Safety of Assessment of Patients With Potential Ischemic Chest Pain in an Emergency Department Waiting Room: A Prospective Comparative Cohort Study

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背景

- 在擁擠的急診室，病人往往需要等待，期間並無醫師或是是護理人員的看照，也沒有可用的儀器可以監測生命徵象
- 在此情形下，讓主訴胸痛的病人等待，是否會延誤病情治療？

研究目的

- 探討胸痛病人在「等候區」的安全性

方法

- 前瞻，比較性質的世代研究
- 繁忙的都會型第三級醫療急診室
-

檢傷 Canadian Triage and Acuity Scale (CTAS), 五級
急性床位的可用性

主訴胸痛的病人 → 等候區
→ 急性床位

- '缺血性胸痛'
- 排除：25歲以下、外傷、明顯的x光表現排除心因性胸痛、末期非心因性疾病、無法溝通，無法聯絡或居無定所
30天內因胸痛再回診

- 追蹤30天(電聯、病歷、資料庫)，檢視兩組病人"急性冠心症(AMI, UA)錯失診斷的比例"，及其他"不良事件"

Acute Myocardial Infarction
Troponin I level >1.0L
Troponin I level between 0.1L and 1.0L and one of the following:
- Dynamic ECG changes consistent with ischemia
- Positive coronary angiogram result (>70% lesion)
- Positive provocative stress test result (nuclide scan or stress ECG)

ECG changes consistent with acute myocardial infarction (MI), including:
- New pathologic Q waves
- New left bundle-branch block (LBBB)
- ST-segment elevation (measured 60 ms after J point) (with no LBBB, paced or ventricular rhythm, benign early repolarization, pericarditis, or left ventricular hypertrophy with strain)
  - >2 mm in 2 contiguous precordial leads
  - >1 mm in 2 contiguous interior or lateral leads
  - >1 mm in V8,V9 (posterior MI)
  - >1 mm in V4R (right ventricular MI)
- Tall R wave in V1 with precordial ST depression (posterior MI)

Thrombolysis with no other cause evident
Death with no other cause evident

Definite Unstable Angina
Rest pain >20 minutes and at least one of the following:
- Troponin between 0.1L and 1.0L with no other criteria for acute myocardial infarction
- ECGs with no persistent ST-elevation but with other reversible changes consistent with ischemia
  - Transient ST elevation >1.0 mm in 2 contiguous leads
  - Dynamic ST depression >0.5 mm in 2 contiguous leads
  - Dynamic T-wave inversion in 2 contiguous leads
- Hospital admission and treatment for acute coronary syndrome with at least one of the following:
  - Positive coronary angiogram test result
  - Positive provocative stress test result

Figure 1. Outcome definitions.

病人離院時並無急性冠心症之診斷且無安排相關追蹤，而在30天內確診爲急性冠心症者，爲錯失診斷之個案

- Tachycardia requiring medical intervention or cardioversion
- Bradycardia requiring medical intervention or pacing
- Respiratory failure requiring assisted ventilations by
  - Bag valve mask
  - Noninvasive positive-pressure ventilation
  - Tracheal intubation
- New congestive heart failure requiring intravenous medications
- Hypotension requiring vasoactive agents
- Chest compressions
- Death

Figure 2. Adverse events.

結果

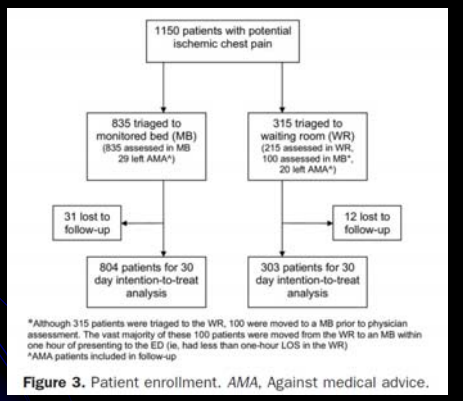

Figure 3. Patient enrollment. *AMA*, Against medical advice.

Table 1. Baseline characteristics.

