Clinical question.

“In adult patients with an ICD or pacemaker and who are in a shockable rhythm requiring defibrillation/ cardioversion (prehospital or in-hospital) (P), does any unique or modified cardioversion/defibrillation strategy (I) compared with standard management (C), improve outcomes (eg. termination of rhythm, ROSC) (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: New topic

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

Conflict of interest specific to this question

Search strategy (including electronic databases searched).

1. The Cochrane library was searched for the terms: (a) ICD AND external defibrillation, (b) pacemaker AND defibrillation, (c) ICD and external cardioversion, and (d) pacemaker and cardioversion. Search (a) resulted in 4 hits which were unsuitable. Search (b) resulted in 18 hits which were unsuitable. Search (c) provided the following 1 suitable result: *Manegold JC, Israel CW, Ehrlich JR, Duray G, Pajitner D, Wegener FT, Hohloser SH. External cardioversion of atrial fibrillation in patients with implanted pacemaker or cardioverter-defibrillator systems: a randomized comparison of monophasic and biphasic shock energy application. Eur Heart J. 2007 Jul;28(14):1731-8. (Manegold, Israel et al. 2007:1731-8) Search (d) resulted in 20 hits which were unsuitable.


3. The Embase database was searched using the same terms used in Pubmed. Search (a) resulted in no new hits compared to that gathered above. Search (b) resulted in no hits compared to that gathered above. Search (c) resulted in no new hits compared to that gathered above. Search (d) resulted in the following new hit: *Adverse effects of direct current cardioversion on cardiac pacemakers and electrodes is external cardioversion contraindicated in patients with permanent pacing systems? Waller C, Callies F, Langenfeld H. Europace. 2004 6:2 (165-168). (Waller, Callies et al. 2004:165-8)

4. The AHA Endnote database was searched using the same terms used in Pubmed (key word search). Search (a) resulted in no hits. Search (b) resulted in the following citation: *Monsieurs KG, Conraads VM, Goethals MP, Snoek JP, Bossaert LL. Semi-automatic external defibrillation and implanted cardiac pacemakers: understanding the interactions during resuscitation. Resuscitation. 1995 Oct;30(2):127-31. (Monsieurs, Conraads et al. 1995:127-31)


State inclusion and exclusion criteria


Exclusion Criteria: Citations identified as letters (Afferness 1982:457-8) (Lechleuthner 1995:253) and editorials (Furman 1981:485-6) (Gammage 2007:1668-9) under the heading publication types were excluded.
• Number of articles/sources meeting criteria for further review:

Eleven articles met criteria for further review. Of these one was LOE 1 (Manegold, Israel et al. 2007:1731-8), three LOE 4 (Altamura, Bianconi et al. 1995:194-8) (Monsieurs, Conraads et al. 1995:127-31) (Godin and Petitot 1989:1011) (Waller, Callies et al. 2004:165-8). The rest were case reports which do not fit any LOE definitions, in this worksheet they have been classified as LOE 5.
### Summary of evidence

#### Evidence Supporting Clinical Question

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<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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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

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

Based upon the search strategy summarized above, there are very few studies addressing the question: *In adult patients with an ICD or pacemaker and who are in a shockable rhythm requiring defibrillation/cardioversion (prehospital or in-hospital) (P), does any unique or modified cardioversion/defibrillation strategy (I) compared with standard management (C), improve outcomes (e.g. termination of rhythm, ROSC) (O).*


*Two case series underscore the importance of training emergency personnel in rhythm identification despite the presence of pacing output artifacts on the ECG (Monsieurs, Conraads et al. 1995:127-31) (Calle and Buylaert 1998:177-83).*

*One randomized trial compared the effect of monophasic versus biphasic shocks on pacemaker system function after the shock, no significant differences in two groups were noted and aside from non-significant transient changes in impedance and sensing, no device malfunction was noted (Manegold, Israel et al. 2007:1731-8).*

**Summary Comment:** Data on safe defibrillation strategies for adult patients with an ICD or pacemaker system is insufficient. Based upon the existing evidence, it seems reasonable that the defibrillator pad/paddle should ideally be placed on the chest wall as far as possible from the generator position when treating an adult victim with a permanent pacemaker or an implantable cardioverter defibrillator.

