Hip effusions or iliopsoas hematomas on ultrasound in identifying hip fractures in the emergency department

Objective:

We evaluated the sensitivity, specificity, predictive values, and likelihood ratios of hip effusion and/or iliopsoas hematoma on point-of-care ultrasound (POCUS) performed by ultrasound fellows and fellowship trained emergency providers to identify hip fractures in emergency department (ED) patients with a high suspicion of hip fracture.

Introduction

Hip pain is a common chief complaint in the emergency department (ED). In the United States, more than 250,000 hip fractures are diagnosed annually with that number projected to increase exponentially over the next 20 years [[1], [2], [3]]. The majority of hip fractures occur in the elderly population

Accurate and early diagnosis of an acute fractures is essential as delays in identification are associated with increased morbidity and mortality [[6], [7], [8]]. Currently, x-ray is the initial imaging modality for evaluation of suspected fracture; however, prior studies have shown its diagnostic limitations with both false negative and positive reports [9,10]. Additionally, reports indicate that approximately up to 10% of patients with hip fractures have normal x-rays [9,11,12]. In patients with high clinical suspicion for fracture, further diagnostic imaging, including computed tomography (CT) scan and/or magnetic resonance imaging (MRI), is often necessary for a timely diagnosis.

CT scans expose patients to radiation and MRI may increase patient's length of ED stay and lead to unnecessary hospital admission.

There is no radiation exposure associated with ultrasound and POCUS can be performed in the ED at the bedside. Therefore, evaluating the utility of POCUS in the ED setting to identify hip fracture is important.

The goal **of this study was to evaluate the test characteristics, including sensitivity, specificity, predictive values, and likelihood ratios of hip effusions and/or iliopsoas hematoma seen on POCUS in the diagnosis of acute hip fracture compared with either x-ray, CT scan, or MRI among ED patients with a suspected hip fracture**

Methods

This was a prospective observational study of a convenience sample of patients with high suspicion of hip fracture at two academic EDs between *2018 and 2021*.

Patients with negative x-rays who did not receive further imaging with magnetic resonance imaging (MRI) or computed tomography (CT) were excluded.

Sonographers were blinded to clinical data and ED imaging results. At the primary site, 8 ultrasound fellows and 4 emergency ultrasound fellowship-trained emergency providers performed the ultrasonographic examinations. At the secondary site, 2 ultrasound fellows, 4 emergency ultrasound-fellowship trained physicians, and 1 sports medicine fellowship-trained emergency provider performed the ultrasonographic examinations.

A positive ultrasound was defined as either the presence of a hip effusion or iliopsoas hematoma on the affected extremity.

The primary outcome measures were sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (LR+), and negative likelihood ratio (LR-) of POCUS findings for identification of a hip fracture compared with a ranked composite reference standard consisting of x-ray, CT, or magnetic resonance imaging (MRI); the highest-level test performed for each patient was used for comparison.

