RESEARCH STUDY

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Discrimination of Malignant from Acute Benign Compression Spinal Fractures with Magnetic Resonance imaging

ARTICLE INFORMATION

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ABSTRACT

Background: Differentiation between malignant and benign vertebral compression fracture is often problematic. This is precisely difficult in elderly who are predisposed to benign compression caused by osteoporosis .Establishing correct diagnosis is of great importance in determining the treatment andprognosis.
A study was performed to determine which magnetic resonance imaging findings are useful in discrimination between metastatic and acute osteoporotic compression fractures of the spine. Recently MRI is being increasingly used for evaluation of these fractures.
Objectives: The aim of this study is to establish the correct diagnosis of malignant and benign compression vertebral fracture by MRI to determine treatment and prognosis.
Methods: MRI of (45)patients with vertebral compression fracture who underwent MRI of spine during 2 years period (2004-2006) in Neuro surgical hospital were retrospectively reviewed by an expedient radiologist , A collapsed vertebra were considered to be acute if there was recent history of back pain of less than 3moths. All MRI sequences needed for spine examination was done(T1WI SE, T2WI GE STIR, and Mylography) and Gadolinium contrast medium was given to all patients..
Results: Of total 45 patients (31male, 14 female, their age range between 18-72years) , The criteria used to differentiate between benign andmalignant collapse spine on MRI was based on the signal intensity, morphology and contrast enhancement for the correct diagnosis. Homogenous and diffuse abnormal signal intensity, posterior convexity and involvement of pedicles are sign that are strongly suggestive of malignant collapse .Conversely, a band like area of low signal intensity adjacent to depressed end plateand preservation of signal intensity of vertebra suggest benign nature of the collapse.
Conclusions: We found that MRI features is helpful in differentiation of malignant and benign compression fractures in majority of cases, and if initial MRI finding are equivocal correlation with other images technique, follow up and biopsy in selected cases helpful in arriving correct diagnosis.

Introduction:

Mean break down of vertebra resulting in a decreased body height associated with pain of less than 3 months duration[1] or reduction in vertebral body height by 20% (4mm) is considered to be indicative of a vertebral compression. Three fractures patterns : wedge, crushedand biconcave have been described [2].
With wedge deformity has a collapse anterior border with almost intact posterior border. Wedge deformity occurs in mid thoracicand thoraco lumbar region in both sexes. [2]
In crush fractures, the entire vertebral is collapsed and clustered in mid thoracic and thoraco lumbar regions.
Biconcave fractures show collapse of the central portion of the body , and they are more prevalent in lumbar region.[2]
A traumatic vertebral compression fracture in the thoracic or lumbar spine are a common clinical problem particularly in elderly patients. Osteoporosis is the most common cause of compression fracture in this age group. The spine is a common site of metastatic disease and account for up to (39)%of all bone metastases.[4]
Compression fracture due to metastatic malignancy are frequently seen in the same age groupand differentiation from benign compression fracture due to osteoporosis often effects appropriate clinical staging ,treatment, and prognostic determination in patient with known malignancies.[5]

Chronic benign compression fracture can be easily detected due to absence of abnormal S.I.in compressed vertebra.[5][4] .However acute osteoporosis compression

can be difficult to differentiate from malignant compression fracture[4] because both osteoporotic and metastatic fractures displayed a low S.I on T1WI and increased S.I on T2WI .A band like low S.I on T1WIand T2WI was more common in acute osteoporotic compression fractures than metastatic compression fractures.[4]. while osseous involvement of pedicles or other posterior elements and the presence of a lesions in the epidural spaces or para spinal regions favor the diagnosis of a malignant tumor.[2].

BVC: consist of : 1-osteoprotic and2.Traumatic collapse

MVC : consist of 1. secondary metastasis and2. Multiple myeloma

Methods:

This is a prospective study was carried out from October 2004 t0 June 2006 in Neuro-surgical Hospital .(45) patients whose ages ranged from(18-72) years with mean age(45). Year were analyzed.

MRI examination was performed using Philips Gyroscan ACS-NT , 1.5 Tesla super conducting magnet using synergy coils.

A collapse vertebra were considered to be acute if there was recent history of back pain of less than 3months.

MRI Techniques:

1. 1st step , explanation to patient nature of examination and possibility of any contraindication like : bullet injury, metallic clips or implant, pacemaker and history of clustrophobia.
2. Studying patient's notes, previous radiological examination, laboratory finding specially (serum alkaline phosphates level)andthe disease status of primary neoplasm 3. placing the patient supine andhis head holder and using synergy coil of spine image is taken from left to right , from front to back and from up to down .
4. MRI sequences needed for spine (vertebral) examination :
1. T1WI SE and T2WI image in sagittal plane.
2. T2WI GE image in the axial plane
3. STIR scan are used as primary scan for detection of vertebral metastases . It can be slightly superior to T2WI , although STIR image are predominantly T1WI , metastasis appear as hyper intense vertebral body lesion.
5. MRI Mylogrphy done for all patients.
6. Nearly all patients(because not available at that time)had I.V contrast medium of (Gd)using (o.1 mmol / Kg).
7. Only 1 patient had laboratory postoperative histo pathological confirmation because of unknown primary origin and vast majority of patient had their laboratory investigation which proved to have a known primary malignancy

Results:

The total number of patient were(45), (31 male) and (14 female) , there were (15) patients with malignant

compression fracture and (30) patients with acute benign compression fractures. .

MRI findings suggestive of benign acute vertebral collapse

1. Low S.I band in adjacent to fractured end plate.

S.I of benign compression fracture varies according to the age of the fracture. Osteoporosis fracture less than 2 months characteristically shows a focal band like area of low S.I adjacent to fractured end plate. Band of low S.I on T1WI and T2 WI was common in acute osteoporotic compression(80%) than metastatic compression.(20%).

