

Syncope: Identifying the real deal and what to do about it

**Gregory J. Misky, M.D.
Assistant Professor of Medicine
Division of General Internal Medicine
Hospital Medicine Section**

Overview

I. Basics

II. Syncope Classification

III. H & P Red Flags

IV. Diagnostic Studies

V. Risk Stratification

Case Study

56 y/o man with h/o HTN brought to ED via ambulance after an event of passing out. Exact duration of the event is unknown, although family present for the event report patient was out "a couple minutes."

Presently, he is tired, but otherwise asymptomatic.

His only medication is a "little white blood pressure pill."

Questions

1. What additional history is needed to determine the cause of his syncope?
2. What diagnostic work-up has the highest yield in determining the cause?
3. What factors determine his need for hospital admission?

Basics

- Sudden, brief loss of consciousness → loss of postural tone due to cerebral under-perfusion
- 1-3% of emergency department visits
- 6% of medical admissions: 6th leading cause of hospitalization in patients > 65
- 10-15% have recurrent syncope < 1 year
- \$2.4 billion annually

Huff et al, Ann Emerg Med 2007;49:431-444
Sun et al, Am J Cardiol. 2005;95:668-671

Enigma

- Symptom, not a disease
- Cause identified in 50-66% of cases
 - usually benign and self-limited
 - can represent serious disease process
- No standard workup for all patients
- No gold standard for diagnostic tests
- Many low-risk patients are hospitalized
- Admitted patients receive little diagnostic care

Enigma, part II



“You’re sick of this? Just try to imagine how we feel.”

Myths

- Most syncope patients require hospital admission
- Pulmonary Embolism and Stroke are common causes of syncope
- CT scans of the head and ECHO are helpful diagnostic tools in evaluating syncope
- Syncope occurs in places other than DIA

Differential diagnosis

- **Etiologies:**

- Vasovagal (neurally-mediated)
- Cardiac (structural, arrhythmia)
- Orthostatic Hypotension
- Neurologic (seizures, vascular)
- Psychiatric
- Multi-factorial (elderly)
- No cause identified

TABLE 1. CAUSES OF SYNCOPE.*

CAUSE	MEAN PREVALENCE (RANGE)
	percent†
Neurally mediated syncope	
Vasovagal attack	18 (8–37)
Situational syncope	5 (1–8)
Carotid-sinus syncope	1 (0–4)
Psychiatric disorders	2 (1–7)
Orthostatic hypotension	8 (4–10)
Medications‡	3 (1–7)
Neurologic disease	10 (3–32)
Cardiac syncope	
Organic heart disease§	4 (1–8)
Arrhythmias	14 (4–38)
Unknown	34 (13–41)

*Reproduced from Linzer et al. with the permission of the publisher.^{8,9}

†Percentages are of patients with syncope.

‡Some of the patients receiving medication may have had neurally mediated syncope but are classified in this category because the studies did not specify it.

§Organic heart disease refers to structural heart disease that causes syncope, such as aortic stenosis, pulmonary hypertension, pulmonary embolism, or myocardial infarction.

Vasovagal

- 20-35% of all syncope
- Neurally-mediated; neurocardiogenic; “fainting”
- Reflex-mediated changes in vascular tone or HR: inappropriate *vasodilation* or *bradycardia* (or both)
- **Examples:**
 - Situational: cough; micturition
 - Emotional: fainting
 - Carotid sinus hypersensitivity: shaving; head turning

