Presenters

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Disclosures

Background

- Thoracic aortic dissection is one of the deadliest cardiovascular diseases encountered in the ED.

- In-hospital mortality up to 27%, even under optimal conditions.

- Difficult to diagnose and study because of the very low incidence of cases (3.5/100,000 per year) and varied clinical presentations.
  - 5,000 to 10,000 cases annually in the U.S.

- The emergency physician must walk a careful line between the significant risks of missing the diagnosis and the considerable clinical and financial burden of overtesting for this rare entity.

Clinical Policy: Critical Issues in the Evaluation and Management of Adult Patients With Suspected Acute Nontraumatic Thoracic Aortic Dissection

From the American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Thoracic Aortic
   Dissection:
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https://www.acep.org/patient-care/clinical-policies/thoracic-aortic-dissection/

ACEP Clinical Policies Framework

Translation of Classes of Evidence to Recommendation Levels

Strength of recommendations regarding each critical question were made by subcommittee members using results from strength of evidence grading, expert opinion, and consensus among subcommittee members according to the following guidelines:

Level A recommendations. Generally accepted principles for patient care that reflect a high degree of clinical certainty (ie, based on evidence from 1 or more Class of Evidence I or multiple Class of Evidence II studies).
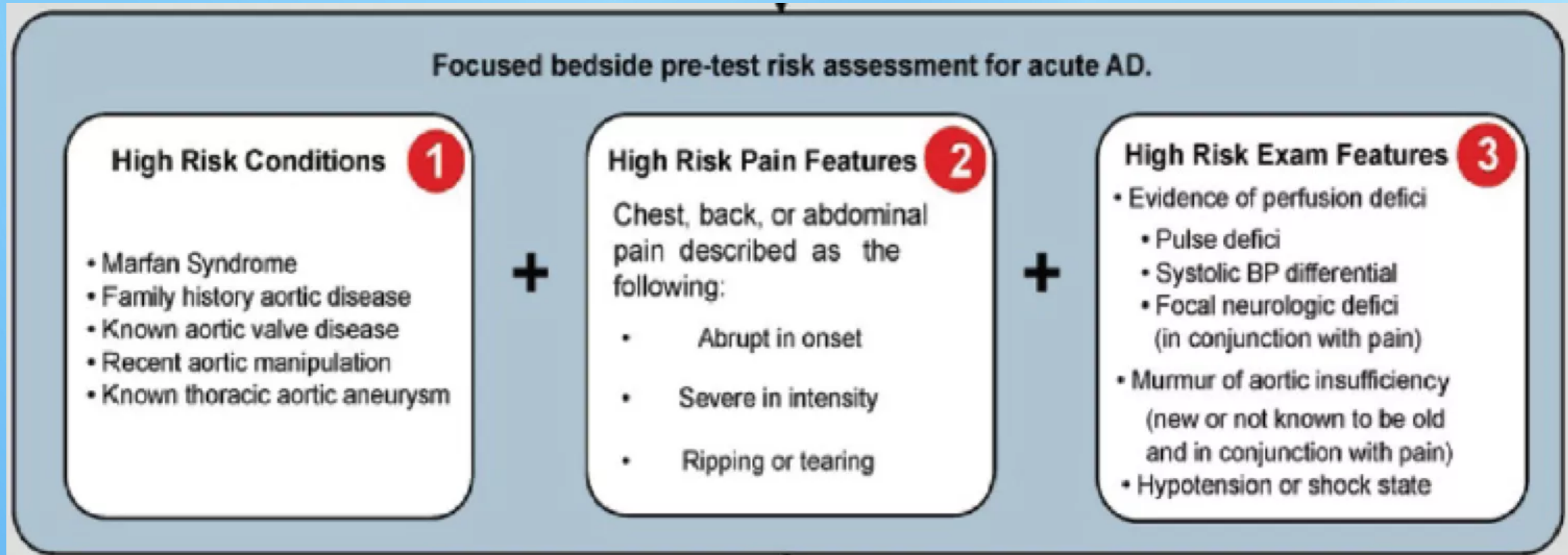
Level B recommendations. Recommendations for patient care that may identify a particular strategy or range of strategies that reflect moderate clinical certainty (ie, based on evidence from 1 or more Class of Evidence II studies or strong consensus of Class of Evidence III studies).

