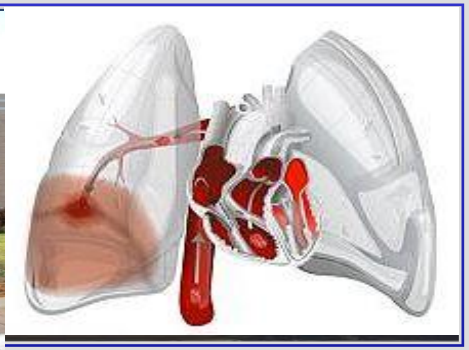




Pulmonary embolism

H. Hod M.D., FACC, FESC.
I.C.C.U. - Leviev Heart Center
Sheba Medical Center, Tel-Aviv University
ISRAEL

THE SPECTRUM OF PULMONARY EMBOLISM

Hemodynamic Instability/Death

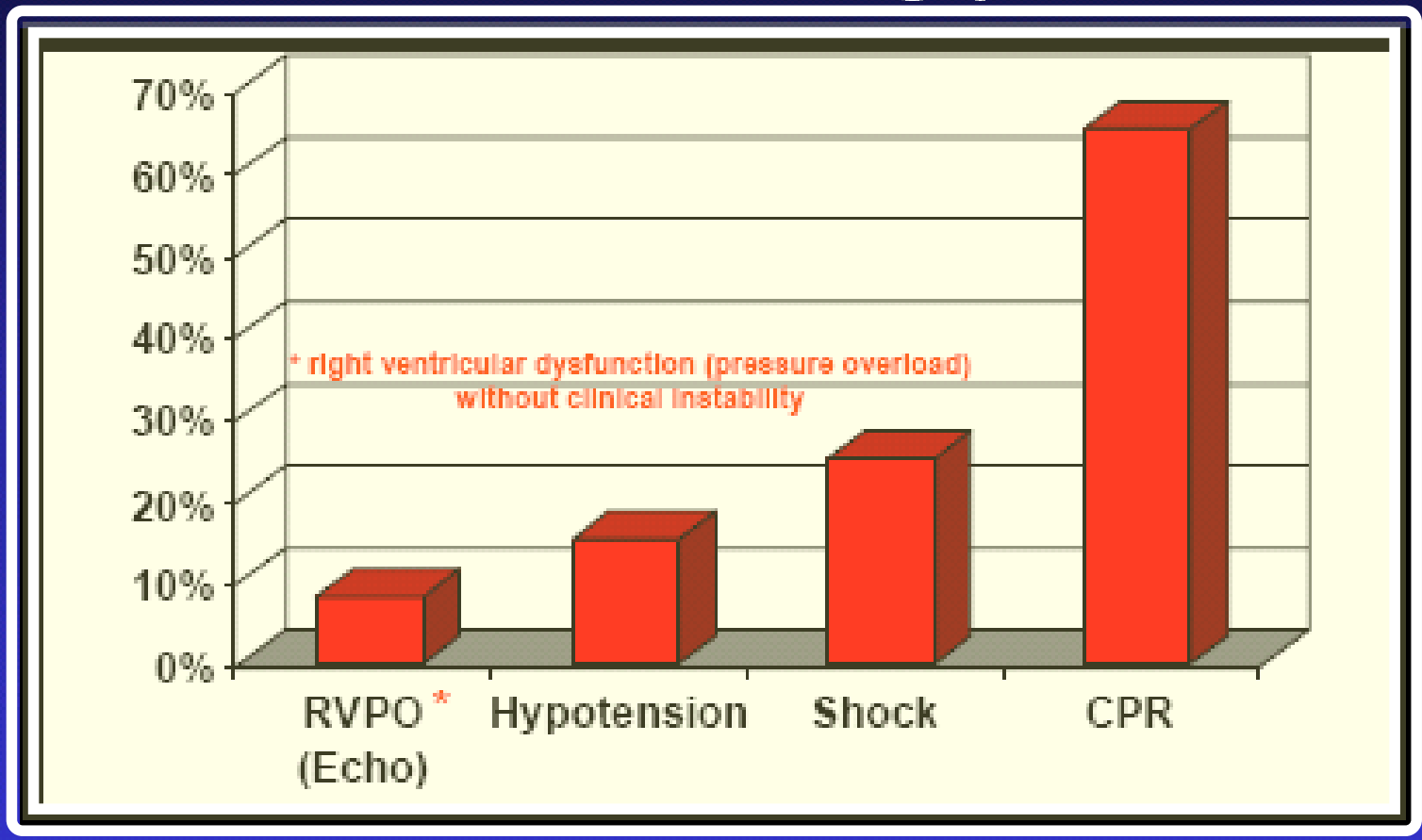
Right Ventricular Dysfunction

Dyspnea

Stable Hemodynamics

Mortality Rates in Relation to the Severity of Clinical Instability at Presentation

Data from the MAPPET Registry



W Kasper et al, *J Am Coll Cardiol* 1997;30:1165-1171

AHA Scientific Statement

Management of Massive and Submassive Pulmonary Embolism, Iliofemoral Deep Vein Thrombosis, and Chronic Thromboembolic Pulmonary Hypertension

A Scientific Statement From the American Heart Association

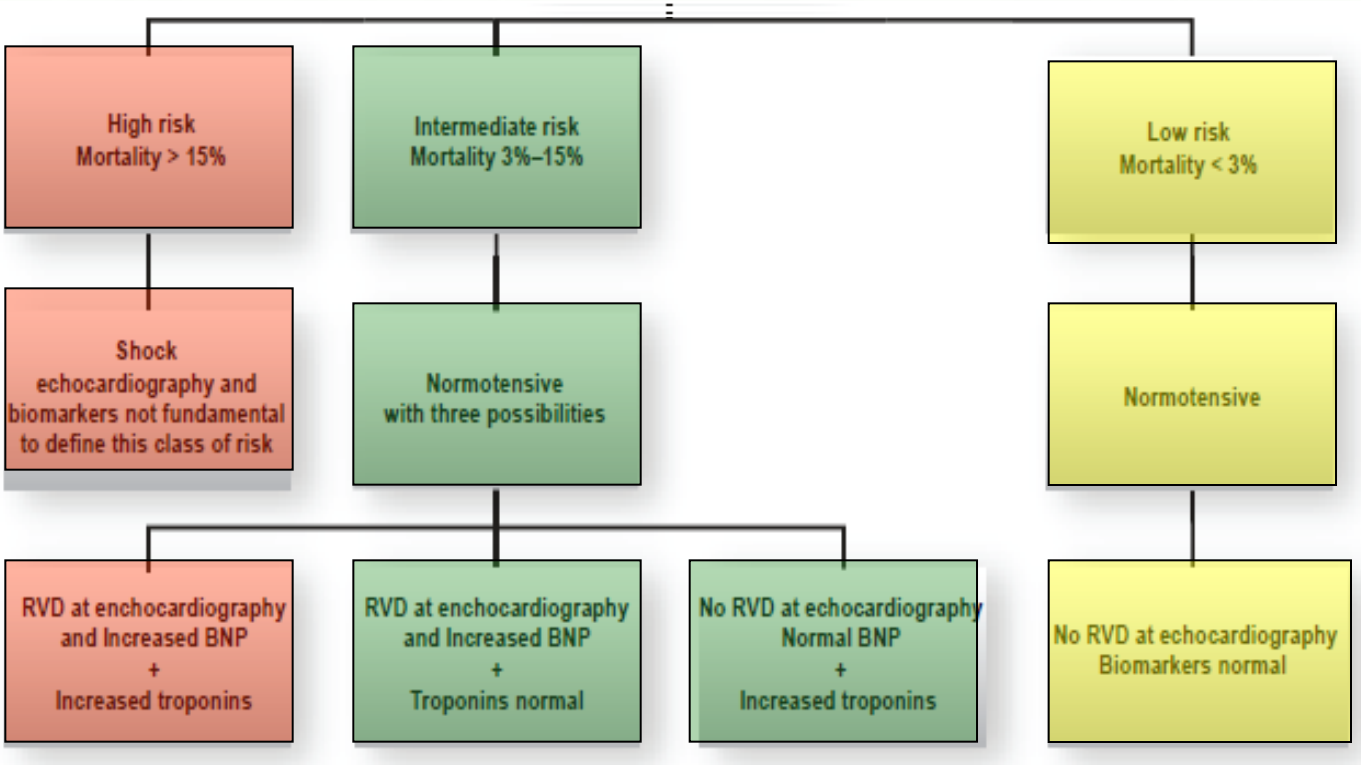
- **Massive PE:** Sustained hypotension, pulselessness, or persistent bradycardia
- **Submassive PE:** RV dysfunction or myocardial necrosis, without hypotension
- **Low Risk PE:** No markers of adverse prognosis

(Circulation 2011; 123: 1788-1830)

European Heart Journal
doi:10.1093/eurheartj/ehn310

Guidelines on the diagnosis and management of acute pulmonary embolism

The Task Force for the Diagnosis and Management of Acute Pulmonary Embolism of the European Society of Cardiology (ESC)



Goals of therapy

- Normalize pulmonary vascular resistance by immediate relief of right heart failure
- Prevention of recurrent thromboembolism

Anticoagulation

- Immediate full anticoagulation is mandatory for all patients suspected to have pulmonary embolism

- Diagnostic investigations should not delay empirical anticoagulant therapy

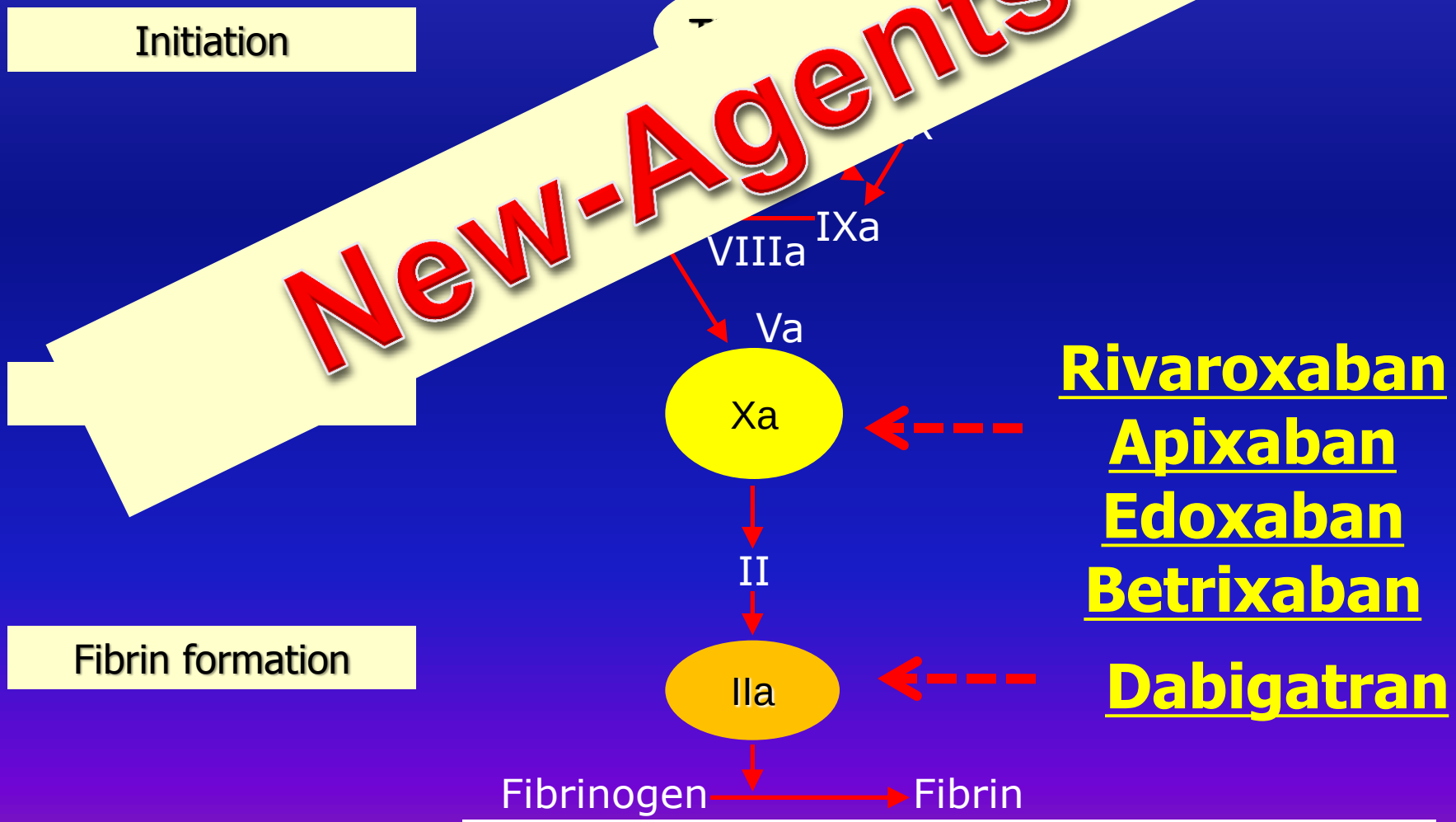
(ESC/AHA Guidelines)

Which parental anticoagulant should be selected?