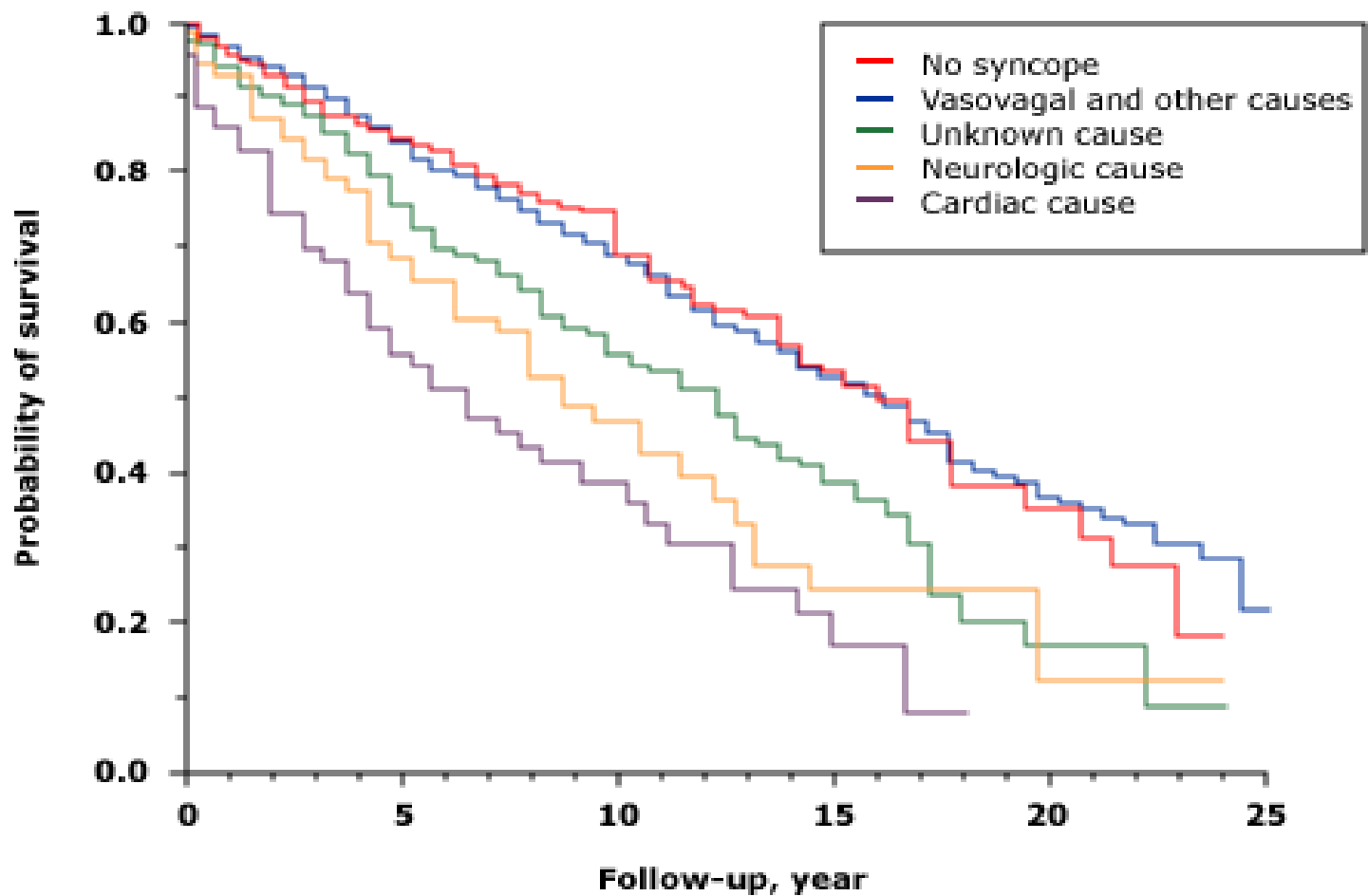
Vasovagal

- **Predictors:**
 - abdominal discomfort before LOC
 - nausea/vomiting during recovery
 - interval between syncopal episodes > 4 years
- No increase in mortality
- Variable diagnostic workup and treatment results

Cardiac

- 10-20% of all syncope
 - Arrhythmia: #1
 - CAD, Valvular heart disease (AS, HOCM)
- Patients with *heart disease* or an *abnormal EKG* have an increased risk of death at one year
- Risk of death doubled in patients with cardiac syncope

Mortality



Cardiac

- ***Presence of structural heart disease*** is the most important factor in predicting risk of death + arrhythmias (sensitivity: 95%)
- Most specific ***predictors of a cardiac cause*** (in patients *with* certain/suspected heart disease)
 - syncope in supine position or during effort
 - blurred vision
 - convulsive syncope

Alboni et al, J Am Coll Cardiol 2001; 37:1921
Soteriades et al, NEJM 2002;347:878-85

Cardiac

- *Absence of heart disease* has high negative predictive value (97%)
- Only *predictor of cardiac cause* (in patients *without* heart disease)
 - palpitations

Orthostatic

- 24% of all syncope, up to 30% in elderly
- **Etiologies:**
 - volume depletion (22%)
 - autonomic dysfunction (DM; Shy-Drager)
 - meds. altering vascular tone +/- HR rate (38%)
- Syncope + \downarrow SBP $>$ 20mm Hg after standing
 - 90% of pts. have within 2 minutes of standing
 - Δ HR $>$ 30 points: specific for hypovolemia

Neurologic

- 10% of all syncope
- Migraines, seizures, vertebral-basilar insufficiency
- Neurologic testing unhelpful in patients lacking neurologic signs or symptoms
 - **CT of head:** only helpful if *focal neurological exam* present or *seizure* is witnessed → new diagnostic information in only 4% of cases
 - **EEG:** only helpful with (+) seizure activity
 - **Carotid ultrasound** unhelpful
- Combined diagnostic yield of 2-6%

Elderly

- Multi-factorial due to an inability to compensate for common situational stresses in setting of:
 - multiple medical problems
 - medications (polypharmacy)
 - physiologic impairments- abnormal physiologic responses to daily events 2° to ↓ baroreceptor sensitivity)
 - volume depletion

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“In a perfect world, you wouldn’t suffer from depression and I wouldn’t profit from it. But we don’t live in a perfect world. OK, well, maybe I do.”

Psychiatric

- 10-20% of syncope
- Panic, generalized anxiety, somatization disorders, depression, and alcohol/substance abuse
- Patients:
 - young
 - heart disease absent
 - recurrent syncope

What helps determine the cause?

- *History, history, history*
 - HPI, PMH, meds.
- Exam
- EKG- recommended in nearly all patients

*** *History, exam and EKG:* answer 1/2 the time

- Routine labs not recommended: helpful <3%
- CT of head, EEG, ECHO, other directed workup based on initial H & P

History of Present Illness

- Loss of consciousness?
- Witnesses?
- Past history of similar event?
- History *prior to* event?
- What was patient doing *at time of* event?
- Accompanying symptoms?
- What was patient like *after* event?

History *prior to event?*

Preceding features

Emotional stressors

Symptoms since starting medication X

Recent GI illness → dehydration

Prodrome

Pale, sweaty and warm

Auras

Long prodrome

No prodrome

(sudden LOC, ø warning)

Etiology

Vasovagal

Seizure

Vasovagal

Arrhythmia

History *at time of event?*

Trigger

Exertion

Stress

Shaving, head rotation

Standing

Accompanying symptoms

Chest pain, palpitations

Nausea, diaphoresis

Headaches

Etiology

Cardiac

Vasovagal

Vasovagal

Orthostatic

Cardiac

Vasovagal

Migraines/seizures

History *after* event?

