardioversion. The patient died following an unsuccessful resuscitation. The vigorous chest thump is suspected having caused the transient AV-block. This complication needs to be considered and the authors recommended avoiding thumping the chest over-vigorously.

No comment about industry funding


Case report; LOE 4, good quality, supportive, B.
A pt with STEMI undergoing PCI experienced profound bradycardia with a concomitant fall in systolic pressure to 40 mmHg immediately after dilation of the RCA. The patient became presyncopal and was instructed to cough, generating systolic arterial pressures of almost 200 mmHg. He maintained consciousness and cooperated with instructions until atropine became effective.

No comment about industry funding


LOE 4, good quality, supportive, BC
Settings and population: 100 hospitalized pts with witnessed onset asystole or life-threatening bradycardia (consciousness-affecting); 95 documented by ECG, others by lack of pulse / presence after PT.
Presenting rhythm:
51 AV block, total ventricular asystole
9 AV block + bradycardia
9 SAN arrest or block with total ventricular arrhythmia
2 extreme SAN bradycardia
29 asystolies without full differential diagnosis

Duration of PT application:
< 1 min: 28
1-3 min: 41
> 3 min: 31 (including 2 >30 min)

Cause:
48 with angina
20 MI
6 pacemaker failure
4 medically caused
3 haemopericardium
rest embolisms, shock, hyperkalemia, etc.

Outcome:
90/100 PT effective
86/100 survivors of acute reanimation phase
62/100 discharged from hospital
of these
53 with pacemaker & 9 with stable sinus rhythm

69 regained consciousness, usually within 10-15 s (or, occasionally, didn't loose it)
47 back to spontaneous SR (of these, 11 also received Alupent)
40 did not recover spontaneous SR and were switched to electrical stimulation
3 had asystole while pacemaker was installed, switched as above
3 showed increasingly less mechanical response and went on to need compressions
5 showed ECG electrical response, but no beat (pulseless electrical activity)
I flutter --> defib and CPR
I absolutely no response, while heart could be electrically stimulated transesophageally (died, heart failure, amyloidosis)

Adverse events:
9 patients complained about pain, of these 4 were given oral analgesics / sedatives, after which PT was tolerated well

1 subcutaneous haematoma
3 patients with repetitive responses (2-3 beats), one glycoside intoxicated, two major lethal MI
1 asystolic patient PT into flutter, defibrillated electrically but died (heart failure, amyloidosis)
1 asystolic patient responded to PT, went into VF twice and was electrically defib, continued PT, discharged with pacemaker

Recommended rate 50–70 min


Review, LOE 4, fair quality, neutral, E
A detailed review on mechanosensitive ion channels from single cells to clinical implications. Experimental animal and cellular information are integrated into computerized modelling of beat-to-beat ventricular electro-mechanical feedback.

Review: LOE 5, good quality, E
A book chapter offering a clear and detailed explanation of effects of acute mechanical stimulation. The authors review and elucidate the history, antiarrhythmic effects, mechanisms, and energy requirements of PT.

Case report, LOE 4, quality fair, opposing, E;
A 71 yrs old man was admitted to hospital with myocardial infarction (inferior and anterior septal). Another period of chest pain was followed by a short syncope. He was then complaining about dizziness. The ECG showed a VT at a rate of 150 bpm and a precordial thump was applied to an area of paradoxical pulsation. This manoeuvre was followed by a change into a faster VT with a rate of 190 bpm. He lost consciousness and electrical cardioversion was required. This was followed by a sinus rhythm with first-degree AV-Block, right-bundle-branch-block and signs of infarction and aneurysm in the anterior and inferior wall. Author's conclusion: mechanical stimulation, such as chest thump, in patients with ventricular tachycardia is considered as hazardous and should be performed when only electrical cardioversion can follow immediately.


LOE 5, neutral, fair quality, E.
This simulation study elucidates the mechanisms of termination of arrhythmia by precordial thump under normal and ischemic conditions and determines the reasons for the decreased efficacy of precordial thump in ischemia. The study uses a complex three-dimensional (3D) model of the electrical behaviour in rabbit ventricles, with acute mechanical stimulation assumed to result in the recruitment of stretch activated channels (SACs). Results: recruitment of SAC by precordial thump does succeed in terminating VT in some cases; the increased mechanosensitivity of the SAC K\textsubscript{ATP} channels in ischemia lowers precordial thump efficacy. In healthy ventricles, where administration of precordial thump results in recruitment of SAC-non selective (NS), the success rate is 60%. Additional activation of K\textsubscript{ATP} channels by mechanical stimulation in the ischemic heart lowers success rates. In the normal heart, K\textsubscript{ATP} channels typically are blocked by the high ATP concentration. Under the conditions of myocardial ischemia, K\textsubscript{ATP} channels become sensitized to mechanical stimulation and their conductance increases.


