



Complete Summary

GUIDELINE TITLE

Defibrillation: 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations.

BIBLIOGRAPHIC SOURCE(S)

Defibrillation. In: 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Suppl):III17-24. [126 references]

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

SCOPE
METHODOLOGY - including Rating Scheme and Cost Analysis
RECOMMENDATIONS
EVIDENCE SUPPORTING THE RECOMMENDATIONS
BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS
QUALIFYING STATEMENTS
IMPLEMENTATION OF THE GUIDELINE
INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES
IDENTIFYING INFORMATION AND AVAILABILITY
DISCLAIMER

SCOPE

DISEASE/CONDITION(S)

Cardiac arrest
Ventricular fibrillation

GUIDELINE CATEGORY

Treatment

CLINICAL SPECIALTY

Cardiology
Emergency Medicine
Family Practice
Internal Medicine

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Emergency Medical Technicians/Paramedics
Health Care Providers
Hospitals
Nurses
Physician Assistants
Physicians
Public Health Departments

GUIDELINE OBJECTIVE(S)

To provide guidance on defibrillation including the sequence of shock delivery and the use and effectiveness of various waveforms and energies during defibrillation

TARGET POPULATION

Individuals experiencing cardiac arrest or ventricular fibrillation

INTERVENTIONS AND PRACTICES CONSIDERED

Treatment

1. Strategies before defibrillation
 - Precordial thump
 - Cardiopulmonary resuscitation
2. Use of automatic external defibrillators (AEDs)
 - Ensuring quality and maintenance of AED programs
 - AED use in hospitals
 - Electrode pad/paddle position and size
 - Use of paddles vs. self adhesive defibrillation pads
 - Biphasic vs. monophasic waveforms for ventricular defibrillation
 - Energy levels for defibrillation
 - Second and subsequent shocks (fixed vs. escalating energy, one shock 3-shock sequences)
 - Defibrillator data collection
 - Prevention of oxygen related fire during defibrillation

MAJOR OUTCOMES CONSIDERED

- Return of spontaneous circulation
- Resuscitation success
- Survival rate
- Long-term clinical outcome

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Hand-searches of Published Literature (Secondary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

All reviewers were instructed to search their allocated questions broadly. Reviewers documented their search strategies to ensure reproducibility of the search. The minimum electronic databases searched included the Cochrane database for systematic reviews and the Central Register of Controlled Trials (<http://www.cochrane.org/>), MEDLINE (<http://www.ncbi.nlm.nih.gov/PubMed/>), EMBASE (www.embase.com), and the master reference library collated by the American Heart Association (AHA). To identify the largest possible number of relevant articles, reviewers were also encouraged to perform hand searches of journals, review articles, and books as appropriate.

The reviewers documented the mechanism by which studies relevant to the hypothesis were selected. Specific study inclusion and exclusion criteria and study limitations were documented. Inclusion of all relevant evidence (from animal and manikin/model studies as well as human studies) was encouraged.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Levels of Evidence

Level 1: Randomized clinical trials or meta-analyses of multiple clinical trials with substantial treatment effects

Level 2: Randomized clinical trials with smaller or less significant treatment effects

Level 3: Prospective, controlled, nonrandomized cohort studies

Level 4: Historic, nonrandomized cohort or case-control studies

Level 5: Case series; patients compiled in serial fashion, control group lacking

Level 6: Animal studies or mechanical model studies

Level 7: Extrapolations from existing data collected for other purposes, theoretical analyses

Level 8: Rational conjecture (common sense); common practices accepted before evidence-based guidelines

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

A worksheet template was provided with step-by-step directions to help the experts document their literature review, evaluate studies, and determine levels of evidence. When possible, 2 expert reviewers were recruited to undertake independent evaluations for each topic.

Assessing the Quality of Evidence

In this step reviewers were asked to determine the level of evidence of relevant studies (Step 2A), assess the quality of study research design and methods (Step 2B), determine the direction of results (Step 2C), and cross-tabulate assessed studies (Step 2D).

