Sensitivity, Specificity, and Predictive Value of Symptoms for a Diagnosis of Acute Coronary Syndrome

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- The authors have no conflicts of interest to disclose

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Background

- Chest pain common in the emergency dept.
  - Patients with undifferentiated chest pain account for approximately 10% of all ED visits[1]

  - Studies found that chest pain, shoulder pain, arm pain, sweating, nausea, and vomiting are predictive of AMI/ACS but findings are not uniform across studies[2]

  - Need rigorous gender specific data to determine appropriate strategies for education & messaging

1. *Nawar EW, Niska RW, Xu J. Advance Data. 2007(386):1-32.*
2. *Canto AJ et al. Amer Heart J. 2012; 163: 572-579*

Background

- ## Gender bias
  - Clinicians tend to think men are at higher risk for ACS than women (this is erroneous & age dependent)
  - Belief that symptoms are the same for women and men[3]

- ## Triage decision-making
  - Rapid and appropriate activation of ACS protocols paramount for effective time-dependent reperfusion therapies which reduce mortality and morbidity
  - Knowledge of the predictive value of symptoms for ACS can improve the process by identifying patients (both women & men) more likely to rule-in

3. Kreatsoulas et al., Reconstructing Angina: Cardiac Symptoms Are the Same in Women and Men. JAMA-IM; 2013

Background

- Patient/public health education
  - Decreased door to balloon-No reduction in mortality (2005-2009) [4]
    - Decreased from 83 to 67 minutes (mortality 4.7%)
    - Authors concluded "efforts with potential to improve outcomes may include increasing patients' awareness of symptoms & reducing the interval from the time of symptom onset to treatment"
  - Slow vs. Fast Symptom Onset: Slow symptom onset associated with longer prehospital delay [5]
    - "an important aspect of ACS educational information-slow onset ACS presentation-has been missed. . . partly explaining why patient decision delay is still a major problem"

4. Menees, D. et al. Door-to-balloon time and mortality among patients undergoing primary PCI, NEJM. Sept. 2013

5. O'Donnell, S. et al. Slow-onset and fast-onset symptom presentations in acute coronary syndrome: New perspectives on prehospital delay, J Emer Med; Oct, 2013

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Objective

Determine the sensitivity, specificity, and predictive value of 13 symptoms for a diagnosis of ACS for women & men

Methods- Sample

- Sample: patients admitted to the emergency department
  - symptoms suggestive of ACS
  - transported by ambulance or walk-in
  - n=736
    - 301 ruled in for ACS
    - 435 ruled-out for ACS

Methods- Setting

4 high volume emergency departments in the Midwest, West, and Pacific Northwest regions of the US
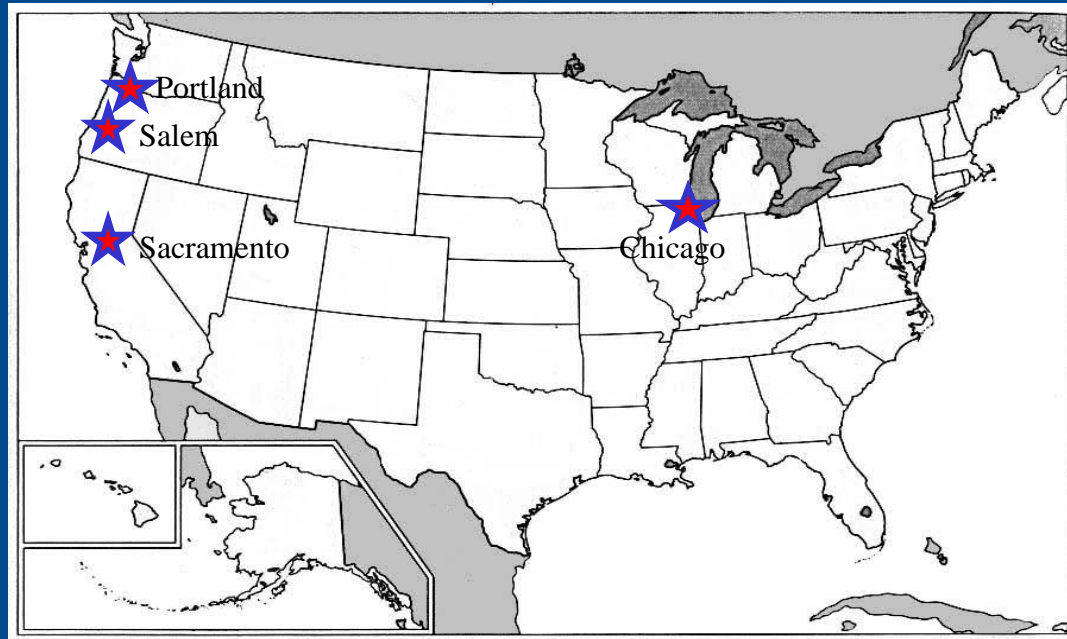
Methods- Procedures