Level C recommendations. Recommendations for patient care that are based on evidence from Class of Evidence III studies or, in the absence of any adequate published literature, based on expert consensus. In instances where consensus recommendations are made, "consensus" is placed in parentheses at the end of the recommendation.

In adult patients with suspected acute nontraumatic thoracic aortic dissection, are there clinical decision rules that identify a group of patients at very low risk for the diagnosis of thoracic aortic dissection?

Clinical Risk Scores for TAD

- A risk assessment score (aortic dissection detection [ADD] risk score) was developed from a risk assessment tool based on a guideline published by multiple professional societies
  - Developed and tested retrospectively

Focused bedside pre-test risk assessment for acute AD.

High Risk Conditions (1)

- Marfan Syndrome
- Family history aortic disease
- Known aortic valve disease
- Recent aortic manipulation
- Known thoracic aortic aneurysm

+

High Risk Pain Features (2)

Chest, back, or abdominal pain described as the following:

- Abrupt in onset
- Severe in intensity
- Ripping or tearing

+

High Risk Exam Features (3)

- Evidence of perfusion defici
  - Pulse defici
  - Systolic BP differential
  - Focal neurologic defici (in conjunction with pain)
- Murmur of aortic insufficiency (new or not known to be old and in conjunction with pain)
- Hypotension or shock state

Score = 0 to 3. One point for each positive category

Level C Recommendation

In an attempt to identify patients at very low risk for acute nontraumatic thoracic aortic dissection, do not use existing clinical decision rules alone. The decision to pursue further workup for acute nontraumatic aortic dissection should be at the discretion of the treating physician.

In adult patients with suspected acute nontraumatic thoracic aortic dissection, is a negative serum D-dimer sufficient to identify a group of patients at very low risk for the diagnosis of thoracic aortic dissection?

D- Dimer in TAD

- 82 articles identified; 24 selected; 11 studies included.

- These studies suffer from selection bias and vary widely in the assays used to measure D-dimer. Even though the cutoff value for a positive test result, as well as the type of assays used to measure D-dimer values, varied in the studies reviewed, D-dimer was highly sensitive for diagnosing acute thoracic aortic dissection, with sensitivities ranging from 91% to 100%.

- However, given the low quality of these Class III studies, strong recommendations about the routine use of D-dimer testing alone cannot be made.

D- Dimer in TAD

- The following conditions may result in a low or false negative D-dimer value in patients with proven thoracic aortic dissection:
  - chronicity,
  - time from symptom onset,
  - presence of thrombosis or intramural hematoma,
  - short length of dissection
  - young age of patient.
- If a patient has a positive D-dimer result, the diagnosis of thoracic aortic dissection cannot be made definitively without imaging.

Level C Recommendation

In adult patients with suspected nontraumatic thoracic aortic dissection, do not rely on D-dimer alone to exclude the diagnosis of aortic dissection.

ORIGINAL RESEARCH ARTICLE

Diagnostic Accuracy of the Aortic Dissection Detection Risk Score Plus D-Dimer for Acute Aortic Syndromes

The ADvISED Prospective Multicenter Study

Key points

- ADD-RS=0/DD−
  - failure rate of 0.3% (95% CI, 0.1–1.9)
  - efficiency of 15.9% (95% CI, 14.3–17.6)

- ADD-RS ≤1/DD−
  - failure rate of 0.3% (95% CI, 0.1–1)
  - efficiency of 49.9% (95% CI, 47.7–52.2)

European Heart Journal

Acute Cardiovascular Care

ESC
European Society
of Cardiology

Original scientific paper

Accuracy of a diagnostic strategy combining aortic dissection detection risk score and D-dimer levels in patients with suspected acute aortic syndrome

Riccardo Gorla[1,2], Raimund Erbel[1], Philipp Kahlert[1], Konstantinos Tsagakis[3], Heinz Jakob[3], Amir-Abbas Mahabadi[1], Thomas Schlosser[4], Holger Eggebrecht[5], Eduardo Bossone[6] and Rolf Alexander Jánosi[1]

Key points

- ADD risk score ≥1
  - sensitivity of 98.8
  - specificity of 64.6%

- ADD risk score ≤1
  - D-dimer had a sensitivity of 93.5%
  - D-dimer specificity of 63.2%,
  - Missed rate of 1.1%.