LOE 5, Good quality, A, supportive. Animal study.
The study found that precordial thumps of various energies did not terminate VF in a swine model of VF. Three different energies of precordial thump were analyzed (single operator clenched fist manual thumps, 30-mph and 40-mph lacrosse ball), two of which are known to readily induce VF in an animal model of commotio cordis. 10 sec after VF induction animals were thumped at different energies for 3 times, after which electrical defibrillation was attempted. The sequence was repeated up to 6 times (i.e max 18 thumps). If asystole followed defibrillation, manual thumps were promptly given to induce ventricular depolarizations until resumption of spontaneous rhythm. Asystole did follow defibrillation in 46 (77%) of the 60 VF inductions. On average, 40 +/- 31 chest thumps were given during each bout of asystole. After termination of chest thumps, spontaneous rhythm occurred after all 46 instances of asystole. Of the 1,772 chest thumps during asystole, 1,469 (83%) resulted in ventricular depolarizations. Induction of ventricular depolarization during asystole was significantly associated with LV pressure generated from manual thump.

Funding was provided by the Louis J. Acompora Foundation.


Case report; LOE 4, fair quality, supportive, A
Precordial thump effectively restored sinus rhythm in a patient that developed asystole (30 s) during transvenous pacing insertion due to sick sinus syndrome. ECG tracing of the event not produced.

No comment about industry funding


Case report; LOE 4, quality good, supportive, BD.
Setting: cath lab. Pulseless victim of tachyarrhythmia self-sustained consciousness by cough-CPR for 62 sec. She remained conscious through resuscitation attempts: 2 defibrillation attempts (200 W, 360 W) and IV lidocaine. Detailed hemodynamic and ECG data reported. Refractory arrhythmia terminates time-coincidently with cough occurrence (highest cough-generated aortic pressure pulse).

No comment about industry funding


LOE 4, good quality, B, opposing
Of 11 pts undergoing electrophysiology studies paced in sustained VT, in none PT was successful. Cardioversion was then obtained by: overdrive pacing in 2, electrical therapy in 9. The thump was delivered by fleshy part of hypothenar eminence from a height of 20-30 cm. No harm or rhythm deterioration.

No comment about industry funding


LOE 4, quality poor, opposing, A
In OOH settings, 50 nonbreathing patients with variable presenting rhythm (normal sinus as well) during resuscitative manoeuvres received a PT when in VF/VT. PT was delivered using the fleshy part of the hypothenar eminence from a height of 20-30 cm. In 23 pts in VF PT had no effect, while in 27 pts in VT PT induced: cardioversion to supraventricular rhythm in 3 (9%), no effect in 12 (44%), rhythm deterioration in 12 (44%; 3 asystole, 8 VF, 1 PEA). In this subset of pts successful resuscitation with standard procedures (drugs/defib) was possible in 52% (12/23). Stable ROSC or hospital admission/discharge are not clearly stated, as for the primary outcome.

Summary of results:
VF 23/23 no improvement
VT: - 3/27 success
  - 12/27 no improvement
  - 12/27 rhythm deterioration

No comment about industry funding


LOE 4, fair quality, supportive, B.
- Case series (n = 17), no control-group, fair documentation
- 45 episodes of VT, PT interrupted 22 (49%).
- 14 males, 3 females, with a range of age from 45 to 75 (mean 65) years
- 2 patients with sustained VT during an acute myocardial infarction; 15 suffered from recurrent VT, with known ischemic heart disease (n=13) (10 with acute myocardial infarction).
- The thumps were delivered to the lower left parasternal region or to the cardiac apex
- Complications: 1 patient with supraventricular tachycardia, which was misinterpreted as VT, developed ventricular flutter after a succession of blows delivered to the chest. Ventricular flutter was successfully treated by DC-Shock. No further complications are reported
- Because of its simplicity (quickly available) a precordial thump is recommended as the first procedure in all cases of VT.
- The precordial thump should be carefully executed with other emergency treatments available.