The levels of evidence used for the 2005 consensus process were modified from those used in 2000. In many situations summary conclusions were based on lower levels of evidence because human clinical trial data was not available. The reviewers assessed the quality of research design and methods and allocated each study to 1 of 5 categories: excellent, good, fair, poor, or unsatisfactory. Studies graded as poor or unsatisfactory were excluded from further analysis.

Reviewers evaluated the direction of the study results as supportive, neutral, or opposed and then depicted the data in 1 of 2 grids. The grids were 2-dimensional, showing quality and levels of evidence. The reviewers completed a Supporting Evidence grid and a Neutral or Opposing Level of Evidence grid.

Controversies Encountered

Studies on Related Topics (Level of Evidence [LOE] 7)

Many reviewers identified studies that answered related questions but did not specifically address the reviewer's initial hypothesis. Examples include the extrapolation of adult data for pediatric worksheets and extrapolation of the results of glucose control in critically ill patients to the postresuscitation setting. Worksheet reviewers were instructed to clearly designate evidence that represented extrapolations. Reviewers could designate such studies as LOE 7, or they could assign a level of evidence based on the study design but include terms such as "extrapolated from" with specific relevant details in the draft consensus

on science statements to indicate clearly that these were extrapolations from data collected for other purposes.

Animal Studies and Mechanical Models

Animal studies can be performed under highly controlled experimental conditions using extremely sophisticated methodology. Irrespective of methodology, all animal studies and all studies involving mechanical models (e.g., manikin studies) were classified as LOE 6. Specific details about these studies (including methodology) are included in the summary of science where appropriate.

Studies Evaluating Diagnosis or Prognosis

The default levels of evidence used for the 2005 consensus process were not designed for the review of studies that evaluate diagnosis or prognosis. For these studies other methods of assigning levels of evidence were considered (such as those proposed by the Oxford Centre for Evidence-Based Medicine [<http://www.cebm.net/>]). Worksheet reviewers planning to include alternative levels of evidence were asked to define such levels clearly and to retain the default levels of evidence.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus
Expert Consensus (Consensus Development Conference)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Worksheet reviewers created a summary of the science. In the summary format reviewers were encouraged to provide a detailed discussion of the evidence, including the outcomes evaluated and the strengths and limitations of the data.

The final step in the science summary process was the creation of draft consensus on science statements and treatment recommendations. Statement templates were provided to standardize the comprehensive summary of information. Elements of the consensus on science statement template included the specific intervention or assessment tool, number of studies, levels of evidence, clinical outcome, population studied, and the study setting. Elements of the treatment recommendation template included specific intervention or assessment tool, population and setting, and strength of recommendation.

The statements drafted by the reviewers in the worksheets reflect the recommendations of the reviewers and may or may not be consistent with the conclusions of the 2005 Consensus Conference.

All 380 participants at the 2005 Consensus Conference received a copy of the worksheets on CD-ROM. Expert reviewers presented topics in plenary, concurrent, and poster conference sessions. Presenters and participants then debated the evidence, conclusions, and draft summary statements. Each day the most controversial topics from the previous day, as identified by the task force chairs,

were presented and debated in one or more additional sessions. The International Liaison Committee on Resuscitation (ILCOR) task forces met daily during the conference to discuss and debate the experts' recommendations and develop interim consensus science statements. Each science statement summarized the experts' interpretation of all the relevant data on a specific topic. Draft treatment recommendations were added if a consensus was reached.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Completed worksheets were posted on the Internet for further review. The initial process involved posting the worksheet to a password-protected area of the American Heart Association Intranet (accessible to worksheet reviewers). In December 2004 the completed worksheets were posted on an Internet site that could be accessed by the public for further review and feedback before the 2005 Consensus Conference in Dallas (www.C2005.org).

Wording of science statements and treatment recommendations was refined after further review by International Liaison Committee on Resuscitation (ILCOR) member organizations and the international editorial board. This format ensured that this final document represents a truly international consensus process.