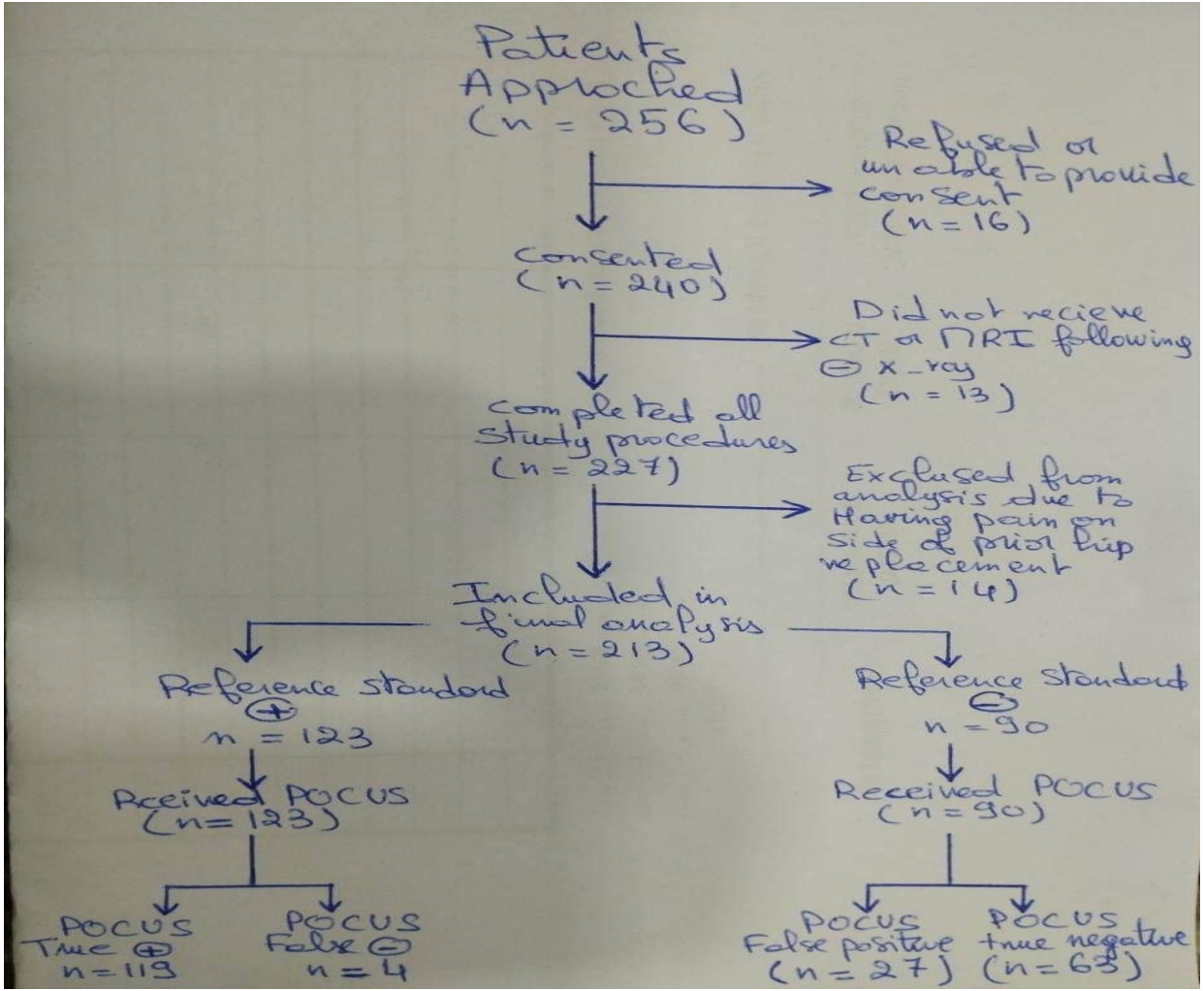
Patients Approached (n = 256)
Refused or unable to provide consent (n = 16)
Consented (n = 240)
Did not recieve CT or MRI following ⊖ X-ray (n = 13)
completed all study procedures (n = 227)
Excluded from analysis due to Having pain on side of prior hip replacement (n = 14)
Included in final analysis (n = 213)
Reference standard ⊕ n = 123
Reference standard ⊖ n = 90
Received POCUS (n = 123)
Received POCUS (n = 90)
POCUS True ⊕ n = 119
POCUS False ⊖ n = 4
POCUS False positive (n = 27)
POCUS true negative (n = 63)

Table 2
Imaging results by modality compared with ultrasound results.

Imaging modality	Ultrasound ($n = 213$)	
X-ray (n = 213)	Positive ($n = 146$)	Negative ($n = 67$)
Positive ($n = 113$)	108 (74.0%)	5 (7.5%)
Negative ($n = 100$)	38 (26.0%)	62 (92.5%)
CT ($n = 116$)	Positive ($n = 60$)	Negative ($n = 56$)
Positive ($n = 35$)	34 (56.7%)	1 (1.8%)
Negative ($n = 81$)	26 (43.3%)	55 (98.2%)
MRI ($n = 14$)	Positive (n = 10)	Negative ($n = 4$)
Positive ($n = 7$)	7 (70.0%)	0 (0.0%)
Negative (n = 7)	3 (30.0%)	4 (100.0%)

CT: computed tomography; MRI: magnetic resonance imaging.

Results

Among 213 patients analyzed, all 213 received an x-ray, 116 received a CT scan, and 14 received an MRI; 113/213 x-rays (53.1%), 35/116 CT scans (30.2%), and 7/14 MRIs (50.0%) were positive for a hip fracture. A total of 123 patients were diagnosed with a hip fracture (57.7%). There were 13 false negative x-ray results. Overall, compared with the reference standard of x-ray, CT, or MRI, POCUS had a sensitivity of 97% (95% CI: 94%, 100%), specificity of 70% (95% CI: 61%, 79%), PPV of 82% (95% CI: 75%, 88%), and NPV of 94% (95% CI: 88%, 100%) in the identification of hip fractures; with a positive likelihood ratio of 3.22 (95% CI: 2.35, 4.43) and negative likelihood ratio of 0.05 (95% CI: 0.02, 0.12)

Conclusion

In a convenience sample of ED patients with high clinical suspicion for hip fracture, the presence of a hip effusion and/or iliopsoas hematoma on POCUS performed by expert emergency ultrasonographers showed high sensitivity in diagnosing patients with a hip fracture.