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Selected Topics: Emergency Radiology

EMERGENCY DEPARTMENT EXTREMITY RADIOGRAPHS IN THE SETTING OF PAIN WITHOUT TRAUMA: ARE THEY WORTH THE PAIN?

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□ **Abstract—Background: Few data exist that correlate acute radiographic findings of extremity imaging with patients' complaints in the acute care setting. Objective: We hypothesize that plain radiographs performed for a complaint of pain in the absence of trauma or signs and symptoms of infection are of low yield. Methods: We retrospectively analyzed the imaging and charts of 1331 patients who presented to our emergency department (ED) and received extremity radiographs with complaints related to limb trauma, infection, and pain alone. Imaging and outcomes of cases interpreted as positive for acute pathology and those interpreted as indeterminate were analyzed using Fisher's exact tests to evaluate the value of extremity radiographs in the setting of isolated limb pain. Results: Of the patients analyzed, 935 presented with trauma, 234 presented with nontraumatic pain, and 161 presented with signs or symptoms of infection. The rate of definitively positive cases was 30.6% for trauma, 20.6% for infection, and 1.3% for pain. When indeterminate cases were included in the analysis, the rate of acutely positive cases rose to 33.4% for trauma, 28.0% for infection, and 3.0% for pain. Among the three definitively positive pain cases, all three were fractures, none of which resulted in emergent surgery or orthopedic consults. Among the four indeterminately positive pain cases, three proved to be false positives. Conclusions: Our data suggest that ED imaging of patients presenting with nontraumatic pain is of extremely low yield, resulting in few acute positive findings that require immediate attention in the ED.** © 2015 Elsevier Inc.

□ **Keywords—emergency radiology; imaging; fracture; extremity**

INTRODUCTION

There are numerous well-established clinical prediction rules about the positive predictive value of imaging in the setting of musculoskeletal trauma and soft tissue infections (1–8). Other studies have evaluated the role of emergency department (ED) radiographic studies for nontraumatic chest and abdominal complaints (9,10). To our knowledge, no study has examined the relationship between patients' complaints and the likelihood of a positive plain radiographic extremity study in an ED setting.

Determining the relationship between complaint and the probability of an acute imaging finding is important for several reasons. First, if a given complaint has a low likelihood of yielding a positive imaging study, then it may be justifiable to forgo the imaging study in the acute setting, sparing both expense and exposure to ionizing radiation. Second, forgoing imaging studies with a low yield can be a means of facilitating improved patient throughput in an ED. Third, identifying complaints with a low probability of imaging findings further defines the pretest probability in these patients and the likely validity of a positive interpretation.

Therefore, we designed a study to examine a potential relationship between patients with musculoskeletal complaints and acutely positive radiographic findings in the acute care setting. We hypothesized that the yield of acute radiographic findings would be much lower when

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obtained for a complaint of isolated pain as compared to those obtained in the setting of trauma or signs/symptoms of infection.

METHODS

We retrospectively examined clinical charts and extremity radiographs performed on patients in our Level I ED between July and October of 2011 (n = 1331). Ours is an academic hospital setting where all studies were ordered by resident and attending physicians; no nursing or triage protocol studies were performed.

Two physicians reviewed images and radiographic reports, comparing these with the histories provided on the imaging request form and the histories documented by the ED physician in the electronic medical record at the time of examination. If there was discordance between the histories provided, the study was categorized according to the history documented by the emergency physician in the electronic medical record. The reviewers accepted the documentation in the records as correct and made no changes. Further, the information contained in the charts was assumed to be complete. The physician reviewers were not blinded to the study protocol, as they were required to flag studies where the history on the request form differed from that documented by the ED physician in the electronic medical record.

Extremity radiographs requested for an indication of trauma, suspected infection, and those requested for nontraumatic limb pain without signs/symptoms of infection, were evaluated for acute findings. Many patients (n = 401) had more than one musculoskeletal study during their ED visit. In these cases, if any one of the studies showed an acute abnormality, the patient was counted as among the patients with acute positive findings. Only if all of the patient's studies showed no acute abnormality, were they counted as negative. For example, if a patient had both a foot and an ankle study, both would have to show no acute finding for the patient to be considered as not having an acute abnormality. This ensured that each patient encounter was represented only once within the study, regardless of the number of extremity radiographs obtained. The radiographic findings were those reported by the original interpreting radiologist and not changed by the chart reviewers.

Acute findings for trauma radiographs were prospectively defined as acute fractures, dislocations, joint/ligamentous injuries, newly broken orthopedic hardware, and previously undocumented foreign bodies. Acute findings for the infection category included radiographic findings consistent with acute osteomyelitis; infected orthopedic hardware, for example, increasing lucency around a prosthesis; non-trauma-related soft tissue gas; and focal soft tissue abnormalities that might represent abscess. In the pain category, acute findings included any and all of the aforementioned findings.

Radiographs were occasionally interpreted as indeterminate for acute findings, for example "cannot rule out osteomyelitis" or "cannot rule out fracture." Because of these indeterminate studies, we analyzed the three cohorts of trauma, infection, and pain in two ways. First, we excluded the indeterminate cases and compared the findings of only the radiographically definitive cases for each category. We subsequently repeated the analysis, including all indeterminate cases in their respective positive groups according to complaint.

Cohorts were compared via Fisher's exact test and 95% confidence intervals (CIs) for observed rates, and proportions were calculated according to the method of Fleiss (11). Differences in observed rates were compared using two-tailed Fisher's exact tests. All analyses were carried out using SAS software, version 9.2 (SAS Institute Inc., Cary, NC).

Examinations that were interpreted by the initial radiologist as either acutely positive or indeterminate, that is, potentially acutely positive, were defined as false positive if the finding yielded no change in emergent management or a subsequent study showed no abnormality. Similarly, radiographs that were interpreted as positive by the radiologist and were concordant with subsequent ED management were called true positive. Negative radiographic examinations were not categorized because the intent of the study was to calculate the yield of positive radiographs relative to a clinical presentation, and long-term management to determine true negatives and false negatives was not available on all patients.

RESULTS

Of the 1331 patient encounters analyzed, 935 complained of trauma, 234 complained of pain alone, and 161 complained of signs and symptoms potentially indicating infection, for example, painful swelling, focal inflammation, or ulcers. Of all the patients reviewed, only one had a history or findings compatible with neoplasm. Because of this, neoplasm was not analyzed as a category, and this patient was excluded. Therefore, 1330 patients were included in the final analysis. The study population was split into three cohorts according to the physicians' recorded complaint: trauma, infection, and pain in the absence of trauma or signs/symptoms of infection. One hundred and seven cases were originally labeled with an indication of pain on the imaging request form, but were subsequently reclassified as trauma when review of ED records revealed the physician's history recorded trauma as the complaint and reason for obtaining the examination. No cases were reclassified as infection after review of the charted histories.