Eur Heart J Acute Cardiovasc Care. 2017 Aug;6(5):371-378.

Academic Emergency Medicine

Official Journal of the Society for Academic Emergency Medicine

Original Contribution

What Is the Specificity of the Aortic Dissection Detection Risk Score in a Low-prevalence Population?

Robert Ohle MA, MSc, MBBCh ✉, Omar Anjum MD, Helena Bleeker MD, Sarah McIsaac MEd, MBBCh

Key points

- ADD risk markers (ADD-RS ≥ 1)
  - sensitivity of 100% (95% CI = 73.5%–100%)
  - specificity of 12.3% (95% CI = 9.1%–16.2%)
  - The negative likelihood ratio was 0
  - positive likelihood ratio was 1.14 (95% CI = 1.1–1.2)

Is the diagnostic accuracy of CTA at least equivalent to TEE or MRA to exclude the diagnosis of thoracic aortic dissection?

REVIEW ARTICLE

Diagnostic Accuracy of Transesophageal Echocardiography, Helical Computed Tomography, and Magnetic Resonance Imaging for Suspected Thoracic Aortic Dissection

Systematic Review and Meta-analysis

Toshiya Shiga, MD, PhD; Zen'ichiro Wajima, MD, PhD; Christian C. Apfel, MD, PhD;
Tetsuo Inoue, MD, PhD; Yoko Ohe, MD, PhD

Table 3. Results of Meta-analysis*

Imaging Technique	Studies Included, No.	Sensitivity	Specificity	Likelihood Ratio†		Diagnostic Odds Ratio	Moses et al[7] Model (Weighted)‡		
				Positive	Negative		a	b	P Value
TEE	10	98 (95-99)	95 (92-97)§	14.1 (6.0-33.2)§	0.04 (0.02-0.08)	6.1 (5.0-7.2)	6.2	−0.35	.45
Helical CT	3	100 (96-100)§	98 (87-99)	13.9 (4.2-46.0)	0.02 (0.01-0.11)	6.5 (4.4-8.7)	3.9	3.2	.53
MRI	7	98 (95-99)	98 (95-100)	25.3 (11.1-57.1)	0.05 (0.03-0.10)	6.8 (5.5-8.0)	6.8	0.25	.53

Radiology

Robert G. Hayter, BS
James T. Rhea, MD
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Robert A. Novelline, MD

Suspected Aortic Dissection and Other Aortic Disorders:

Multi–Detector Row CT in 373 Cases in the Emergency Setting[1]

Table 2

Accuracy of Multi–Detector Row CT in Diagnosis of Acute Aortic Dissection and Other Acute Aortic Disorders in 372 Cases

Parameter	Value*
No. of true-positive cases	67
No. of false-positive cases	0
No. of false-negative cases	1
No. of true-negative cases	304
Sensitivity (%)	99 (67/68); 95% CI: 92.1, 100
Specificity (%)	100 (304/304); 95% CI: 98.8, 100
Positive predictive value (%)	100 (67/67)
Negative predictive value (%)	99.7 (304/305)
Accuracy (%)	99.5 (371/373)

Table 3

Alternative Findings Identified with Aortic Dissection Multi–Detector Row CT Protocol

Alternative Finding	No. of Cases*
Acute cholecystitis and biliary conditions	12 (3.2)
Thoracic aortic dilatation†	7 (1.9)
Acute bowel condition	7 (1.9)
Pneumonia	6 (1.6)
Chest mass	4 (1.1)
Thromboembolic disease	3 (0.8)
Acute pancreatitic abnormality	3 (0.8)
Retroperitoneal hematoma	2 (0.5)
Acute renal abnormality	2 (0.5)
Musculoskeletal abnormality	2 (0.5)
Total no. of alternative diagnoses	48 (12.9)

Level B Recommendation

Emergency physicians may use CTA to exclude thoracic aortic dissection because it has accuracy similar to that of TEE and MRA.