- Disorientation + slow return to consciousness
= *seizures*
- LOC > 5 minutes = *seizures*
- *Presence of trauma* not predictive of underlying pathology or severity of pathology

* *result* of fall may be > *cause* of fall

Past Medical History

- DM
- Psychiatric
- Cardiac (CAD, CHF, HOCM/AS)
- Neurologic (Seizures, Parkinson's)

- (+) Family history of sudden cardiac death
 - Long QTc syndrome
 - Brugada syndrome
 - Pre-excitation syndrome

Medications

- Frequent culprit (esp. elderly)
- Document side effects: ↓ HR and ↓ BP
- **Antihypertensive and antidepressant agents: #1**
 - other: anti-anginals, analgesics, CNS depressants
- Cumulative: diuretic + anti-psychotic + CNS agent + β-Blocker
- May predispose to malignant arrhythmias (via ↑QTc):
Quinidine, Amiodarone, Procainamide, psychotropics

When all else fails



Exam

- **Vital signs**
 - orthostatic; “relative” hypotension?
 - * persistent hypotension a concern
- **HEENT**
 - tongue biting highly specific for seizures
- **Cardiac**
 - pulses, murmurs
- **Neurologic**
 - focal findings (CVA)
 - Δ mental status (post-ictal, meds.)

Case

The ED provider is unable to obtain further history and asks you what workup you would like performed.

You suggest...

What diagnostic work-up has the highest yield in determining the cause?

- H & P = 45% of cases
- **Most frequently obtained tests:**
 - EKG (99%), telemetry (95%), cardiac enzymes (95%), head CT (63%)
- Cardiac enzymes, CT, ECHO, carotid U/S and EEG affect diagnosis or management in <5% of cases

Orthostatic vital signs

- Performed 38% of time
- Highest yield in affecting/determining:
 - diagnosis (18-26%)
 - management (25-30%)
 - cause of syncope (15-21%)

Yield of Diagnostic Studies

Table 2. Diagnostic Tests Obtained in Evaluation of Syncopal Episodes in Older Patients^a

Test	Obtained	Abnormal Findings ^b	Affected Diagnosis ^c	Helped Determine Etiology ^c	Affected Management ^c
Electrocardiogram	2081 (99)	438 (21)	147 (7)	72 (3)	153 (7)
Telemetry	2001 (95)	314 (16)	212 (11)	95 (5)	245 (12)
Cardiac enzymes test	1991 (95)	108 (5)	31 (2)	9 (0.5)	29 (1)
Head CT	1327 (63)	138 (10)	28 (2)	7 (0.5)	28 (2)
Echocardiogram	821 (39)	516 (63)	35 (4)	13 (2)	36 (4)
Postural BP recording	808 (38)				
Strict criteria ^d		230 (28)	142 (18)	122 (15)	202 (25)
Loose criteria ^d		445 (55)	212 (26)	173 (21)	241 (30)
Carotid US	267 (13)	122 (46)	2 (1)	2 (0.8)	6 (2)
EEG	174 (8)	68 (39)	2 (1)	1 (0.6)	2 (1)
Head MRI	154 (7)	46 (30)	20 (13)	3 (2)	19 (12)
Cardiac stress test	129 (6)	53 (41)	13 (10)	2 (2)	12 (9)

Cost Analysis of Diagnostic Studies

Table 3. Costs of Diagnostic Tests in the Evaluation of Syncopal Episodes^a

Tests Obtained	Cost Per Test, \$ ^b	Total Cost, \$ ^c	Cost per Test Affecting Diagnosis or Management, \$ ^d
EEG	$1115 \times 0.34 = 379$	$65\,946 = (379 \times 174)$	$65\,946/2 = 32\,973$
Head CT scan	$1545 \times 0.34 = 525$	$696\,675 = (525 \times 1327)$	$696\,675/28 = 24\,881$
Cardiac enzymes test	$357 \times 0.34 = 121$	$694\,298 = (121 \times 5738 \text{ sets})$	$694\,298/31 = 22\,397$
Troponin I alone	$78 \times 0.34 = 26$	$149\,188 = (26 \times 5738 \text{ sets})$	$149\,188/31 = 4813$
Carotid US	$1294 \times 0.34 = 440$	$117\,480 = (440 \times 267)$	$117\,480/6 = 19\,580$
Head MRI	$3316 \times 0.34 = 1127$	$173\,558 = (1127 \times 154)$	$173\,558/20 = 8678$
Cardiac stress test	$2492 \times 0.34 = 848$	$109\,392 = (848 \times 129)$	$109\,392/13 = 8415$
Echocardiogram	$809 \times 0.34 = 275$	$225\,775 = (275 \times 821)$	$225\,775/36 = 6272$
Electrocardiogram	$221 \times 0.34 = 75$	$156\,075 = (75 \times 2081)$	$156\,075/153 = 1020$
Telemetry	$255 \times 0.34 = 87$	$174\,087 = (87 \times 2001)$	$174\,087/245 = 710$
Postural BP ^e	5	$4040 = (5 \times 808)$	$4040/241 = 17$

EKG

- Identifies (with rhythm strip) only 5% of syncope
- Noninvasive and cheap
- *Bradycardia* suggested by findings of first-degree heart block, bundle-branch block and sinus bradycardia
- *Ventricular tachycardia* more likely with h/o previous MI or pronounced LVH (HCM)

EKG

- Prolonged QTc (meds, lytes) → Torsades de Pointes
 - Wolff-Parkinson-White syndrome → Ventricular pre-excitation (usu. SVT)
 - Brugada syndrome → Sudden death
- * *Patients with normal EKG have low likely of dysrhythmia as cause of syncope*

Abnormal EKG

- Non-sinus rhythm or rhythm abnormalities
- New changes from old EKG
- Intra-ventricular conduction disorders
- LVH/RVH
- Evidence of prior MI
- ST-T wave changes c/w myocardial ischemia

Cardiac Workup

If:

- 1- structural heart disease can't be confirmed clinically
- 2- syncope associated with exercise
- 3- structural heart disease of unknown significance

...then: ECHO and stress testing are recommended

- **ECHO** not useful in pts. with normal EKG and no cardiac history
- **Telemetry** > 24 hrs: rarely increases yield in detecting *symptomatic* arrhythmias
- BNP? D-dimer?

