CHAPTER **33**

OSTEOMYELITIS: Comparing MRI Accuracy With Histology Results

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The objective of this article is to achieve an accuracy rate using magnetic resonance imaging (MRI) solely, for the detection of suspected osteomyelitis and correlating it with positive histologic results after bone biopsy. This study involves 60 patients with more than half of the patients having osteomyelitis that originated from a diabetic foot ulcer. Although the majority of the patient population were patients with diabetes, it should be noted that other disease processes were not excluded.

OSTEOMYELITIS

Osteomyelitis is defined as an infection of the bone and marrow[1] where the infection first affects the cortex (osteitis), then after breaking through the cortical shell, involves the marrow cavity (osteomyelitis). MRI is perfectly suited to identify this type of process because it detects changes in both the cortex and medullary canal. Osteomyelitis is a pathologic process that needs to be treated without delay. When haste is not implemented in the treatment of osteomyelitis, conversely, there is a decrease in the cure rate and increase in the rate of complications and morbidity.[2] Numerous imaging modalities have been used including radiography, scintigraphy, computed tomography, and MRI[3] to better target a more localized zone or boundaries for suspected osteomyelitis. These boundaries become extremely important when treating the diabetic patient population so that appropriate bone debridement is performed for complete resolution of the infection. Patients with diabetes seem to develop an acute onset of osteomyelitis whereas signs of subacute or chronic osteomyelitis are usually not present.

Numerous articles in the literature show that MRI is highly sensitive in the detection of osteomyelitis with greater specificity and spatial resolution than bone scintigraphy, thus allowing a quicker diagnosis. The sensitivity of MRI ranges from 60%-100% and the specificity ranges from 50%-90% for osteomyelitis.[4-8] This purpose of this study is not to compare the specificities or sensitivities of MRI with that of bone scintigraphy, because this has been done in other areas of research.[9-11]

Since the advent of high field strength MRI and the development of smaller, local coils, the detail of MRI for use in soft tissue and bone has improved quite dramatically over the past 5-10 years. The real advantage is that MRI will reveal abnormalities in osseous structures and soft tissues much sooner than other imaging modalities. For the diagnosis of osteomyelitis, time is essential. For these reasons, MRI is increasingly becoming the modality of choice for detecting osteomyelitis and in situations where anatomic details are necessary for planning surgical intervention for debridement and resection.

MRI can aid in the diagnosis of osteomyelitis via hypointensity change on T1-weighted images and hyperintensity on T2-weighted/STIR (Short Tau Inversion Recovery) images surrounding the questioned bone especially when it is contiguous with an ulcer or abscess formation. The more profound the T2 signal intensity in the bone marrow, the more likely this intensity change is representative of osteomyelitis. Enhancement of an infectious process can be obtained with the use of gadolinium.

CASE STUDY

A 54-year-old male with diabetes presented with cellulitis of his right great toe from a long-standing ulcer (Figures 1, 2). Cellulilitis was present for approximately one week before presentation to our office. He was consequently admitted to the local hospital for intravenous antibiotics, workup of osteomyelitis with MRI and radiographs, and definitive procedures for resolution. MRI revealed hypointensitiy changes on T1-weighted images (Figure 3) and hyperintensity changes on the STIR images (Figure 4). Ultimately, the patient underwent a terminal Symes amputation with bone biopsy. The biopsy was positive for acute osteomyelitis.

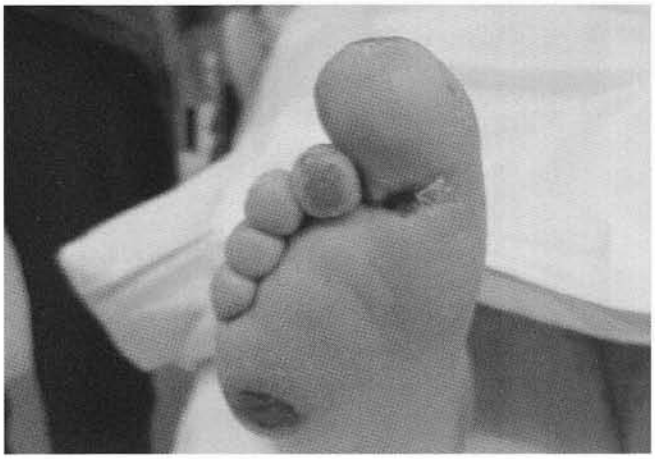

Figure 1. Initial plantar view.