In adult patients with suspected acute nontraumatic thoracic aortic dissection, does an abnormal bedside TTE establish the diagnosis of thoracic aortic dissection?

Transthoracic Echocardiography (TTE)

- The diagnosis of thoracic aortic dissection is time sensitive and is frequently complicated by hemodynamic instability, limiting the ability to send the patient for tests such as CT or MRI

- TTE can be conducted at the bedside for an unstable patient.

- As the number of emergency physicians trained to perform TTE increases, it is immediately available in an increasing number of EDs

TTE for Acute TAD Literature

- Few high-quality studies addressing this important diagnostic question in ED populations.
    - 51 studies identified, 36 selected, 6 included

- All studies suffered from some degree of spectrum bias because they enrolled a population with a higher prevalence of thoracic aortic dissection (19% to 93%) than that typically reported in ED patients being evaluated for thoracic aortic dissection.

- Many studies of TTE included TTEs that were performed after a diagnosis of thoracic aortic dissection was already established, likely inflating the sensitivity

- 4 of 6 included studies are older than 20 years, limiting the generalizability to current ultrasound technology that has since improved.

- None of the studies evaluated emergency physician–performed TTE; rather they evaluated TTE performed by echo technicians or cardiologists

TTE for Acute TAD (Class II)

- In a Class II study, Evangelista et al evaluated TTE in 143 consecutive patients, of whom:
    - 8 had immediate indications for surgery due to hemodynamic instability and TTE findings consistent with thoracic aortic dissection,
    - 7 had inadequate echocardiography windows, and
    - 128 had adequate echocardiography windows.
    - Prevalence of thoracic aortic dissection was 60% among the entire enrolled population.

- **Diagnostic test characteristics were:**
    - sensitivity 74% (95% CI 65% to 84%)
    - specificity 74% (95% CI 62% to 85%)

Evangelista A, Avegliano G, Aguilar R, et al. Impact of contrast enhanced echocardiography on the diagnostic algorithm of acute aortic dissection. Eur Heart J. 2010;31:472-479.

TTE for Acute TAD (Class III)

- In 5 Class III studies with varying prevalence of disease, TTE was reported to have:
    - sensitivity ranging from 59% to 80%
    - specificity 0% to 100%

39. Khandheria BK, Tajik AJ, Taylor CL, et al. Aortic dissection: review of value and limitations of two- dimensional echocardiography in a sixyear experience. J Am Soc Echo. 1989;2:17-24.
40. Kodolitsch Y, Krause N, Spielmann R, et al. Diagnostic potential of combined transthoracic echocardiography and x-ray computed tomography in suspected aortic dissection. Clin Cardiol. 1999;22:345-352.
41. Nienaber CA, von Kodolitsch Y, Nicolas V, et al. The diagnosis of thoracic aortic dissection by noninvasive imaging procedures. N Engl J Med. 1993;328:1-9.
42. Roudaut RP, Billes MA, Gosse P, et al. Accuracy of M-mode and twodimensional echocardiography in the diagnosis of aortic dissection: an experience with 128 cases. Clin Cardiol. 1988;11:553-562.
43. Victor MF, Mintz GS, Kotler MN, et al. Two dimensional echocardiographic diagnosis of aortic dissection. Am J Cardiol. 1981;48:1155-1159.

Level B Recommendation

In adult patients with suspected nontraumatic thoracic aortic dissection, do not rely on an abnormal bedside TTE result to definitively establish the diagnosis of thoracic aortic dissection.

Level C recommendations

In adult patients with suspected nontraumatic thoracic aortic dissection, immediate surgical consultation or transfer to a higher level of care should be considered if a TTE is suggestive of aortic dissection. (Consensus recommendation)

In adult patients with acute nontraumatic thoracic aortic dissection, does targeted heart rate and blood pressure lowering reduce morbidity or mortality?