Characteristics	Monitored Bed	Waiting Room	Difference (95% CI)*
Number of patients	804	303	
Age, y, mean (SD)	56.6 (15.1)	49.7 (14.8)	6.9 (4.9 to 8.9)
Male sex, No. (%)	488 (60.7)	172 (56.7)	3.9 (−2.6 to 10.6)
EMS arrival, No. (%)	260 (32.3)	60 (20.0)	12.3 (6.6 to 18.0)
Ongoing chest pain at triage, No. (%)	650 (80.9)	216 (71.3)	9.6 (3.8 to 15.7)
Median time to physician,† min (IQR)	28 (17 to 46)	25 (12 to 45)	3 (2 to 4)
Median time to first ECG, min (IQR)	37 (27 to 57)	51 (21 to 73)	14 (12 to 16)
Mean initial pulse rate (SD)	*9.9 (19.5)	81.0 (16.8)	1.1 (−1.2 to 3.4)
Mean initial systolic blood pr	i2.7 (26.6)	140.6 (24.8)	2.1 (−1.2 to 5.4)
Mean initial diastolic blood pressure, mm Hg (SD)	79.3 (14.1)	81.2 (13.8)	1.9 (0.0 to 3.8)
Mean initial respiratory rate, breaths/min (SD)	18.6 (3.3)	18.0 (2.0)	0.6 (0.3 to 0.9)
Initial abnormal ECG result, No. (%)‡	223 (27.7)	45 (14.9)	12.9 (7.4 to 17.8)
Previous ACS, No. (%)	224 (27.9)	41 (13.5)	14.4 (9.1 to 19.0)
Smoker,† No. (%)	250 (31.1)	101 (33.3)	2.2 (−3.8 to 8.5)
Hypertension, No. (%)	327 (40.7)	92 (30.4)	3.3 (4.0 to 16.3)
Diabetes, No. (%)	117 (14.6)	34 (11.2)	3.3 (−1.3 to 7.4)
Hyperlipidemia, No. (%)	235 (29.2)	66 (21.8)	7.5 (1.4 to 13.0)

ACS, Acute coronary syndrome.
*Continuity correction applied for differences between proportions.
†Indicates that the proportion of waiting room patients exceeds the proportion of monitored bed patients.
‡ST-segment deviation and T-wave inversion considered abnormal, regardless of conditions such as left ventricular hypertrophy or left bundle-branch block. T-wave flattening considered normal.

較年輕
較少來急診
等候區病人較晚做到ECG
急性病床病人初始ECG異常比例較高
較少高血壓及冠心症病史

Table 2. Diagnoses and outcome events, stratified by cohort.

Results	Monitored Bed	Waiting Room	Difference* (95% CI)†
Number of patients	804	303	
30-day diagnosis, No. (%, 95% CI)			
Acute myocardial infarction	31 (3.9)	9 (3.0)	0.9 (−1.9 to 3.0)
Definite unstable angina	63 (7.8)	14 (4.6)	3.2 (0.2 to 6.0)
Possible unstable angina	19 (2.4)	4 (1.3)	1.0 (−1.1 to 2.6)
No ACS but adverse event	32 (4.0)	2 (0.7)	3.3 (1.3 to 5.0)
No ACS and no adverse event	659 (82.0)	274 (90.4)	8.5 (3.7 to 12.6)
Number of ACS	94 (11.7)	23 (7.6)	4.1 (−0.2 to 7.6)
Missed cases of ACS, No. (%, 95% CI)	0 (0, 0.0 to 0.4)	0 (0, 0.0 to 1.0)	0.0 (−1.6 to 0.6)
Index visit outcome events, No. (%)			
Death during index visit	4 (0.5)	0 (0.0)	0.5 (−1.1 to 1.4)
PCI during index visit‡	30 (3.8)	12 (4.0)	0.2 (−2.2 to 3.5)
CABG during index visit	15 (1.9)	1 (0.3)	1.5 (−0.4 to 2.8)
30-day outcome events, No. (%)§			
Death during 30-day follow-up	4 (0.5)	0	0.5 (−1.1 to 1.4)
PCI during 30-day follow-up	40 (5.0)	13 (4.3)	0.7 (−2.7 to 3.3)
CABG during 30-day follow-up	19 (2.4)	2 (0.6)	1.7 (−0.4 to 3.2)

Table 3. ED adverse events stratified by cohort.