- Research staff recorded response to 13-item validated symptom checklist
  - *usually within 15 minutes of triage*
  - *symptoms collected prospectively*
  - *measured dichotomously (yes/no)*
- Written consent after admission & stabilization in examination or hospital room
- Measures of covariates were collected in the examination or hospital room

Methods-Analyses

- Categorical data
  - X^2 test for independence
- Normally distributed continuous data
  - Means, standard deviations, & CIs
- Sensitivity & specificity
  - determined with mixed effect logistic regression
  - symptom considered to be sen./spec. if ≥60%
  - adjusted for covariates and data collection site
- Likelihood of ACS diagnosis
  - determined with mixed effect logistic regression

Results- Demographics

Characteristic	ACS n=301 (41%)	No ACS n=435 (59%)	Female n=272 (37%)	Male n=464 (63%)
Age (Mean, SD)	61.3 (12.2)*	58.6 (15.4)*	60.8 (15.2)	59.1 (13.5)
Sex (n, %)				
Female	77 (25.6)**	195 (44.8)**		
Male	224 (74.4)**	240 (55.2)**		
Race/Ethnicity (n, %)				
Black	41 (13.6)	67 (15.4)	47 (17.3)	61 (13.1)
White	213 (70.8)	306 (70.3)	191 (70.2)	328 (70.7)
Hispanic	14 (4.7)	20 (4.6)	11 (4.0)	23 (5.0)
Other	31 (10.3)	42 (9.7)	22 (8.1)	51 (11.0)
Income (n, %)				
0-<$50,000	152 (50.5)**	259 (59.5)**	162 (59.6)	259 (55.8)
≥$50,000-<100,000	62 (20.6)	65 (14.9)	43 (15.8)	84 (18.1)
≥$100,000	31 (10.3)	59 (13.6)	32 (11.8)	58 (12.5)
Missing	46 (15.3)	52 (12.0)	35 (12.9)	63 (13.6)

Note: *p<.01; **p<.001

Results- Clinical Characteristics

Characteristic	ACS n=301 (41%)	No ACS n=435 (59%)	Female n=272 (37%)	Male n=464 (63%)
Diabetes (n, %)	92 (31.8)*	102 (24.6)*	64 (24.3)	130 (29.5)
Missing	12 (4)	20 (4.6)	9 (3.3)	23 (5)
BMI (SD)				
Underweight	5 (1.7)	10 (2.3)	8 (2.9)	7 (1.5)
Normal	69 (22.9)	93 (21.4)	66 (24.3)	96 (20.7)
Overweight	116 (38.5)	135 (31.0)	90 (33.1)	161 (34.7)
Obese	98 (32.6)	164 (37.7)	92 (33.8)	170 (36.6)
Smoking Status (n, %)				
Never	142 (47.2)	235 (54.0)	161 (59.2)**	216 (46.6)**
Former	77 (25.6)	101 (23.2)	63 (23.2)	115 (24.8)
Current	69 (22.9)	79 (18.2)	40 (14.7)	108 (23.3)
Hypertension	195 (64.8)	253 (58.2)	156 (57.4)	292 (62.9)