Acknowledgements:
None

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**Citation List**


*This was a letter to the editor discussing 2 previous articles related to pacemaker damage due to external countershocks published in previous issues of the journal "Pacing and Clinical Electrophysiology". The letter recommended using a vector transverse to the vector for typical external countershocks to reduce the probability of pacemaker damage. This article was not included in LOE tables due to lack of original data.*


*This article assessed the safety of external countershocks in 36 patients with old (pre-2000) unipolar pacemakers. Transient (up to 30 minutes) loss of capture was seen in 18 patients who received high energy shocks. Transient sensing failure was also observed in 17 patients. Pacemaker malfunction requiring generator replacement was noted in 3 patients. This case series was characterized as LOE 4.*


*This is a case report of a right sided dual chamber pacemaker which developed complete battery drainage after 2 consecutive high energy external shocks during cardiac surgery. Notably the anterior paddle was near the pulse generator. This case report was classified as LOE 5.*


*This study examined old pacemakers and found that programming changes can be observed when defibrillation paddles are near the pulse generator. This report was classified as LOE 5.*


*This article highlights the importance of training emergency care givers in identification and interpretation of pacemaker output artifacts. Such output artifacts can occasionally fool the AED and caregivers into thinking that a native stable rhythm exists, thus delaying appropriate therapy. This case report was classified as LOE 5.*

Colquhoun, M., S. Jones, et al. (2006). "Emergency management of arrhythmias and/or shocks in patients with implantable cardioverter defibrillators (ICDs). A statement on behalf of the Resuscitation Council (UK), Heart Rhythm UK (formerly The British Pacing and
Electrophysiology Group, BPEG), The Joint Royal Colleges Ambulance Liaison Committee (JRCALC) and the Ambulance Services Association (ASA).” *Resuscitation* **71**(3): 278-82.

The purpose of this statement is to familiarize emergency care providers with ICD and pacemaker function. Treatment algorithms for management of arrhythmias and shocks in patients with ICDs and pacemakers are provided. This article was not included in LOE tables due to lack of original data.


This editorial discusses cases of pacemaker malfunction after defibrillation and difficulties in recognizing the existence of a pacemaker by emergency personnel who are about to provide therapy. This article was not included in LOE tables due to lack of original data.


This editorial discusses the results of Manegold et al's study suggesting that interrogation of pacemakers prior to and after external cardioversion for AF is reasonable. It highlighted the results of Manegold et al discussed below. This article was not included in LOE tables due to lack of original data.


*Cases of pacemaker failure (older devices) during electrocautery and after cardioversion are discussed in this article. This case series was characterized as LOE 4.*


*Complete loss of pacemaker function is reported in a patient who received an external shock for VF. The paddle was placed directly on the pulse generator. This case report was classified as LOE 5.*


*This case report discusses the possibility of electric shock to emergency care providers by the patient's ICD. The paramedic was not wearing gloves and gel from the external paddle was present on the patient's chest which may have enhanced conduction. This article was not included in LOE tables due to lack of original data pertaining to the clinical question.*


*The study compared pre and post pacemaker and ICD parameters after mono or biphasic external cardioversions for AF. No clinically significant (statistically significant changes were present but had no meaningful clinical effect) changes in parameters were noted. Cumulative energy was lower in biphasic compared to monophasic shocks but no differences in device response or conversion to SR was found between the two groups. The reference was classified as neutral LOE 1 for the comparison of monophasic versus biphasic defibrillation, and supportive LOE 4 for the clinical question.*


*This case series presents a case where pacemaker artifact inhibited the recognition of underlying VF by emergency care providers thus delaying therapies. A second case with temporary loss of capture after defibrillation for VF is also presented. This case series was characterized as LOE 4.*


*This letter to the editor suggests the use of a magnet to convert to asynchronous mode when appropriate pacemaker function after external cardioversion is considered. This case report was classified as LOE 5.*


*This case series reports the incidence of 3 cases of increased capture thresholds (requiring lead revision) after external cardioversions in recipients of contemporary devices. The authors suggest informing the patients of higher risk and consideration of pharmacologic or internal low energy cardioversion for AF in the setting of implanted devices. This case series was characterized as LOE 4.*