Linzer et al, Annals of Intern Med 1997; 127:76-84
Kapoor et al, NEJM 2000; 343:1856-1862

Good Advice



Case

The ED provider asks your opinion on whether this patient is appropriate to be admitted to the hospital.

You point out...

What factors determine need for hospital admission?

TABLE 3. REASONS FOR HOSPITALIZATION OF PATIENTS WITH SYNCOPE.

Admission for diagnostic evaluation
Structural heart disease
Known coronary artery disease
Congestive heart failure
Valvular or congenital heart disease
History of ventricular arrhythmias
Physical findings characteristic of heart disease (e.g., findings characteristic of aortic stenosis)
Symptoms suggestive of arrhythmias or ischemia
Syncope associated with palpitations
Chest pain suggestive of coronary disease
Exertional syncope
Electrocardiographic abnormalities
Ischemia
Conduction-system disease (e.g., bundle-branch block and first-degree atrioventricular block)
Unsustained ventricular or supraventricular tachycardia
Prolonged QT interval
Accessory pathway
Right bundle-branch block with ST-segment elevation in leads V ₁ , V ₂ , and V ₃
Pacemaker malfunction
Neurologic disease
New stroke or focal neurologic findings
Admission for treatment
Structural heart disease
Acute myocardial infarction
Pulmonary embolism
Other cardiac diseases diagnosed as causing syncope
Orthostatic hypotension
Acute, severe volume loss (e.g., dehydration and gastrointestinal bleeding)
Moderate-to-severe chronic orthostatic hypotension
Older age
Treatment of multiple coexisting abnormalities
Discontinuation of offending drug or modification of dose
Drugs causing torsade de pointes and a long QT interval
Adverse drug reaction such as anaphylaxis, orthostasis, or bradyarrhythmias

Table 1 Our emergency department's existing syncope guidelines based on the European Society of Cardiology,^{9,10} American College of Physicians^{6,7} and American College of Emergency Physicians guidelines⁸

High risk (admit)	Medium risk (consider discharge with early outpatient review)
History findings	
Palpitations related to syncope	Age >60 years
Associated chest pain	No prodromal symptoms
Associated headache	Previous myocardial infarct
Related to exertion	Known history of valvular heart disease
Family history of sudden death at <60 years	Known angina/coronary artery disease
Previous history of VT/VF/cardiac arrest	Known history of congestive cardiac failure
Examination findings	
Systolic heart murmur heard	>20 mm Hg drop on standing
Signs of heart failure present	Diastolic heart murmur heard
Systolic BP <90 mm Hg	Ventricular pause >3 s on carotid sinus massage
Suspicion of pulmonary embolism	Trauma associated with collapse
AAA detected	
New neurological signs on examination	
Suspicion of CVA or SAH	
FOB present on PR	
Other suspicions of GI bleed	
ECG findings	
Mobitz type II heart block	Right bundle branch block
Wenckebach heart block	QRS duration >120ms
Bifascicular block	Old T wave/ST segment changes
Complete heart block	Frequent pre-excited QRS complexes
Sinus pause >3 s	Q waves unchanged from old ECG
New ST elevation ventricular tachycardia	Atrial fibrillation or flutter
Sinus bradycardia <50	PR >200 ms (first-degree heart block)
Sinoatrial block	
QTc >450 ms	Low risk (consider discharge)
NEW T wave/ST segment changes	None of the above characteristics
Brugada's (ST segment elevation V1-V3)	
Arrhythmogenic right ventricular dysplasia	

AAA, abdominal aortic aneurysm; BP, blood pressure; CVA, cerebrovascular accident; FOB, faecal occult blood; GI, gastrointestinal; PR, rectal examination; SAH, subarachnoid haemorrhage; VF, ventricular fibrillation; VT, ventricular tachycardia.

ED Risk Stratification

- Outcome: arrhythmia or mortality at 1 year
- *Predictors:*
 - Age > 45
 - Abnormal EKG
 - h/o Ventricular Arrhythmia
 - h/o CHF
- With each individual predictor, patients 3-5x more likely to have an event at 1 year
- *Event rate:*
 - 0% if none of four risk factors
 - 27% with 3 or 4 risk factors

Who to Admit: OESIL

- 270 consecutive European syncope patients
- 1° Endpoint (12 month mortality): 11.5% of pts.
- 4 predictors of increased risk of 1-year mortality:
 - Age > 65
 - Abnormal EKG
 - Syncope without a prodrome
 - Cardiovascular disease on history