Case series; LOE 4, fair quality, supportive, A.
In an epidemiological study on patients with AMI designed to investigate VT the authors report of 27 patients treated with PT. Success rate of PT for VT is 48% (13/27). No ECG tracings produced. In-hospital setting. (Japanese)

No comment about industry funding


Case report; LOE 4, quality good, supportive, B
Population: 7 pts experiencing VF (4), asystole (2), high AV block (1). Settings: cath lab (6) and CCU (1). 3 pts previously reported by Criley et al 1976. In all pts were monitored with ECG, invasive art pressure (except 1), in two Doppler flow, and in one also ventriculography. All pts maintained consciousness by cough-CPR as much as 92 sec before definitive therapy. One pt served as self-control since in prior episode of VF did not cough as instructed and lost consciousness in 15 sec. No harm.

No comment about industry funding


Case report; LOE 4, fair quality, supportive, BC
4 pts were treated in-hospital by PT (rhythms: 2 VT, 1 VF, 1 Asy). While in the pt in asystole PT induced VT, in all the others it restored sinus rhythm. 3/4 were discharged alive. No harm.

No comment about industry funding


LOE 4, good quality, supportive, AC
The first prospective study evaluating PT in OOH-CA victims. Core endpoints of the study were: (1) return of spontaneous circulation (ROSC) stemming from PT as only resuscitation manoeuvre, and (2) any PT-induced change in rhythm. Survival to hospital discharge was measured as secondary endpoint. Results: the vast majority of patients (138 of 144; 95.8%) experienced neither ROSC nor any change in presenting rhythm. PT was directly responsible for ROSC in 2.1% of overall study population (3 of 144), contributing 9.7% to the overall number of ROSC (3 of 31).
- In EMS-witnessed CA, the success rate of PT for ROSC was as high as 27.3% (3 of 11), highlighting the need for early application of PT. Overall survival among EMS-witnessed CA victims was 36.4% (4 of 11); one half of these were cardioverted by PT.
- Hospital discharge: PT was the original cause of ROSC in two of eight cases (25%) discharged alive. Patients in whom ROSC was caused by non-PT interventions had a survival rate of 21.4% (6 of 28), compared to 2/3 among those in whom ROSC occurred upon PT.
- VF/VT: PT made no contribution to either ROSC or survival in the tachyarrhythmic OOH-CA sub-group, which consisted mainly of non-witnessed CA cases (23 of 24).
- Asystole: out of 78 victims of CAAs, 3 responded to PT by ROSC (a contribution of 18.8% to ROSC in this sub-group: 3 of 16), of whom 2 were discharged neurologically intact. No adverse effects of PT delivery were observed. PT was unable to promote ROSC, unless CA was asystolic and EMS-witnessed.
- Time to intervention: among the 11 EMS-witnessed CA, ROSC was directly achieved by PT in 3 cases (approx 27%); all of these patients were in CAAs and time from collapse to PT delivery was brief (22–160 s). In these three cases, asystole was brief, probably secondary to conduction-disturbances, and not the by-product of late VF, where there was no indication of PT success. In another three instances, PT caused a change in rhythm. In these cases, collapse was not EMS-witnessed, and time to PT was significantly longer (4–17min, during which no bystander CPR was performed), reconfirming the relation between timely intervention and success highlighted in the current ILCOR guidelines.
There was no single incident in this study, whether after witnessed or non-witnessed CA, where PT gave rise to negative side effects. In conclusion, PT contributed to overall ROSC (one in ten) and survival (one in four), in particular in witnessed early asystolic CA (one in two). The authors suggest that PT should continue to be considered in EMS-witnessed OOH-CA, specifically in early asystole—the condition in which it was first reported.

No industry funding.


Case report; LOE 5, poor quality (no controls), supportive, B.
A sharp precordial thump was employed to terminate 12 episodes of ventricular tachycardia (VT) in five patients with coronary heart disease. The authors assume that a precordial thump, through electromechanical transduction, provides a low energy current that depolarizes a re-entry pathway. Hence chest thump is an important maneuver for treating cardiac arrest initiated by VT.

Setting: CCU.
Population: not specified whether all pts were pulseless (one pt self-administered PT).
Intervention: thumps were delivered to the lower chest, midsternum or the left precordial area.
Adverse events: in one case the VT rate accelerated after the first thump but a second thump converted the VT into sinus-rhythm, 1 pt complained of soar chest for 3 days.

