# UYGUN ya da UYGUNSUZ ŞOKLAR MORTALİTEYİ ARTTIRIYOR MU?

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- Takılabilir kardiyoverter defibrilatörler (ICD) tarafından uygulanan şoklar ventriküler taşiaritmilerin tedavisinde hayat kurtarıcıdır.

- Kalp nedenli ani ölüm (ani kardiyak ölüm),semptomların başlangıcından sonra bir saat içinde ve kardiyak bir nedenle oluşan ölüm olarak tanımlanır.

- Bu ölümler genellikle malign aritmiler nedeniyle oluşur ve %80-90 kadarından ventrikül taşikardisi (VT) veya ventrikül fibrilasyonu (VF) sorumludur. Diğer nedenler ise bradikardi, asistol ve nabızsız elektriksel aktivitedir.

- ICD tedavisi bu hastaların hem birincil hem de ikincil korunmasında yaygın olarak kullanılmaktadır.

- ICD implantasyonunda ana endikasyonu primer korunma gelmektedir (%82 ABD, %55 Avrupa)
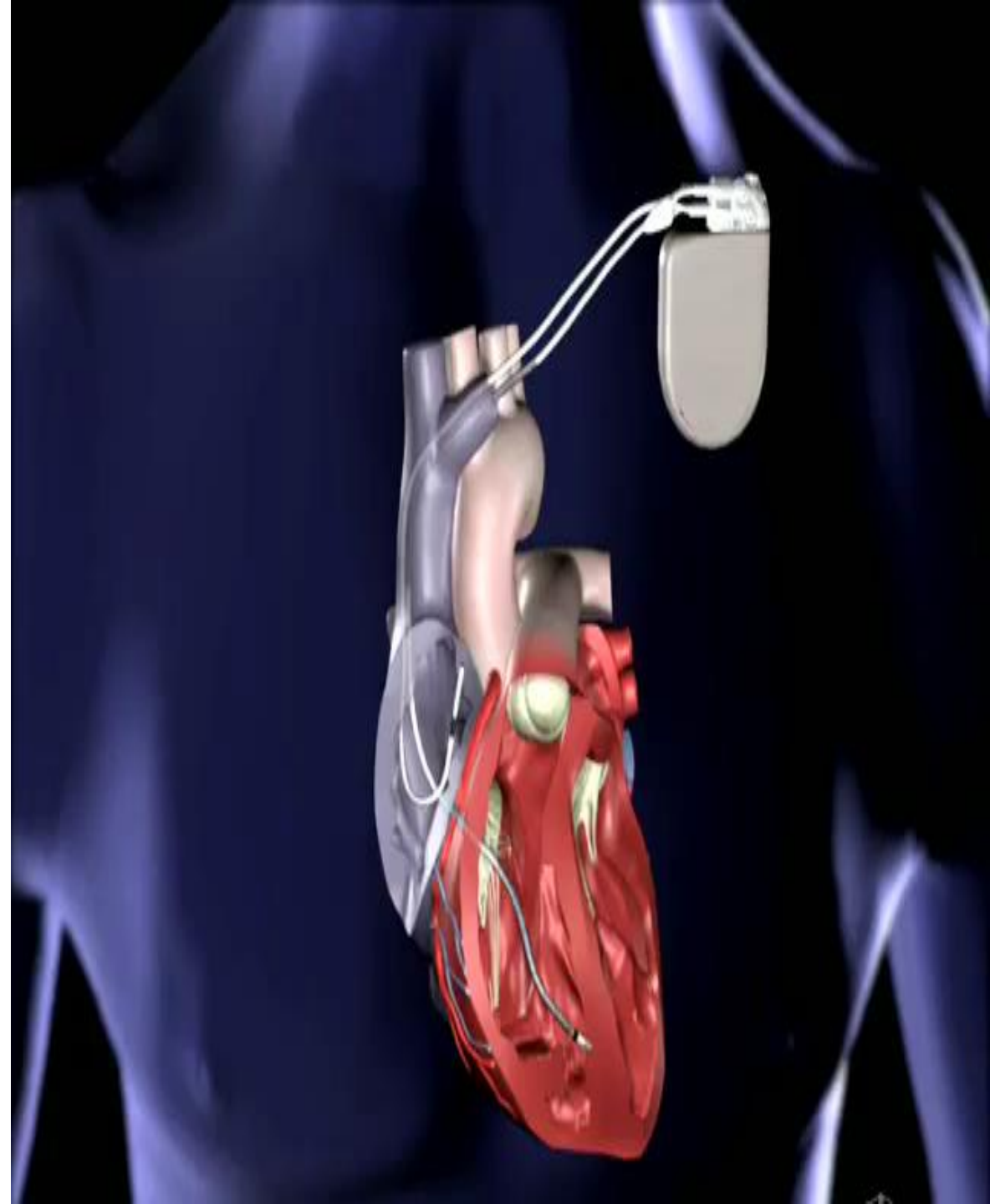
1966- Mirowski ICD fikri	
1969- İlk deneysel ICD modeli	
1969- İlk transvenöz defibrilasyon	
1975- İlk hayvan modelli ICD implantasyonu	
1980- İlk insan ICD implantasyonu	
1981- ICD'ye kardiyoversiyon özelliği eklenmesi	
1985-FDA'in ICD onayı	
1988- İlk programlanabilen insan ICD implantasyonu	

CASH – Cardiac Arrest Study Hamburg (1994)

AVID – Amiodarone versus Implantable Defibrillator (1995)

MADIT – Multicenter Automatic Defibrillator Implantation Trial (1996)

CABG–Patch – Coronary Artery Bypass Graft Patch Trial (1997)

MUSTT – Multicenter Unsustained Tachycardia Trial (1999)

CIDS – Canadian Implantable Defibrillator Study (2000)