Adverse Event, No.	Monitored Bed (%, 95% CI)	Waiting Room (%, 95% CI)	Difference (95% CI)*
Number of patients	804	303	
Death in ED	0 (0, 0 to 0.4)	0 (0, 0 to 1.0)	0 (−1.6 to 0.6)
Chest compressions in ED	0 (0, 0 to 0.4)	0 (0, 0 to 1.0)	0 (−1.6 to 0.6)
Hypotension in ED	1 (0.1, 0 to 0.2)	0 (0, 0 to 1.0)	0 (−1.6 to 0.6)
Assisted ventilation in ED	0 (0, 0 to 0.3)	0 (0, 0 to 1.0)	0 (−1.6 to 0.6)
Tachyarrhythmia in ED	29 (3.6, 2.3 to 4.9)	2 (0.7, 0 to 1.6)	2.9 (0.7 to 4.6)
Bradyarrhythmia in ED	2 (0.2, 0 to 0.4)	0 (0, 0 to 1.0)	0.2 (−1.3 to 1.0)
New severe CHF in ED	1 (0.1, 0 to 0.2)	0 (0, 0 to 1.0)	0 (−1.6 to 0.6)
Total adverse events	32 (4.0, 2.6 to 5.3)	2 (0.7, 0 to 1.6)	3.3 (1.3 to 5.0)

CHF, Congestive heart failure.
*Monitored bed group minus waiting room group.

急性病床病人不良事件比例較高

Table 4. Diagnostic utilization and hospital resource use.*

Utilization	Monitored Bed	Waiting Room	Difference (95% CI)†
Number	804	303	
Diagnostic test at index visit, No. (%)			
0-h ECG performed	798 (99.3)	293 (96.7)	2.5 (0.7 to 5.4)
6-h ECG performed	327 (40.7)	91 (30.1)	10.6 (4.1 to 16.8)
0-h cardiac biomarker performed	691 (86.0)	223 (73.6)	12.3 (6.9 to 18.2)
6-h cardiac biomarker performed	368 (45.8)	118 (38.9)	6.8 (0.1 to 13.3)
Provocative testing‡ at index ED visit	10 (1.2)	2 (0.7)	0.6 (−1.4 to 1.8)
Provocative testing‡ within 30 days	188 (23.3)	64 (21.1)	2.2 (−3.6 to 7.6)
ED cardiology consultation	215 (26.7)	54 (17.8)	8.9 (3.2 to 14.1)
Hospital utilization			
Patients discharged within 3 h, No. (%)	138 (17.2)	85 (28.0)	10.9 (5.2 to 16.9)
Admission during index visit, No. (%)§	158 (19.7)	36 (11.8)	7.8 (2.9 to 12.0)
Admission during 30-day follow-up	200 (24.9)	39 (12.9)	12.0 (6.9 to 16.9)

*Difference—proportion in the monitored bed group to proportion in the waiting room group.
†Provocative testing—exercise treadmill test or stress myocardial perfusion imaging. Outpatient provocative testing typically took place within 48 hours. Admission: 21 patients who were initially discharged from the ED at the index visit were subsequently admitted for unstable angina after a positive outpatient stress ECG or radionuclide scan result.
‡Differences indicate a higher proportion in the waiting room group than the monitored bed group. Continuity correction was used for the CI.

等候區病人消耗較少的醫療資源

結論

- 等候區世代：
  - 無個案錯失急性冠心症之診斷
  - 僅2個案有不良事件發生，但治療後併無後遺症

→經由適當的檢傷及診視，將穩定的胸痛病患置於等候區是安全且有效率的

→雖然於等候區診治病患仍有些不妥，但於急診室病患眾多時，可能可以作爲一變通方法，節省醫療資源，將急性病床及人力留給更需要的病患

討論

- 限制：
  - 未考慮兩組病人本質上的差異就進行比較
  - 未將"不典型"急性冠心症的病患列入研究
- 不建議將胸痛病患置於等候區視作常規
- 在有良好檢傷及能快速的診視情況下，於急診室病患眾多時，可考慮彈性的將穩定胸痛病患置於等候區，保留急性病床給更需要的病患

Original Contribution

Limitations of risk score models in patients with acute chest pain☆,☆☆

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背景

- 常用之心血管疾病風險指標：
  - Goldman risk score
  - Thrombolysis in Myocardial Infarction (TIMI) risk score
  - Sanchis score
- 對於急性胸痛病患，風險指標評估的準確性?