1. **Unfractionated heparin:** use if patient might require thrombolysis, embolectomy, or IVC filter
2. **Low molecular weight heparins or fondaparinux**: use for patients only requiring anticoagulation
3. **Direct thrombin inhibitors:** use for confirmed or suspected HIT

SITES OF ACTION

Coagulation Pathway **Drug[illegible]on**



(Hankey GJ and Eikelboom JW. *Circulation* 2011;123:1436-1450)

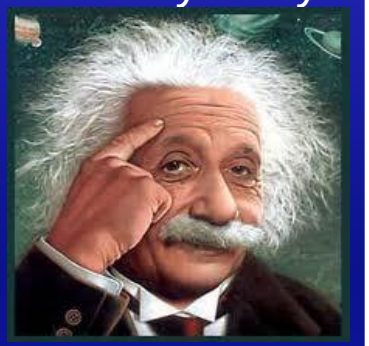
Oral Rivaroxaban for the Treatment of Symptomatic Pulmonary Embolism

The EINSTEIN–PE Investigators

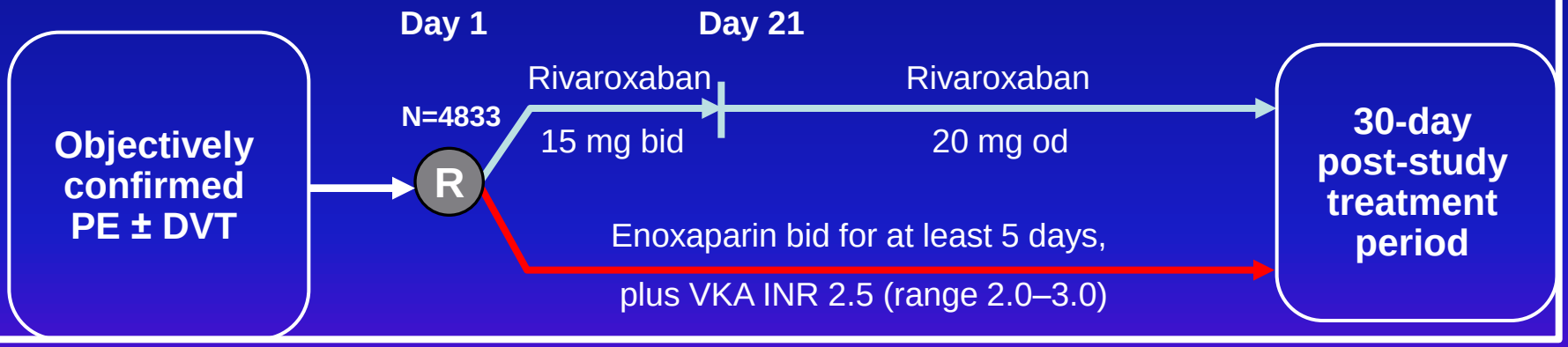
N Engl J Med 2012;366:1287-97.

Randomized, open-label, event-driven, non-inferiority study **(N=4,832)**

- Up to 48 hours' heparins/fondaparinux treatment permitted before study entry
- 88 primary efficacy outcomes needed
- Non-inferiority margin: 2.0



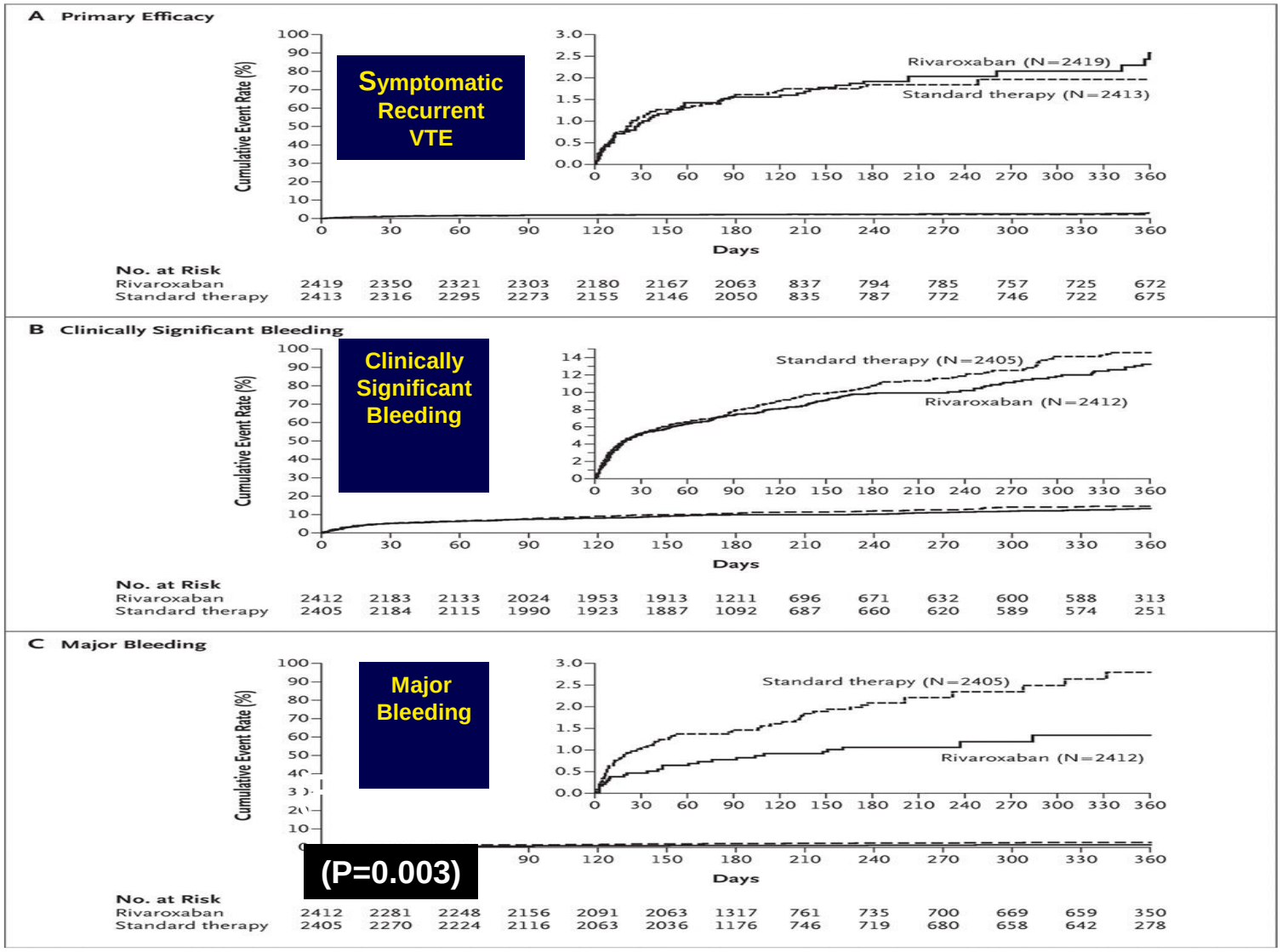
Predefined treatment period of 3, 6, or 12 months

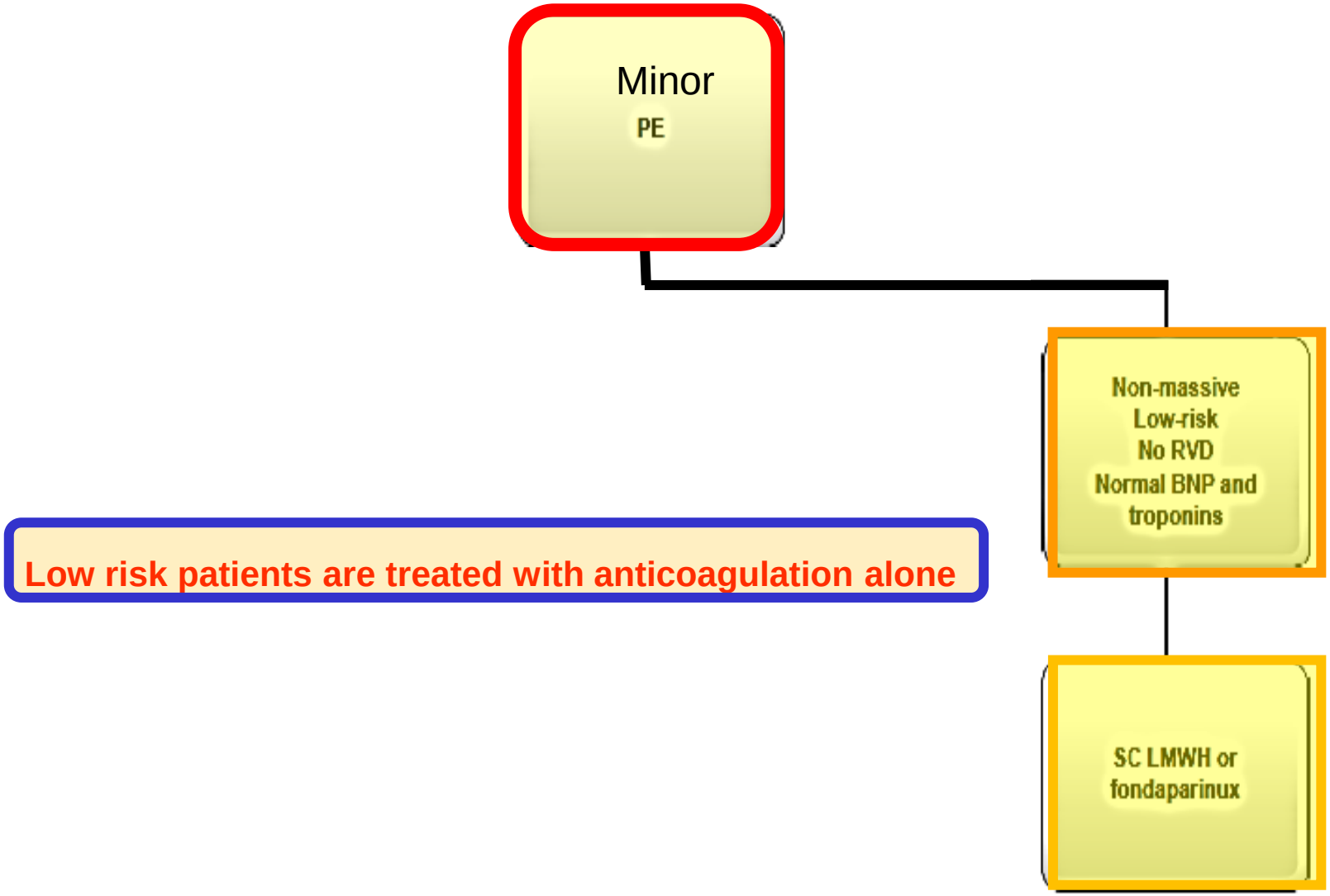


Primary efficacy outcome: first recurrent VTE ◆

Principal safety outcome: first major or nonmajor clinically relevant bleeding ◆

(N=4,832)


A Primary Efficacy
Symptomatic Recurrent VTE
Cumulative Event Rate (%)
Rivaroxaban (N=2419)
Standard therapy (N=2413)
Days
No. at Risk
Rivaroxaban 2419 2350 2321 2303 2180 2167 2063 837 794 785 757 725 672
Standard therapy 2413 2316 2295 2273 2155 2146 2050 835 787 772 746 722 675
B Clinically Significant Bleeding
Clinically Significant Bleeding
Standard therapy (N=2405)
Rivaroxaban (N=2412)
No. at Risk
Rivaroxaban 2412 2183 2133 2024 1953 1913 1211 696 671 632 600 588 313
Standard therapy 2405 2184 2115 1990 1923 1887 1092 687 660 620 589 574 251
C Major Bleeding
Major Bleeding
(P=0.003)
No. at Risk
Rivaroxaban 2412 2281 2248 2156 2091 2063 1317 761 735 700 669 659 350
Standard therapy 2405 2270 2224 2116 2063 2036 1176 746 719 680 658 642 278


Minor
PE
Non-massive
Low-risk
No RVD
Normal BNP and troponins
SC LMWH or fondaparinux
Low risk patients are treated with anticoagulation alone

Massive PE

- **Thrombolysis (but contraindicated in 20- 40% pts')**
- **Surgical Embolectomy**
- **Catheter Thrombectomy**

WHAT IS THE EVIDENCE FOR THE USE OF THROMBOLYSIS IN MASSIVE PE?

Fibrinolysis in high-risk PE

	Thrombolyis (n = 128)	Heparin (n = 126)	Odds Ratio
Recurrences	3.9%	7.1%	0.61 (0.23-1.62)
Deaths	6.2%	12.7%	0.47 (0.20-1.10)
Death or recurrence	9.4%	19.0%	0.45 (0.22-0.92)
Haemorrhage	21.9%	11.9%	1.98 (1.00-3.92)

Wan et al. Circulation 2004; 110: 744-9

Thrombolysis Compared With Heparin for the Initial Treatment of Pulmonary Embolism

A Meta-Analysis of the Randomized Controlled Trials

Susan Wan; Daniel J. Quinlan, MBBS; Giancarlo Agnelli, MD; John W. Eikelboom, MBBS

CLINICAL RESEARCH STUDY

The American Journal of Medicine (2012) 125, 465-470

THE AMERICAN JOURNAL of MEDICINE®

Thrombolytic Therapy in Unstable Patients with Acute Pulmonary Embolism: Saves Lives but Underused

Paul D. Stein, MD,[a,b] Fadi Matta, MD[a,b]

[a]Department of Research, St Mary Mercy Hospital, Livonia, Michigan; [b]Department of Medicine, Michigan State University College of Osteopathic Medicine, East Lansing.

