CLINICAL VALUE OF BONE SCAN IN THE EVALUATION OF LOW BACK PAIN : A RETROSPECTIVE STUDY

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INTRODUCTION

Low back pain is one the most common disabling and costly health problems in the western countries. Only in United States, it is one of the leading causes of hospitalization and surgery (1 & National Center for Health Statistics: National Hospital Discharge Survey, unpublished data, 1988). Moreover, the total annual costs associated with low back pain, adding the indirect costs of disability compensation and affected productivity, reaches approximately $100 billion in USA (2).

Even though it has a very good prognosis, the proper etiologic identification is not even possible most of the time. Different disorders can clinically be manifested by low back pain; therefore, appropriate clinical workup is necessary for the diagnosis.

Multiple tests, varying from laboratory to imaging methods, have been used by family practitioners, surgeons etc.... However, their indication remains controversial and changes according to the medical specialty (3). Some groups believe that unless the patient present with symptoms and signs that suggest systemic underlying disease, imaging procedures are not useful in terms of affecting the clinical management or even changing the clinical diagnosis (4). New developments in the anatomic cross-sectional imaging, with the advent of new constrast agents and techniques, especially in the MRI field, promoted an overuse of these methods.

Functional imaging methods, such as bone scan, present a limited role in evaluating patients with low back pain. However, some groups defend the diagnostic use of this method in conjuction with tomographic techniques (SPECT) and with other conventional imaging modalities (5-7).

The purpose of this study was to determine the efficacy of bone scan in comparison with other methods in evaluating a group of patients with low back pain.

MATERIAL AND METHODS

Patients

Thirty-eight out of 150 patients who had undergone bone SPECT as part of their clinical work up, were included in this study. All the patients were referred by the Physical Rehabilitation Department of the Hospital of the University of Pennsylvania. Their ages varied from 16 to 73 years-old, 21 were male and 17 female. All present with clinically persistent low

back pain with an average length of symptoms of (range from 1 to 360 months). All patients were followed up for a minimum of 1 year to confirm the clinical diagnosis and to evaluate the response to therapy.

Methods

Conventional spinal radiographs (n=35), magnetic resonance imaging (n=35), electromyography (n=17), computerized tomography (n=7) and bone scintigraphy (n=38) were completed within 3 weeks of the initial clinical investigation.

Conventional spine X-rays were obtained in anteroposterior, lateral and oblique views of lumbar spine as well of the SI joints. MR scans were done in a 1.5-Tesla machine (Sigma-General Electric, USA), using a T1 and T2-weighted fast spin-echo sagittal images followed by T1 and T2-weighted axial oblique images of the lumbar spine. Gadolinium-enhanced images were obtained following the conventional sequences in most of patients.

Bone scintigraphy was performed using a dual-headed SPECT scanner (Prism 2000, Picker-International-OH), with a set of low energy, high resolution collimator. The planar or whole body images were obtained 2-3 hours after IV injection of 740-1110 MBq of methyl-dyphosphonate labeled with Technetium-99m (MDP Tc-99m).Planar imaging was acquired for about 500.000 counts per view. The SPECT images were done using a circular orbit, with each head rotation 180 degrees over the lumbar sacral spine. A 128x128 matrix was used, getting 64 projection images, each of them with 20 seconds of duration. A Wiener filter was used for prefiltering followed by a back-projection Ramp filter. three different orthogonal planes were used (transaxial, sagittal and coronal) and the slice thickness was 6-8 mm.

The interpretation of planar and tomographic images was based on following visual score: 0=no abnormal uptake, 1=mild abnormal uptake, 2=moderate abnormal uptake and 3=intense abnormal uptake. Two experienced reader reviewed the bone scintigraphies and both were blinded to clinical and to other studies data. When a discrepant result was obtained, a consensus between the two readers was achieved.

The imaging studies were correlated to the final clinical diagnosis. The number of lesions detected by each method was not computed and only the location and patterns of the lesions in correspondance to the final clinical diagnosis were considered for the analysis. Incidental lesions observed in areas that not corresponded to the cilnical profile of the patient were not described or even considered into the analysis.

RESULTS

The clinical and the diagnostic test data are shown in the table 1. Disk herniation with radiculopathy was seen in 15 patients (39%), facet disease and degenerative joint disease in 5 (13%), mechanical low back pain in 4 (11%) and discitis in 1 patient (3%).

In bone scintigraphy, the SPECT finding were concordant with the planar findings in 12 patients. SPECT was able to show abnormalities not seen on planar images in 15 patients. More intense uptake was.also observed in 11 patients using SPECT compared to planar. The difference in magnitude of the abnormalities seen on these two techniques is shown in the table 2.