No comment about industry funding


Case report; LOE 4, fair quality, supportive, A;
Precordial thumps were applied to five patients (four with acute myocardial infarction and one with chronic ischemic heart disease) in several episodes of tachyarrhythmias. Precordial thumps terminated five episodes of ventricular tachycardia (VT). In four of these cases sinus rhythm was restored. In one instance the VT rate accelerated and in another two cases VT deteriorated into ventricular fibrillation (VF). One episode of VF responded to a precordial thump and sinus rhythm was restored. The other had to be defibrillated. The authors conclude that precordial thumping should be an advocated manoeuvre in the coronary care units.

No comment about industry funding


Case report; LOE 4, poor quality, supportive, E
53 yr-old with AMI complicated by complete AV block was fist-paced successfully for 1 hr until automatic ventricular rhythm was established by isoproterenol infusion. The problem relapsed and was again managed by thumping the precordium several hours later. Eventually external mechanical pacing failed to evoke QRS complexes and pt died.
Other 10 cases of complete AV block and agonal rhythms in which cardiac automaticity could be elicited by PT/fist-pacing are presented. None survived, as the purpose was not to bridge to more definite therapy (not available at the time).

No comment about industry funding


Case report (n = 4): First report in literature of successful use of mechanical stimulation of the heart in a case of cardiac standstill with an Adam-Stoke-Attack. Three subsequent cases are described.

Case report; LOE 4, fair quality, supportive, AE
First report in literature of successful use of mechanical stimulation of the heart in a case of ventricular standstill with an Adam-Stoke attack. Three subsequent cases are described. (ECG recordings documented.)

No comment about industry funding


Case report; LOE 4, fair quality, neutral, E
Suggests that digitalis may favour rhythm deterioration when delivering PT in case of VT. The same 3 patients serve as their own control since when therapy with digoxin was halted PT did not accelerate VT but rather restore NSR in 2 and did not modify the rhythm in the third case.

No comment about industry funding

Case report; LOE 5, poor quality (no controls), supportive, B.
During Doppler echocardiographic examination, a patient with MI developed atrial fibrillation with ventricular pauses. Manual external pacing was instituted by rhythmic thumping 20 to 30 cm over the left lateral precordium at rates of 75 to 85/min. The patient remained conscious and echo-Doppler showed forward flow similar to atrial pacing. ECG tracings also showed a wide QRS complex with a varying morphology. Brief termination of manual external pacing produced asystole without Doppler flow. The patient was sustained by fist pacing for 60 seconds before ventricular pacing could be instituted.

No comment about industry funding


LOE 4, Good quality, B, supportive
PTs were directed to the left, lower half of the sternum with the clenched fist from a height of 30 to 40 cm and the force was increased when the manoeuvre failed.
Tachyarrhythmias were initially addressed with a single chest thump which was repeated up to 3 times. Only then series of chest thumps (2 to 8) were provided and these series were repeated up to 10 times.
Summary of results: a) 20/37 (54%) VT success rate with (largely multiple) PT; b) 17/37 (46%) no improvement; c) none/37 worsening of rhythm; d) indication that success rate correlates with VT rate: ≤160 bpm success 77% (17/22), if >160 bpm 20% (3/15); e) not effective for VF.
No complications or rhythm deterioration (i.e. acceleration of VT or change into VF) were observed. Only two patients complained chest pain while being thumped.
No comment about industry funding


Case report; LOE 4, fair quality, supportive, E
A patient with AMI cardioverts 33 episodes of VT abrupt forceful coughs. VT was drug-refractory. When the patient was unable to promptly cough consciousness was compromised and cardioversion was necessary to terminate VT.
No comment about industry funding


Case report; LOE 4, fair quality, supportive, E
Brief description of fist pacing in a patient with complete AV block and ventricular standstill. ECG produced.
No comment about industry funding


Case report; LOE 4, fair quality, supportive, E
In three patients with ventricular asystole continuous rhythmical chest thumps were used, each thump was followed by an QRS complex; metabolic acidosis did not occur; in one case thumping was used for 40 minutes.
1) 60 yrs old woman developed Adam Stockes attacks after fracture of the pacemaker with consequent complete heart block. She received several periods of chest thumping, each over some minutes, until electrical pacing was reestablished.
2) 83 yrs old woman with a complete heart block and ventricular standstill, some days after myocardial infarction. Percussion pacing achieved an adequate cardiac output before an electrical pacemaker was placed (died later because of cerebral lesions.)
3) 77 yrs old man with instable angina pectoris and diabetes mellitus developed complete heart block. Percussion pacing was performed until placement of an elecrical pacemaker.
The following routine is recommended by the authors in patients with cardiac asystole:
1) Thump to the left of the lower sternum.
2) If no spontaneous activity occurs, continue chest thumping until an adequate pulse is achieved.
3) If no ventricular activity occurs, start CPR and ALS resp.
No comment about industry funding