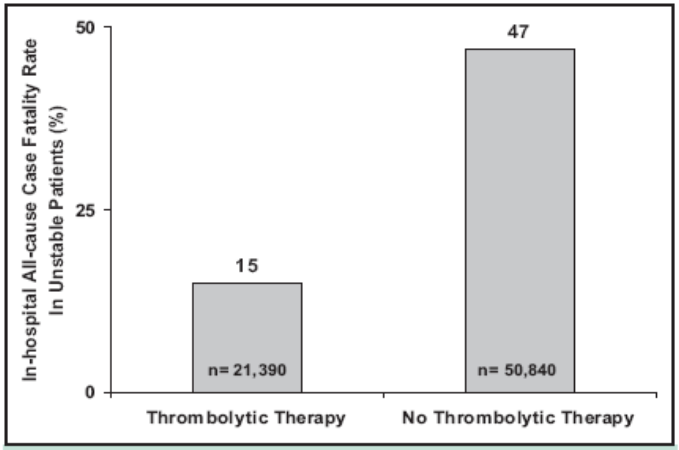


Figure 2 In-hospital all-cause case fatality rate in unstable patients with pulmonary embolism who received thrombolytic therapy and in those who did not. The number (n) in both groups is shown within the bar. Difference of mortality, $P < .0001$.

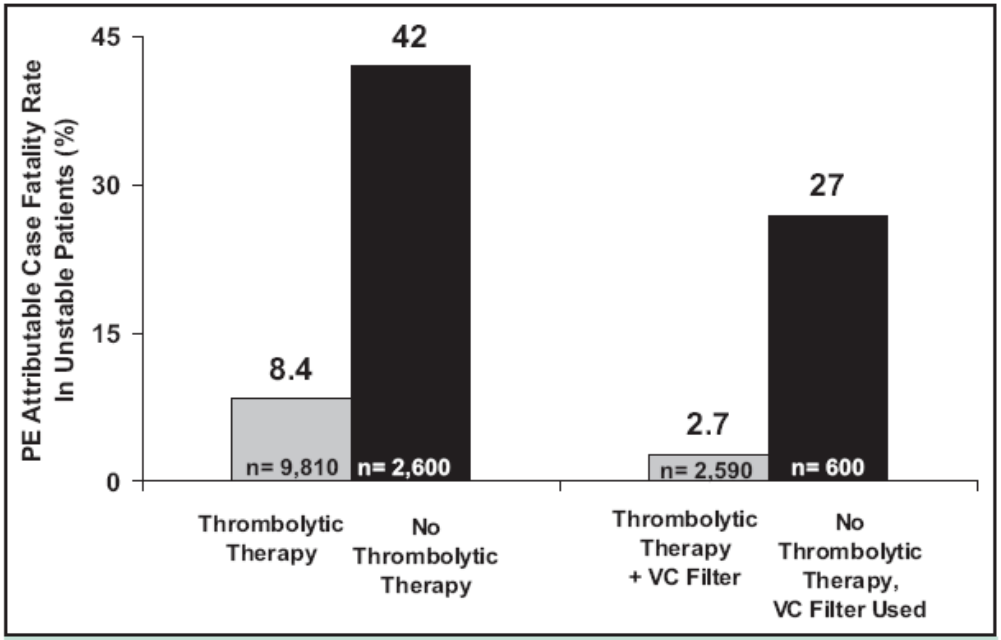


Figure 3 In-hospital death attributable to pulmonary embolism in unstable patients with pulmonary embolism. All unstable patients (*left*). Unstable patients who received a vena cava filter (*right*). The number (n) in each group is shown within the bar. Differences of case fatality rate, $P < .0001$. PE = pulmonary embolism; VC = vena cava.

HCUP Nationwide Inpatient Sample (NIS). Healthcare Cost and Utilization Project (HCUP). 1998-2008. Agency for Healthcare Research and Quality, Rockville, MD. Available at: www.hcup-us.ahrq.gov/nisoverview.jsp. Accessed November 11, 2011.

CLINICAL RESEARCH STUDY

The American Journal of Medicine (2012) 125, 50-56

THE AMERICAN JOURNAL of MEDICINE®

Intracerebral Hemorrhage with Thrombolytic Therapy for Acute Pulmonary Embolism

Paul D. Stein, MD,[a,b] Fadi Matta, MD,[a,b] David S. Steinberger, MD,[c] Daniel C. Keyes, MD[d,e]

[a]Department of Research, St Mary Mercy Hospital, Livonia, Mich; [b]Department of Internal Medicine, College of Osteopathic Medicine, Michigan State University, East Lansing; [c]Department of Internal Medicine, St Mary Mercy Hospital, Livonia, Mich; [d]Department of Emergency Medicine, St Mary Mercy Hospital, Livonia, Mich; [e]Department of Emergency Medicine, St Joseph Mercy Hospital, Ann Arbor, Mich.

Table 3 Intracerebral Hemorrhage in All Patients Who Received Thrombolytic Therapy

	Intracerebral Hemorrhage	95% CI	*P* Value	Relative Risk* (95% CI)
All PE	430/49,500 (0.9%)	0.79-0.95		
Stable	280/27,900 (1.0%)	0.86-1.10		
Unstable	150/21,600 (0.7%)	0.58-0.80	.0003	0.7 (0.57-0.84)
Primary PE	250/39,300 (0.6%)	0.56-0.72		
Secondary PE	180/10,300 (1.7%)	1.50-2.00	<.0001	0.4 (0.30-0.44)

PE = pulmonary embolism.
*Stable vs unstable and primary vs secondary.

HCUP Nationwide Inpatient Sample (NIS). Healthcare Cost and Utilization Project (HCUP). 1998-2008. Agency for Healthcare Research and Quality, Rockville, MD. Available at: www.hcup-us.ahrq.gov/nisoverview.jsp. Accessed August 10, 2011.

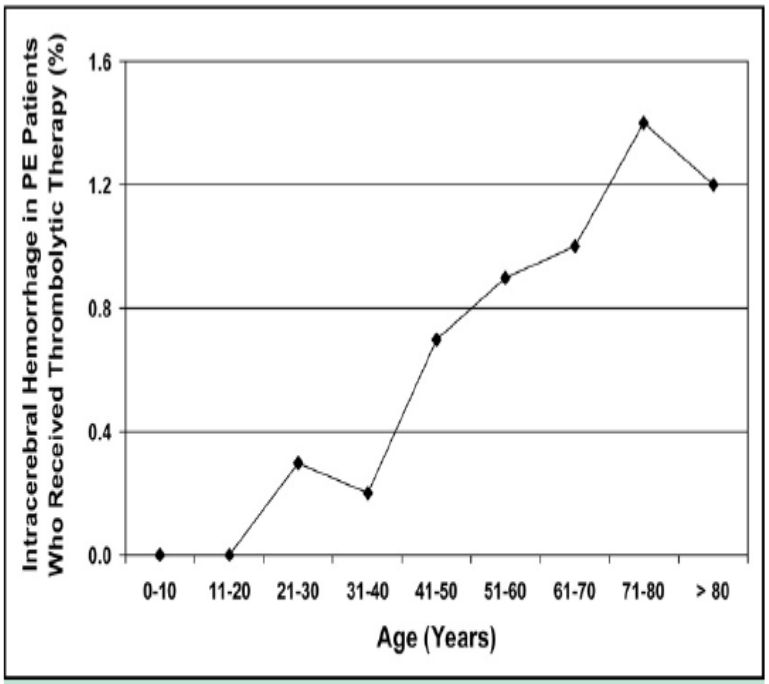
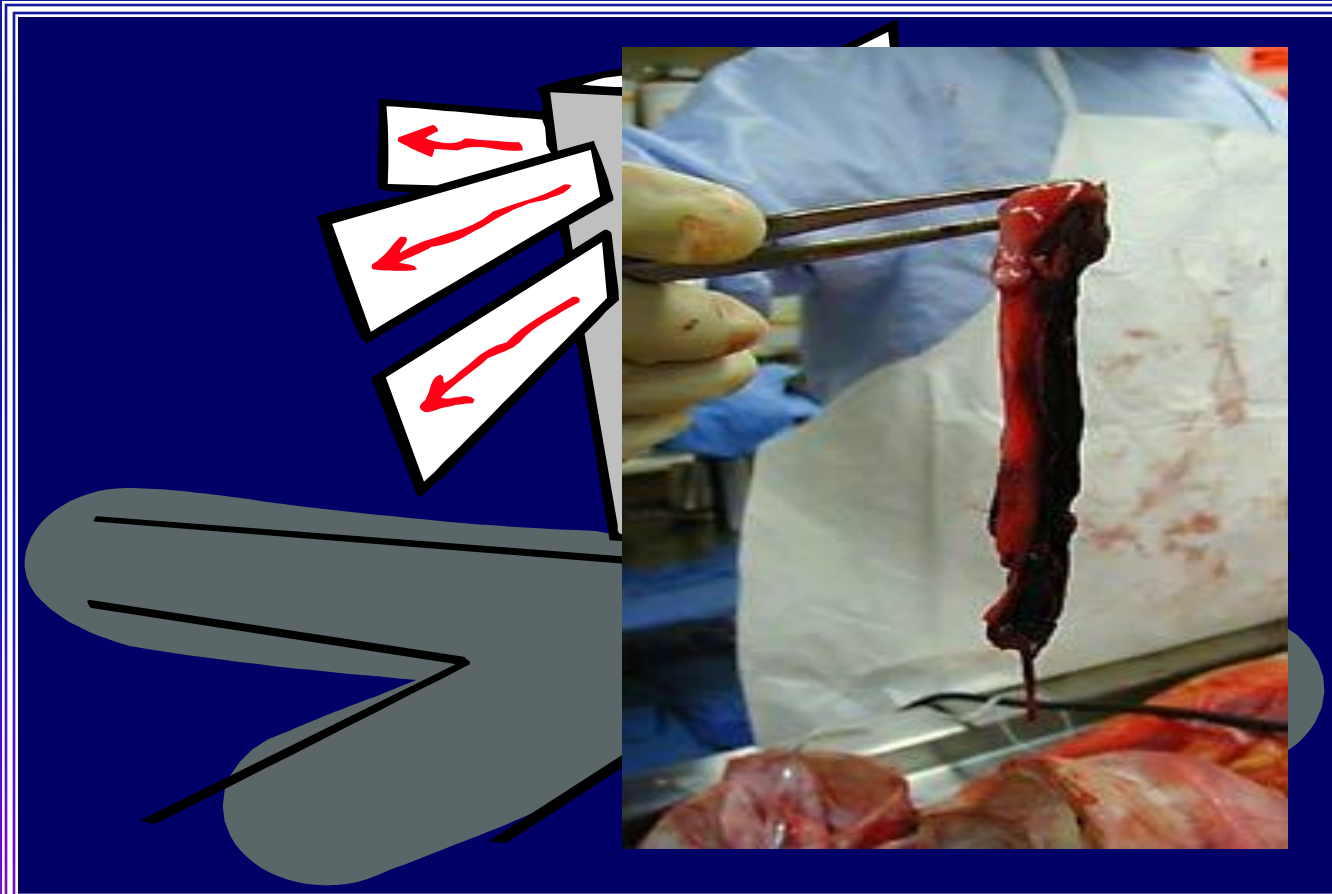


Figure 3 Proportion of patients with pulmonary embolism who received thrombolytic therapy and had an intracerebral hemorrhage in relation to age. For patients aged more than 10 years, $r = -0.9572$, $P = .0002$, slope = 0.1964/decade of age. PE = pulmonary embolism.

WHAT ARE THE ALTERNATIVES TO THROMBOLYSIS ?



CLINICAL RESEARCH STUDY

The American Journal of Medicine (2012) 125, 471-477

THE AMERICAN JOURNAL of MEDICINE®

Case Fatality Rate with Pulmonary Embolectomy for Acute Pulmonary Embolism

Paul D. Stein, MD, Fadi Matta, MD

Department of Research, St. Mary Mercy Hospital, Livonia, Mich; and Department of Osteopathic Medical Specialities, Michigan State University College of Osteopathic Medicine, East Lansing.

Table 4 Case Fatality Rate with Pulmonary Embolectomy According to Use of Vena Cava Filters

	Case Fatality Rate		Relative Risk	
	Fatal/Embolectomy (%)	95% CI		95% CI
All PE unstable				
Vena cava filter	130/520 (25)	22-29		
No vena cava filter	250/430 (58)*	53-63	0.43[a]	0.36-0.51
All unstable	380/950 (40)	37-43		
All PE stable				
Vena cava filter	210/1500 (14)	12-16		
No vena cava filter	480/1320 (36)*	34-39	0.39[a]	0.33-0.44
All stable	690/2820 (24)**	23-26	0.61[b]	0.55-0.68
Primary PE unstable				
Vena cava filter	80/390 (21)	17-25		
No vena cava filter	155/280 (55)*	50-61	0.37[a]	0.30-0.46
All primary unstable	235/670 (35)	32-39		
Primary PE stable				
Vena cava filter	105/960 (11)	9-13		
No vena cava filter	165/440 (38)*	33-42	0.29[a]	0.23-0.36
All primary stable	270/1400 (19)**	17-21	0.55[b]	0.47-0.64
Primary PE no comorbidity unstable				
Vena cava filter	10/130 (7.7)	4-14		
No vena cava filter	45/90 (50)*	40-60	0.15[a]	0.08-0.29
All primary no comorbidity Unstable	55/220 (25)	20-31		
Primary PE no comorbidity stable				
Vena cava filter	35/440 (8.0)	6-11		
No vena cava filter	55/175 (31)*	25-39	0.25[a]	0.17-0.37
All primary no comorbidity stable	90/615 (15)***	12-18	0.59[b]	0.43-0.79

CI = confidence interval; PE = pulmonary embolism.
*P <.0001, filter vs no filter.
**P <.0001, stable vs unstable.
***P <.001, stable vs unstable.
[a]Relative risk vena cava filter vs no vena cava filter.
[b]Relative risk stable vs unstable.