Overall, planar bone scintigraphy was concordant with the clinical diagnosis in 11 cases (29%). The SPECT was concordant in 26 (68%), MRI in 22 (63%), X-ray in 7 (20%). Electromyography was positive in 9 patients

(53%) and CT in 4 (57%). If the MRI and bone SPECT were considered together, 80% of the lesions would be detected by these imaging techniques. When the percentage of concordance was analyzed according to the specific pathologic condition, different results were demonstrated. MRI was concordant with the clinical diagnosis in 100% of cases with facet disease, in 75% of cases with SIJ syndrome, in 73% of cases with intervertebral disk disease and in 40% of cases with degenerative joint disease. Both methods failed to show any abnormality in 4 cases with mechanical low back pain.

DISCUSSION

Imaging and laboratory studies (e.g. erythrocyte sedimentation rate) are frequently requested too early during the course of low back pain. Considering that in most situations the symptoms shortly disappear without any special treatment, controversies still exist regarding the best test, the right sequence and the right timing for their indication. It is well know that a very few patients require a conventional radiographic examination (8,9). Despite its low cost and high availability, some studies have shown that its diagnostic yield of unexpected findings is extremely low (10). Moreover, herniated interverbral discs and spinal stenosis, which usually require surgery, are seldom detected by plain films. In the other hand, degenerative changes frequently seen on plain radiographs are unlikely causes of low back pain (11). Large interobserver variability concerning the interpretation is also reported using plain radiography (12). However, patients with underlying systemic disease such as malignancy, infection and inflammatory spondylitis may be benefited by radiographic survey.

The use of anatomical cross-sectional imaging studies has been increased with the technological improvement of computed tomography (CT) and recently, magnetic resonance imaging (MRI). CT is very accurate in detecting facet joint disease as well as disk herniation (13). In diagnosing protruding nucleus pulposus, CT is as effective as mielography; however, as the interpretation is solely based on shape of the disk, false negative and false positive interpretations may occur (14). MRI also provides images with very good spatial resolution. Nowadays, the spinal imaging work up begins with MRI in most institutions (15). The advantages of multiplanar imaging and the better tissue characterization using the different imaging sequences give informations not previously available by another single test. Many groups believe that for patients with intervertebral disk disease, MRI is the most sensitive test. Because MRI measures the altered water content of the nucleus pulposus, the incipient degenerative changes are seen earlier on MRI compared to radiographs (16). However, the exact significance of these changes needs to be clarified since in a recent study involving 302 asymptomatic young women, disk dehydration was seen in almost 1/3 of them (17). Other advantage of MRI is that in the post operative evaluation of disk disease, better distinction between fibrosis and recurrent disease is achieved with gadolinium-enhanced MRI in contrast to CT that occasionally does not permit such differentiation. The use of CT and MRI should only be indicated in situations that clinically request prompt identification like patients with low back pain and abnormal neurological examination or patients who failed under conservative treatment. In our series, MRI was very accurate in detecting degenerative and intervertebral disk disease. Only two cases were not diagnosed by MRI, both being diagnosed by electromyography and with good therapeutic response after caudal never block. In the other

hand, MRI failed to detect 4 of 6 cases with SIJ syndrome. It is important to mention that these cases did not include inflammatory sacroiliitis. Most of the cases corresponded to dysfunction of SIJ (due to mechanical overload) rather than to inflammatory process. None but one presented with positive laboratory tests. As expected, MRI showed poor performance in patients with facet joint disease.

