Implementation of Quality Assurance for CTA PE Interpretation Utilizing Artificial Intelligence Monitoring to Avoid Missed Diagnosis of Acute Pulmonary Embolism

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Purpose

Background

• Artificial Intelligence (AI) is becoming more common in radiology, aiding in early detection and potentially improving accuracy and patient care

• Studies report radiologist error rates up to 4%, varying by sample size, modality, patient group, and skill-set of radiologists

• In one study, retrospective application of AI identified 77% missed pulmonary embolism cases by radiologists*

Purpose

Opportunity for Improvement

**BASELINE**

At our institution AI is utilized for detection of acute pulmonary embolism (PE), notifying radiologists via a desktop widget when PE is identified by the AI algorithm.

Retrospective application of the AI tool to 912 CTA PE studies (2 months) identified 20 missed PE of 103 studies positive for PE.

Few anecdotal instances of missed PE cases noted due to radiologists overlooking AI widget notifications.

At least once, a discordant result went undetected for over 2 weeks.

No established quality assurance (QA) process to ensure review of notification or concordance.

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**Intervention**

Implement a systemic QA process to maximize utility of the AI tool.

- Check for concordance with radiologist’s report
- Check accuracy of AI interpretation
- Ensure appropriate follow up for discordant /missed cases
Methods

Establishing QA Process

• Team of QA radiologists and PACS administrators established
• PACS administrators screened all cases positive by AI interpretation for discrepant radiologists’ reports
• QA radiologists determined if a PE was potentially missed
• If missed PE suspected by QA radiologist, study was referred back to the interpreting radiologist
• If interpreting radiologists agreed that study was positive for PE, addendum of report was issued and referring provider informed as necessary
• Key outcome was number of overlooked PE
Methods

QA Workflow

- QA period from Dec. 2019 through Mar. 2020
Results

Discordant Studies Identified

335
Cases Flagged Positive by AI

115
Discordant Cases

220
Concordant Cases

18 Cases Positive for PE on 2\textsuperscript{nd} Review
Results

PE Detection

• Of 335 cases flagged by AI as positive, 238 cases deemed truly positive for PE for a PPV of 71 %

• 220 cases correctly identified as positive for PE by initial radiologists interpretation
  • 18 cases positive for PE overlooked on initial interpretation

• 8.2 % improved PE detection rate with use of AI and QA process
Results

Overlooked Cases

• 18 cases overlooked despite correct AI identification
  • 13 cases caused by human error (did not see notification)
  • 5 cases caused by technical error (notification not received or received late after initial interpretation)

• All 18 cases reviewed by the QA team and communicated to referring providers within 12 hours
  • 17 received anticoagulation subsequently
  • 1 lost to follow up
  • No adverse outcomes reported
Results

Overlooked Cases: Study Type and PE Locations

### Study Type

- **CTA PE**: 13
- **CT CAP**: 3
- **CT Aorta**: 1
- **CT Abd**: 1

5 Overlooked Incidental PE

### PE Location

- **Subsegmental**: 11
- **Segmental**: 6
- **Lobar**: 1
Conclusions

• AI assistance with QA process improved detection of acute PE with downstream changes in patient treatment

• Key factors for AI success:
  • Having “local champions” advocating for AI
  • Radiologists’ interest in new technology and potential added value of AI
  • Departmental culture of innovation

• Key hindering factors for AI success:
  • Inconsistent AI performance
  • Large variance in acceptance and engagement by radiologists

• Path forward includes collaboration with AI developers to build automated mechanism to identify discordant cases in real time, increasing acceptance of AI by demonstrating clinical value, and continued QA processes monitoring for discrepant cases