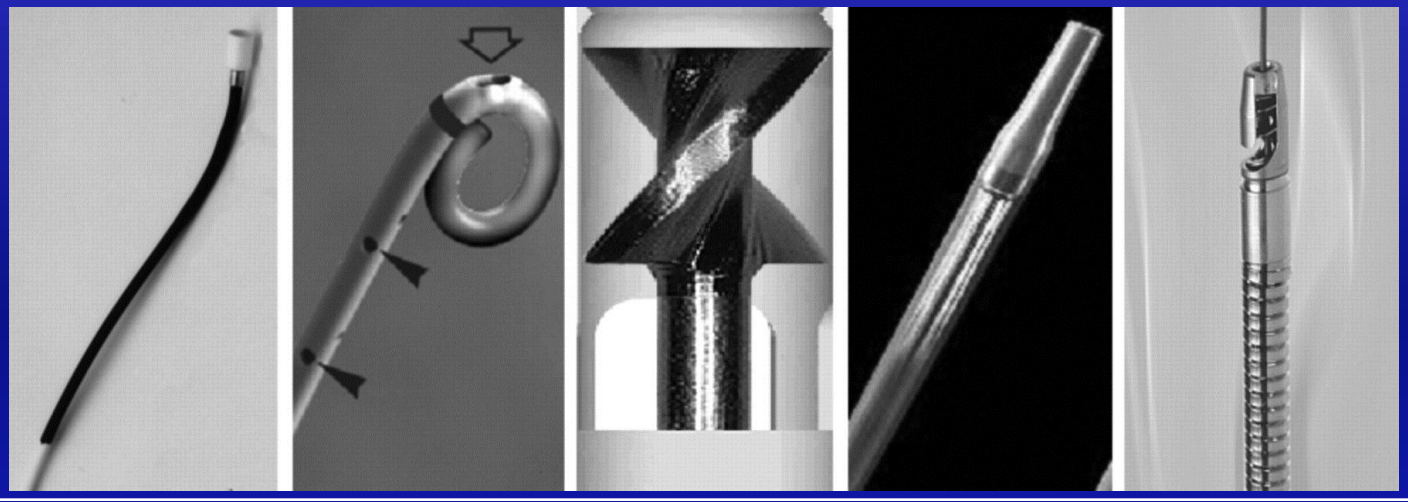
HCUP Nationwide Inpatient Sample (NIS). Healthcare Cost and Utilization Project (HCUP); 1998-2008. Rockville, MD: Agency for Healthcare Research and Quality. Available at: www.hcup-us.ahrq.gov/nisoverview.jsp. Last accessed December 5, 2011.

Catheter Thrombectomy

The only alternative to thrombolysis or surgical embolectomy

1. **Hemodynamic instability**
2. **Subtotal or total filling defect in left and/or right main PA**
3. **Failed thrombolysis or contraindication to thrombolysis**

Catheter Thrombectomy



There currently are 4 categories of catheter interventional techniques for removing PE:

- **Aspiration thrombectomy (syringe suction applied to a vacuum suction cup at the tip of the catheter)**
- **Fragmentation (manually breaking clots with pigtail or Amplatz catheters)**
- **Rheolytic thrombectomy (a high-speed jet of saline)**
- **Rotational thrombectomy (ASPIREX)**

- **Limited experience**

- **Best results when pulmonary catheter embolectomy was used adjunct to thrombolytic therapy = "*Pharmacomechanical Thrombolysis* "**

- **No RCT (Grade IIb C)**

Pooled data of hemodynamic parameters, clinical success rates, and rates of major bleeding in patients who underwent embolectomy with and without thrombolytic agents

Catheter Type and Technique	No. of Patients	Hemodynamic Parameters						Clinical Success	Major Bleeding	
		Mean Systemic BP		Mean PAP		Mean PaO_2 †		n (%)	Catheter Insertion Site	Other Site
		Before	After	Before	After	Before	After			
Aspiration technique										
Greenfield/pulmonary embolectomy catheter										
No lytics[5–7,19–22]	89	60	81	33	21	46	81	72 (81)*	4 (15)	2 (2)
Systemic lytics[21,23]	9	50	87	31	20	50	75	9 (100)	0 (0)	0 (0)
Local lytics[20]	9	—	—	31	24	—	—	9 (100)	0 (0)	0 (0)
Systemic and local[24]	1	—	—	20	19	—	—	1 (100)	0 (0)	0 (0)
Fragmentation technique										
Pigtail or other angiographic catheter										
No lytics[25,26]	3	28	63	38	29	32	77	2 (67)	0 (0)	0 (0)
Systemic lytics[27]	21	70	93	25	21	—	—	15 (71)	0 (0)	0 (0)
Local lytics[12,25,28–35]	121	67	81	33	22	53	90	115 (95)	1 (1)	1 (1)
Systemic and local[26,45,54]	30	65	69	32	30	37	135	24 (80)	2 (7)	1 (3)
Amplatz catheter										
No lytics[36,37]	8	86	108	49	53	—	—	7 (88)	1 (13)	0 (0)
Local lytics[36,37]	6	85	93	64	60	—	—	6 (100)	0 (0)	0 (0)
Rheolytic technique										
Rheolytic angiojet catheter										
No lytics[4,38,39]	8	—	—	42	30	85	91	6 (75)	0 (0)	0 (0)
Local lytics[40,41]	23	—	—	—	—	—	—	20 (87)	0 (0)	0 (0)
Hydrolyzer catheter										
Local lytics[42,44]	12	47	97	46	30	73	94	11 (92)	0 (0)	0 (0)
Systemic and local[43]	8	—	—	43	36	—	—	8 (100)	0 (0)	0 (0)

* Clinical success with steel cup = 23 of 27 patients (85%); clinical success with plastic cup = 49 of 62 patients (79%).

† Preoperative blood gases were obtained under varying levels of FiO_2.

Abbreviations as in Table 1.

Am J Cardiol 2007;99:415–420

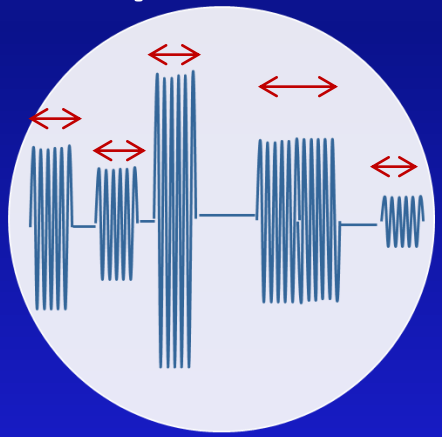
Complications of catheter thrombectomy

- Pericardial tamponade
- Pulmonary hemorrhage
- Pulmonary artery perforation
- Distal embolization

Ultrasound accelerated thrombolysis

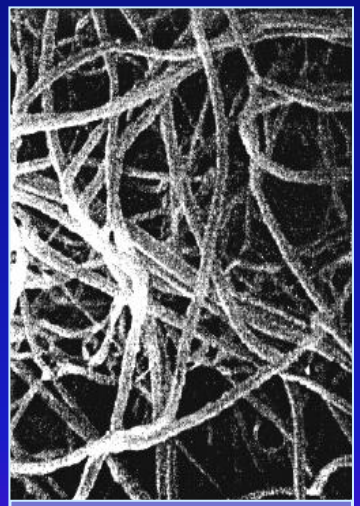
Mechanism of Action

Ultrasound pulses

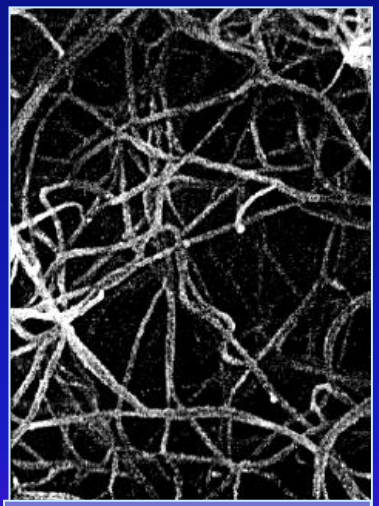


Ultrasound delivered in:
High frequency (2.2 Mhz)
Low power (0.5 W per element)
Pulses of varying waveforms

Fibrin separation

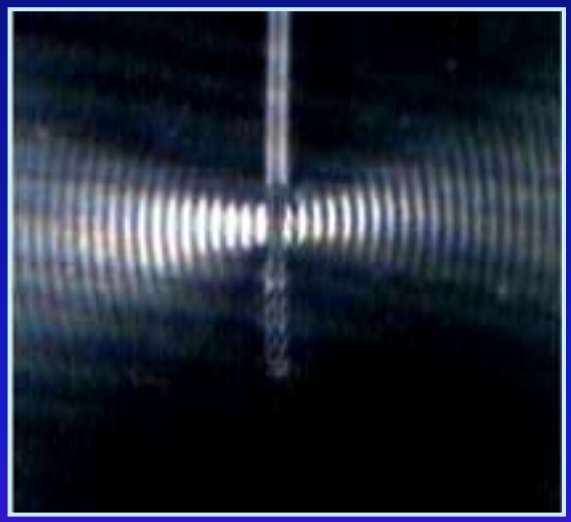


Fibrin without Ultrasound



Fibrin With Ultrasound

Active drug delivery by acoustic streaming

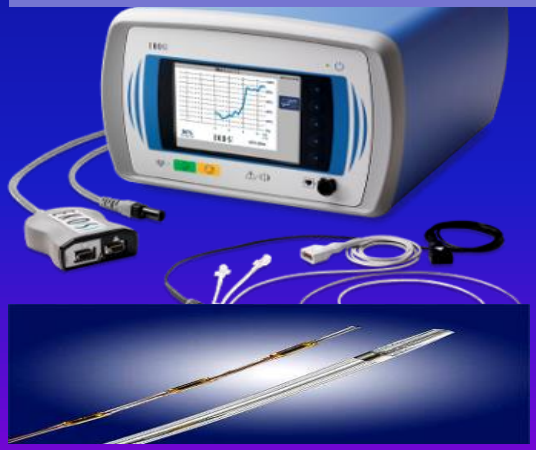


Ŧ Braaten et al. Thromb Haemost 1997; 78:1063-8.

The ULTIMA Trial

A Prospective, Randomized, Controlled Study of Ultrasound Accelerated Thrombolysis for the Treatment of Acute Pulmonary Embolism

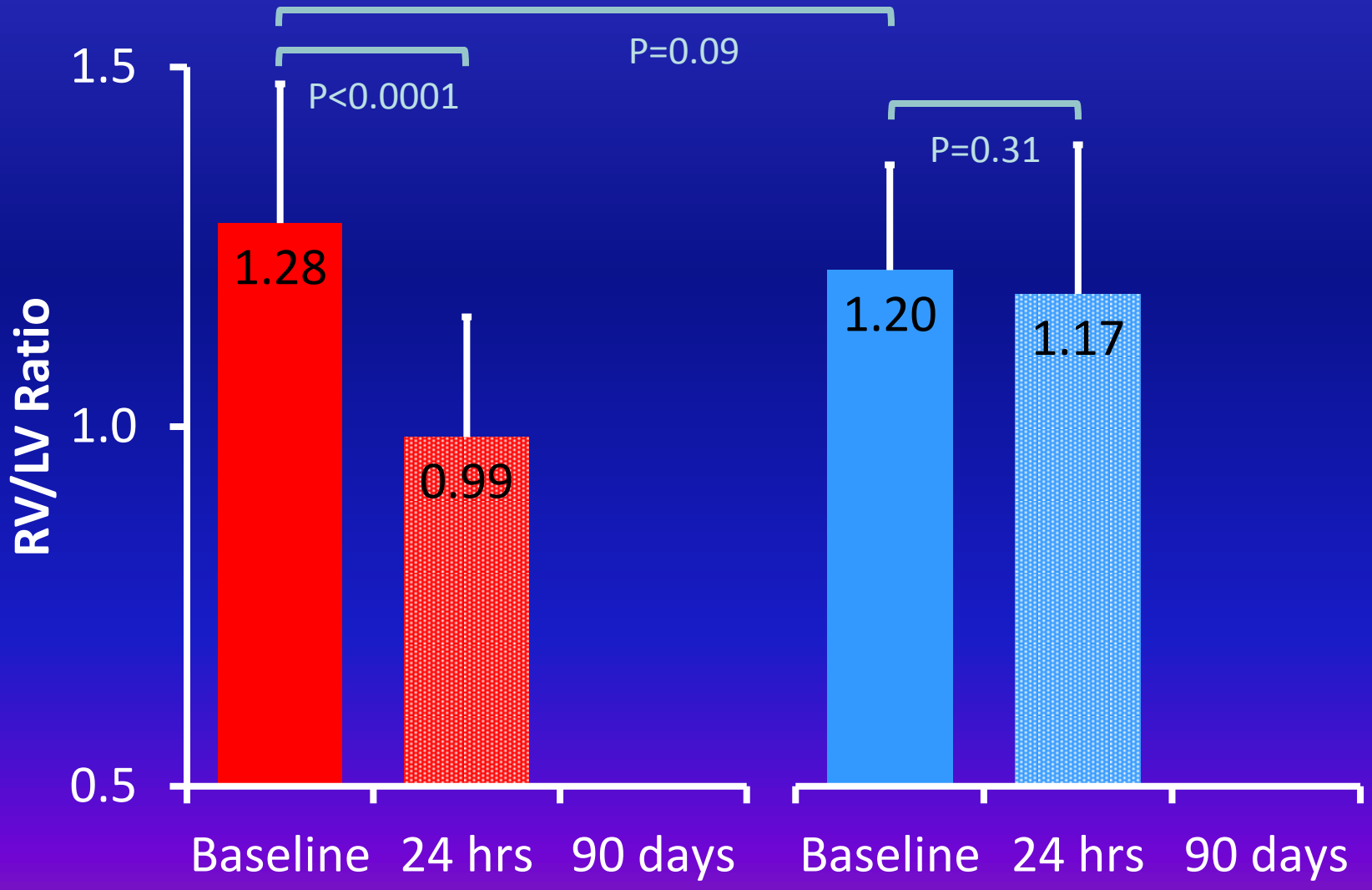
EKOS EkoSonic® Mach 4e Endovascular System