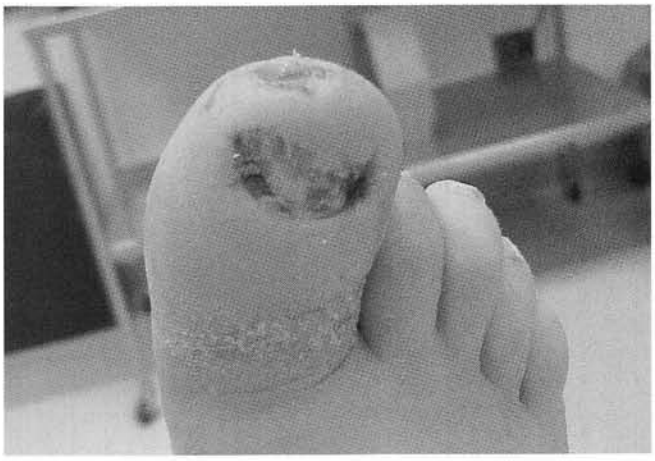

Figure 2. Initial clinical presentation.

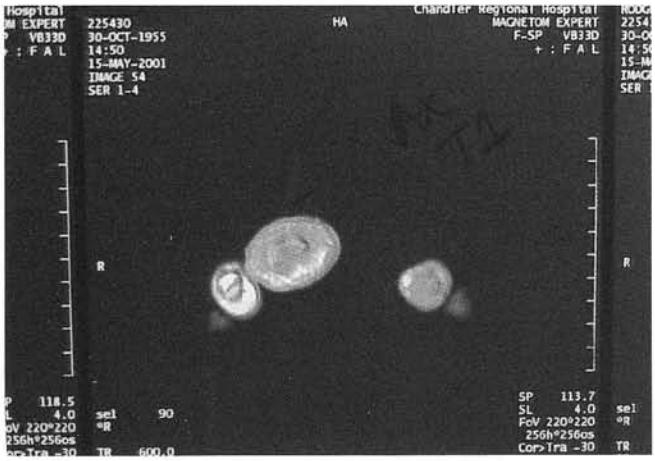

Figure 3. T1-weighted MRI.

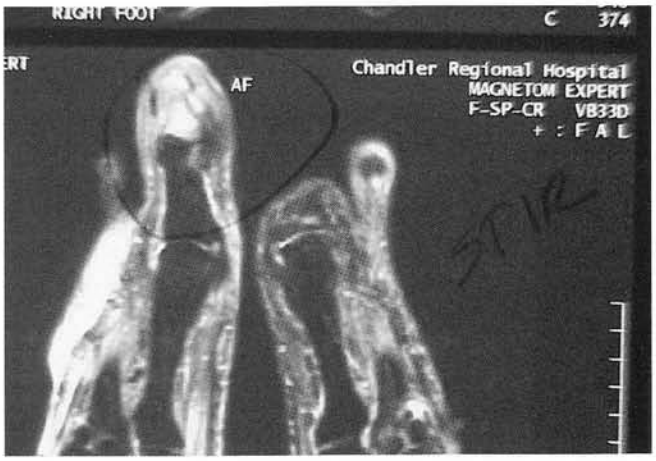

Figure 4. STIR image.

DISCUSSION

Table 1 reflects the details of the chart review. There were approximately 60 patients involved in this study, with 53 of these osteomyelitis cases resulting from diabetic pathology. Out of the 60 patients, MRI findings for osteomyelitis were read as positive in all 60 patients by both the radiologist and the surgeon. The histology associated with the bone biopsy was positive in 57 patients. The histology yielded acute osteomyelitis in 30 patients, chronic osteomyelitis in 10 patients, and a combination of both acute and chronic osteomyelitis in 17 patients. The histology results were negative after bone biopsy in just 3 patients. This yields an accuracy rate of 95% for the MRI detection of osteomyelitis.

CONCLUSION

Patients undergoing a workup for osteomyelitis with MRI alone and correlating these results with histopathologic results for this study yielded a 95% accuracy rate. To date, many studies have compared sensitivities and specificities of MRI with scintigraphy for osteomyelitis but few, if any, have correlated the accuracy of MRI with histology results. MRI is a very useful adjunct for detecting osteomyelitis but does not serve as a replacement for bone biopsy, which is the gold standard for diagnosing bone infection. Of course, the accuracy of the MRI is dependent on the appropriate interpretation read by the radiologist and surgeon. The improvement of the coils used in accordance with MRI, the importance of requesting 3 mm cuts for finer detail, and appropriate views of the