OESIL

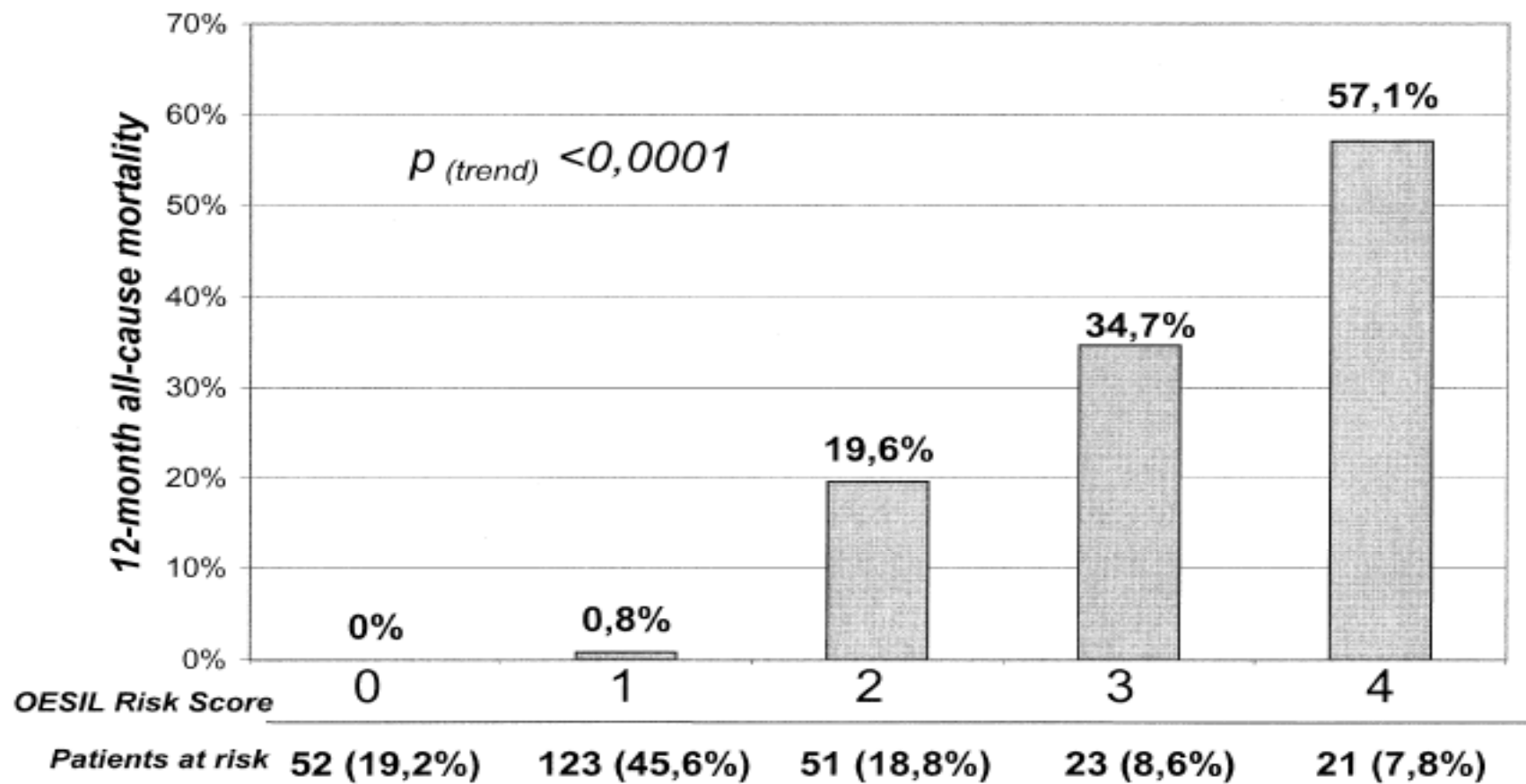
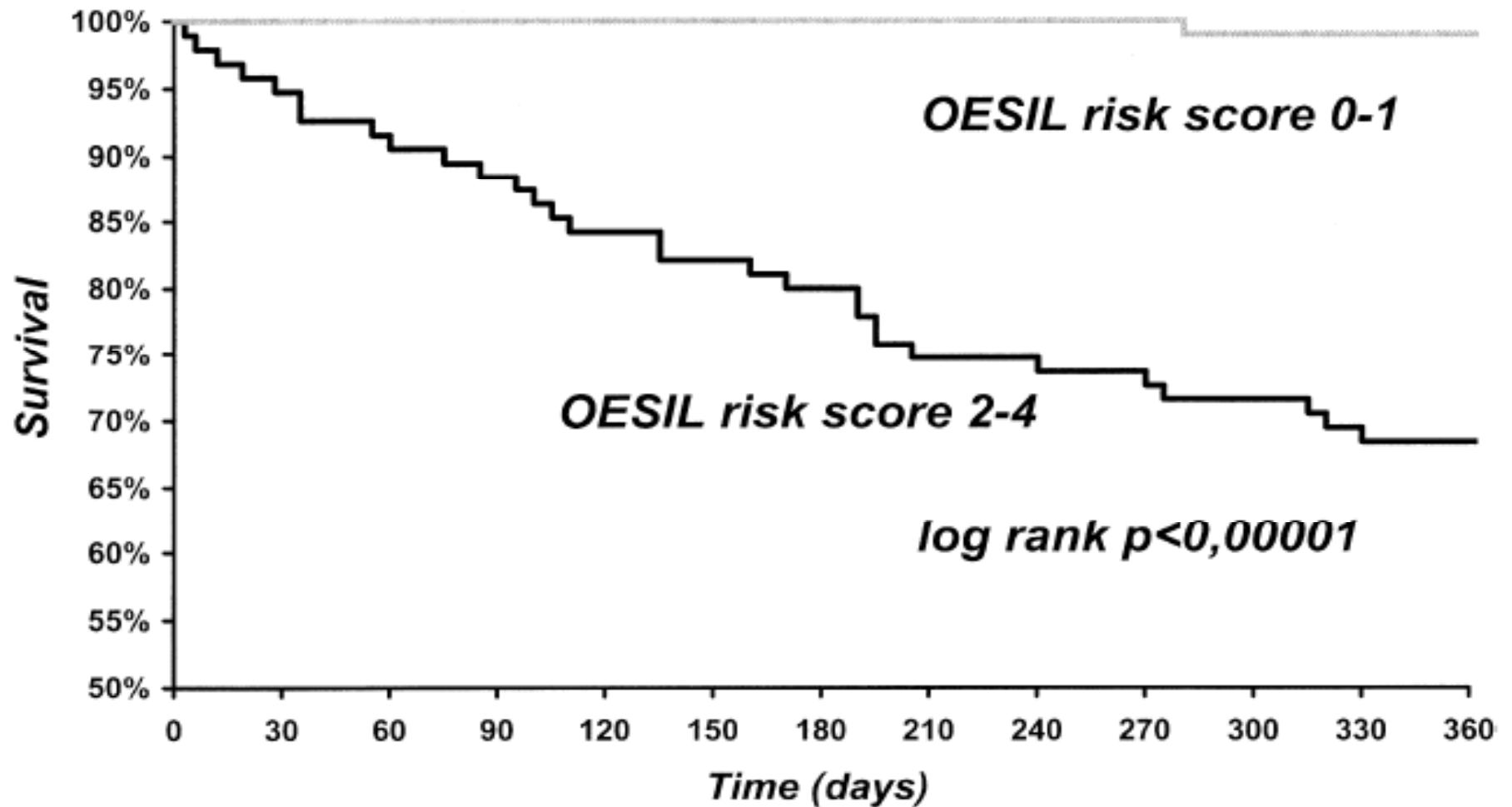


