

The 4 control dogs showed no significant differences in AFR generation when comparing shocks administered before and after saline infusion rather than SOD/CAT. *Conclusion:* antioxidant enzymes markedly attenuate free radical generation by DC shocks. If free radicals are a mechanism of defibrillation injury in patients, drugs with free radical inhibiting or scavenging properties may prevent such injury.

959-102 What "Dose" of Oxygen is Required in Treating Prolonged Cardiac Arrest

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Introduction: Selective aortic (Ao) perfusion and oxygenation (SAPO) with oxygenated ultra-purified polymeric bovine hemoglobin (UPBH) is an effective adjunct to ACLS in the treatment of cardiac arrest. The optimal volume of oxygenated UPBH, equivalent to a dosage of oxygen, is not known.

Purpose: Determine the dose/response relationship between intra-Ao UPBH and return of spontaneous circulation (ROSC).

Methods: Randomized, interventional study using a canine model of VF with a prolonged "down-time" and CPR based on external chest compression. After chloralose anesthesia, the blood gases and vital signs were normalized. ECG, Ao arch and intra-esophageal pressures were measured continuously. A descending Ao occlusion-inflation balloon catheter was placed through the femoral artery. Ventricular fibrillation was induced and BLS begun after 10 min. Inter-animal differences in BLS were minimized by standardization of esophageal pulse pressure and Ao blood gases. At 13 min, the Ao occlusion balloon was inflated and 10, 20 or 30 cc/kg of UPBH (equivalent to 1.8, 3.6, and 5.4 ml O₂/kg) was infused at 300 cc/min. Defibrillation with 8 J/kg was attempted at end infusion. *Results:* N = 17. Only 2 of 5 animals given 10 cc/kg of UPBH had ROSC, versus 4 of 5 given 20 cc/kg, and all 7 animals given 30 cc/kg had ROSC (p = 0.05). All resuscitated animals were alive at one hour. *Conclusions:* There is a dose-response relationship between the volume of oxygen administered by SAPO and the rate of ROSC after prolonged cardiac arrest. Thirty cc/kg of UPBH, equivalent to 5.4 ml O₂/kg, appeared optimal in this model.

959-103 A Systematic Approach to the Evaluation of Chest Pain in the Emergency Department: A Prospective Risk Assessment and Treatment Protocol Based on Patient Presentation, ECG and Rest Technetium 99m-Sestamibi

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Ideal treatment of acute myocardial infarction (AMI) and unstable angina (UA) require rapid evaluation and triage in the ED. Appropriate patient triage and disposition can reduce admissions and optimize resource utilization including reduced CCU length of stay (LOS). Historically less than 20 percent of patients admitted with chest pain (CP) rule in for AMI. However, all patients must be initially evaluated in the same fashion until the risk of AMI or UA can be determined and appropriate treatment initiated. Given the diagnostic limitation of the presenting symptoms and initial ECG, we designed and are prospectively testing a systemic protocol to evaluate all patients who present to the ED with CP. All patients are assigned to one of five levels based on risk and probability of AMI and of ischemia: 1. AMI; 2. Probable AMI/UA; 3. Possible AMI/UA; 4. Possible UA; and 5. Non-cardiac CP. In the absence of a diagnostic ECG needed for assignment to level 1, (ST elevation), or level 2, (ST depression), immediate injection of Tc99m-sestamibi in the ED is used to further stratify patients in levels 3 and 4. If the evaluation of any given patient becomes positive, the assigned level is increased to one of higher risk with appropriate changes in therapy.

Since January 1994, 560 patients with potential cardiac chest pain have been enrolled into levels 1-4. Level 5 patients were treated for obvious non-cardiac causes. Predicted risk of AMI with distribution of patients and actual incidence of AMI is as follows:

Level	Predicted Risk of AMI	% Patients	AMI (%)	CCU LOS
1	>95%	4%	100%	2.9 days
2	50-95%	31%	21%	1.7 days
3	5-50%	23%	3%	21 hrs
4	<5%	42%	0%	0

There were no in-hospital deaths in any of these patients. This protocol appears safe, can be systematically applied to include all patients who present with CP, and will thus help maximize resource utilization by appropriately triaging patients and reducing LOS.