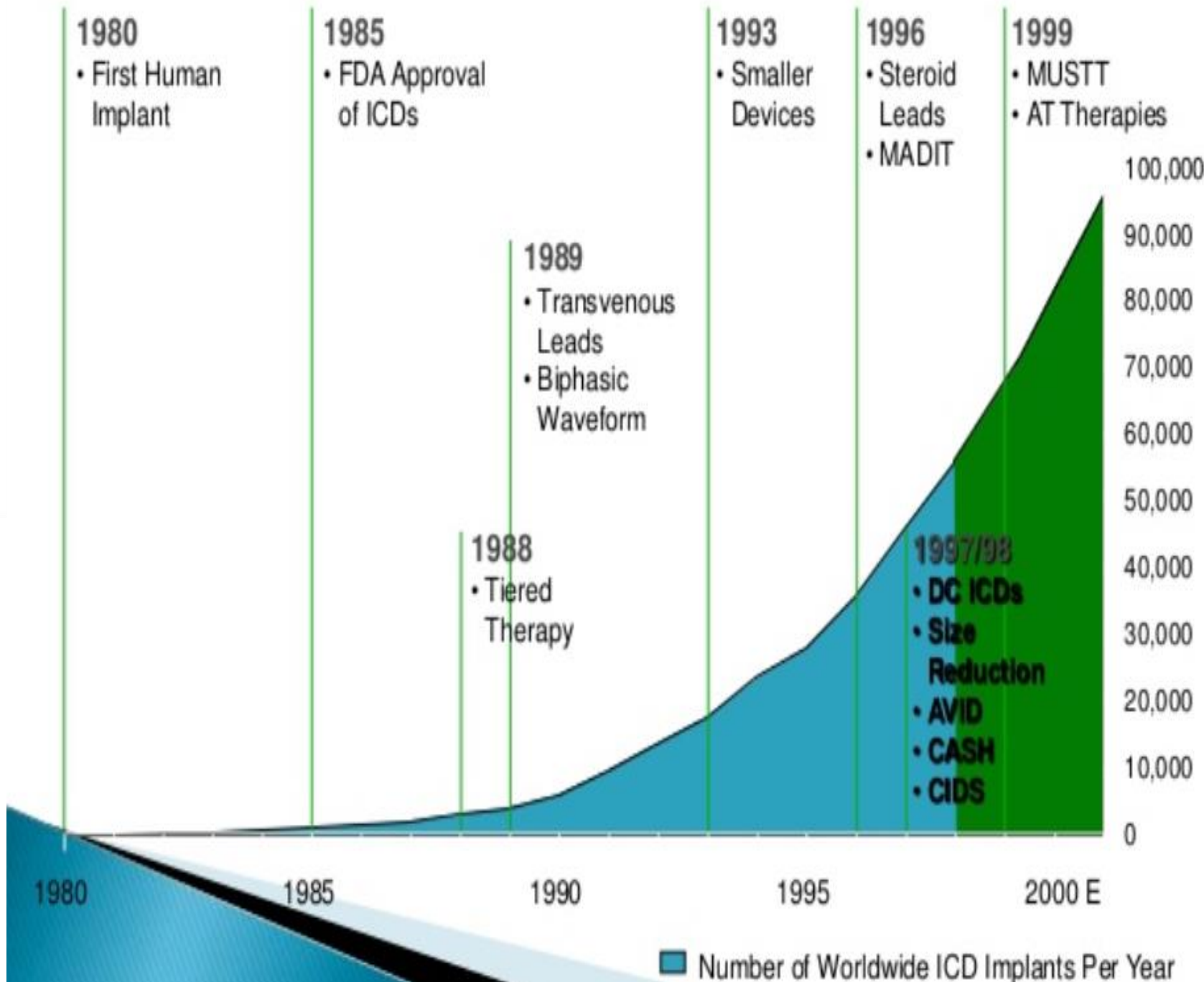MADIT II – Multicenter Automatic Defibrillator Implantation Trial (2002)
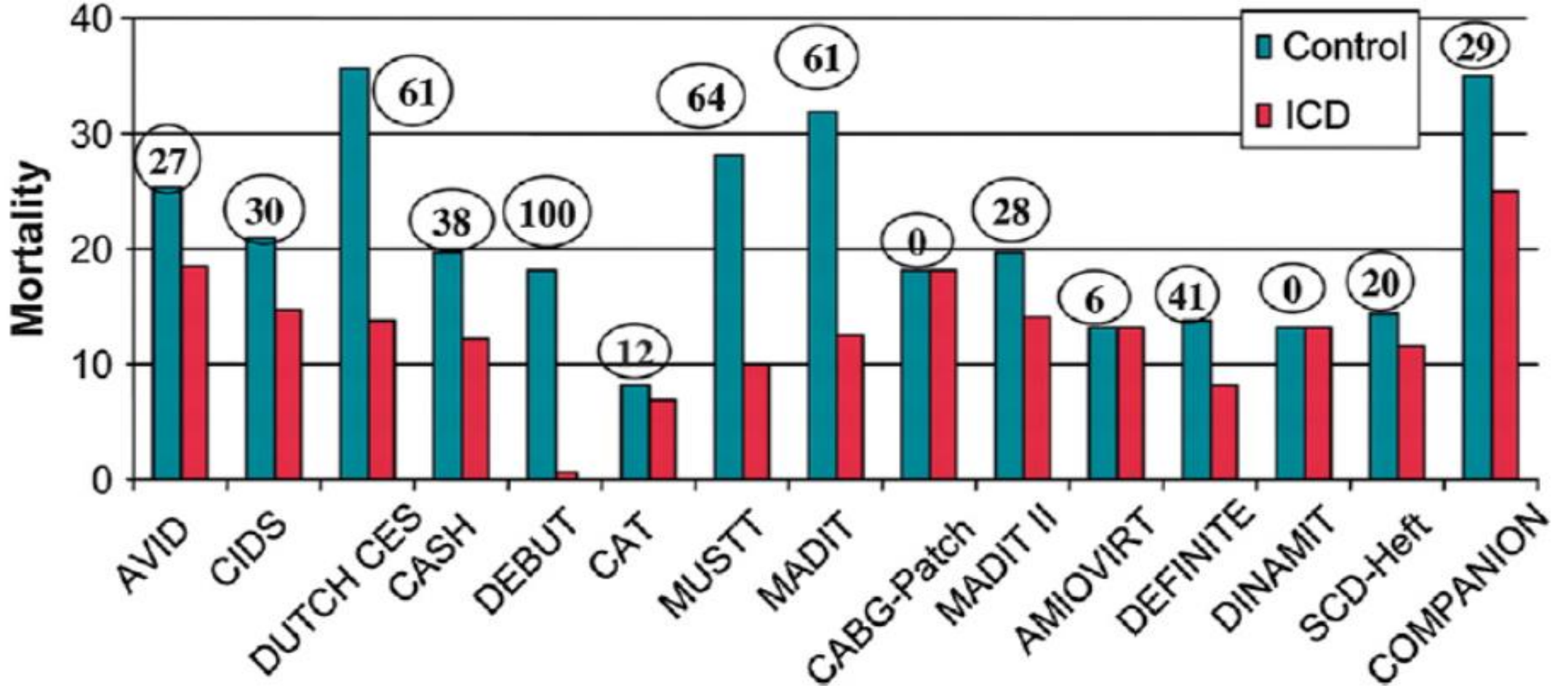
209 cc 113 cc 80 cc 80 cc 72 cc 54 cc

62 cc 49 cc 39.5 cc 39 cc 39.5 cc 39 cc 39.5 cc 36 cc

1980
• First Human Implant

1985
• FDA Approval of ICDs

1993
• Smaller Devices

1996
• Steroid Leads
• MADIT

1999
• MUSTT
• AT Therapies

1989
• Transvenous Leads
• Biphasic Waveform

1988
• Tiered Therapy

1997/98
• DC ICDs
• Size Reduction
• AVID
• CASH
• CIDS

100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0

1980 1985 1990 1995 2000 E

☐ Number of Worldwide ICD Implants Per Year

ICD terapisinin mortalite üstündeki etkinliğini gösteren büyük çalışmalar

Şok Paradoksu

Erdil Yaşaroğlu © www.komikaze.net

Şok Paradoksu

- 1988 yılında ilk bu konu tartışılmaya başlanmış.
- Hayvan çalışmalarında elektroşok uygulanmasının miyokarda etkisi araştırılmış.