Hemodynamics and TAD Management

- The leading cause of death in patients with an aortic dissection is not the initial intimal tear, but progressive dissection that results in rupture.

- Progression of dissection has been attributed to the pulsatile nature of blood flow. Wheat described 2 key forces that may be targeted.
  - kinetic energy of the blood flow that can be reduced if the velocity of the blood flow is reduced
  - pressure differentials throughout the aorta.
  - Based on basic science studies largely conducted in animals

- Medications that reduce heart rate and blood pressure have been recommended in the acute treatment of aortic dissection based on these principles

- In their study from 1968, Wheat and Palmer suggested lowering the systolic blood pressure to 100 mm Hg to 120 mm Hg. They inferred that the optimal blood pressure is the lowest one that maintains mentation and urine output.

- Major specialty consensus guidelines currently present therapeutic targets of a heart rate of 60 beats/min and a systolic blood pressure less than 120 mm Hg

- However, there is limited data to support specific blood pressure and heart rate targets in the acute setting. The majority of studies on hemodynamic control describe the success of therapeutic protocols that include various blood pressure and heart rates.

Literature on Hemodynamics and Acute TAD

- 55 articles were identified in the search. 37 selected for further review, with 1 study included

- In a Class III study by Kodama et al, 171 patients with a thoracic aortic dissection were followed for 27 months with 32 meeting the target heart rate control of less than 60 beats/min. Heart rate was measured at 6 AM, noon, and 6 PM every day during the acute treatment with β-blockers.

- The target heart rate was defined as an average of heart rate 3, 5, and 7 days after onset of treatment.

- In patients with tight blood pressure control, the rate of adverse events was lower in those who also met the heart rate target (odds ratio 0.25; 95% CI 0.08 to 0.77).

- Maintaining a systolic blood pressure greater than 140 mm Hg has not been independently associated with an increase in aortic size in a multivariate analysis.

- In addition, there are no prospective human studies that demonstrate preferential treatment order of lowering heart rate before the blood pressure when selecting the initiating pharmacologic agent.

Kodama K, Nishigami K, Sakamoto T, et al. Tight heart rate control reduces secondary adverse events in patients with type B acute aortic dissection. Circulation. 2008;118:S167-S170.

Level C Recommendation

In adult patients with acute nontraumatic thoracic aortic dissection, decrease blood pressure and pulse if elevated. However, there are no specific targets that have demonstrated a reduction in morbidity and mortality.

(Consensus recommendation)

Discussion & Questions

Additional References:

- **Slide #9:** Rodgers AM, Hermann LK, Booher AM, et al. Sensitivity of the aortic dissection detection risk score, a novel guideline-based tool for identification of acute aortic dissection at initial presentation: results from the international registry of acute aortic dissection. *Circulation*. 2011;123:2213-2218.

- **Slide #15:** Nazarian P, Mueller C, Soeiro AM et al. Diagnostic Accuracy of the Aortic Dissection Detection Risk Score Plus D-Dimer for Acute AorticSyndromes: The ADvISED Prospective Multicenter Study. *Circulation*. 2018;137:250-258.

- **Slide #22:** Shiga T, Wajima Z, Apfel, et al. Diagnostic accuracy of transesophageal echocardiography, helical computed tomography, and magnetic resonance imaging for suspected thoracic aortic dissection: systematic review and meta-analysis. *Arch Intern Med*. 2006;166:1350-1356.

- **Slide #23:** Shiga T, Wajima Z, Apfel, et al. Diagnostic accuracy of transesophageal echocardiography, helical computed tomography, and magnetic resonance imaging for suspected thoracic aortic dissection: systematic review and meta-analysis. *Arch Intern Med*. 2006;166:1350-1356.

- **Slide #24:** Hayter RG, Rhea JT, Small A, et al. Suspected aortic dissection and other aortic disorders: multi-detector row CT in 373 cases in the emergency setting. Radiology. 2006;238:841-852.

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