Fig. 1 Rates of 12-month all-cause mortality according to the OESIL score in the derivation cohort.

OESIL



San Francisco Syncope Rule (SFSR)

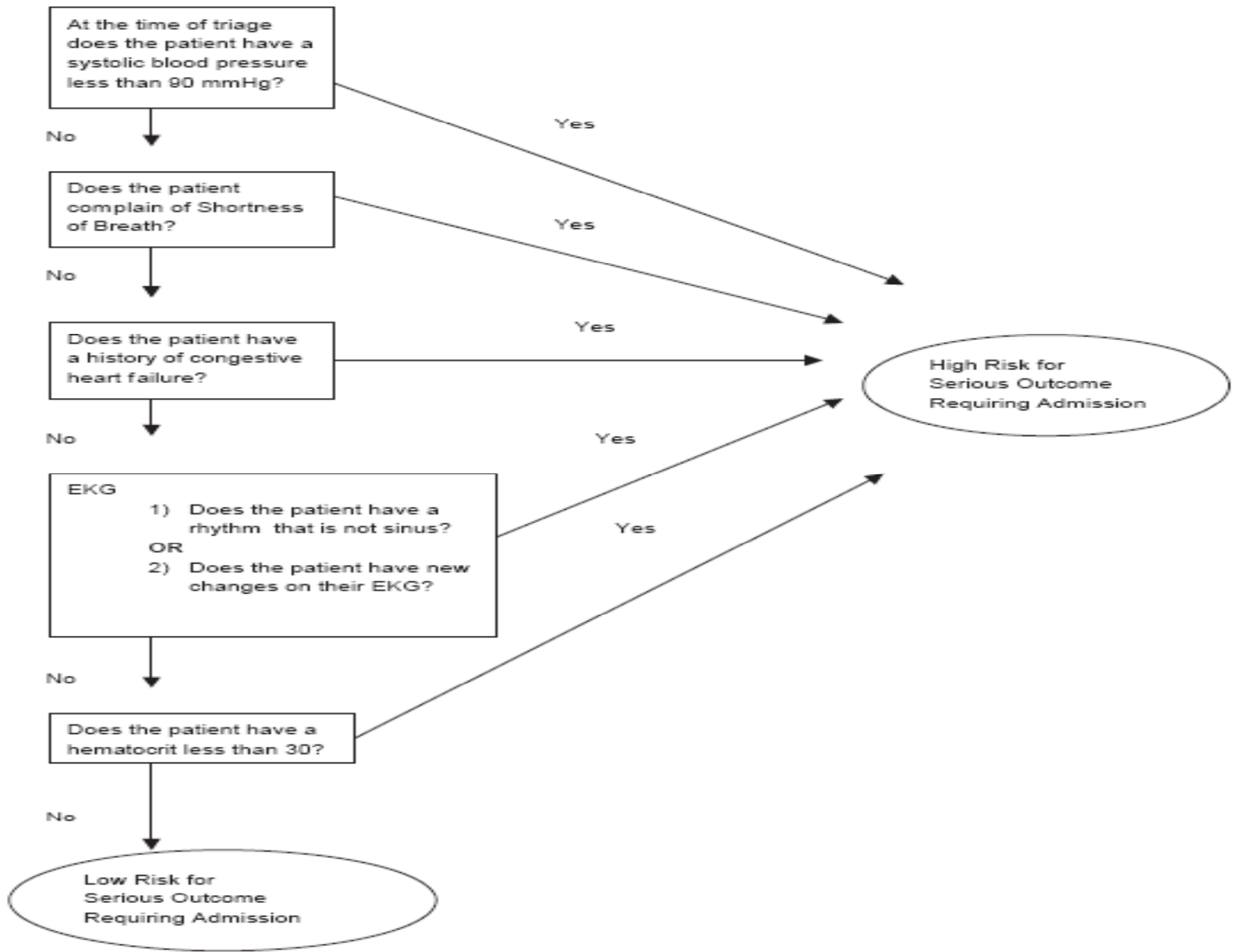
- **Objective:** compare clinical decision rule to physician decision-making to predict *serious outcomes within 7 days* of ED visit