Note: *p<.05 ; **p<.01

Symptom Differences by Diagnosis

Symptom	ACS (n = 301)	No ACS (n = 435)	p-value*
Chest pressure	64%	58%	0.104
Shoulder pain	32%	31%	0.880
Sweating	34%	31%	0.393
Palpitations	**19%**	**28%**	**0.008**
Chest discomfort	68%	66%	0.526
Upper back pain	**19%**	**29%**	**0.001**
Shortness of breath	**46%**	**60%**	**0.000**
Arm pain	35%	29%	0.097
Unusual fatigue	**34%**	**49%**	**<.0001**
Nausea	32%	35%	0.407
Lightheaded	**36%**	**46%**	**0.006**
Chest pain	**71%**	**61%**	**0.006**
Indigestion	21%	22%	0.658
Mean number of symptoms (SD)	5.10 (3.01)	5.45 (3.27)	0.136

Note: **Bolded items are statistically significant.** *Individual symptoms tested with Pearson chi-square test. Number of symptoms tested with t test.

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Results- Sensitivity and Specificity of Symptoms for an ACS Diagnosis by Sex

Symptom*	Females		Males	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Chest pressure	**66**	36	**63**	41
Shoulder pain	45	**67**	29	**72**
Sweating	37	**70**	33	**70**
Palpitations	27	**66**	17	**77**
Chest discomfort	**66**	33	**69**	34
Upper back pain	34	**64**	14	**78**
Shortness of breath	58	39	41	40
Arm pain	49	**69**	32	**72**
Unusual fatigue	40	54	32	52
Nausea	38	58	30	**70**
Lightheaded	40	55	34	58
Chest pain	**67**	37	**72**	36
Indigestion	30	**78**	18	**76**

Note: Bolded values are considered sensitive and/or specific. *Model estimated values were adjusted for data collection site.

Predictive Value of Symptoms for an ACS Diagnosis by Sex

Symptom*	Females Odds Ratios (CI)	Males Odds Ratios (CI)
Chest pressure	1.63 (0.81, 3.30)	1.34 (0.84, 2.15)
Shoulder pain	**2.53 (1.29, 4.96)**	1.11 (0.67, 1.85)
Sweating	1.81 (0.91, 3.62)	1.64 (1.00, 2.70)
Palpitations	0.97 (0.49, 1.92)	1.00 (0.56, 1.78)
Chest discomfort	1.07 (0.52, 2.23)	1.18 (0.72, 1.94)
Upper back pain	1.02 (0.52, 1.98)	0.76 (0.42, 1.38)
Shortness of breath	*1.36 (0.68, 2.70)*	**0.49 (0.30, 0.79)**
Arm pain	**2.15 (1.10, 4.20)**	1.21 (0.74, 1.99)
Unusual fatigue	0.94 (0.49, 1.80)	0.72 (0.45, 1.15)
Nausea	1.23 (0.65, 2.33)	1.02 (0.62, 1.67)
Lightheaded	1.22 (0.63, 2.38)	1.09 (0.68, 1.76)
Chest pain	1.38 (0.69, 2.74)	1.50 (0.91, 2.48)
Indigestion	1.87 (0.91, 3.83)	0.80 (0.45, 1.40)

Note: ACS is acute coronary syndrome. CI is confidence interval. *Models were adjusted for data collection site, age, obesity, diabetes, and functional status. Bolded symptoms are significant. Italicized symptoms showed an interaction effect by sex in non-stratified models ($p < 0.05$).

Strengths and Limitations

- Strengths
  - Well-powered study
  - Symptoms self-reported at presentation to ED
  - Geographic & ethnic diversity

- Limitations
  - Convenience sample enrolled between 0700 & 2300
  - Sampling bias: not all ACS & non-ACS patients enrolled
  - Study population: only patients presenting to ED
  - Limited predictive power of odds ratios

Conclusions

- There were far more similarities than differences in symptom predictors between women and men

- There was an interaction effect for sex and Shortness of breath

  - Women with SOB-30% more likely to have ACS compared to women without SOB
  - Men with SOB-1/2 as likely to have ACS compared to men without SOB

Conclusions

- Shoulder and arm pain were significant predictors of ACS for women only

- Shortness of breath, shoulder pain, and arm pain are important symptoms in determining added likelihood of an ACS diagnosis for women

Thank You

Questions/Comments?

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