Death and damage caused by multiple direct current shocks: studies in an animal model 🔒

C. M. WILSON, J. D. ALLEN, J. B. BRIDGES, A. A. J. ADGEY

Abstract ⊖

Patients who require multiple defibrillator shocks have a poor prognosis. In healthy greyhounds the acute mortality increased as the number of transthoracic shocks (400 J) applied increased (one shock 0/6: five shocks 8/18:10 shocks 12/17 dogs died acutely from asystole or electromechanical dissociation). The appearance on electron microscopy of the myocardium of these dogs showed few specific abnormal features to account for the total contractile failure that occurs in these dogs. In the survivors, significant ST segment elevation was recorded from the precordial leads of the dogs receiving five and 10 shocks, but not those receiving a single shock. At three days there was significantly more macroscopic cardiac damage in the 10-shock (13.1 ±1.8g) than in the five-shock (7.2 ± 2.0) group (P>005). One shock caused little damage. Hence a single highenergy shock was well tolerated in this model. Multiple shocks caused cardiac injury and acute pump failure. These studies indicate the need to reassess why patients die following multiple shocks, and re-emphasise the need for optimized first-shock effectiveness.

-*Eksternal defibrilasyon ile enerji bağımlı makroskopik miyokardial hasar ve sol ventrikül sistolik fonksiyonlarında kısa süreli azalma olduğunu göstermişlerdir.*
-*Yine bu alanda yapılan deneysel çalışmaların sonucunda, şok uygulanmasının; hücre membranında elektroporazizasyona ve hücresel nekroza yol açtığı, hücre membran proteinlerinde fosforilasyon ve hücre içi kalsiyum hemostazında bozulma, hücre içi kalsiyum miktarında artışa neden olduğu gösterilmiştir.*

Effect of Ventricular Shock Strength on Cardiac Hemodynamics

TAKASHI TOKANO, M.D., DAVID BACH, M.D., JASON CHANG,
JAMES DAVIS, M.D., JOSEPH J. SOUZA, M.D., ADAM ZIVIN, M.D.,
BRADLEY P. KNIGHT, M.D., RAJIVA GOYAL, M.D., K. CHING MAN, D.O.,
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University of Michigan Medical Center, Ann Arbor, Michigan

Ventricular Defibrillation and Cardiac Function. *Introduction:* The effect of implantable defibrillator shocks on cardiac hemodynamics is poorly understood. The purpose of this study was to test the hypothesis that ventricular defibrillator shocks adversely effect cardiac hemodynamics.

Conclusion: Defibrillator shocks > 9 J delivered during the baseline rhythm or during defibrillation energy requirement testing result in a 10% to 15% reduction in cardiac index, whereas smaller energy shocks do not affect cardiac hemodynamics. The duration and extent of the adverse effect are proportional to the shock strength. Shock strength, and not ventricular fibrillation, appears to be most responsible for this effect. Therefore, the detrimental hemodynamic effects of high-energy shocks may be avoided when low-energy defibrillation is used. (*J Cardiovasc Electrophysiol, Vol. 9, pp. 791-797, August 1998*)

- *Yapılan başka çalışmalar göstermiştir ki, her bir intrakardiyak şok sonrası endokardiyal ve epikardiyal dokulara kadar uzanan miyokardiyal hasarlar oluşmaktadır.*

- *Her bir intrakardiyak şok sonrası tüm kardiyak biyomarkerlarda (troponin, CKMB, miyoglobin) anlamlı yükselmeler olmaktadır.*

- *Şoka bağlı olarak sadece ventriküler fonksiyonlar değil atriyal fonksiyonlarında etkilendiği gösterilmiştir.*

Atria are more susceptible to electroporation than ventricles: Implications for atrial stunning, shock-induced arrhythmia and defibrillation failure

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BACKGROUND Defibrillation shock is known to induce atrial stunning, which is electrical and mechanical dysfunction.

OBJECTIVE We hypothesized that atrial stunning is caused by higher atrial susceptibility to electroporation vs ventricles. We also hypothesize that electroporation may be responsible for early recurrence of atrial fibrillation.

METHODS We investigated electroporation induced by 10-ms epicardial high-intensity shocks applied locally in atria and ventricles of Langendorff-perfused rabbit hearts (n = 12) using optical mapping.

RESULTS Electroporation was centered at the electrode and was evident from transient diastolic depolarization and reduction of action potential amplitude and maximum upstroke derivative. Electroporation was voltage-dependent and polarity-dependent and was significantly more pronounced in the atria vs ventricles ($P < .01$), with a summary 50% of Effective Dose (ED50) for main measured parameters of 9.2 ± 3.6 V/cm and 13.6 ± 3.2 V/cm in the atria vs 37.4 ± 1.5 V/cm and 48.4 ± 2.8 V/cm in the ventricles, for anodal and cathodal stimuli, respectively. In atria (n = 5), shocks of both polarities (27.2 ± 1.1 V/cm) transiently induced conduction block and reentry around the inexcitable area. Electroporation-induced ectopic activity was a possible trigger for reentry. However, in the thicker ventricles, electroporation and resulting conduction slowing and block were restricted to the surface only, preventing complete block and arrhythmia. The upstroke morphology revealed that the wave front dived below the electroporated region and resurfaced into unaffected epicardial tissue.

CONCLUSION We showed that the atria are more vulnerable to electroporation and resulting block and arrhythmia than the ventricles.

KEYWORDS Electroporation; Atrial stunning; Conduction block; Atrial fibrillation; Optical mapping; Defibrillation

(Heart Rhythm 2008;5:593–604) © 2008 Heart Rhythm Society. All rights reserved.

Şok Paradoksu; İlk meta-analiz

ORIGINAL ARTICLE

Prognostic Importance of Defibrillator Shocks in Patients with Heart Failure

Jeanne E. Poole, M.D., George W. Johnson, B.S.E.E., Anne S. Hellkamp, M.S., Jill Anderson, R.N., David J. Callans, M.D., Merritt H. Raitt, M.D., Ramakota K. Reddy, M.D., Francis E. Marchlinski, M.D., Raymond Yee, M.D., Thomas Guarnieri, M.D., Mario Talajic, M.D., David J. Wilber, M.D., Daniel P. Fishbein, M.D., Douglas L. Packer, M.D., Daniel B. Mark, M.D., M.P.H., Kerry L. Lee, Ph.D., and Gust H. Bardy, M.D.
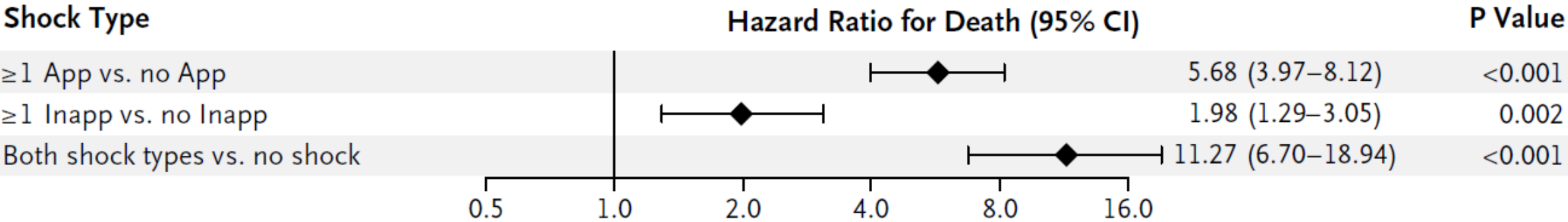
CONCLUSIONS

Among patients with heart failure in whom an ICD is implanted for primary prevention, those who receive shocks for any arrhythmia have a substantially higher risk of death than similar patients who do not receive such shocks.

Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT)

A

Shock Type	Hazard Ratio for Death (95% CI)		P Value
≥1 App vs. no App		5.68 (3.97–8.12)	<0.001
≥1 Inapp vs. no Inapp		1.98 (1.29–3.05)	0.002
Both shock types vs. no shock		11.27 (6.70–18.94)	<0.001

0.5   1.0   2.0   4.0   8.0   16.0

B

Shock Type	Hazard Ratio for Death (95% CI)		P Value
1 App vs. no App		3.98 (2.52–6.30)	<0.001
≥2 Apps vs. no App		8.23 (4.64–14.59)	<0.001
≥2 Apps plus 1 Inapp vs. no shock		15.89 (7.42–34.02)	<0.001

0.5   1.0   2.0   4.0   8.0   16.0   32.0

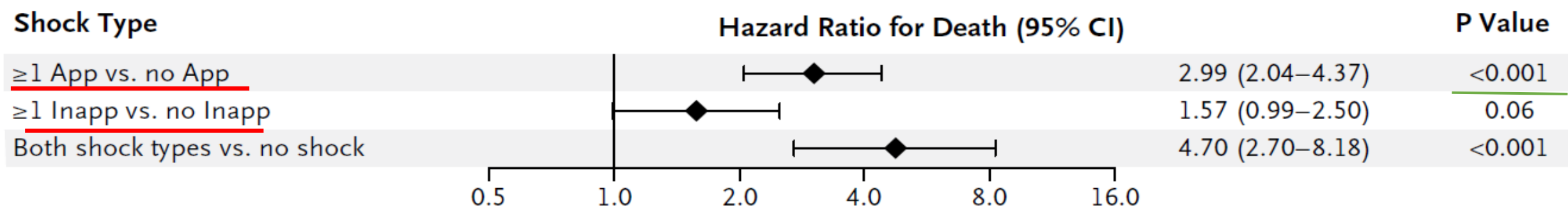| Shock Type	Hazard Ratio for Death (95% CI)	P Value
≥1 App vs. no App	2.99 (2.04–4.37)	<0.001
≥1 Inapp vs. no Inapp	1.57 (0.99–2.50)	0.06
Both shock types vs. no shock	4.70 (2.70–8.18)	<0.001

(Axis: 0.5 1.0 2.0 4.0 8.0 16.0)

Figure 2. Hazard Ratios for the Risk of Death among Patients Who Survived at Least 24 Hours after a First ICD Shock.

Table 2. Time from ICD Shock to Death among Patients Who Received at Least One Shock.*

Type of Shock	All Patients	Patients Who Died	Time from Shock to Death			Kaplan–Meier Survival Rate 1 Year after Shock
			Median	Interquartile Range	Full Range	
				days		%
Any shock	269	77	204	1–630	0–1872	82.5±2.4
One or more inappropriate shocks only	87	10	294	28–509	0–735	94.9±2.5
One or more appropriate shocks	182	67	168	1–797	0–1872	76.9±3.2
NYHA class II	117	31	206	1–977	0–1872	84.0±3.5
NYHA class III	65	36	168	7–626	0–1343	64.2±6.1
Ischemic heart failure	93	49	96	0–443	0–1872	62.6±5.2
Nonischemic heart failure	89	18	622	204–908	1–1785	91.6±3.0
First shock for ventricular fibrillation	77	33	3	0–622	0–1872	74.6±5.0
First shock for ventricular tachycardia	105	34	258	59–797	0–1785	78.5±4.2

Differences in effects of electrical therapy type for ventricular arrhythmias on mortality in implantable cardioverter-defibrillator patients

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Wathen MS, DeGroot PJ, Sweeney MO, et al. Prospective randomized multicenter trial of empirical antitachycardia pacing versus shocks for spontaneous rapid ventricular tachycardia in patients with implantable cardioverter defibrillators. PainFREE Rx II Trial Results. Circulation 2004;110:2592–2596.

Wilkoff BL, Ousdigian KT, Sterns LD, et al. A comparison of empiric to physician-tailored programming of implantable cardioverter-defibrillators: results from the prospective randomized multicenter EMPIRIC trial. J Am Coll Cardiol 2006;48:330–339.

Wilkoff BL, Williamson BD, Stern RS, et al. Strategic programming of detection and therapy parameters in implantable cardioverter-defibrillators reduces shocks in primary prevention patients: results from the PREPARE (Primary Prevention Parameters Evaluation) Study. J Am Coll Cardiol 2008;52:541–550.

METHODS Cox models evaluated effects of baseline characteristics, ventricular tachycardia (VT; <188 bpm), fast VT (FVT; 188–250 bpm), ventricular fibrillation (VF; >250 bpm), and therapy type (shocks or ATP) on mortality among 2135 patients in four trials of ATP to reduce shocks.
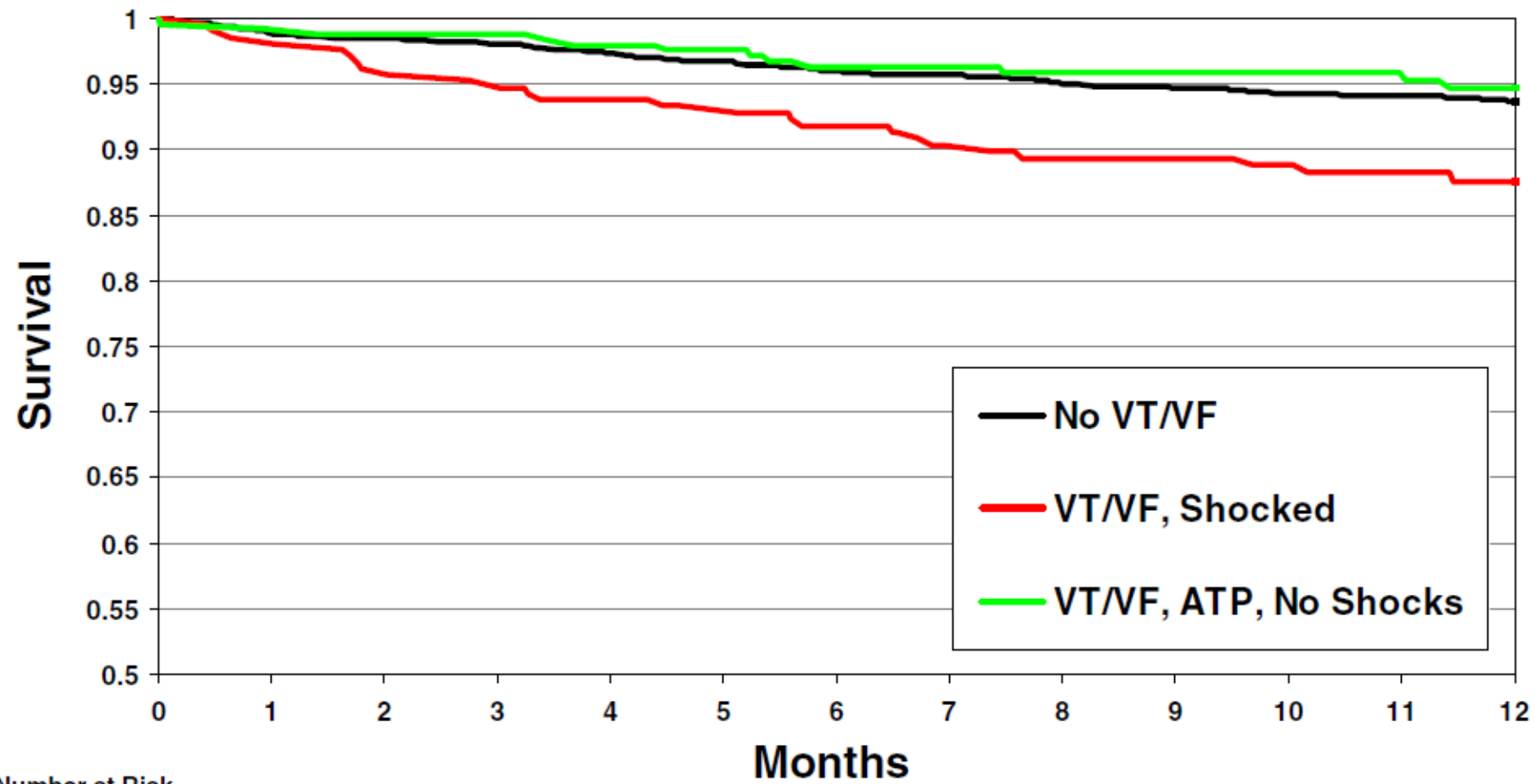
Number at Risk				
No VT/VF (N=1671)	1584	1472	1355	812
VT/VF, Shocked (N=211)	201	186	172	97
VT/VF, ATP, No Shocks (N=253)	247	229	206	126