(Serious outcome = MI, arrhythmia, PE, CVA, SAH, sig. hemorrhage, any condition requiring return ED visit/hospitalization)

- Identify low risk syncope patient who can be discharged with <2% chance of a serious outcome by day 7

SFSR

- 55% of all patients (n=684) admitted
 - 52% of patients = high risk
 - 11.5% (79 pts.) = serious outcome
 - *Increase in adverse events* with any of the following:
 - Initial SBP < 90mmHg (ED triage)
 - (+) SOB
 - h/o CHF
 - Abnormal EKG
 - Hematocrit <30
- Admission warranted



SFSR

Table 2 Classification of performance of physician judgment to predict a 2% or less chance of a serious outcome by day 7

Physician judgment	Serious outcome	
	Yes	No
>2%	74	287
<2%	5	318

Sensitivity = 94% (95% CI, 86%-94%); specificity = 52% (95% CI, 51%-53%); κ = 0.44 (95% CI, 0.34-0.54).

Table 3 Overall performance of the SFSR to predict patients with serious outcomes

Decision rule	Serious outcomes	
	Yes	No
Yes	76	230
No	3	375

Bootstrap estimates for CIs: sensitivity = 96.2% (95% CI, 92%-100%); specificity = 61.9% (95% CI, 58%-66%).

SFSR

- If *none* of the SFSR are present, patient at *low risk* of serious outcome → lower admission rates by 10% and still predict all serious outcomes
- **Conclusions:**
 - 1- physician judgment good at predicting which patients develop serious outcomes
 - 2- physicians still admit a large # of low-risk pts.

ED Risk Stratification: ROSE

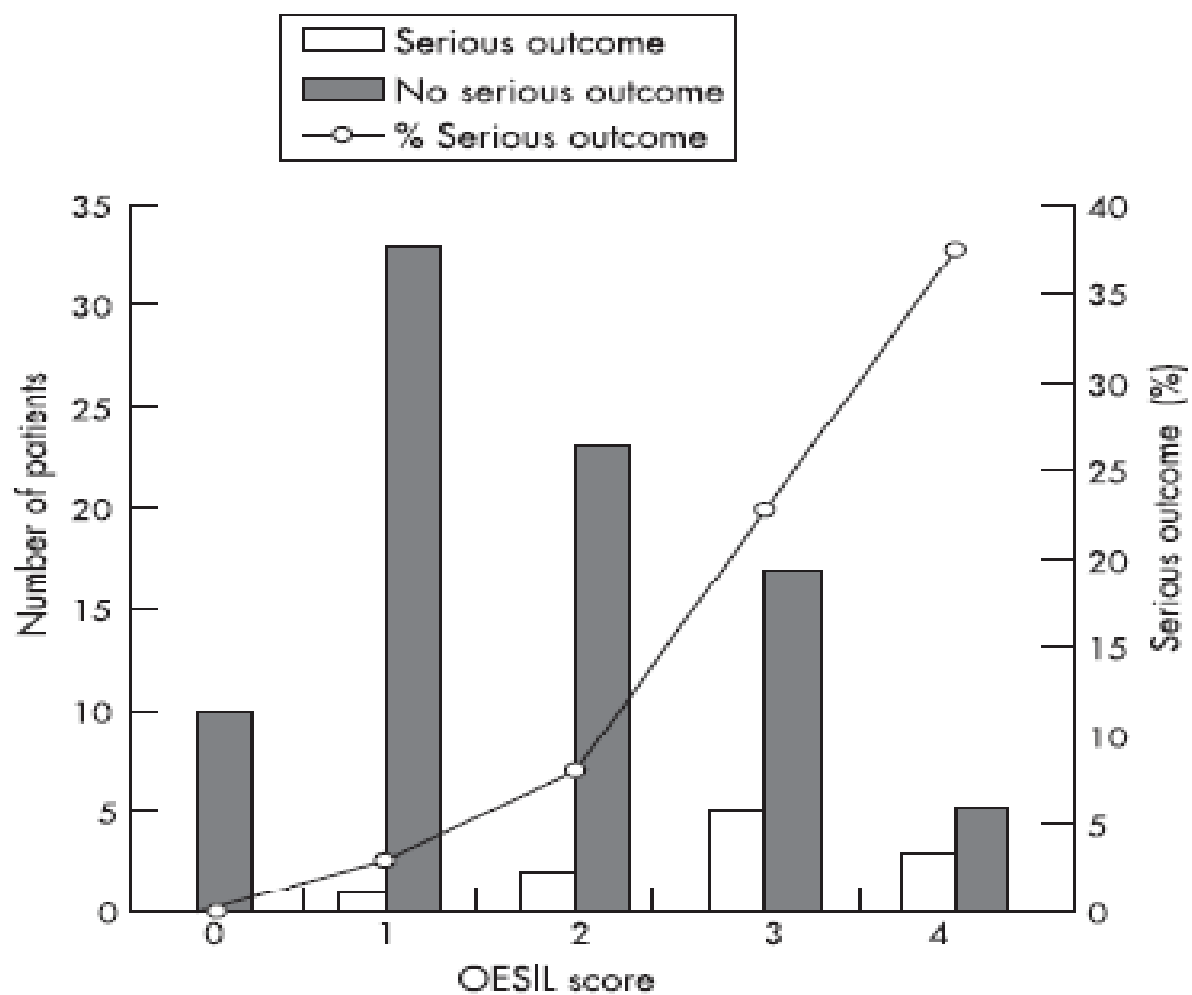
- Risk Stratification of Syncope in the ED (pilot)
- Comparison of ROSE with SFSR & OESIL to predict serious outcomes @ 1 wk, 1 mo. & 3 mos.
- 44 admitted, 55 discharged