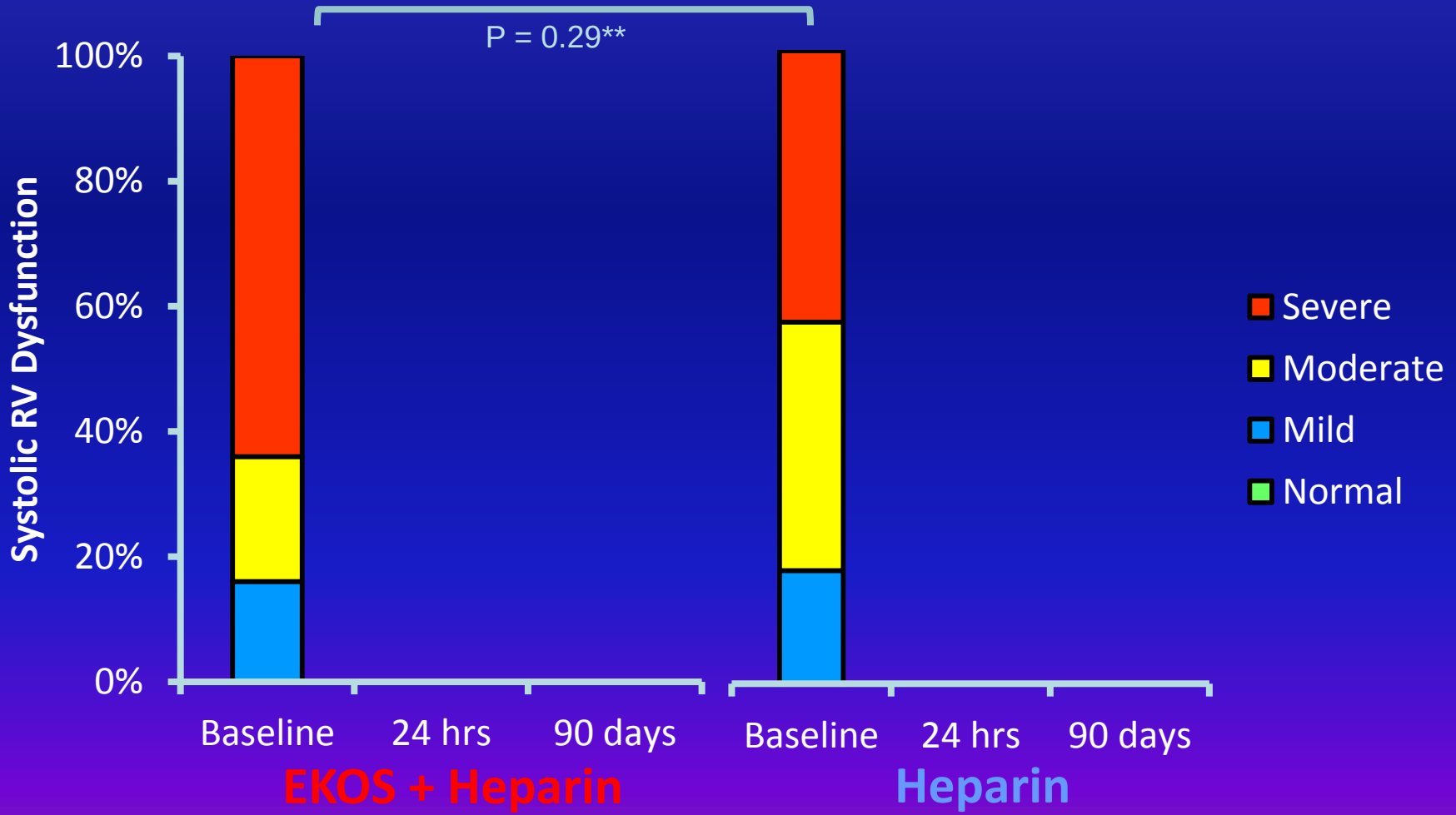
Nils Kucher, M.D.
Clinics for Angiology & Cardiology
University Hospital Bern
Bern, Switzerland

59 Patients

RV/LV ratio (echo)



