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SHORT COMMUNICATION

Performance of ultrasounds compared with radiographs to detect chronic enthesitis signs in patients with ankylosing spondylitis

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Abstract To assess the performance of ultrasound in detecting erosion, swelling, and new bone comparing to radiographs in five lower limb entheses in patients with ankylosing spondylitis (AS). Prospective study of 60 patients meeting modified New York criteria for AS. Lateral radiographs of both knees and ankles followed by a high-resolution Doppler ultrasound examination with a high-frequency (15 MHz) linear probe were performed. Ultrasound had an excellent sensitivity, but specificity was very weak compared to radiographs for erosion, swelling, and new bone formation. Negative and positive predictive values were good only for erosion. Ultrasound seems to be a performant instrument in detecting signs of chronic enthesitis particularly when radiograph is normal.

Keywords Ankylosing spondylitis · Radiographs · Ultrasound · Sensitivity · Specificity

Background

The demonstration of enthesitis is crucial both to the diagnosis of ankylosing spondylitis (AS) and to the evaluation of disease activity [1]. Clinical examination is often insufficient in detecting enthesitis [2, 3]. Radiographs remain the imaging procedure of reference in detecting enthesitis erosion and new bone. Many recent studies have established the usefulness of ultrasound (US) for the diagnosis of enthesitis, mainly by detecting signs of acute enthesitis such as peritendinous edema, hypoechogenicity, and Doppler hyperemia. However, US performance in detecting chronic enthesitis signs has not been evaluated [4, 5].

The objectives of our study were to assess the performance of ultrasound in detecting erosion, swelling, and new bone comparing to radiographs in five lower limb entheses.

Patients and methods

We prospectively studied 60 consecutive patients meeting modified New York criteria for AS [6] and seen at the rheumatology department of the M. Kassab Institute in Manouba, Tunisia. We excluded patients having a history of knee or ankle surgery, local corticosteroid injection at the study sites within 6 weeks before the sonographic evaluation, or lower limb neuropathy.

The following entheses were assessed using lateral radiographs of both knees and ankles followed by a high-resolution Doppler ultrasound examination: patellar insertion of the quadriceps tendon, proximal and distal insertions of the patellar tendon, calcaneal insertions of the Achilles tendon and plantar fascia. A Philips HD11^{TM} machine was used, with a high-frequency (15 MHz) linear probe at all sites except the superficial plantar fascia, whose deeper location required a 4- to 8-MHz linear probe. The sonographer was a radiologist specialized in musculoskeletal imaging who was unaware of the radiographic data. Criteria for chronic enthesitis (erosion, swelling, and new bone formation) were assessed by both radiographs and ultrasound in each entheses. For swelling, we used

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normal thickness average established by Glasgow Ultrasound Enthesitis Scoring (GUESS) (quadricipital: 6.1 mm; Patellar, proximal: 4 mm; Patellar, distal: 4 mm; Achilles tendon: 5.3 mm; Plantar fascia: 4.4 mm) [7].

Results

60 patients were included in this study, 48 (80%) men and 12 women with a mean age of 36 ± 11 years (range 20–74 years) and a mean disease duration of 8.8 years (range 0.5–25 years). Table 1 shows the distribution of radiographic and ultrasonographic criteria across the 120 entheseal sites; and Table 2 shows US performance assessed by measurement of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) in detecting erosion, swelling, and new bone in enthesitis compared with radiographs.

Swelling in quadricipital entheses and erosion in Achilles tendon entheses were the most frequent radiographic signs whereas erosion in Achilles tendon entheses and new bone in quadricipital entheses were the most frequent US signs observed in our study. If we combine the five entheses sites for erosion, swelling, and new bone formation, ultrasound had an excellent sensitivity, but specificity was very weak compared to radiographs. Negative and positive predictive values were good only for erosion. If we analyze the entheses sites separately, sensitivity, specificity, and NPV of ultrasound were excellent in detecting new bone in quadricipital entheses and specificity was very good in detecting swelling. In patellar proximal entheses, NPV was excellent for erosion and new bone, sensitivity was very good for new bone, and specificity was very good for erosion. In patellar distal entheses, NPV was excellent for swelling and new bone, sensitivity was good for erosion, and specificity was good for new bone. In Achilles tendon, sensitivity was good for erosion and new bone, specificity was good for swelling, NPV was very good for swelling and new bone, and PPV was good for erosion. Finally in plantar fascia, sensitivity was good for swelling and NPV was good for swelling and new bone.