959-104 The Potential Use of Impedance Cardiography as a Hemodynamic Sensor for Automated External Defibrillators

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Automated external defibrillators use ECG analysis algorithms to identify ventricular fibrillation (VF) and ventricular tachycardia (VT). VT can be associated with a wide range of blood pressures and automated defibrillators determine the need for DC shock based on the heart rate alone. The incorporation of a hemodynamic sensor may improve the accuracy of an automated defibrillator. The impedance cardiogram (ICG) has been used to non-invasively measure cardiac output and its peak value, dz/dt(max), correlates well with aortic blood flow. We have developed a system whereby the ICG can be recorded at cardiac arrests through the same two ECG/defibrillator pads, placed in an antero-apical position, that are used to monitor or shock the patient. At 103 cardiac arrest calls and in 20 healthy volunteers (C) the ICG was recorded for a period of at least 10s without CPR artefact: 9 records were rejected because of poor quality. The rhythms were divided into VF, asystole (As), agonal rhythm (Ag), electromechanical dissociation (EMD), VT requiring DC shock (VTs) and VT not requiring DC shock (VTns). The ICG tracings were ensemble averaged to remove any electrical noise and dz/dt(max) was measured.

dz/dt(max)	C	VTns	VTs	EMD	Ag	VF	As
Mean $\Omega \cdot s^{-1}$	0.622	0.413*	0.191*	0.178*	0.118*	0.112*	0.098*
\pm SEM $\Omega \cdot s^{-1}$	0.058	0.041	0.032	0.022	0.011	0.010	0.004
Number	20	20	7	22	20	14	19

*p < 0.01 compared with C (Kruskal-Wallis)

C was significantly greater than all other rhythms. VTns was significantly greater than the pulseless rhythms EMD, Ag, VF and As. There was no significant difference between VTs and the pulseless rhythms. Thus the ICG is a potential hemodynamic sensor for automated external defibrillators.

959-105 Emergency Center Tc99m-sestamibi SPECT Imaging for Unexplained Chest Pain: Cost Savings and Outcome Analysis

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Emergent myocardial perfusion imaging (MPI) has been shown to be accurate in diagnosis of acute MI. We assessed the financial and pt outcome implications of such imaging.

Method: 50 pts presenting to emergency center (EC) with unexplained chest pain received resting Tc99m-sestamibi SPECT MPI as part of their EC evaluation with a gamma camera dedicated to this purpose. If resting scan was nl, adenosine stress imaging was performed in EC at cardiologist's (MD) discretion. Influence of MPI was determined by MD questionnaire completed immediately before and after MPI results were made available. Cost savings analysis was based on pre- vs post-MPI management strategy and historical analysis of costs. 45 pts were followed avg 9 months post MPI.

Results: MPI altered pt management in 34/50 pts (68%). 29 pts were sent home rather than admitted based on EC MPI. 9/21 admitted pts were sent to lower intensity beds. Total cost savings was \$88,533 (\$1771/pt). 35 pts were asymptomatic on follow-up, 8 had recurrent chest pain and 6 had at least 1 EC visit for chest pain. No pt with nl MPI had a major cardiac event or revascularization on follow-up.

Conclusion: The use of acute EC SPECT MPI is a cost effective means of assigning pts to a low risk group that may be followed safely on an outpatient basis.