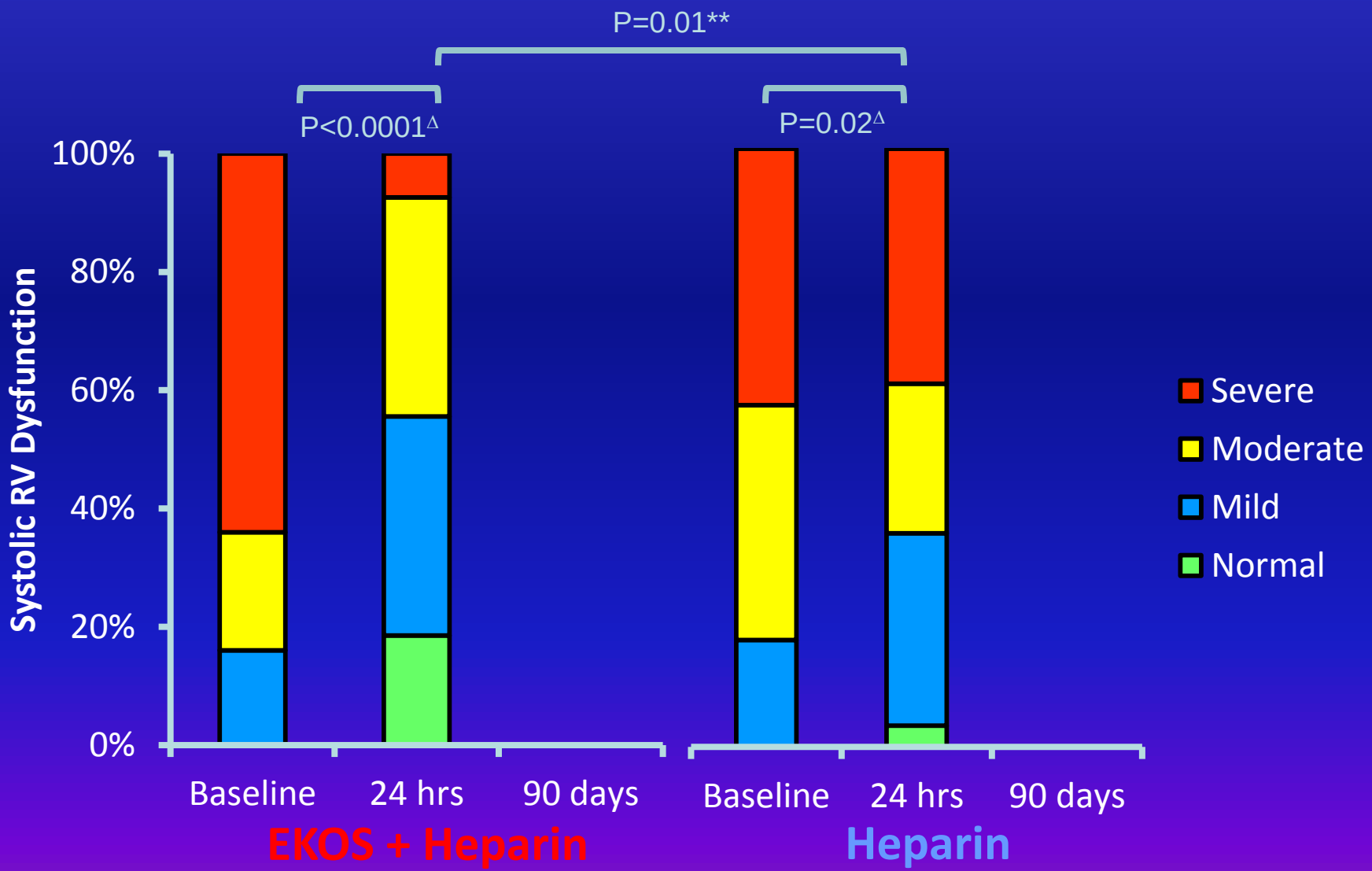
Systolic RV dysfunction



**Two-sided exact Mantel-Haenzel test

Δ Wilcoxon rank sum test

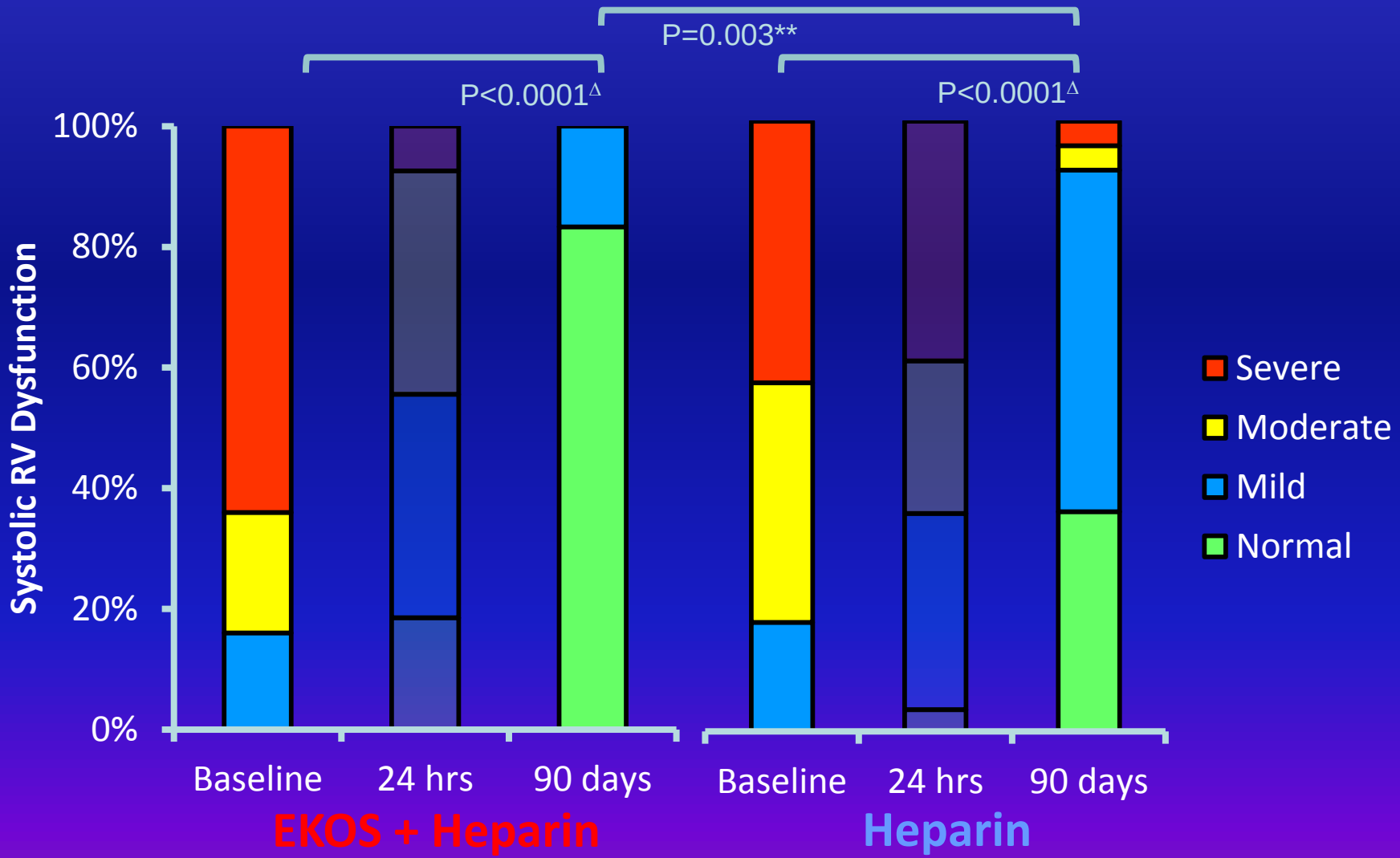
Systolic RV dysfunction



**Two-sided exact Mantel-Haenzel test

Δ Wilcoxon rank sum test

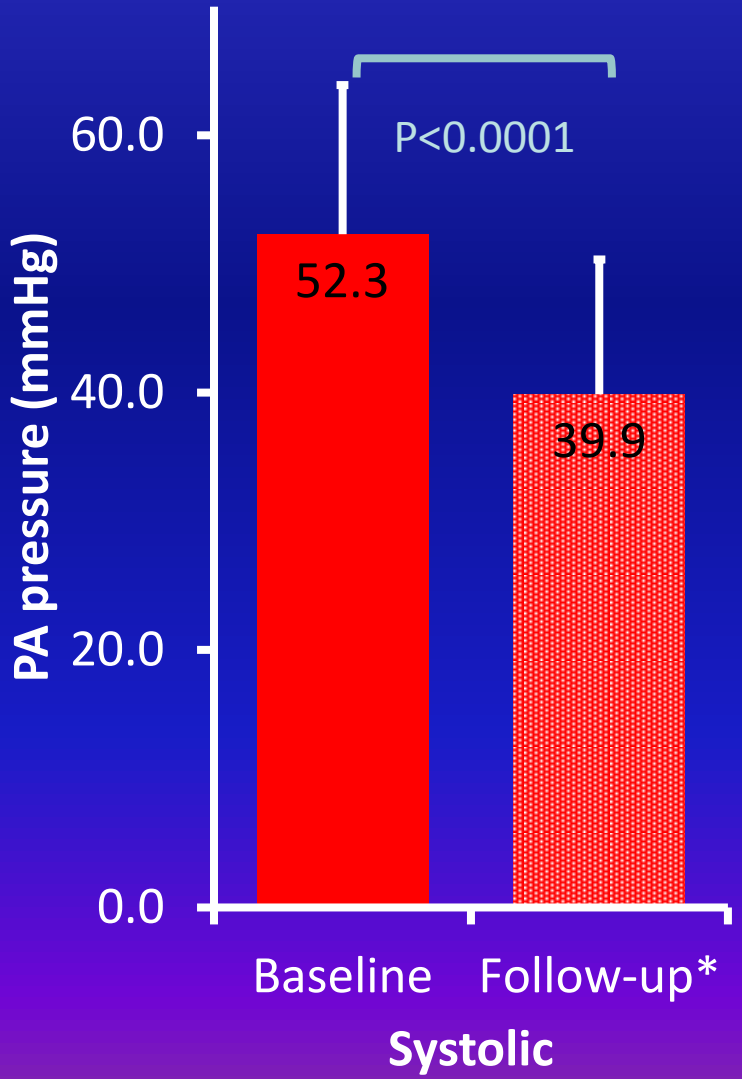
Systolic RV dysfunction



**Two-sided exact Mantel-Haenzel test

Δ Wilcoxon rank sum test

Invasive PA pressure (EKOS group)



* Measurements obtained at 18 ± 3 hours after initiation of therapy

Sub-massive PE

- 25-40 % of all PE
- 3-15% mortality

Thrombolytic Therapy for Sub-massive PE

- The effect of thrombolytic agents on the outcome of hemodynamically stable patients who have sub-massive PE has been debated for decades:
  - The risk of serious hemorrhage associated with thrombolytic therapy
  - Patients may gradually improve with heparin Tx alone

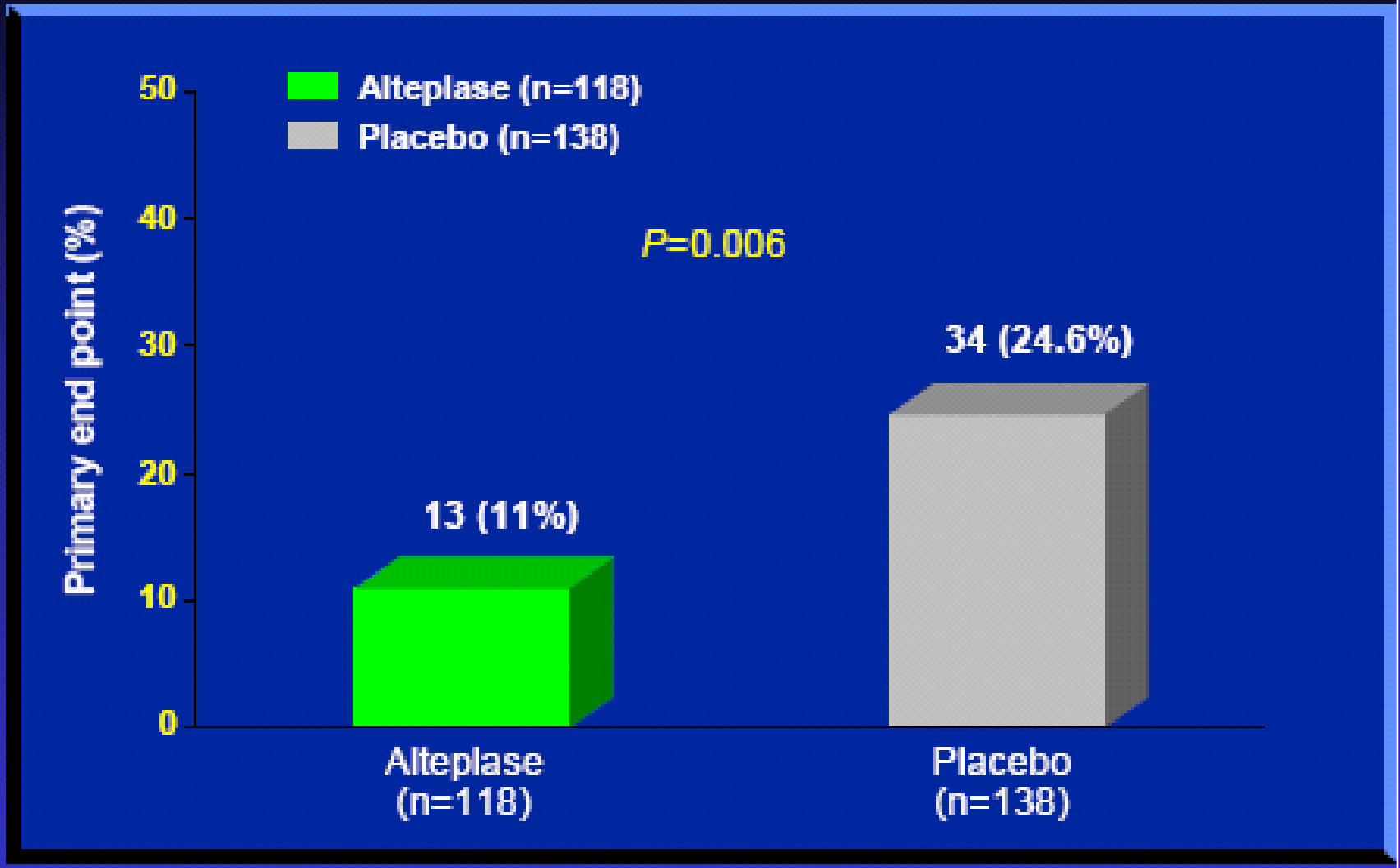
HEPARIN PLUS ALTEPLASE COMPARED WITH HEPARIN ALONE IN PATIENTS WITH SUBMASSIVE PULMONARY EMBOLISM **MAPPET-3**

STAVROS KONSTANTINIDES, M.D., ANNETTE GEIBEL, M.D., GERHARD HEUSEL, PH.D., FRITZ HEINRICH, M.D., AND WOLFGANG KASPER, M.D., FOR THE MANAGEMENT STRATEGIES AND PROGNOSIS OF PULMONARY EMBOLISM-3 TRIAL INVESTIGATORS*

(N Engl J Med 2002;347:1143-50.)

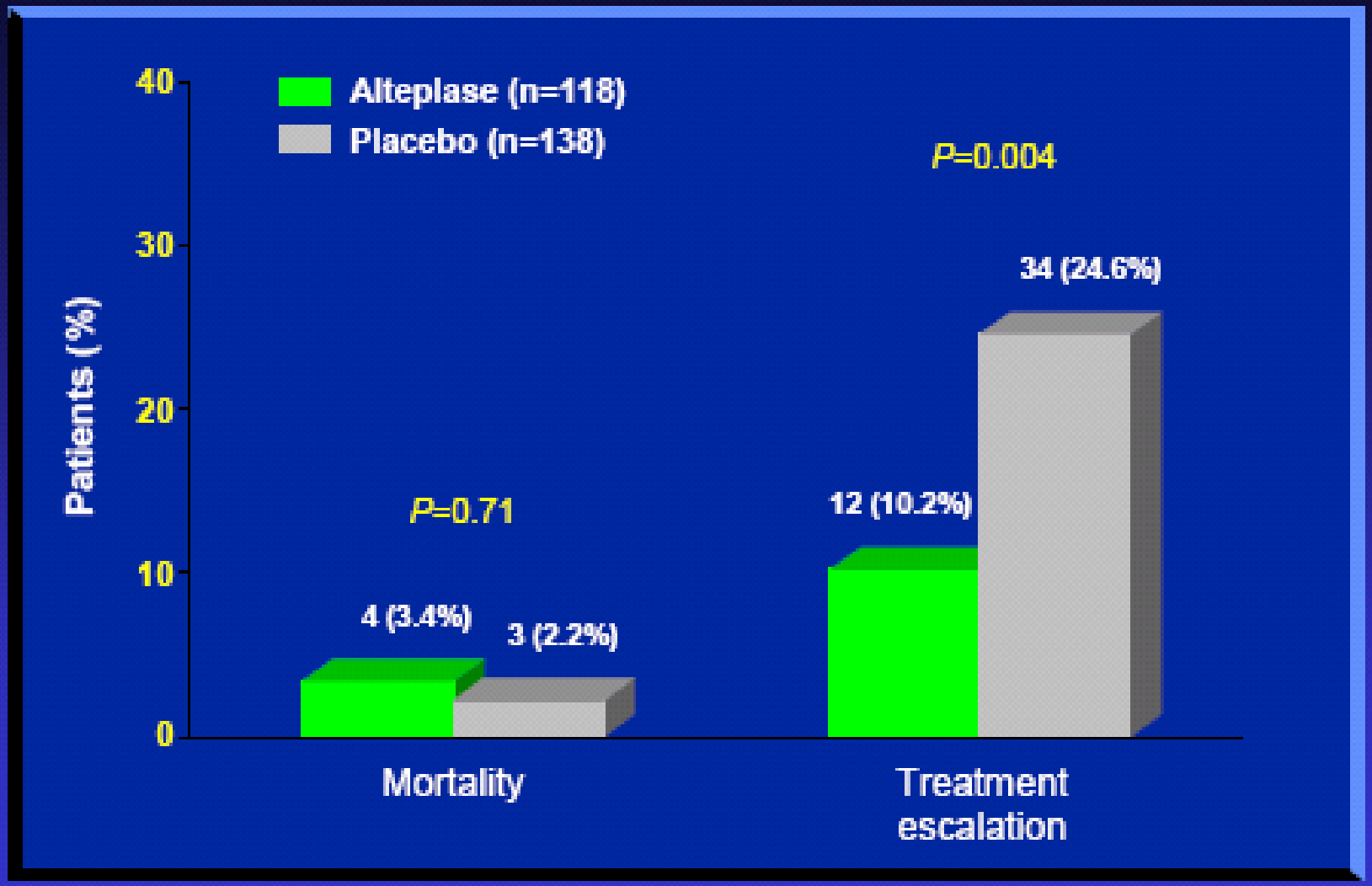
- **Multicenter randomized placebo-controlled trial**
- **118 pts w/ sub-massive PE were randomized to receive heparin plus alteplase vs heparin plus placebo**

Mortality Or Escalation of Treatment



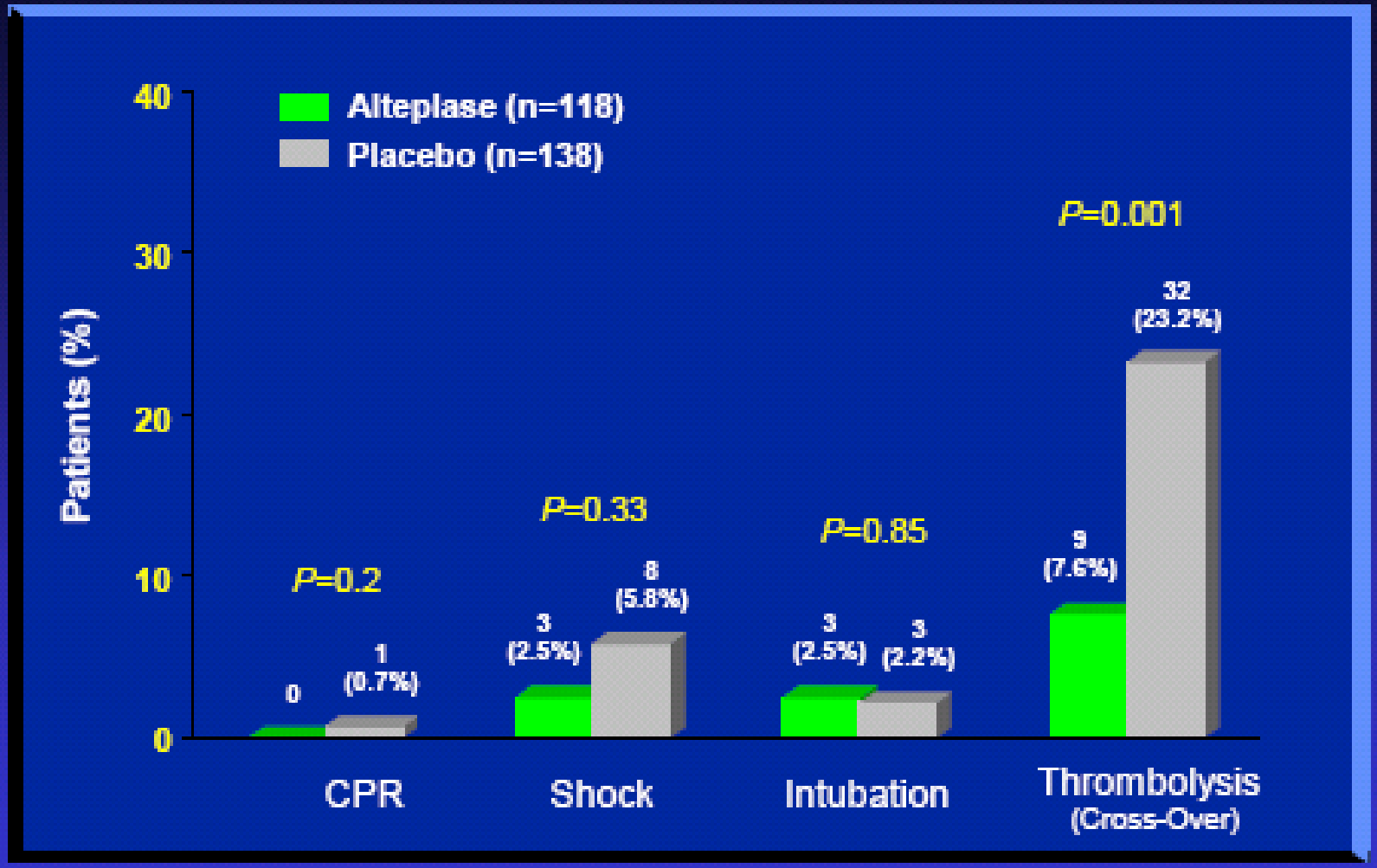
S. Konstantinides et al., *N Engl J Med* 2002;347:1143