Discussion

Several recent studies proved that high-resolution Doppler ultrasound was useful in the detection of acute enthesitis in patients having normal radiographs and even asymptomatic enthesitis [4, 5, 8–11]. Otherwise, radiographs are still widely used as the first-line investigation for diagnosing chronic enthesitis [9, 10, 12]. In this field, the performance of ultrasound comparing to radiographs has not been investigated and its diagnosis value in chronic enthesitis is still unknown. Our study shows that high-resolution ultrasound has an excellent sensitivity but weak specificity in detecting erosion, swelling, and new bone. The important proportion of false positives can explain this lack of specificity since ultrasound detects much more signs of chronic enthesitis than radiographs. For instance, thin calcification can be undetected by radiographs [9, 13], and erosions can be masked by calcifications [13]. Multiplanar US approach can improve the visibility of erosions when these are associated with new bone [4, 10, 11]. Some difficulty can be encountered in swelling evaluation; in fact, tendon and entheses thickness are not standardized and this may induce measurement bias if we try to compare results of different studies together [12]. In our study, ultrasound seems to have acceptable PPV and NPV in detecting entheses swelling.

If we analyze the entheses sites separately, heel and quadricipital entheses were previously studied [14, 15] but performance of ultrasound comparing to radiographs has not been investigated. Kamel et al. found that US images of heel enthesitis showed irregular fusiform thickening and calcifications in 84.3% of cases while radiographs were normal. Otherwise, ultrasound seems to be more performant than MRI in detecting early and even late changes of enthesopathy [15] and was not able to detect any calcification process at the insertion site [15].

Conclusion

In conclusion, ultrasound seems to be a performant instrument in detecting signs of chronic enthesitis

Table 1 Distribution of radiographic and sonographic criteria across 120 entheseal sites in 60 patients with ankylosing spondylitis

Criterion		Quadricipital (%)	Patellar, proximal (%)	Patellar, distal (%)	Achilles tendon (%)	Plantar fascia (%)	Any site (%)
Radiographic criteria	Erosion	5.8	3.3	15	38.3	1.6	21
	Swelling	43.3	15	5.8	15	12.5	18.3
	New bone	9.1	1.6	4.1	22.5	20.8	11.6
Sonographic criteria	Erosion	75	59	89	95.8	15	98
	Swelling	48	63	65	20	30	96
	New bone	93	84	69	83	75.8	100

Table 2 Performance of ultrasounds in detecting erosion, swelling, and new bone in enthesitis comparing with radiographs in patients with ankylosing spondylitis

		Sensitivity	Specificity (%)	PPV (%)	NPV (%)
Quadricipital	Erosion	9.1	84	25.23	61.5
	Swelling	36.5	88.3	70.37	35.48
	New bone	91.5	96	12	96.87
Patellar, proximal	Erosion	20	88	7.14	96.22
	Swelling	55	21	11.11	73.33
	New bone	88	52	35.29	94.23
Patellar, distal	Erosion	76	41	25.3	41.05
	Swelling	50	32	5	90
	New bone	40	77	7.14	96.73
Achilles tendon	Erosion	86	28	71.4	50
	Swelling	35	70.87	16.6	86.29
	New bone	88.88	52	35.29	94.23
Plantar fascia	Erosion	–	–	–	–
	Swelling	74.4	33.33	17.64	73.33
	New bone	52	66.31	28.8	84
Any site	Erosion	100	20	93.22	100
	Swelling	95.5	13.3	76.7	50
	New bone	96.7	6.9	52.63	66.6

PPV positive predictive value, *NPV* negative predictive value

particularly when radiograph is normal. The use of ultrasound may be generalized for detecting both acute and chronic signs of enthesitis.

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