The use of bone scintigraphy in patients with low back pain is strictly limited. A lesion that is characterized by increased reparative new bone formation is easily detected by bone scan. Minimum metabolic turnover is required to produce a hot spot on scintigraphy (18). There is a consensus that when an underlying disease is present, specially malignancy or infection, a bone scan is considered a very sensitive test to be indicated (6,14,19). However, poor spatial resolution poses limitations in spinal imaging, specially in surgical related disease. Before the arrival of SPECT, the difficulties in determining the exact location of the abnormality in the planar images impaired the clinical utility of bone scintigraphy in this particular group of patients. The development of tomographic techniques (SPECT) permitted significant improvements concerning the clinical interpretation of bone scans. The use of SPECT has been reported in different pathologic conditions such as fractures (20,21), discitis (22), spondylolysis and spondylolystesis (23), facet joint disease (24), sacroiliac joint disease (25), and chronic low back pain (26). While SPECT is very sensitive for facet joint disease diagnosis, it is very limited for intervertebral disk disease with nerve root compression symptomatology (6) However, focal lesions on bone scans associated with disk disease have been reported (27). Patients with degenerative disk disease may present with secondary narrowing of the disk space and with regional osteophytes that can explain an increased concentration of radiophosphonate on bone scans. Even though these alterations are considered non specific, the potential for localize the site of abnormality helps in the selection of further imaging investigation. In our retrospective review, 11 of 15 cases with nucleus pulposus herniation showed at least one focus of abnormality ipsilateral to the algic point on bone scintigraphy. We considered SPECT positive in those situations because it gave the right localization of the abnormality according to the clinical profile and final diagnosis. However, the exact significance of those alterations in enhancing the low back pain symptomatology is not well defined. Mild degenerative changes can be associated with normal scintigraphies. If an ostheophyte is insert as the stress is dispersed over a sufficiently large area, no new bone formation is seen and therefore a normal pattern is observed on scintigraphy (18). It is well demonstrated that various common anatomical abnormalities such as disk calcification, mild apophyseal joint disease, Schmorl nodes, spina bifida occulta and mild to moderate scoliosis are unlikely causes of low back pain. This may explain the low rate of detection of DJD in our series. In contrast, very high rate of concordance was observed in the investigation of facet joint disease and SIJ arthralgia. Although few prospective studies have been done comparing different imaging techniques in the detection of facet joint disease, some groups have already reported very good results using bone SPECT (6, 24, 26, 28 - 30). Fogelman et al. (26), evaluating 34 patients with chronic low back pain, demonstrated clear superiority of SPECT over conventional planar images and over radiographs. Similar results were observed using SPECT as compared to CT. In our study, we have only one case with "failed back syndrome" in a patient previously submitted to multiple

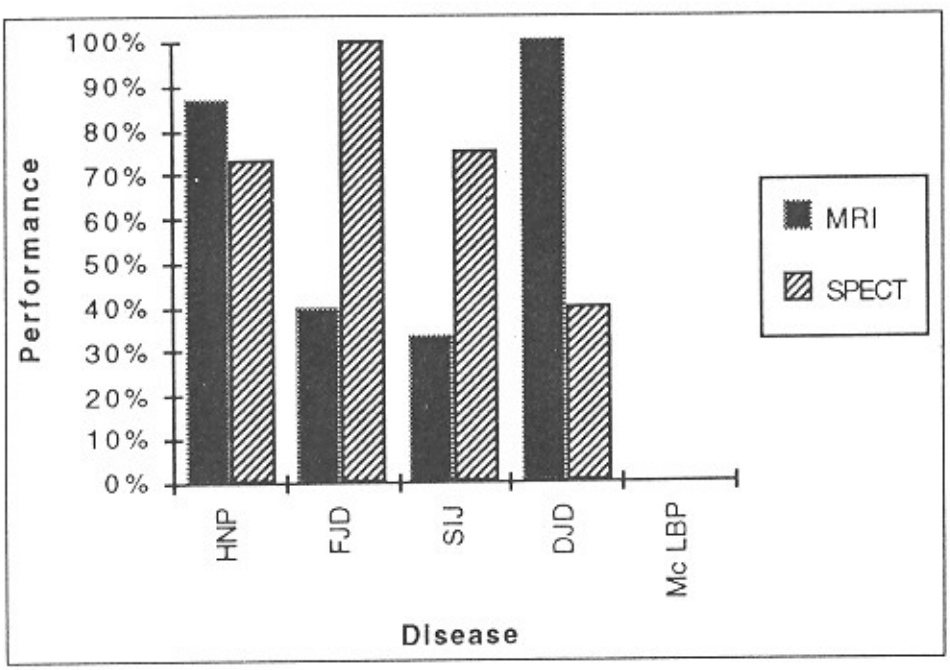
level laminectomy. The SPECT was positive in this patient while MRI and X-ray were negative. Lusins et al. (28), studying 25 patients with persistent low back pain after laminectomy, showed that SPECT is most useful where there is high probability of instability, especially on multiple level laminectomies.

In the detection of inflammatory SIJ disease, MRI has been showed to be equally accurate or even superior to bone scintigraphy (31). However, in our series SPECT showed better performance compared to MRI. As other groups had already reported, SPECT is not only sensitive for detection of inflammatory processess of SI joints, but also disorders caused be altered spinal mechanics (25). In most patients of our series, a definite causes of SIJ uptake was not established, even though, a local block for pain relief worked out in all of them. MRI was suboptimal on those, especially because no inflammation could be associated as the probable etiology by clinical or laboratory tests.

The criticism of our syudy is that involves a retrospctive analysis of 38 patients. The data probably was biased by the selection criteria that included persistent low back pain. We reviewed the studies blinded to the clinical profile but aware that the patient was complaining of low back pain.