Discussion

This experiment introduces the possibility that electrical therapy type may influence mortality risk in some ICD patients. The main findings are that (1) patients with VA episodes and [Uygunsuz şoklar] mortality ($\approx 20\%$ increased risk p[...] [...]n patients with neither or patients wi[...] ATP; (2) patients with more VA episodes and more shocks have higher mortality than patients with less of both; (3) VA occurrence rates, durations, and electrical therapy burden of both types were highest among patients who were shocked and died; and (4) inappropriate shocked episodes were not associated with increased mortality risk.

mortality risk; electrical trauma from shocks, but not ATP, increases risk;

Survival After Shock Therapy in Implantable Cardioverter-Defibrillator and Cardiac Resynchronization Therapy-Defibrillator Recipients According to Rhythm Shocked

The ALTITUDE Survival by Rhythm Study

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Charlotte, North Carolina; Los Angeles and Palo Alto, California; Hershey, Pennsylvania; Salt Lake City, Utah; Jonesbor... ...d St. ...l ...d R...r..., Minnesota

Altda yatan aritmi mekanizması

Conclusions Compared with no [shock, patients with ventricu]lar rhythms and atrial fibrillation had an increased risk of death. There was no significant difference in survival after inappropriate shocks for sinus tachycardia or noise/artifact/oversensing. In this study, the adverse prognosis after first shock appears to be more related to the underlying arrhythmia than to an adverse effect from the shock itself. (J Am Coll Cardiol 2013;62:1674–9) © 2013 by the American College of Cardiology Foundation

Inappropriate Implantable Cardioverter-Defibrillator Shocks

Incidence, Predictors, and Impact on Mortality

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Theo Stijnen, PhD,† Lieselot van Erven, MD, PhD,* Jeroen J. Bax, MD, PhD,*
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Objectives	The purpose of this study was to assess the incidence, predictors, and outcome of inappropriate shocks in implantable cardioverter-defibrillator (ICD) patients.
Background	Despite the benefits of ICD therapy, inappropriate defibrillator shocks continue to be a significant drawback. The prognostic importance of inappropriate shocks outside the setting of a clinical trial remains unclear.
Methods	From 1996 to 2006, all recipients of defibrillator devices equipped with intracardiac electrogram storage were included in the current analysis and clinically assessed at implantation. During follow-up, the occurrence of inappropriate ICD shocks and all-cause mortality was noted.
Results	A total of 1,544 ICD patients (79% male, age 61 ± 13 years) were included in the analysis. During the follow-up period of 41 ± 18 months, 13% experienced ≥1 inappropriate shocks. The cumulative incidence steadily increased to 18% at 5-year follow-up. Independent predictors of the occurrence of inappropriate shocks included a history of atrial fibrillation (hazard ratio [HR]: 2.0, $p < 0.01$) and age younger than 70 years (HR: 1.8, $p = 0.01$). Experiencing a single inappropriate shock resulted in an increased risk of all-cause mortality (HR: 1.6, $p = 0.01$). Mortality risk increased with every subsequent shock, up to an HR of 3.7 after 5 inappropriate shocks.
Conclusions	In a large cohort of ICD patients, inappropriate shocks were common. The most important finding is the association between inappropriate shocks and mortality, independent of interim appropriate shocks. (J Am Coll Cardiol 2011;57:556–62) © 2011 by the American College of Cardiology Foundation

	Univariate				**Multivariate**		
	HR	95% CI	p Value		HR	95% CI	p Value
Female	0.8	0.6–1.2	0.34				
Age <70 yrs	1.7	1.1–2.3	<0.01*		1.8	1.3–2.5	0.01
History of AF	2.0	1.5–2.7	<0.01*		2.0	1.5–2.7	<0.01
History of smoking	1.2	0.9–1.6	0.32				
Secondary indication for ICD	1.1	0.8–1.5	0.48				
Nonischemic heart disease	1.3	1.0–1.8	0.04*				
No statins at baseline	1.4	1.0–1.8	0.03*		1.3	1.0–1.7	0.09
Beta-blocker	0.8	0.6–1.1	0.22*				
NYHA functional class III to IV	1.0	0.7–1.3	0.96				
Interim appropriate shocks	1.6	1.0–2.7	0.04*		1.6	1.0–2.6	0.06

Table 2 Predictors of ≥1 Inappropriate Shocks

The main findings of the current study on the incidence, predictors, and outcome of inappropriate shocks can be summarized as follows: 1) the cumulative incidence of inappropriate shocks was 7% at 1-year follow-up, 13% at 3-year follow-up, and 18% at 5-year follow-up; 2) misdiagnosis of supraventricular tachycardia was the leading cause (76%) of inappropriate shocks; 3) age younger than 70 years, history of AF, no statin use, and interim appropriate shocks were predictors of inappropriate shocks; and 4) inappropriate shocks were associated with a higher risk of all-cause mortality.