研究目的

- 運用接受ROMICAT研究中的胸痛病患，檢視前述三個風險指標用以評估急性冠心症的準確性

方法

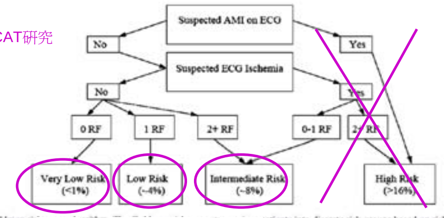
- ROMICAT研究：
  - 前瞻、觀察性的世代研究 (於單一的第三級醫院進行)
  - 對因急性胸痛來急診卻無法確診急性冠心症，而又強烈懷疑而安排住院之病患，進行cardiac multidetector computed tomography (CMCT)
- 對上述病患進行三種風險指標評估發生急性冠心症的風險，再根據CMCT的結果，檢視三種風險指標的準確性及一致性

Table 2 Inclusion and exclusion criteria

Inclusion criteria
Age of >18 y
>5 min of chest pain within the previous 24 h
No or nondiagnostic ECG changes
Normal initial cardiac biomarkers
Admitted to rule out MI through standard care protocols
Sinus rhythm
Ability to perform a breath hold of 10-15 s
Exclusion criteria
Elevated troponin I or creatine kinase-MB levels in the initial blood sample obtained in the ED
New diagnostic ECG changes (ST-segment elevation or depression of >1mm or T-wave inversion of >4 mm in >2 anatomically contiguous leads
Hemodynamic or clinical instability (SBP of <80 mm Hg, clinically significant atrial or ventricular arrhythmias, persistent chest pain despite therapy)
Known allergy to iodinated contrast agent
Serum creatinine level of >1.3 mg/dL
Metformin treatment, hyperthyroidism
Inability to provide informed consent
Perceived interference with standard clinical care of patients

The Goldman risk score

ROMICAT研究



Low Intermediate High

Fig. 1 Goldman ris… …orithm … patients into discrete risk groups based on risk of major adverse cardiac events (dysrh… …mp fail… …2 … …itial presentation. Goldman risk factors included SBP of below 110 mm Hg, bilateral rales heard above the bases on physical examination, and known unstable ischemic heart disease (defined as a worsening of previously stable angina, a new onset of angina, or pain that was the same as previous MI). The derivation and validation of the above protocol are from Goldman et al [8,9] and adapted with permission. Because patients enrolled in ROMICAT had nondiagnostic ECGs, there were no patients classified as "high risk" in this study, leaving 3 Goldman risk categories (very low, low, and intermediate) for analysis. For consistency with TIMI and Sanchis, we use the nomenclature of low ("Very Low" in figure), intermediate ("Low" in figure), and high ("Intermediate" in figure) to refer to these 3 Goldman categories in the text. AMI indicates acute MI; RF, Goldman risk factor.

Table 1 TIMI risk scoring criteria[a]

1. Age of >65 y
2. Documented prior coronary stenosis of >50%
3. Three or more conventional cardiac risk factors
4. Use of aspirin in preceding 7 d
5. Two or more anginal events in the past 24 h
6. ST-segment elevation or depression of >1 mm
7. Elevated cardiac biomarkers

[a] Derived from the TIMI-11B study [18], the score is additive without weighting (0-7). We categorized patients into 3 risk groups: low (0-2), intermediate (3-4), and high (5-7).

Sanchis risk scores

1. Geleijnse chest pain score ≧ 10 (1 point)
2. 2 or more chest pain episodes within 24 hours (1 point)
3. Age greater than 66 years (1 point)
4. Insulin-dependent diabetes mellitus (2 points)
5. Prior percutaneous transluminal coronary angioplasty (1 point)

Low risk (0-1 points), intermediate risk (2 points), and high risk (3-6 points)

