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Differences between orthopaedic evaluation and radiological reports of conventional radiographs in patients with minor trauma admitted to the emergency department

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ABSTRACT

Introduction: During night and on weekends, in our emergency department there is no radiologist on duty or on call: thus, X-ray examinations (XR) are evaluated by the orthopaedic surgeon on duty and reported the following morning/monday by radiologists. The aim of our study was to examine the discrepancy rate between orthopaedists and radiologists in the interpretation of imaging examinations performed on patients in our tertiary level orthopaedic institution and the consequences of delayed diagnosis in terms of patient management and therapeutic strategy.

Materials and methods: We retrospectively reviewed all cases of discrepancy between orthopaedists and radiologists, which were categorized according to anatomical location of injury, initial diagnosis and treatment, change in diagnosis and treatment. We used the Chi square test to compare the frequencies of discrepancies between patients ≤ 14 and > 14 years of age.

Results: From January to December 2016, 19,512 patients admitted to our emergency department performed at least an imaging examination; among these patients, 13,561 underwent XR in absence of an attending radiologist. A discrepant diagnosis was found in 337/13,561 (2.5%; 184 males; mean age: 36.7 ± 23.7 , range 2–95); 151/337 (45%) discrepancies were encountered in the lower limbs, with ankle being the most common site of misdiagnosis (64/151), and 103/337 (30%) in the upper limbs, with the elbow being the most frequent site in this district (35/103). We found 293/337 false negatives (87%) and 44/337 false positives (13%), with 134 and 13 patients needing treatment change, respectively. We found 85/337 discrepancies (25%) in patients ≤ 14 years of age, and 252/337 (75%) in those > 14 years. The distribution of discrepancies per anatomic district was significantly different ($P < 0.001$) in these two groups of patients.

Conclusions: A low rate of discrepancy between orthopaedists and radiologists in evaluating images of patients admitted to our emergency department was found, although treatment change occurred in about half of cases. A thorough and accurate clinical evaluation is crucial to provide a correct treatment and prognosis.

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1 Introduction

Clinical practice in the emergency department may be challenging for attending physicians. The need for rapid diagnosis, the unavoidable lower cooperation of patients compared to the ordinary work, and excessive pressure and strains, may easily lead to diagnostic errors [1]. Moreover, radiologists may not be easily accessible in this setting after normal daytime work [2]. Indeed, in

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some orthopaedic centres, all plain films performed at night in the emergency department are read by the on-duty orthopaedist and then reported by the attending radiologist the next morning. Nevertheless, images interpretation by orthopaedist with no support of radiologist may be challenging for several reasons: (i) anatomical location and type of fracture (scaphoid, calcaneus, radial head, etc.); (ii) inadequate imaging projections; (iii) patient non-compliance because of pain or some level of unconsciousness; (iv) insufficient clinical information; (v) multiple injuries; (vi) different level of experience of physicians. Although patients can be recalled for new clinical evaluation or further imaging examinations in case of discrepancy in images interpretation, this may result in delayed treatment, less favourable clinical outcome, higher costs (more visits, missed time at work, etc) and economic claims [3,4].

Most studies dealing with missed injuries in trauma patients have analysed factors promoting the misdiagnosis [5], whereas only few have focused on how clinical management is affected or on consequences of delayed diagnosis [6]. Moreover, it has not been well investigated the frequency of missed fractures and the outcome of diagnostic errors in emergency departments in which images interpretation does not involve radiologists.

The aim of our study was to examine the discrepancy rate between orthopaedists and radiologists in the interpretation of imaging examinations performed on patients in our tertiary level orthopaedic institution and the consequences of delayed diagnosis in terms of patient management and therapeutic strategy.

2 Materials and methods

2.1 Study design

This retrospective study was approved by our Ethical Committee (Ospedale San Raffaele, Milano, Italy) and patients' informed consent was waived. This study has been conducted according to the principles expressed in the Declaration of Helsinki.