Analysis of the Primary End Point



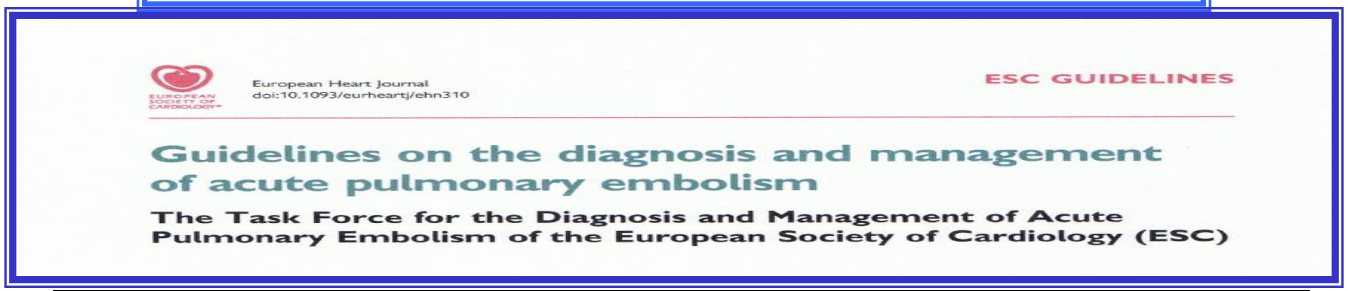
S. Konstantinides et al., *N Engl J Med* 2002;347:1143

Analysis of Escalation of Treatment



S. Konstantinides et al., *N Engl J Med* 2002;347:1143

Fibrinolysis in intermediate-risk PE



Routine use of thrombolysis in non-high-risk patients is not recommended, but may be considered in selected patients with intermediate-risk PE and after thorough consideration of conditions increasing the risk of bleeding. Thrombolytic therapy should be not used in patients with low-risk PE.

Grade IIb, level B

Torbicki et al. Eur Heart J 2008; 29: 2276-2315

Fibrynolisis for submassive PE

AHA PE Guidelines 2011

- Submassive PE: severe RV dysfunction, or major myocardial necrosis, or worsening respiratory insufficiency, with low risk of bleeding (class IIb,Level of evidence C)

(Circulation 2011; 123: 1788-1830)

PEITHO: Pulmonary Embollsm THrOmbolysis Study

A prospective, randomized, double-blind, placebo-controlled, international, multicenter, parallel-group comparison trial evaluating the efficacy and safety of single i.v. bolus tenecteplase as compared with standard treatment in normotensive patients with acute pulmonary embolism and with echographic (or spiral CT) and laboratory evidence of right ventricular dysfunction.

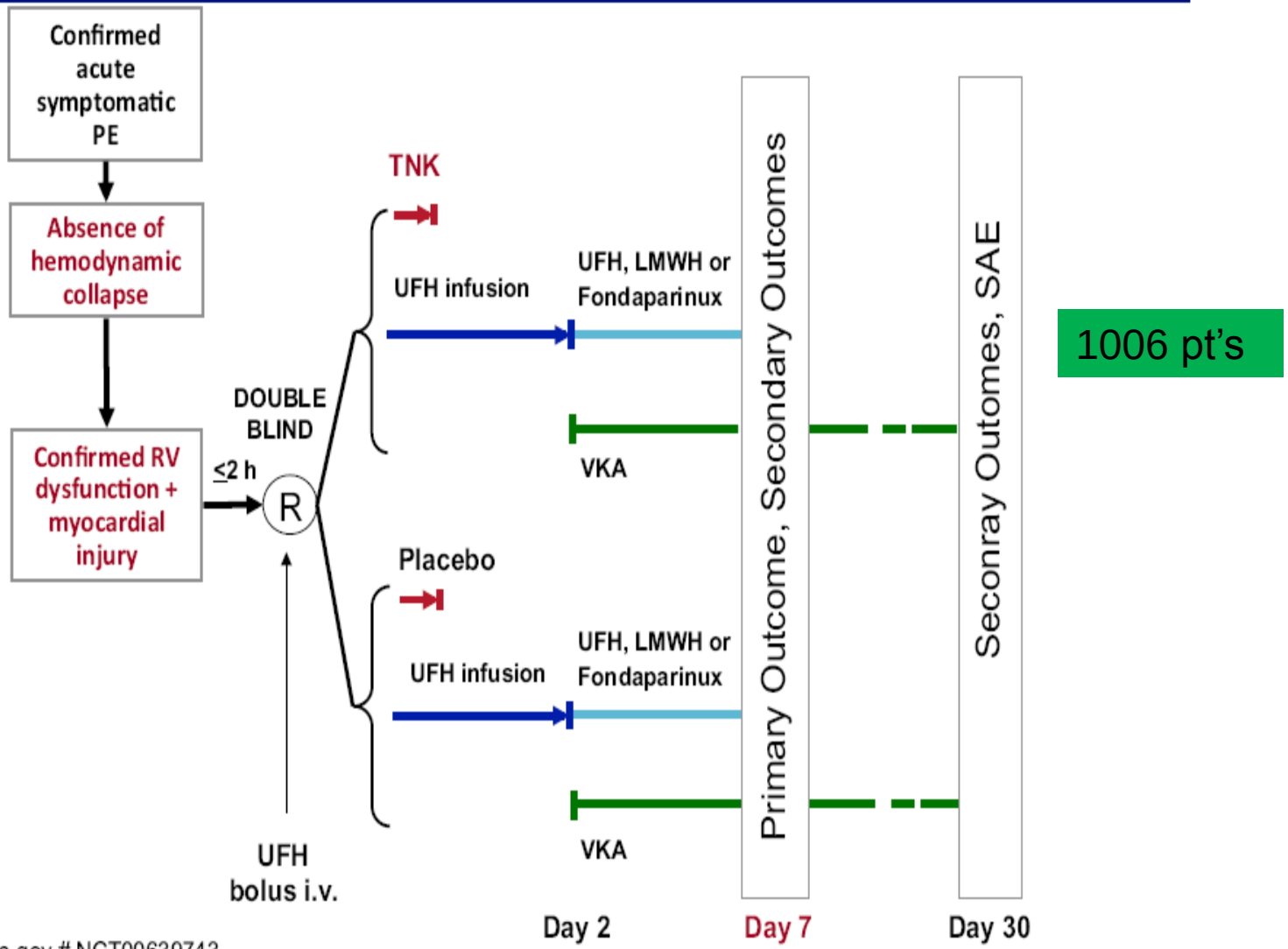
PEITHO: Inclusion criteria

1) Age ≥ 18 years
2) Acute PE confirmed by:
    a) lung scan, *or*
    b) spiral CT, *or*
    c) pulmonary angiogram
3) RV dysfunction *plus* myocardial injury:
    a) echocardiography *or* CT

    PLUS

    b) positive troponin I *or* T test

PEITHO: Overview of study design



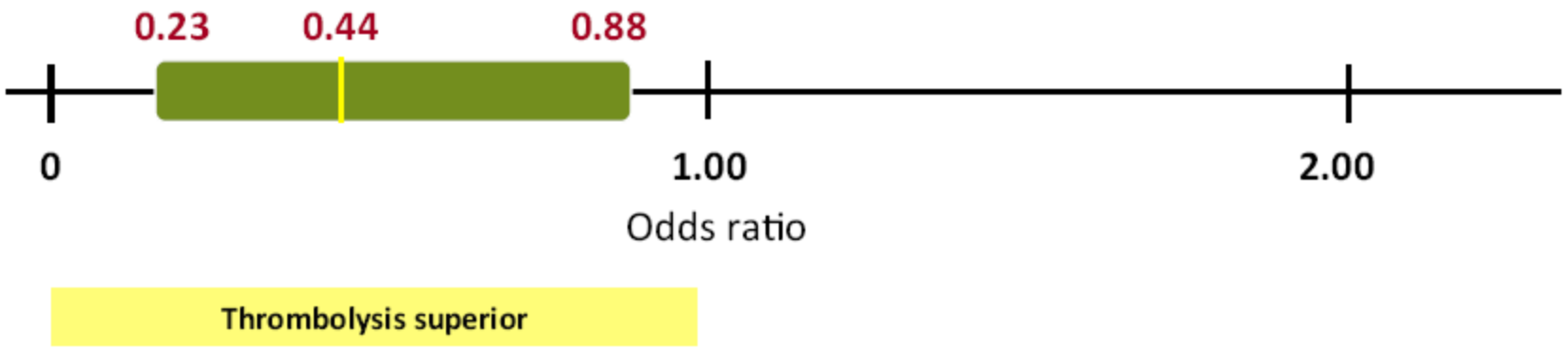
1006 pt's

ClinicalTrials.gov # NCT00639743
EudraCT # 2006-005328-18

S Konstantinides for the PEITHO Steering Committee. Am Heart J 2012;163:33-38.e1

PEITHO: Primary efficacy outcome

	Tenecteplase (n=506)		Placebo (n=499)		*P* value
	n	(%)	n	(%)	
All-cause mortality or hemodynamic collapse within 7 days of randomization	13	(2.6)	28	(5.6)	0.015



PEITHO: Analysis of primary efficacy outcome

	Tenecteplase (n=506)		Placebo (n=499)		*P* value
	n	(%)	n	(%)	
All-cause mortality within 7 days	**6**	**(1.2)**	**9**	**(1.8)**	**0.43**
Hemodynamic collapse within 7 days	**8**	**(1.6)**	**25**	**(5.0)**	**0.002**
Need for CPR	1		5		
Hypotension / blood pressure drop	8		18		
Catecholamines	3		14		
Resulted in death	1		6		

All stroke	2.4%	0.28%	0.03
Major bleeding	6.3%	1.5%	<0.005

PEITHO: Conclusions

- In patients with intermediate-risk pulmonary embolism, intravenous bolus tenecteplase significantly reduced the primary end point of death or hemodynamic collapse within 7 days of randomization.
- The results of PEITHO justify the concept of risk stratification of normotensive patients with acute PE.
- They confirm the notion that early "advanced" (recanalization) treatment prevents clinical deterioration in patients with evidence of right ventricular dysfunction and myocardial injury.
- In PEITHO, the benefits of thrombolysis came at the cost of a significantly increased risk of major, particularly intracranial, hemorrhage.
- The patient's age should be taken into account when weighing the expected benefits versus risks of systemic thrombolysis in clinical practice.