Predictors of Mortality in Patients With an Implantable Cardiac Defibrillator: A Systematic Review and Meta-analysis

3.1.4 Characteristics related to ICD

Inappropriate shocks	0.438	0.093	3	188694	1.55 [1.29, 1.86]	
Appropriate shocks	0.61	0.127	4	189463	1.84 [1.43, 2.36]	
Any shocks	0.737	0.068	1	185778	2.09 [1.83, 2.39]	
Both shocks	0.85	0.197	1	185778	2.34 [1.59, 3.44]	

Conclusions: This meta-analysis identified strong reliable mortality predictors in ICD-HF patients. Age, renal dysfunction, chronic obstructive pulmonary disease, diabetes, peripheral vascular disease, decreased left ventricular ejection fraction, and ICD shocks during follow-up were strong predictors of mortality; ischemic cardiomyopathy

	HR	95% CI	P	HR	95% CI	P
Baseline variables						
History of atrial fibrillation	1.3	1.0–1.7	0.11	1.4	1.0–1.7	<0.01
Age >70 yrs	2.7	2.2–3.4	<0.01	1.9	1.5–2.5	<0.01
NYHA functional class >II	2.0	1.6–1.5	<0.01	1.5	1.1–1.9	0.03
Renal clearance <90 ml/min	2.7	2.0–3.7	<0.01	1.7	1.2–2.4	0.02
QRS duration >120 ms	2.0	1.6–2.5	<0.01	1.4	1.1–1.8	0.02
No use of beta-blockers	1.3	1.0–1.7	0.01			
Interim events						
Inappropriate shock	1.4	1.0–2.0	0.07	1.6	1.1–2.3	0.01
Per inappropriate shocks (5)	1.3	1.1–1.6	<0.01	1.4	1.2–1.7	<0.01
Interim appropriate shocks	2.5	1.9–3.3	<0.01	1.6	1.2–2.1	<0.01

Van Rees JB et al. J Am Coll Cardiol, 2011;57:556-562

Systematic Review/Meta-analysis

Predictors of Mortality in Patients With an Implantable Cardiac Defibrillator: A Systematic Review and Meta-analysis

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Conclusions: This meta-analysis identified strong reliable mortality predictors in ICD-HF patients. Age, renal dysfunction, chronic obstructive pulmonary disease, diabetes, peripheral vascular disease, decreased left ventricular ejection fraction, and ICD shocks during follow-up were strong predictors of mortality; ischemic cardiomyopathy and male sex were not. Further research is needed to study other potential predictors, particularly biomarkers.

69%) (Supplemental Fig. S12). Any type of shock, including appropriate, inappropriate, any type of shock, and appropriate and inappropriate shocks, was an independent predictor. The comparison of different types of shocks showed that the mortality risk associated with appropriate shocks (HR, 1.84; 95% CI, 1.43-2.35; $I^2 = 81$%) was not significantly different ($P > 0.20$) from the mortality risk associated with inappropriate shocks (HR, 1.55; 95% CI, 1.29-1.86; $I^2 = 3$%), electrical storm (HR, 2.4; 95% CI, 1.34-4.31), or appropriate and inappropriate shocks (HR, 2.34; 95% CI; 1.59-3.44; $I^2 = 0$%). These results are shown in Figure 6. The occurrence of antitachycardia pacing during follow-up was not associated with increased mortality (high to moderate confidence).

1.35.1 Inappropriate vs. no shocks

Bhavnani 2010	0.148	0.2	21.0%	1.16 [0.78, 1.72]
Saxon CRT-D 2010	0.47	0.169	29.1%	1.60 [1.15, 2.23]
Saxon ICD 2010	0.61	0.178	26.3%	1.84 [1.30, 2.61]
van Rees 2011	0.47	0.188	23.7%	1.60 [1.11, 2.31]
Subtotal (95% CI)			100.0%	1.55 [1.29, 1.86]

Heterogeneity: Tau² = 0.00; Chi² = 3.10, df = 3 (P = 0.38); I² = 3%
Test for overall effect: Z = 4.73 (P < 0.00001)

1.35.2 Appropriate vs. no shocks

Bhavnani 2010	0.737	0.13	19.7%	2.09 [1.62, 2.70]
Panotopoulos 1997	0.329	0.15	18.5%	1.39 [1.04, 1.86]
Saxon CRT-D 2010	0.92	0.114	20.7%	2.51 [2.01, 3.14]
Saxon ICD 2010	0.718	0.143	18.9%	2.05 [1.55, 2.71]
van Rees 2011	0.336	0.089	22.2%	1.40 [1.18, 1.67]
Subtotal (95% CI)			100.0%	1.84 [1.43, 2.35]

Heterogeneity: Tau² = 0.06; Chi² = 21.60, df = 4 (P = 0.0002); I² = 81%
Test for overall effect: Z = 4.79 (P < 0.00001)

1.35.3 Both appropriate and inappropriate vs. no shocks

Saxon CRT-D 2010	0.737	0.278	50.2%	2.09 [1.21, 3.60]
Saxon ICD 2010	0.963	0.279	49.8%	2.62 [1.52, 4.53]
Subtotal (95% CI)			100.0%	2.34 [1.59, 3.44]

Heterogeneity: Tau² = 0.00; Chi² = 0.33, df = 1 (P = 0.57); I² = 0%
Test for overall effect: Z = 4.31 (P < 0.0001)

1.35.5 Any shocks (Appropriate or Inappropriate) vs. no shocks

Saxon CRT-D 2010	0.761	0.09	57.2%	2.14 [1.79, 2.55]
Saxon ICD 2010	0.708	0.104	42.8%	2.03 [1.66, 2.49]
Subtotal (95% CI)			100.0%	2.09 [1.83, 2.39]

Heterogeneity: Tau² = 0.00; Chi² = 0.15, df = 1 (P = 0.70); I² = 0%
Test for overall effect: Z = 10.85 (P < 0.00001)
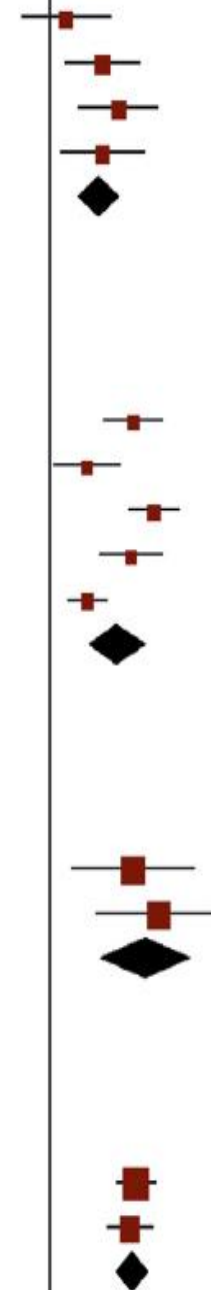
Systematic Review/Meta-analysis

A Systematic Review and Meta-analysis of the Association Between Implantable Cardioverter-Defibrillator Shocks and Long-term Mortality

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Conclusions: Our analysis showed a significant association between appropriate and inappropriate ICD shocks and mortality, with a stronger association for appropriate shocks. Previous trials of ICD therapy reduction programming have shown a significant reduction of inappropriate shocks. The management of appropriate shocks is more challenging and may be optimized by the assessment and treatment of the underlying ventricular arrhythmias. The role of therapies aimed at modifying the arrhythmic substrate and the potential impact on ICD shocks and mortality requires further investigation.

shock. Clinical variables such as EF, NYHA class, type of cardiomyopathy, and length of follow-up did not affect primary outcome in our meta-regression models.