The manuscript was ultimately approved by all ILCOR member organizations and by an international editorial board. The American Heart Association (AHA) Science Advisory and Coordinating Committee and the editor of *Circulation* obtained peer reviews of this document before it was accepted for publication. The document is being published simultaneously in *Circulation* and *Resuscitation*, although the version in *Resuscitation* does not include the sections on stroke and first aid.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Strategies Before Defibrillation

Precordial Thump

One immediate precordial thump may be considered after a monitored cardiac arrest if an electrical defibrillator is not immediately available.

Cardiopulmonary Resuscitation (CPR) before Defibrillation

A 1-1/2 to 3-minute period of CPR before attempting defibrillation may be considered in adults with out-of-hospital ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT) and Emergency Medical Services (EMS) response (call to arrival) intervals >4 to 5 minutes. There is no evidence to support or refute the use of CPR before defibrillation for in-hospital cardiac arrest.

Use of Automatic External Defibrillators (AEDs)

AED Programs

Use of AEDs by trained lay and professional responders is recommended to increase survival rates in patients with cardiac arrest. Use of AEDs in public settings (airports, casinos, sports facilities, etc.) where witnessed cardiac arrest is likely to occur can be useful if an effective response plan is in place. The response plan should include equipment maintenance, training of likely responders, coordination with local EMS systems, and program monitoring. No recommendation can be made for or against personal or home AED deployment.

AED Program Quality Assurance and Maintenance

AED programs should optimize AED function (rhythm analysis and shock), battery and pad readiness, operator performance, and system performance (e.g., mock codes, time to shock, outcomes).

AED Use in Hospitals

Use of AEDs is reasonable to facilitate early defibrillation in hospitals.

Electrode-Patient Interface

Electrode Pad/Paddle Position and Size

Paddles and electrode pads should be placed on the exposed chest in an anterolateral position. Acceptable alternative positions are anteroposterior (paddles and pads) and apex posterior (pads). In large-breasted patients it is reasonable to place the left electrode pad (or paddle) lateral to or underneath the left breast. Defibrillation success may be higher with 12-cm electrodes than with 8-cm electrodes. Small electrodes (4.3 cm) may be harmful; myocardial injury can occur.

Self-Adhesive Defibrillation Pads Versus Paddles

Self-adhesive defibrillation pads are safe and effective and are an acceptable alternative to standard defibrillation paddles.

Initial Shock Waveform and Energy Levels

Biphasic Versus Monophasic Waveforms for Ventricular Defibrillation

Biphasic waveform shocks are safe and effective for termination of VF when compared with monophasic waveform shocks.

Energy Level for Defibrillation

There is insufficient evidence for or against specific selected energy levels for the first or subsequent biphasic shocks. With a biphasic defibrillator it is reasonable to use 150 J to 200 J with biphasic truncated exponential (BTE) waveforms or 120 J with the rectilinear biphasic waveform for the initial shock. With a monophasic waveform defibrillator, an initial shock of 360 J is reasonable.

Second and Subsequent Shocks

Fixed Versus Escalating Energy

Nonescalating- and escalating-energy biphasic waveform defibrillation can be used safely and effectively to terminate VF of both short and long duration.

1-Shock Protocol Versus 3-Shock Sequence

Priorities in resuscitation should include early assessment of the need for defibrillation (see National Guideline Clearinghouse [NGC] summary for the American Heart Association guideline [Adult Basic Life Support](#)), provision of CPR until a defibrillator is available, and minimization of interruptions in chest compressions. Rescuers can optimize the likelihood of defibrillation success by optimizing the performance of CPR, timing of shock delivery with respect to CPR, and the combination of waveform and energy levels. A 1-shock strategy may improve outcome by reducing interruption of chest compressions. A 3-stacked shock sequence can be optimized by immediate resumption of effective chest compressions after each shock (irrespective of the rhythm) and by minimizing the hands-off time for rhythm analysis.

Related Defibrillation Topics

Defibrillator Data Collection

Monitor/defibrillators modified to enable collection of data on compression rate and depth and ventilation rate may be useful for monitoring and improving process and outcomes after cardiac arrest.