Animal: LOE 5: fair quality, supportive, E
Animal study (swine and rabbits) in complete AV block. Transthoracic mechanical stimulation was obtained with an automated 'cardiac thumper'.
No comment about industry funding

LOE 5, fair quality, opposing, A
In an animal model of asphyxial CA (tube occlusion) asystole was left untreated for 5 min (n=10). Resuscitation was begun with 5 forceful precordial thumps (PT) at 2 sec interval, which resulted unsuccessful in all animals. Chest compression plus epinephrine restored spontaneous circulation in all animals. The same dogs then developed post-resuscitation tachyarrhythmias (n=6) which were treated with the same PT algorithm leading to: sinus rhythm in 2, no effect in 2, VF in 2. Additional 5 dogs were asphyxiated until obtaining severe hypotension (systolic arterial pressure 50 mmHg) and then treated with 5 PTs leading to: 1 asystole, 2 VT, 1 VF, 1 no effect. All animals were turned in VF by electrical shock and PT attempted without success. Altogether standard resuscitation allowed ROSC in 14/15 animals.
No comment about industry funding

LOE 5, fair quality, supporting, B.

Setting:
- 31 pacemaker patients with insufficient native pacemaker activity
- 19 healthy volunteers (control)
- non-emergency situation in presence of defib equipment, informed consent taken
- on demand pacemaker
- manual stimulation by physician or patient (PT self-application)
- single or salvo at higher than intrinsic rate

Findings:
- in all 50 PT-induced PVB or 'overdrive pacing' (up to 130 BPM) was possible
- PT pacing conducted by physician or patients for up to 6 min
- PVB QRS configuration (left or right bundle block-like) depended on whether primarily RV (left-sternal) or LV location (apex / mamillary ocation) was used often preceded by 'spike' artifact
- successful PT caused competent cardiac contraction
- force required to trigger PVB not measured, depended on physique (usually low impact; higher forces in emphysema or muscular individuals)
- out of locations tested, left parasternal edge, lower third, most reliable (RV closest to chest wall)
- in 4 individuals RA an RV pressure measured: pressure wave during 0.04-0.06 s (often with multiple oscillations), about 0.02-0.04 s after ECG 'spike'; successful PVB caused when RV pressure increased by at least 15-20 mmHg; if wrong location, even pressure increase up to 30 mm Hg did not cause PVB
- also measured pressure increase in water-filled balloon on chest (270-300 mm Hg)
- no side effects(i.e. fractures, haematomas, elevated cardiac enzyme levels or rhythm deterioration): pain - in particular with self-administered PT - well tolerated
- even beats in vulnerable period did not cause repetitive runs, automaticity, VT, or VF

Interpretation:
- suggest local distention in small area as probable trigger (as generalised pressure increase from sub-optimal locations didn't do the trick)
- 15-20 mm Hg benign (compare to pressure increase during cough of 100 mmHg or more)
- PVB can be triggered on whole chest, but best lower left-sternal edge
- absence of negative side effects, even when PT targeted vulnerable period, is no proof that they couldn't occur
- suggest that those would be more probably by contusio cordis (even if small)
- note that repetitive excitation in hypoxic heart (Scherf & Borneman) had different morphology from PT-induced beat, suggesting different site and mechanisms (escape automaticity) of origin
- suggest use of single PT and repetitive PT-pacing, also self-applied
- state that boundaries to other CPR interventions (compressions) need to be elucidated
No comment about industry funding


Case series; LOE 4, good quality, supportive, E
Animal; LOE 5; good quality, supportive, E
No comment about industry funding


Case report; LOE 4, fair quality, supportive, E
ECG produced of a case of fist thumping for asystole. The authors suggests the following strategy for witnessed CA (regardless whether monitored). Start with precordial thump, if monitored and asystole attempt fist pacing, if unsuccessful begin standard CPR
No comment about industry funding