Table 3. Meta-regression of mortality HR for appropriate shock vs no shock on EF, NYHA class, ischemic cardiomyopathy, and length of follow-up

Variable	β-coefficient	95% confidence interval		P value
Ejection fraction (%)	−1.72	−0.86	0.51	0.19
NYHA class ≥ III (%)	−0.004	−0.45	0.44	0.921
Ischemic cardiomyopathy (%)	−0.04	−0.48	0.41	0.45
Length for follow-up (y)	0.001	−0.05	0.05	0.97

Association of Implantable Cardioverter Defibrillator Therapy with All-Cause Mortality—A Systematic Review and Meta-Analysis

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   Conclusion: Appropriate shocks were associated with an increased mortality in ICD patients. However, whether inappropriate shocks worsened the clinical outcome was controversial, and larger prospective trials are needed to clarify the issue. (PACE 2016; 39:81–88)

Study or Subgroup	log[Hazard Ratio]	SE	Weight	Hazard Ratio IV, Random, 95% CI	Hazard Ratio IV, Random, 95% CI
1.2.1 Any shock vs. no shock					
Jacob S 2010	-0.21	0.73	0.7%	0.81 [0.19, 3.39]	
Larsen GK 2011	0.44	0.19	10.5%	1.55 [1.07, 2.25]	
Pacifico A 1999	0.64	0.3	4.2%	1.90 [1.05, 3.41]	
Saxon LA-CRTD 2010	0.71	0.1	37.9%	2.03 [1.67, 2.47]	
Saxon LA-ICD 2010	0.76	0.09	46.7%	2.14 [1.79, 2.55]	
Subtotal (95% CI)			100.0%	**2.00 [1.78, 2.26]**	

Heterogeneity: Tau² = 0.00; Chi² = 3.92, df = 4 (P = 0.42); I² = 0%
Test for overall effect: Z = 11.30 (P < 0.00001)

1.2.2 Appropriate shocks vs. no shock					
Bhavnani SP 2010	0.74	0.17	21.9%	2.10 [1.50, 2.92]	
Jacob S 2010	0.06	0.38	6.4%	1.06 [0.50, 2.24]	
Saxon LA-CRTD 2010	0.92	0.11	33.8%	2.51 [2.02, 3.11]	
Saxon LA-ICD 2010	0.72	0.14	27.2%	2.05 [1.56, 2.70]	
Streitner F 2013	0.5	0.28	10.7%	1.65 [0.95, 2.85]	
Subtotal (95% CI)			100.0%	**2.07 [1.69, 2.53]**	

Heterogeneity: Tau² = 0.02; Chi² = 6.44, df = 4 (P = 0.17); I² = 38%
Test for overall effect: Z = 7.11 (P < 0.00001)

1.2.3 Inappropriate shocks vs. no shock					
Bhavnani SP 2010	0.15	0.2	26.9%	1.16 [0.79, 1.72]	
Jacob S 2010	0.49	0.62	2.8%	1.63 [0.48, 5.50]	
Saxon LA-CRTD 2010	0.47	0.17	37.1%	1.60 [1.15, 2.23]	
Saxon LA-ICD 2010	0.61	0.18	33.2%	1.84 [1.29, 2.62]	
Subtotal (95% CI)			100.0%	**1.54 [1.25, 1.89]**	

Heterogeneity: Tau² = 0.00; Chi² = 3.02, df = 3 (P = 0.39); I² = 1%
Test for overall effect: Z = 4.13 (P < 0.0001)

1.2.4 Both shocks vs. no shock					
Poole JE 2008	2.42	0.27	33.5%	11.25 [6.62, 19.09]	
Saxon LA-CRTD 2010	0.74	0.28	33.3%	2.10 [1.21, 3.63]	
Saxon LA-ICD 2010	0.79	0.28	33.3%	2.20 [1.27, 3.81]	
Subtotal (95% CI)			100.0%	**3.74 [1.25, 11.17]**	

Heterogeneity: Tau² = 0.86; Chi² = 24.45, df = 2 (P < 0.00001); I² = 92%
Test for overall effect: Z = 2.36 (P = 0.02)

0.01   0.1   1   10   100
Favours [shocks]   Favours [no shock]

Test for subgroup differences: Chi² = 6.96, df = 3 (P = 0.07), I² = 56.9%

Peki ama neden ?

- *Şok sonrası kaos ortamının oluşturduğu kardiyak output ve kan basıncındaki azalmaların, özellikle orta/ciddi düşük EF'li hastaların tolere edilemediği*

- *ICD şok sonrası miyokardiyal disfonksiyon geliştiği ve bununda post-şok elektromekanik disosiasyona yol açtığı*

- *ICD takılan hastalarda gelişen sağ ventriküler bradikardi pacing durumunun hastada; kısa-uzun-kısa sekanslar sonucu ventriküler aritmileri tetikleyebileceği*

- *Yine sağ ventriküler bradikardi pacing sekonder gelişen sağ ve sol remodeling, ejeksiyon fraksiyonunda azalma, sağ atriyal basınç artışı, pulmoner arter basıncı artışı, pulmoner kapiller kama basıncı artışlarına neden olması*

- *Lead tip kısmında gelişen endokardiyal fibrozisin reentren halkaya neden olarak ventriküler aritmilere neden olabileceği*

- *Şoklara sekonder gelişen anksiyete ve depresyon durumlarının mortaliteye katkı sağladığı*

Şokları azaltmada ne yapılabilir ?

- ***Ablasyon uygulanması***
- ***ICD programlanması***
- ***Anti-taşikardik pacing***
- ***Farmakolojik tedavi***
- ***Sempatik denervasyon***

Farmakolojik yaklaşım

- ***Antiaritmik ilaçlar***
- ***ACEi/ARB grubu ilaçlar***
- ***Statinler***

Antiaritmik ilaçlar

- *Amiadarone uygun ve uygunsuz şokları azalttığı*
- *OPTIC trial de; amiadaronun beta blokerlerden üstün olduğu*
- *Sotalolün amiadarona alternatif olduğu, ancak amiadaron kadar etkin olmadığı;*

gösterilmiştir.

Effect of Angiotensin-Converting Enzyme Inhibitors and Receptor Blockers on Appropriate Implantable Cardiac Defibrillator Shock in Patients With Severe Systolic Heart Failure (from the GRADE Multicenter Study)

ACEi/ARB grubu ilaçlar

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Heather L. Bloom, M____ ____ MD, PhD[h]
Samir F. Saba____ ____ [d],

