Multifaceted Approach to CT Dose Reduction for “Rule-Out Aortic Dissection”

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Background

• Acute Aortic Syndromes
  – Aortic Dissection
  – Intramural hematoma
  – Penetrating atherosclerotic ulcer
  – Aortic rupture

• Incidence reported 5-30 / 1 million per year
Acute Aortic Syndromes

• Mortality
  – 20% before hospitalization
  – 20% during hospital admission
  – 20% over the next 10 years

• Difficulty in clinical diagnosis
  – Signs and symptoms lack sensitivity and specificity for AAS
  – Correctly suspected in only 15-43% of cases

Research Background

• IRB approved retrospective review of all patients referred for evaluation of AAS within the Montefiore Medical Center enterprise from 1/1/06 – 8/1/10

• Analysis focused on clinical and radiographic parameters associated with AAS

• Models of proposed clinical algorithms suggested and performance evaluated
Research Background

• Based on retrospective data available, clinical algorithms for appropriate imaging were developed

• Performance of these proposed models was calculated
Research Background: Results

• Internal audit of CT use for indication of AAS illuminated a system wide problem:
  – Large population radiation burden
  – Multiphase CT protocol
  – Overall, low incidence of AAS in those imaged
  – Poor and inconsistent clinical predictors utilized by referring ED staff

Purpose:

• To describe a multifaceted approach to CT dose reduction for patients suspected of having AAS at a large inner-city academic medical center

• Highlight themes and aspects of these successful efforts that can be extrapolated to other clinical scenarios and other imaging settings
Goal: Successful radiation reduction

- Elimination of unnecessary scans
- Technical Modifications
- Inter-Departmental Collaboration
- Attention to Quality Improvement Processes

Methods:

- 6 key elements of this effort:
  - CT Technical parameters
  - Radiation dose archive
  - Multiphase imaging optimization
  - Unification of imaging protocol across multiple imaging sites
  - Development of clinical predictors of AAS
  - Collaboration with referring clinicians in development of powerful research database
Methods:

• Composite results of these multiple efforts evaluated
  – Overall CT radiation dose
  – Consistency of CT dose archive
  – Referral patterns and audit of appropriate indications
  – Audit of overall positive rate as surrogate for appropriateness
  – Availability of essential clinical data for research

Modification 1:
CT Technical Parameters

• Standardized voltage settings for all “CT Aortic Dissection” cases reduced to 100 kVp
Modification 2: Dose Recording

- Institution of Department wide requirement for Dose Report inclusion in PACS with each study

Modification 3: Multiphase Scanning Reduction

- Previous standard protocol included pre-contrast imaging of chest and abdomen for detection of intramural hematoma
- Standard protocol altered to pre-contrast imaging of the thorax only
Modification 4: Protocol Uniformity

• Montefiore Medical Center represents an integrated health care network of 6 hospitals and 3 full time ERs
• Medical Center has continued to expand with new hospitals and new affiliations with other local entities
• Emergency Department volume consistently within top 5 nationally

• Greater than 275,000 ED visits /year
• Greater than 48,000 CT exams / year
Modification 4: Protocol Uniformity

• Recognition of heterogeneous imaging protocols that existed across hospital enterprise

• Unified protocol with standard study name “CT Aortic Dissection”

Modification 5: Referring Physician Collaboration

• Research and audit using an interdisciplinary approach with active involvement of our primary referral base, ED physicians

• Development and publication of clinical algorithm based on retrospective data

• Collaborative initiative yielded a focused effort on optimizing patient selection
Modification 6: Prospective Data Accrual

- Order Entry for new imaging study allowed for *a priori* development of unique interface to require all relevant research data to be entered prospectively.

- Effective tool for prospective research reliant on clinical records and for validation of proposed clinical algorithm.
Results:

- 6 months of data accrual (8/13-1/14) – 192 cases of “CT Aortic Dissection” performed

- Comparison made to published institutional data which predated this multifaceted approach

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Study Population</th>
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</thead>
<tbody>
<tr>
<td>Cases (N=)</td>
<td>1465</td>
<td>192</td>
</tr>
<tr>
<td>Mean Effective Dose</td>
<td>43 ± 20 mSv</td>
<td>13 ± 6 mSv</td>
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<tr>
<td>Incidence rate</td>
<td>2.7 %</td>
<td>4.3 %</td>
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<tr>
<td>Dose Recorded</td>
<td>61%</td>
<td>100%</td>
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</tbody>
</table>
Results:

Goal: Successful radiation reduction

- Elimination of unnecessary scans
- Inter-Departmental Collaboration
- Attention to Quality Improvement Processes
- Technical Modifications

• Optimized voltage
• Limitation of multiphase acquisition

• Resulted in **70% reduction in Effective Dose**
Elimination of unnecessary scans

- Trend to increased incidence in the imaged population implies more appropriate patient selection
- Elimination of pre-contrast abdominal imaging

Goal: Successful radiation reduction

Technical Modifications

Inter-Departmental Collaboration

Attention to Quality Improvement Processes

- Standardized technique across large enterprise
- Consistent archive of radiation dose
- Uniform exam title allows for easy and focused audit
Goal:
Successful radiation reduction

- Development of clinical algorithm
- Assist in implementation of optimization techniques
- Elimination of unnecessary scans
- Attention to Quality Improvement Processes
- Technical Modifications
- Inter-Departmental Collaboration
- Development of clinical algorithm
- Assist in implementation of optimization techniques
- Builds rapport and respect for colleagues across multiple specialties
- Collaborative research opportunities

Discussion I:

- Complexity contributes to many challenges in the Radiology community
- Solutions must address various components that contribute to practice optimization
Discussion II:

• Often, the solutions to these complex challenges require alterations both in radiology practice and clinical interactions

• Involvement of clinical services facilitates effective problem solving, increases the likelihood of successful implementation and contributes to robust clinical research

Discussion III:

• The Radiology community serves a crucial role in stewardship in Quality Assurance measures and leading interdisciplinary problem solving
References


Thank You

Goal: Successful radiation reduction