Oxygen and Fire Risk During Defibrillation

Rescuers should take precautions to minimize sparking (by paying attention to pad/paddle placement, contact, etc) during attempted defibrillation. Rescuers should try to ensure that defibrillation is not attempted in an oxygen-enriched atmosphere.

CLINICAL ALGORITHM(S)

The International Liaison Committee on Resuscitation (ILCOR) Universal Cardiac Arrest Algorithm is provided in the "Introduction" section of the original guideline document (see "Availability of Companion Documents" field).

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of evidence supporting the recommendations is not specifically stated.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate application of cardiopulmonary resuscitation and defibrillation techniques to increase the chance of successful intervention

POTENTIAL HARMS

- Potential complications of the precordial thump include rhythm deteriorations, such as rate acceleration of ventricular tachycardia (VT), conversion of VT into ventricular fibrillation (VF), complete heart block, and asystole.
- The use of small electrodes (4.3 cm) may be harmful to patients; myocardial injury can occur.
- There is the potential of fire risk during defibrillation in the presence of an oxygen enriched atmosphere.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

This document summarizes current evidence for the recognition and response to sudden life-threatening events, particularly sudden cardiac arrest in victims of all ages. The broad range and number of topics reviewed and the inevitable limitations of journal space require succinctness in science statements and, where recommendations were appropriate, brevity in treatment recommendations. This is not a comprehensive review of every aspect of resuscitation medicine; some topics were omitted if there was no evidence or no new information.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Clinical Algorithm

For information about [availability](#), see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness
Safety

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Defibrillation. In: 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Suppl):III17-24. [126 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2005 Nov 29

GUIDELINE DEVELOPER(S)

American Heart Association - Professional Association

SOURCE(S) OF FUNDING

American Heart Association

GUIDELINE COMMITTEE

International Liaison Committee on Resuscitation (ILCOR)

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Not stated

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

A robust conflict of interest policy was developed to ensure full disclosure of potential conflicts and to protect the objectivity and credibility of the evidence evaluation and consensus development process. This policy is described in detail in an editorial companion document (see "Availability of Companion Documents" field). Representatives of manufacturers and industry did not participate in this conference.

Potential conflicts of interest of the editorial board are listed in Appendix 3 of the original guideline document (see "Availability of Companion Documents" field). Potential conflicts of interest of the worksheet authors are noted in the worksheets and can be accessed through the links to the worksheets contained in the original guideline document. All 380 attendees were required to complete forms in order to document their potential conflicts of interest. Most attendees were also worksheet authors. The information from the conflict of interest forms completed by all conference attendees, including worksheet authors, can also be accessed at the website http://circ.ahajournals.org/content/vol112/22_suppl/#APPENDIX. Readers of the print version can also access the statements at the American Heart Association website: www.C2005.org.

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available from the [American Heart Association Web site](#).

Print copies: Available from the American Heart Association, Public Information, 7272 Greenville Ave, Dallas, TX 75231-4596; Phone: 800-242-8721

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Introduction. 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Circulation* 2005 Nov 29;112(22 Supplement):III-1-III-4.
- The evidence evaluation process for the 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Circulation* 2005 Nov 29;112(22 Supplement):III-128-III-130.
- Conflict of interest management before, during, and after the 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Circulation* 2005 Nov 29;112(22 Supplement):III-131-III-132.
- Controversial topics from the 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Circulation* 2005 Nov 29;112(22 Supplement):III-133-III-136.

- Appendix 1: Worksheet topics and authors. Circulation 2005 Nov 29;112(22 Supplement):B1-B14.
- Appendix 3: Conflict of interest for editors, editorial board, special contributors and reviewers, and honorees. Circulation 2005 Nov 29;112(22 Supplement):B16-B18.
- Interdisciplinary topics: 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Supplement):III-100-III-108.

Electronic copies: Available from the [American Heart Association Web site](#).

Print copies: Available from the American Heart Association, Public Information, 7272 Greenville Ave, Dallas, TX 75231-4596; Phone: 800-242-8721

PATIENT RESOURCES

None available

NGC STATUS

This NGC summary was completed by ECRI on February 2, 2006. The information was verified by the guideline developer on March 7, 2006.

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