959-106 Characteristic Mechanisms and Outcome of Cardiopulmonary Arrest in Congestive Heart Failure Patients

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Recent studies suggest the mechanism of sudden death in congestive heart failure (CHF) patients is less frequently VT/VF than previously believed. In order to further understand the characteristics and mechanisms of death in CHF patients, we evaluated 146 patients who underwent cardiopulmonary resuscitation during hospitalization for congestive heart failure, ischemic heart disease, and noncardiac causes. Clinical characteristics and outcomes are described below:

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	CHF/Cardiac	nonCHF/Cardiac	noncardiac
N	30	26	90
Age	63 (49.71)	67 (60.72)	63 (29.71)
Sex (% male)	37	58	60
Initial Rhythm N (%)			
VT/VF	7 (25)	11 (44)	24 (27)
Asystole	6 (21.4)	6 (24)	33 (37.5)
Bradycardia	5 (17.9)	2 (8)	6 (6.8)
EMD	6 (21.4)	1 (4)	13 (14.8)
Other	4 (14.3)	5 (20)	12 (13.6)
ROSC	21 (70)	13 (50)	51 (56.7)
Survival to D/C	1 (3.3)	4 (15.4)	2 (2.2)

Patients with nonCHF/Cardiac disease had a higher ROSC than patients with CHF and noncardiac diseases ($p = 0.016$). In summary, patients with CHF often experience cardiopulmonary arrest with bradycardic or EMD arrests. Although patients with CHF are resuscitated with a high degree of success their in-hospital survival was low. Furthermore, the high rate of bradycardic and EMD arrests may explain the low in-hospital survival rates.

959-107

Outcome of In-hospital Cardiopulmonary Resuscitation

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Cerebral and overall performance after successful resuscitation is an important measure of its success. To evaluate resuscitation attempts in adults (age ≥ 18 years) by the 24-hrs resuscitation team in our hospital (1,032 beds; 27,500 admissions/years), we prospectively collected data from resuscitation forms and retrospectively from medical records. Performance was assessed retrospectively by means of the Cerebral and Overall Performance Categories (CPC/OPC).

Results: A total of 1205 calls were received from June 1988 up to January 1994 (the emergency room and general wards always call upon the team, CCU/ICU only when intubation is required). 717/1205 calls were confirmed arrests in 675 adults (mean age 58, 43% >70 years). Resuscitation was not attempted in 10 arrests. Return of spontaneous circulation occurred in 347/717 arrests (49%), followed by transfer to the ICU or CCU. Of the 347 initial survivors 93 (27%) died within 24 hrs, and another 138 (40%) died later during their hospital stay. 101 (15%) pts (38% >70 years) were discharged from the hospital alive. VF/VT as initial rhythm was present in 60 (60%) survivors and ischaemic heart disease (ICD 410-414) was diagnosed in 40 (40%) survivors.

Outcome performance was assessed at the time of discharge. Good outcome: CPC1, 90 pts (90%); OPC1, 78 (78%); Moderate disabilities: CPC2, 4 pts (4%); OPC2, 14 pts (14%); Severely disabled/vegetative state: CPC/OPC3-4, 7 pts (7%). A total of 36 pts (36%) died after discharge, of which 19 (53%) died within the first year.

Conclusion: Survivors after of in-hospital circulatory arrest have a good prognosis in terms of cerebral and overall performance, but long term successes are limited.

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Implantable Cardioverter — Defibrillators

Tuesday, March 21, 1995, Noon-2:00 p.m.
Ernest N. Morial Convention Center, Hall E
Presentation Hour: 1:00 p.m.-2:00 p.m.

960-83

A Prospective Study of Tested versus Nontested Antitachycardia Pacing in Implantable Cardioverter-Defibrillators

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The value of testing antitachycardia pacing (ATP) for the termination of ventricular tachycardias (VT) in implantable defibrillators was evaluated in a prospective trial. Pre-discharge testing of antitachycardia pacing was attempted in 66 consecutive patients (pts) with non-thoracotomy third-generation implantable cardioverter-defibrillators (ICD). VT's could be induced in 18 pts (group A: 14 CAD, 3 DCM, 1 other) and were terminated by ATP at the pre-discharge testing at least twice. In 48 pts (group B: 30 CAD, 9 DCM, 9 others) the effectivity of ATP could not be tested due to non-inducible VT. ATP was programmed in both groups as an autodecremental ramp with 81% of the tachycardia cycle length and up to 4 sequences with 8 to 11 stimuli. The mean follow-up was 10 months.