Our institution provides tertiary level orthopaedic care with a hardworking emergency department specialized in minor traumatology. Indeed, no polytrauma patient is received due to the presence of a dedicated general hospital nearby. At our emergency department, a fully qualified orthopaedist with 3–30 years' experience in traumatology is always present and supported by junior and senior residents seven days a week, 24 h a day. The emergency department is also staffed by an attending radiologist with 1–25 years' experience in musculoskeletal imaging who is present five days a week and provides a 12-h daily service. Indeed, at night and on weekend days no radiologists' coverage is provided, then plain films performed at emergency department are read by attending orthopaedic physicians, according to local regulations. Images are then stored and reported the following morning/monday by the attending radiologist, who has 1 to 25 years' experience in musculoskeletal radiology.

Each time image interpretation is not confirmed by the radiologist, a form is filled in accordance with the orthopaedist on duty, in order to discuss the different diagnosis, and patient's name is saved in a discrepancy register. Consequently, patients can be recalled for a new clinical evaluation, further imaging examinations if needed, and change therapeutic strategy if necessary.

Further imaging examination or follow-up were considered as the reference standard to confirm the final diagnosis.

We included in our study all those cases listed in our emergency department discrepancy register during the year 2016 as a result of a misdiagnosis achieved by the orthopaedist in absence of attending radiologist. Discrepancies were systematically

categorized according to the anatomical location of injury, initial diagnosis and treatment, change in diagnosis and treatment.

The site of injury was categorized as skull, spine, clavicle, sternum and ribs, shoulder, elbow, forearm, wrist, hand, pelvis, hip, femur, knee, leg, ankle, midfoot, forefoot, or fingers. All patients received a discharge diagnosis categorized by orthopaedists as non-traumatic pain (pain without reported trauma), contusion, sprain, dislocation, and fracture (a comprehensive category, including infractions, greenstick/torus fractures, salter-harris fractures, etc). Treatment was categorized as conservative (rest, non-steroidal anti-inflammatory drugs, ice, etc.), mild immobilization (bandaging), stiff immobilization (splint pinstripe), or surgery.

A radiology resident with five years' experience in musculoskeletal radiology reviewed the discrepancy register and divided the cases as follows: (i) false negatives related to missed fractures, including cases wrongly interpreted as negative, those with overlooked collateral traumatic findings in correctly detected fracture framework, or even fractures more severe than initially deemed by the orthopaedist; (ii) false positives, including those cases considered positive for fracture by the orthopaedists and reported later as negative by the radiologist.

A subgroup analysis was also performed in patients ≤ 14 and > 14 years of age.

Finally, we asked our legal office to provide data regarding compensation requests related to the patients included in our analysis received up to mid August 2017.

2.2 Statistical analysis

We used the Chi square test to compare the frequencies of discrepancies between patients ≤ 14 and > 14 years of age. The SPSS software (version 24, IBM, Armonk, NY) was used. A P-value lower than 0.05 was considered as statistically significant.

3 Results

From January to December 2016, 24,860 patients were admitted to the triage of our emergency department. Of them, 405 left the hospital before being visited.

Among the remaining 23,455 patients who underwent thorough clinical evaluation, 19,512 patients (83.2%) performed at least an imaging examination: 19,337 underwent X-ray examinations (XR), 347 computed tomography, 130 magnetic resonance imaging. Among these patients, 13,561 (70.1%) underwent XR in absence of an attending radiologist, while the remaining 5951 (29.9%) underwent XR, which was interpreted by a radiologist during the day hours.

Out of 13,561 patients who were admitted at our emergency department and had a XR read by the attending orthopaedist in absence of radiologist, a discrepant diagnosis was found in 337 of them (2.5%; 184 males, 153 females; mean age: 36.7 ± 23.7 years, range 2–95).

Discrepancies were mainly encountered in the lower limbs, with 151/337 (45%) cases. Among them, ankle was the most common site of discrepancy (64/151, 42% in the lower limb; 64/337, 19% overall). Discrepancies in the upper limbs were found in 103/337 cases (30%), with the elbow being the most frequent site of misdiagnosis in 35 cases (35/103, 34% in the upper limb; 35/337, 10% overall) of images misinterpretation.

Among the discrepant cases, we found 293/337 false negatives (87%) with missed fractures and 44/337 false positives (13%) with initial wrong diagnosis of fracture refuted by the radiologist. As a consequence, changes in treatment strategy occurred in 147 patients, mostly related to lost traumatic injuries needing proper treatment.

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