結果

- 413病人，排除241人，24人拒絕 → 148人進入研究

Table 3 Baseline clinical characteristics

Characteristic	All patients (n = 148)	Patients with ACS (n = 17)	Patients without ACS (n = 131)
	n (%)	n (%)	n (%)
Age, mean ± SD	54.6 ± 12.3	54.0 ± 11.8	58.6 ± 15.9
Male sex	87 (59)	15 (88)	72 (55)
Known CAD	24 (16)	9 (53)	15 (12)
Cardiac risk factors			
Tobacco use	56 (38)	10 (59)	46 (37)
Hypertension	71 (50)	12 (71)	59 (47)
Hypercholesterolemia	78 (53)	11 (65)	67 (54)
Family history	75 (51)	11 (65)	64 (51)
Diabetes mellitus	14 (10)	4 (24)	10 (8)
Framingham risk score			
Score (%), mean ± SD	9.7 ± 7.2	12.4 ± 7.9	9.3 ± 7.0
Total	148 (100)	17 (11)	131 (89)

CAD indicates coronary artery disease.

Table 5 Test characteristics for prediction of ACS[a]

Parameter:	Risk score: Goldman %	Goldman 95% CI	TIMI %	TIMI 95% CI	Sanchis %	Sanchis 95% CI	CMCT[b] %	CMCT[b] 95% CI
Sensitivity	53	29-77	35	13-58	41	18-65	100	81-100
Specificity	72	64-79	85	79-91	86	80-92	46	35-57
NPV	92	87-97	91	86-96	92	87-97	100	93-100
PPV	20	8-31	23	7-39	28	10-46	23	13-35
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Odds of ACS[c]	2.9	1.03-8.0	3.0	1.01-9.1	4.3	1.46-12.8	∞	—

CMCT indicates cardiac multidetector computed tomography angiography; NPV, negative predictive value; PPV, positive predictive value.
[a] For all test characteristics, risk scores were dichotomized using the composite of high- and intermediate-risk scores compared vs low-risk scores.
[b] Figures for diagnostic accuracy of computed tomography–based presence of any coronary plaque to predict ACS during index hospitalization were adapted directly from ROMICAT [5].
[c] For ORs, low-risk categories were used for the comparison group.

敏感度不佳

危險因子越多，ACS的機會越高

既使在低危險性組，仍有確診ACS的個案

Table 4 Proportions of patients with ACS using risk categories

Risk model	Low risk, n (%)	Moderate risk, n (%)	High risk, n (%)
Goldman	8/102 (8)	3/24 (13)	6/22 (27)
TIMI	11/122 (9)	5/25 (20)	1/1 (100)
Sanchis[a]	10/121 (8)	5/22 (23)	2/3 (67)

[a] For use of Sanchis, only 146 patients could be categorized because of 2 patients with incomplete history data.

Table 6 Agreement of risk scores for the prediction of ACS using weighted κ statistics[a]

Risk Model:	Goldman	TIMI	Sanchis
Goldman	—	0.30	0.18
TIMI	0.30	—	0.43
Sanchis	0.18	0.43	—

[a] Weighted κ statistics was used to compare correlations of ordinal categories (low, moderate, and high).

一致性差

結論

- 目前常用的三種心血管風險指標(Goldman, TIMI, Sanchis)，對用於急性胸痛病人偵測急性冠心症的敏感度差
- 因研究樣本數目少，須再進行更大規模的研究來確認

討論

- 限制：
  - 病人選擇是根據ROMICAT研究的標準，無法推廣到一般族群
  - 爲單一機構的研究，樣本數少且確診急性冠心症的比例低(僅17例)
- 將風險指標評估結果分成低、中、高風險族群，雖未能展現其敏感度，但三種風險指標都指出，危險因子越多的急性胸痛病人，越容易得到急性冠心症

THANKS FOR YOUR ATTENSION !

Geleijnse chest pain score

- Location
  - Substernal +3
  - Precordial +2
  - Neck, jaw, epigastrium +1
  - Apical -1
- Radiation
  - Either arm +2
  - Shoulder, back, neck, jaw +1
- Characteristics
  - Crushing, pressing, squeezing +3
  - Heaviness, tightness +2
  - Sticking, stabbing, pinprick, catching –1
- Severity
  - Severe +2
  - Moderate +1
- Influenced by
  - Nitroglycerin +1
  - Stature –1
  - Breathing –1
- Associated symptoms
  - Dyspnea +2
  - Nausea or vomiting +2
  - Diaphoresis +2
- History of exertional angina +3