Table 1

REVIEW OF 60 PATIENTS

Patient	Date	MRI	Histology	Location	Diagnosis
1	2/18/99	+	+ acute	L calcaneus	DM ulcer
2	5/23/99	+	+ acute	L GT	DM ulcer cellulitis
3	9/27/99	+	+ chronic	GT	DM ulcer cellulitis
4	10/14/99	+	+ acute	R GT	DM ulcer cellulitis
5	11/10/99	+	+ acute	L 2 toe	DM ulcer cellultis
6	12/8/99	+	+ chronic	L 3 toe	DM ulcer cellulitis
7	12/9/99	+	+ chronic	R 1,2 mets	DM abscess
8	12/23/99	+	+ acute, chronic	R calcaneus	DM ulcer
9	1/29/00	+	+ acute	L GT	DM ulcer
10	2/1/00	+	+ chronic	R 4 toe	DM ulcer
11	2/16/01	+	+ acute	L foot	DM ulcer cellulitis
12	2/16/00	+	+ acute, chronic	R 2 toe	DM ulcer gangrene
13	2/23/00	+	+ chronic	R 3 toe	PVD ulcer gangrene
14	2/24/00	+	+ acute	R 3 L 4 toe	DM ulcer cellulitis
15	4/12/00	+	+ acute	R 5 met	DM ulcer
16	4/16/00	+	+ acute, chronic	L sesamoid	DM abscess
17	4/27/00	+	+ acute	R 3 toe	DM ulcer cellulitis
18	4/29/00	+	-	L 3 toe	DM cellulitis
19	5/8/00	+	+ acute, chronic	L GT	DM ulcer cellulitis
20	5/31/00	+	+ chronic	R GT	DM ulcer
21	6/8/00	+	+ chronic	L GT	Phenol matrixectomy
22	6/9/00	+	+ acute	L 1 met	DM ulcer
23	6/9/00	+	+ acute	L 3 toe	DM ulcer
24	6/15/00	+	+ acute	R 3 toe	DM ulcer cellulitis
25	6/15/00	+	+ acute	R 5 met	Ulcer cellulitis
26	6/28/00	+	+ acute	R 2 toe	DM ulcer cellulitis
27	7/2/00	+	+ acute	L GT	DM ulcer
28	7/5/00	+	+ acute, chronic	R 5 met	DM ulcer
29	7/28/00	+	+ acute, chronic	R 2 met	DM ulcer cellulitis
30	7/28/00	+	+ acute	L 5 toe	DM gangrene cellulitis
31	7/31/00	+	+ acute	L 2, 3 toe	DM ulcer cellulitis
32	8/7/00	+	+ acute	R 1 met	DM ulcer cellulitis
33	8/8/00	+	+ acute	L 5 toe	DM ulcer
34	10/18/00	+	+ acute, chronic	R 1 met	PVD ulcer cellulitis
35	10/24/00	+	+ acute, chronic	R sesamoid	DM ulcer cellulitis
36	10/26/01	+	+ acute, chronic	R 2 met	DM ulcer cellulitis
37	11/7/00	+	+ acute	L 5 met	DM ulcer cellulitis
38	11/15/00	+	+ acute, chronic	L GT	DM ulcer cellulitis
39	12/7/00	+	+ acute, chronic	R 4, 5 toe	DM ulcer cellulitis
40	12/14/00	+	+ acute	R 3 toe	DM ulcer cellulitis
41	1/4/01	+	+ acute	R 2, 3, 4, 5 met	DM ulcer cellulitis
42	1/23/01	+	+ chronic	R 2, 3, 4, 5 toes	DM ulcer gangrene
43	2/23/01	+	+ chronic	L 3, 4, 5 mets	DM ulcer cellulitis
44	2/23/01	+	+ acute, chronic	R 3 toe	DM ulcer cellulitis
45	2/28/01	+	+ chronic	R 3 toe	PVD ulcer
46	3/10/01	+	-	R sesamoid	PVD ulcer
47	4/10/01	+	+ acute, chronic	R 5 met	DM ulcer cell
48	4/11/01	+	-	L 2 toe	DM ulcer cellulitis
49	4/16/01	+	+ acute, chronic	R 5 met	DM ulcer cellulitis
50	5/7/01	+	+ acute, chronic	R 3 toe	DM ulcer cellulitis
51	5/7/01	+	+ acute	R GT	DM ulcer cellulitis
52	5/9/01	+	+ acute	R GT	DM gangrene cellulitis
53	5/30/01	+	+ acute	R 5 met	DM ulcer cellulitis
54	5/30/01	+	+ acute, chronic	R 1, 2 toe	DM ulcer cellulitis
55	7/9/01	+	+ acute	L GT	Paronychia longstanding
56	7/16/01	+	+ acute, chronic	R 5 met	DM ulcer
57	7/31/01	+	+ acute	R 1 met	DM ulcer
58	8/20/01	+	+ acute	R 1 met	DM ulcer cellulitis
59	9/3/01	+	+ acute	L 2 met	DM, foreign body, cellulitis
60	9/16/01	+	+ acute	R 1 met	Neuropathy ulcer

associated pathology have contributed to an overall better quality image over the last 5-10 years. This has enhanced the ability to detect acute osteomyelitis allowing for an improved surgical intervention and cure, which is of utmost importance in the patient with diabetes.

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