Results:	group A	group B
ATP-tested patients (n)	yes 18	no 48
VT episodes	532	491
ATP-termination	468	430
ATP unsuccessfull	29	41
VT-acceleration	35 (6.6%)	20 (4.7%)
ATP-success rate	88%	88%

Conclusion: The autodecremental ramp is a safe and effective antitachycardia pacing mode for terminating spontaneous ventricular tachycardias in 88% regardless of the result of the pre-discharge test.

960-84

Randomized Prospective Comparison of Four Burst Pacing Algorithms for Spontaneous Ventricular Tachycardia

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Burst antitachycardia pacing (ATP) is highly efficacious for termination of monomorphic ventricular tachycardia (MVT). Since several pacing sequences are usually programmed as a single therapy, optimal programming is presently unknown. In 40 patients (P) with MVT and a 3rd generation AICD, 4 burst ATP were prospectively compared (as a first single ATP) during follow-up in a randomized design crossing over every 2-3 months. Burst ATP modes (A to D) were defined by pacing cycle length (PCL, as % of VTCL) and number of beats (No B) (Table). A second ATP zone was programmed in a non selected way in all patients.

Results (Table): 374 episodes (317 considered MVT) received ATP therapies in 23 patients. RR intervals could be retrieved for MVT-CL analysis in 168 episodes. Success rate of combined first (randomized) and second (non selected) therapies was 92%. Acceleration rate estimation was 2%.

Therapy	A	B	C	D	global	p
PCL/No B	91/7	81/7	91/15	81/15		
All VT	68%	46%	85%	61%	69%	<0.001
VTCL < 350*	82%	14%	44%	38%	47%	0.03
VTCL > 350°	73%	100%	91%	86%	90%	ns

* CL < 350: group of MVT with CL < 350 ms. ° CL > 350: MVT with CL > 350 ms

Conclusions: 1. Efficacy of the tested burst pacing modes differs significantly, at least in fast VT. 2. Contrary to what could be expected, "less aggressive" bursts seem to be more efficacious, even in fast VT.

960-85

Implantation of a Single-Lead Unipolar Transvenous Cardioverter/Defibrillator (ICD) Under Local Anesthesia

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The purpose of this study was to prospectively evaluate single-lead unipolar transvenous ICD implantation under local anesthesia and defibrillator threshold testing under mild sedation.

In 12 consecutive patients (mean age, 61 ± 10 years) transvenous ICD implantation was performed (9 patients had ischemic heart disease, 3 patients dilated cardiomyopathy). The presenting arrhythmia was ventricular fibrillation in 4 patients, and monomorphic ventricular tachycardia in 8 patients. Mean LVEF was $26 \pm 11\%$. A single-lead unipolar transvenous ICD with biphasic defibrillation pulse was implanted subpectorally in all patients under local anesthesia with 1% lidocaine. During defibrillation threshold (DFT) testing sedation was applied with 11.5 ± 5.1 mg (0.14 ± 0.05 mg/kg) midazolam. For DFT determination 5.8 ± 1.3 episodes of ventricular fibrillation (mean total ventricular fibrillation time 52.4 ± 14.7 seconds) were induced. Mean DFT was 12.8 ± 4.3 J, mean duration of the implantation procedure was 58 ± 13 minutes. Heart rate, mean arterial blood pressure, and arterial oxygen saturation were not significantly different before and after DFT determination. One patient had moderate pain during DFT testing, and 3 patients had mild pain during the surgical procedure. Symptoms during the procedure were evaluated using a standardized questionnaire. Severe feeling of panic and surprise, and discomfort of moderate degree was reported by 2 patients. There were no complications. Hospital length of stay: all patients were discharged on the second postoperative day. Postimplant ICD testing was performed successfully without sedation 3.5 ± 1.4 days after ICD implantation, in 6 patients as an outpatient procedure.

Conclusions: Single-lead unipolar transvenous ICD systems can safely be implanted under local anesthesia and mild sedation during defibrillation threshold testing. The procedure is well tolerated.