Moderate Pulmonary Embolism Treated With Thrombolysis (from the "MOPETT" Trial)

Mohsen Sharifi, MD[a,b,*], Curt Bay, PhD[b], Laura Skrocki, DO[a], Farnoosh Rahimi, MD[a], and Mahshid Mehdipour, DMD[a,b], "MOPETT" Investigators

Am.J.Card 2013

"Safe Dose" t-PA

- For ≥ 50Kg = 10mg in 1 min followed by 40 mg in 2 hr
- For < 50 Kg = 0.5mg/Kg total dose : 10 mg in 1 min followed by remainder in 2 hr

Concomitant Anticoagulation

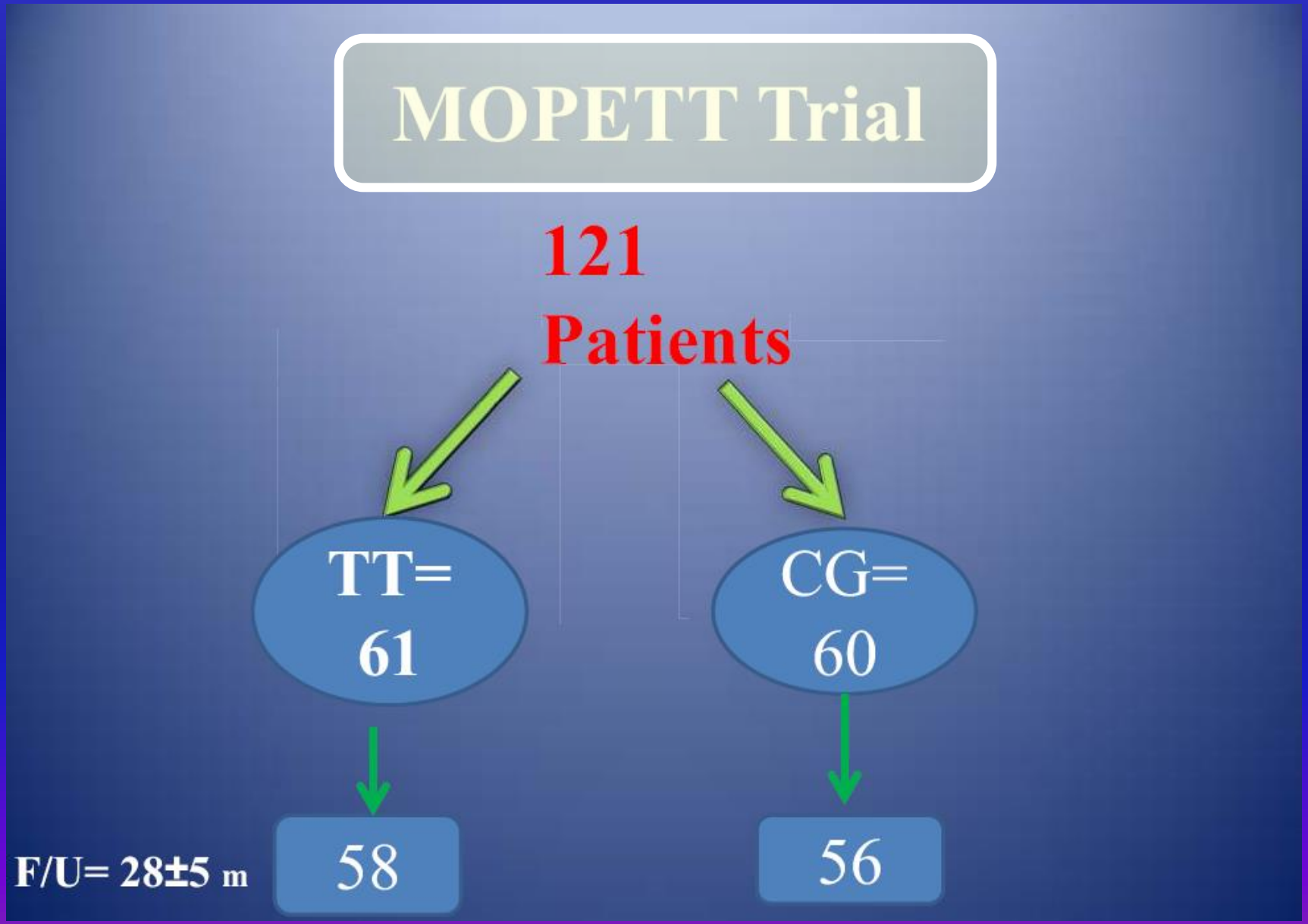
TG

- Enoxaparin (80%) : 1mg/Kg/SQ (not to exceed 80 mg for initial dose)
- Heparin (20%) Bolus = 70 U /Kg, and not to exceed 6000U

  Maintenance 10 U/Kg/ Hr while tPA being infused (not to exceed 1000U/Hr)

  1 hr after termination of t-PA increased to 18 U/Kg/Hr

Adjusted to PTT 1.5-2 X baseline


MOPETT Trial
121
Patients
TT=
61
CG=
60
58
56
F/U= 28±5 m

Primary Endpoints

	TG N= 58	CG N=56	p Value
Pulmonary HTN at 28 m	9 (16)	32 (57)	p<0.001
Pulmonary HTN + recurrent PE at 28 m	9 (16)	35 (63)	p<0.001

Pulmonary HTN= PASP> 40 mmHg

Secondary Endpoints

	TG N= 61	CG N=60	p Value
Recurrent PE	0	3 (5)	0.077
Mortality	1(1.6)	3 (5)	0.301
PE + Mortality	1 (1.6)	6 (10)	0.0489
Hospital Stay	2.2±0.5	4.9±0.8	<0.001
In-hospital Bleeding	0	0	-

Conclusions

- Low dose thrombolysis is safe and effective in moderate PE
- Rapid reduction in PA pressures
- Reduction of Pul HTN & recurrent PE at 28 m
- No bleeding/ ICH

Treatment Protocol I

- **All patients admitted to the ICCU were closely monitored for:**

Respiratory status :

(RR and O_2 saturation)

Hemodynamic status:

(BP,HR,urine output)

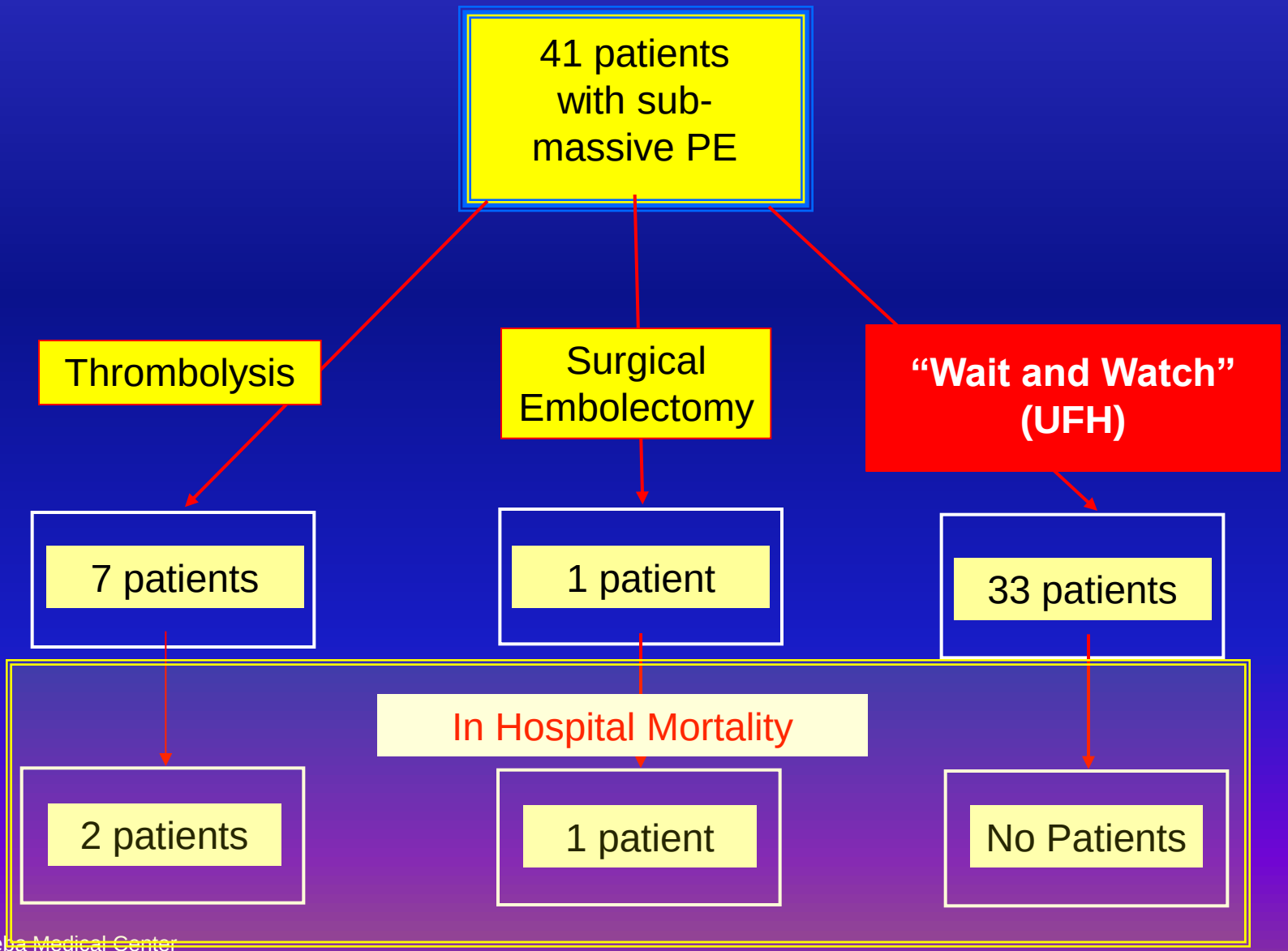
Treatment Protocol II

- Unfractioned heparin (UFH) with a target PTT of 80-90 seconds
- Daily echogardiographic exams to evaluate RV size , function and PA pressure were preformed
- Escalation therapy (thrombolysis or embolectomy) was considered if the clinical status of the patient deteriorated or did not improve within 24-48hrs

Risk Markers and Clinical Characteristics

Risk Marker (number of patients)		Clinical Characteristics (at admission to ICCU)		
RV Dysfunction	Elevated Troponin	Blood Pressure (MAP)	Pulmonary Hypertension (maximal SPAP)	O2 Saturation in room air
41(100%)	24(59%)	100±13mmHg	54±16mmHg	88%

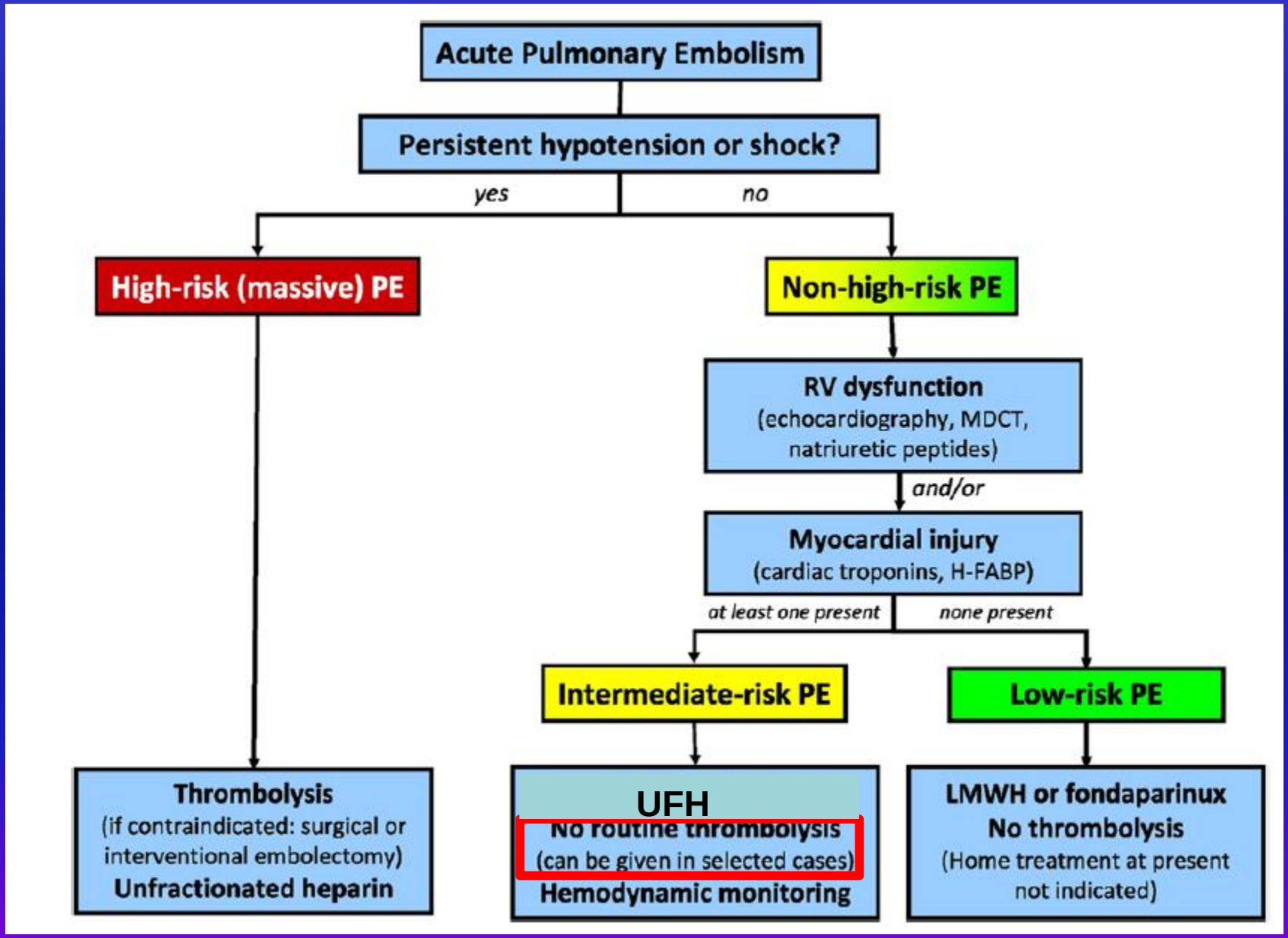
Outcome-Summary



“Wait and watch” (UFH)- Outcome

Improved RV Size and Function	Improvement in Hypoxemia	Pulmonary Hypertension at Admission	Pulmonary Hypertension After Treatment	In Hospital Mortality
25(100%)*	33(100%)	52±15* mmHg	37±12* mmHg	0 (0%)

*Data available for 25 patients


Acute Pulmonary Embolism
Persistent hypotension or shock?
yes
no
High-risk (massive) PE
Non-high-risk PE
RV dysfunction
(echocardiography, MDCT, natriuretic peptides)
and/or
Myocardial injury
(cardiac troponins, H-FABP)
at least one present
none present
Intermediate-risk PE
Low-risk PE
Thrombolysis
(if contraindicated: surgical or interventional embolectomy)
Unfractionated heparin
UFH
No routine thrombolysis
(can be given in selected cases)
Hemodynamic monitoring
LMWH or fondaparinux
No thrombolysis
(Home treatment at present not indicated)


PULMONARY EMBOLISM
Survivor
Thank You