- 11 of 99 syncope patients over 3 months with *serious outcome*:

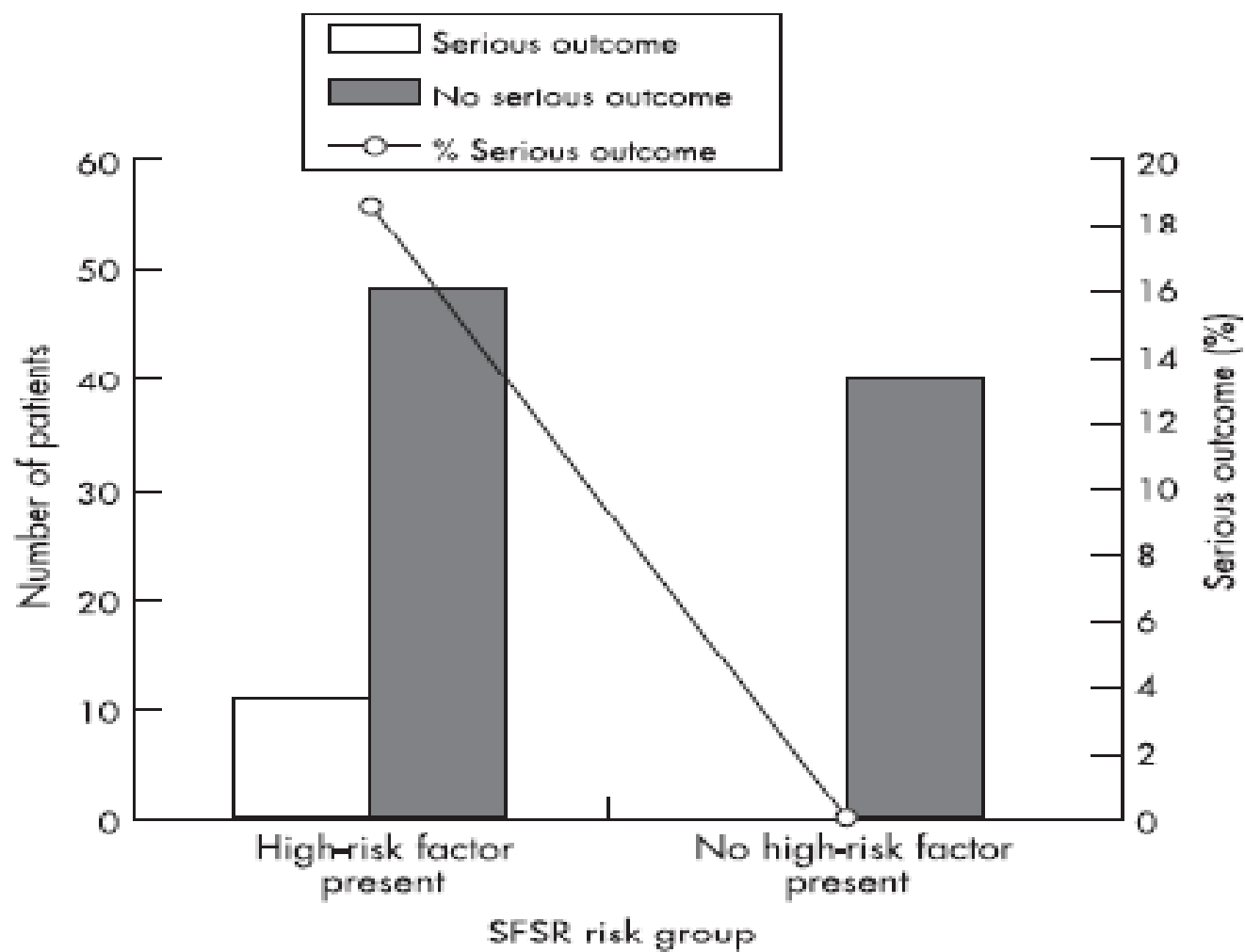
OESIL: 0=0%, 1=3%, 2=8%, 3=23%, 4=38%

SFSR factors: none (n=40)=0%; 1+ (n=59)=19%

ROSE: OESIL



ROSE: SFSR



ROSE

- Risk of serious outcome at 1 wk, 1 mo., and 3 mos.= 8%, 8% and 11%
- ROSE, OESIL and SFSR identify syncope patients with ↑ probability of medium-term serious outcome
- SFSR: good sensitivity, but ↑ hospital admissions

Syncope Red Flags

- Advanced Age
- Abnormal EKG
- Lack of prodrome
- History of cardiovascular disease- CHF, ventricular arrhythmia, symptoms (palpitations or chest pain)
- SBP < 90
- (+) SOB
- Hematocrit < 30
- Other: presence of serious injury, acute/severe volume loss, adverse drug reaction

Case

Patient was admitted to the hospital overnight for observation given his h/o CHF and an EKG revealing old Q waves inferiorly.

He had no further symptoms.

ECHO in the am was unremarkable and he was discharged back to DIA.

Syncope Pearls

- History, exam and EKG provide most answers
- Orthostatic VS are high-yield, low-cost
- EKG identifies highest risk patients
- Patients without cardiac disease + a normal EKG are at low risk of a (-) outcome
- Risk Stratification:
 - Identify and admit patients at *high risk* of bad outcomes and initiate appropriate testing
 - Identify *low risk* patients to avoid unnecessary admissions and workups