Sudden ca____
athy. Altho____
blockers (A____
has not bee____
patients w____
implantabl____
brillator E____
Treatment____
1,509 patie____
(80%) on ____
matched p____
334 (22%) ____
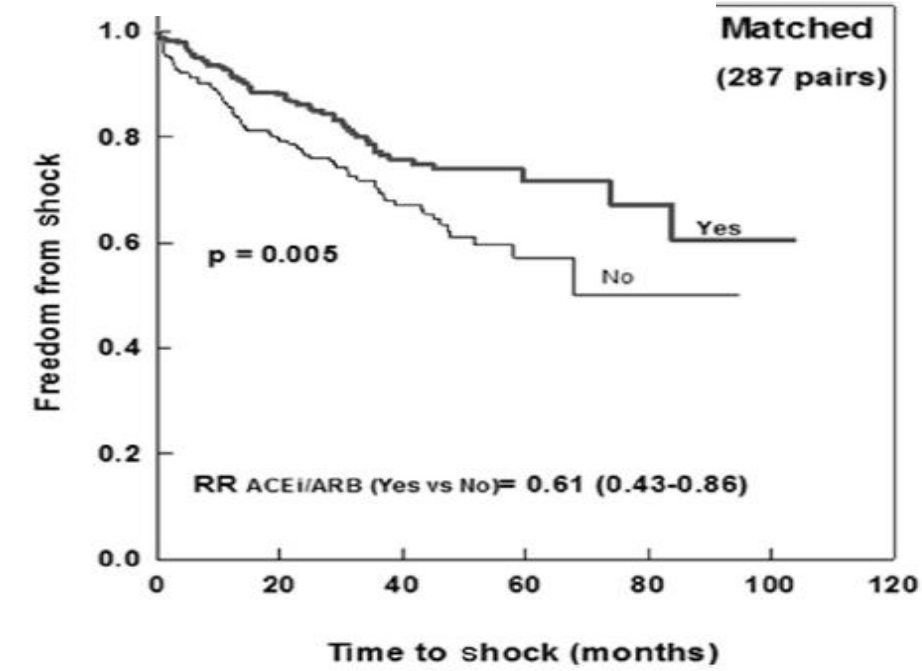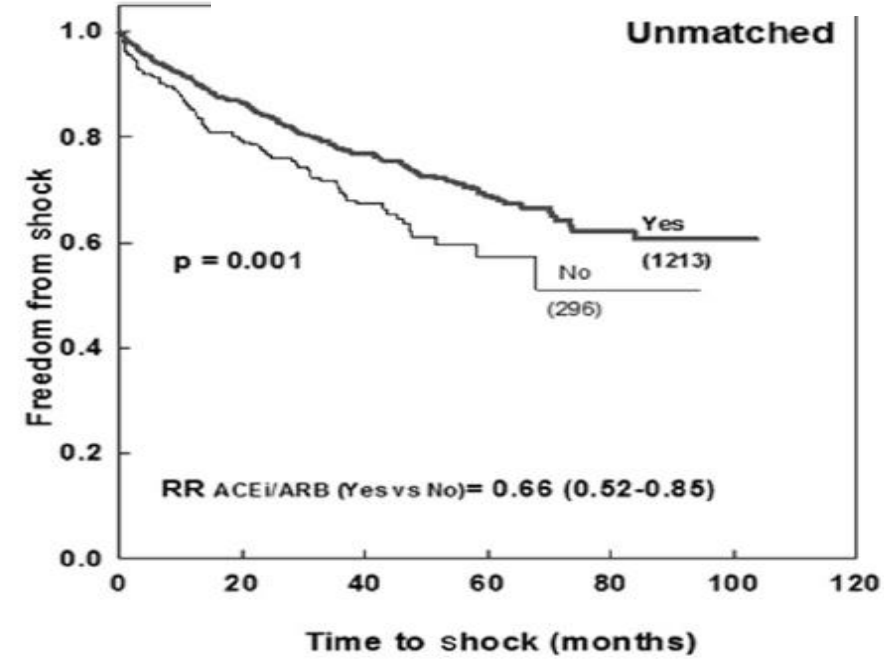
with lower incidence of shocks at 1, 3, and 5 years in the matched cohort (7.7%, 16.7%, and 18.5% vs 13.2%, 27.5%, and 32.0%; RR = 0.61 [0.43 to 0.86]; p = 0.005). Among patients with glomerular filtration rate (GFR) >60 and 30 to 60 ml/min/1.73 m², those on no-ACEi/ARB were at 45% and 77% increased risk of ICD shock compared with those on ACEi/ARB, respectively. ACEi/ARB were associated with significant lower incidence of appropriate ICD shock in patients with cardiomyopathy and GFR ≥30 ml/min/1.73 m² and with neutral effect in those with GFR <30 ml/min/1.73 m². © 2015 Elsevier Inc. All rights reserved. (Am J Cardiol 2015;115:924—931)

Association between statin therapy and reductions in atrial fibrillation or flutter and inappropriate shock therapy[†]

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Conclusion Among a cohort with ICDs at high risk for cardiac arrhythmias, statin therapy was associated with a reduction in AF/AFL tachyarrhythmia detection and inappropriate shock therapy.

Reduction in the intensity rate of appropriate shocks for ventricular arrhythmias with statin therapy.

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Abstract

Higher rate of implantable cardioverter-defibrillator (ICD) shocks has been associated with increased mortality and morbidity. The aim of our study was to determine whether statins reduced the intensity rate of appropriate shock therapy for ventricular tachycardia/fibrillation in patients with an ICD placed for left ventricular systolic dysfunction. In this retrospective single center analysis, patients with an ejection fraction <or=35% who underwent ICD implantation were divided into treatment and control groups based on statin use. A zero-inflated negative binomial model was used to compare the intensity rate of appropriate ICD shocks between the 2 groups. Characteristics associated with shock-free follow-up were assessed using a stepwise logistic regression model. We found 699 patients eligible for inclusion, with 412 (59%) in the statin treatment group. The adjusted mean intensity rate of shocks was lower in patients on statin therapy (intensity rate ratio = 0.22; 95% confidence interval, 0.12-0.41; P < 0.001). Statin use was associated with a significantly higher probability of shock-free follow-up (odds ratio = 1.64; 95% confidence interval, 1.09-2.48; P = 0.019). In conclusion, statins reduced the intensity rate of appropriate shock therapy for ventricular tachycardia/fibrillation and increased probability of shock-free follow-up in patients with cardiomyopathy. Larger randomized trials are needed to confirm this relationship.

Statinler

Sempatik denervasyon

Cardiac sympathetic denervation in patients with refractory ventricular arrhythmias or electrical storm: Intermediate and long-term follow-up

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CONCLUSION In patients with VT storm, bilateral CSD is more beneficial than left CSD. The beneficial effects of bilateral CSD extend beyond the acute postsympathectomy period, with continued freedom from ICD shocks in 48% of patients and a significant reduction in ICD shocks in 90% of patients.

The Association Between ICD Interventions and Mortality is Independent of their Modality: Clinical Implications

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M.D.,* FRANCESCA GABRIELLI, M.D.,* GAETANO ANTONIO LANZA, M.D.,*
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Conclusions

Our data show that patients receiving sporadic appropriate ICD interventions are at increased mortality risk as compared to patients without ICD interventions, independently of the modality of treatment. Our data suggest that the occurrence of any ICD intervention should prompt a careful clinical reassessment to improve antiarrhythmic therapy or identify potentially reversible causes of worsening heart failure.

Reduction of ICD Shock Burden by Eliminating Back-Up Pacing Induced Ventricular Tachyarrhythmias

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pacing-induced VT (PIT)

PIT is a frequent mechanism of VTs in ICD patients resulting in a substantially increased shock burden

Uygun intrakardiyak şoklar ventriküler taşiaritmileri tedavi ederek yaşamı korurken, bununla beraber yapılan çalışmalar şoklar ve mortalite arasında anlamlı ilişki olduğunu gösterilmiştir. Bu anlamlı ilişkinin iskemik kökenli olan ve EF si <%25 olan hasta gruplarında çok daha fazla önemli bilinmektedir.