The diagnostic value of imaging techniques in patients with low back pain has been questioned. CT shows herniated disks in almost 20% of subjects who have never had back pain and MRI man show signs of bulging discs in approximately 45% of asymptomatic individuals (32-33). In a recent survey of 1,100 physicians of different specialties, it was observed that a little consensus, either within or among different specialties, is observed concerning the use of diagnostic tests for patient with low back pain (15). MRI was the most frequently used procedure. Fewer than 3% of physicians would ask a bone scan for patients with sciatica. However, the use of SPECT is recent and shows larger potential for clinical utilization compared with conventional planar or whole body images. In this study, MRI and SPECT showed better clinical value even though their accuracy seems to be suboptimal when different disorders are grouped together. However. MRI is very accurate to detect surgical conditions such as nucleus pulposus herniation with root nerve compression and spinal stenosis. On the other hand, SPECT is more accurat in facet joint disease evaluation. Further studies have to be carried out in a prospective way to compare these different imaging techniques in a larger sample of patients with chronic low back pain.

FIGURE 1. Diagnostic performance of MRI and SPECT



HNP =	Herniated nucleus pulposus	DJD =	Degenerative joint disease
FJD =	Facet joint disease	SIJ =	Sacroiliac joint disease
Mc LBP =	Mechanical low back pain		

TABLE 1. Clinical and imaging data

PATIENT	AGE	SEX	DURATION of SYMPTOMS	DIAGNOSIS	X-RAY	MRI	PLANAR	SPECT	EMG	CT
1	23	female	6 months	discitis(L2-L3)	-	+	+	+	#	#
2	28	male	2 months	HNP (L5-S1)	+	+	-	-	#	+
3	16	male	10 months	HNP+radiculopathy (L5-S1)	-	+	-	+	#	#
4	48	female	5 months	HNP (L5-S1)	#	+	+	+	+	#
5	41	male	4 years	HNP (L4-L5)	+	+	_	+	#	#
6	73	male	24 months	Instability (post-op)	-	-	+	+	#	#
7	67	male	12 months	FJD (post-op)	-	+	-	+	+	#
8	36	male	25 months	HNP+radiculopathy	-	+	-	-	#	+
9	31	male	48 months	HNP (5)	-	+	-	-	#	-
10	35	female	3 months	SIJ	-	+	-	+	-	+
11	40	female	36 months	McLBP	-	-	-	-	#	#
12	34	female	120 months	L5 Radiculopathy	-	-	-	-	+	#
13	23	female	1 months	SIJ	-	-	+	+	#	#
14	55	female	18 months	SIJ	-	-	-	-	#	#
15	42	male	2 months	HNP+radiculopathy (L5-S1)	-	+	+	+	+	#
16	49	female	2 months	L5 radiculopathy	+	+	+	+	+	#
17	32	female	4 months	SIJ syndrome	-	-	-	+	#	#
18	57	female	25 months	DJD	+	+	+	+	+	#
19	49	male	360 months	FJD+SIJ	#	+	+	+	#	+
20	43	male	60 months	L5-S1 radiculopathy	-	+	+	+	+	#
21	57	male	240 months	FJD	+	+	+	+	+	#
22	16	male	12 months	DJD	-	#	-	+	#	#
23	39	male	62 months	SIJ	-	#	-	+	-	-
24	47	femal	19 months	HNP	#	+	-	+	#	#
25	28	male	5 months	McLBP	-	-	-	-	#	#
26	19	female	60 months	SIJ	-	#	-	+	#	#
27	32	female	72 months	DJD	-	+	-	-	-	#
28	70	male	24 months	FJD	-	-	-	+	-	-
29	30	male	36 months	FJD	-	-	-	+	#	#
30	73	femal	2 months	L5 radiculopathy	+	+	-	+	#	#
31	28	female	2 months	SIJ	-	-	-	-	-	#
32	39	male	19 months	Radiculopathy	-	-	-	+	+	#
33	40	male	1 months	McLBP	-	-	-	-	#	#
34	41	male	7 months	HNP+radiculopathy	-	+	-	+	+	#
35	36	female	28 months	McLBP	-	-	-	-	-	#
36	59	male	144 months	DJD	-	+	-	-	#	#
37	60	female	9 months	DJD	+	+	+	+	-	#
38	35	male	60 months	L5 radiculopathy/spondylolisthesis	-	+	-	+	#	#

HNP = Herniated nucleus pulposus
McLBP = Mechanical low back pain
DJD = Degenerative joint disease
SIJ = Sacroilica joint disease
FJD = Facet joint disease

\+ = concordant with cilical diagnosis
\- = not concordant with clinical diagnosis
\# = not done

TABLE 2. Distribution of lesion's score according to the technique used on bone scan.

IMAGE / SCORE	0-1	2-3
PLANAR	32	6
SPECT	18	20

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