2. Spared normal bone marrow S. I :

Spared normal bone marrow S. I of vertebral body was highly suggestive sign of acute benign compression(90%).while in malignant compression (13.3%).

3. Retropulsion of a posterior bone fragment:

Retropulsion of bone fragment was more frequent in osteoporosis compression fracture (26.6%)than metastatic compression(6.6%).

It is possible that some or all of cases of metastatic disease with retropulsion of bone fragment were due to pre existing compression fractures that were secondarily involved by metastatic disease. It is possible that metastatic disease can occasionally be associated with retropulsion of bone fragment.[4]

Result of malignant vertebral collapse :-

1. Convex posterior border : A convex border of vertebral body was more frequent in metastatic compression fracture (40%)than acute benign compression fracture(16.6%).
2. Involvement of pedicle and posterior element : in most malignant compression fracture , tumor involvement of the bone marrow of vertebral body has already spread to the pedicle and neural arch before collapse , where as reactive B.M change usually spare pedicle in osteoporotic compression fracture.

Pedicle involvement has high sensitivity (60%)in malignant compression fracture while in BVC was(13.3%).

3. Epidural mass : An epidural soft tissue mass was suggestive of malignant vertebral collapse particularly when it was encasing epidural mass. (60%)while only (10%) in BVC .

Epidural expansion is seen on MRI , axial scan ,play an important role here .(20)

4. Diffuse abnormal low S.I of vertebral body: Was more frequent in Malignant collapse (80%) , than in benign collapse (26.6%).
5. Level of vertebral collapse: We find that Lumbar level was more in MVC (80%) in comparison to (56.6%)in BVC…

Table (1) Gender Distribution :-

Gender	BVC	%	MVC	%
Male	22	73.3	9	60
Female	8	26.6	6	40
Total	30	100	15	100
GD enhancement	BVC	%	MVC	%
	30	100	15	100
Total	30	100	15	100

6. Table (2): pattern of GD enhancement .

7. We found that all BVC (30=100%) had intense heterogeneous enhancement on T1WI +Gdand all MVC had intense heterogeneous enhancement on same sequence , mean it is not useful in differentiation between BVC and MVC.

Multiple level AVC	No	Total	%
BVC	7	30	23.3%
MVC	3	15	20%

8. Table (3) : multiplicity of vertebral collapse

9. About multiplicity of vertebral collapse, it was found that (23.3%) in BVC and (20%) in MVC ,which mean it is not a useful criteria for differentiation between both conditions.

MRI finding suggest MVC	MVC	%	BVC	%
Convex posterior border of vertebral body	6	40	5	16.6
Pedicle involvement	9	60	4	13.3
Epidural mass	9	60	3	10
Diffuse abnormal SI	12	80	8	26.6
Lumbar in location	12	80	17	56.6

10. Table (4) MRI finding suggestive of MVC:

11. From this table we found that diffuse abnormal low S.I on T1WI were highly suggestive of MVC (80%) and pedicle destruction (60%).Lumbar in location had also high proportion (80%) but it also high proportion in BVC (56.6%) which mean it has high predilection to lumbar site. **(5)**

MRI finding in BVC	BVC	%	MVC	%
Band like S.I (low S.I in T1WIandT2WI)	24	80	3	20
Retropulsion of bone fragment	8	26.6	1	6.6
Presence of normal B.M S.I	27	90	2	13.3
Multiple fracture	7	23.3	3	20

12. Table(5) MRI finding suggestive of BVC (benign vertebral collapse),(S.I : signal intensity), (B.M : bone marrow)

13. From table (5) we found that Band of low S.I and preservation of normal B.M S.I were highly suggestive of BVC.

Types of MVC	NO.	Age	%
Ca Prostate	4	60-72	20
Bronchogenic carcinoma	2	45-65	13.3
Ca Breast	4	35-56	20
Multiple myeloma	2	56-62	13.3
Osteosarcoma	1	18	6.6
Ca thyroid	1	56	6.6
Un known origin	1	61	6.6

Table (6) : Type of MVC(malignant vertebral collapse)

14. We found that Ca prostate in male and Ca breast in female is the highest (20 %)causing MVC.

15. **Table (7) :Age distribution.**

AGE	BVC	%	MVC	%
18-39	13	43.3	2	13.3
40-59	6	20	6	40
Above 60	11	36.6	7	46.6
total	30	100	15	100

16. Age distribution: patient age range between (18-72)years ,mean age (45)years old highest %of BVC (18-39)years, and highest % of MVC (above 60years)

17. **(6)**

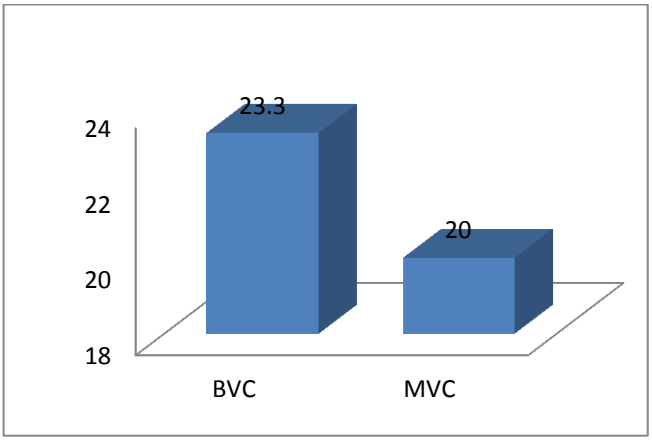

Fig. (1)

Multiplicity of vertebral collapse(
BVC :benign vertebral collapse MVC : malignant vertebral collapse

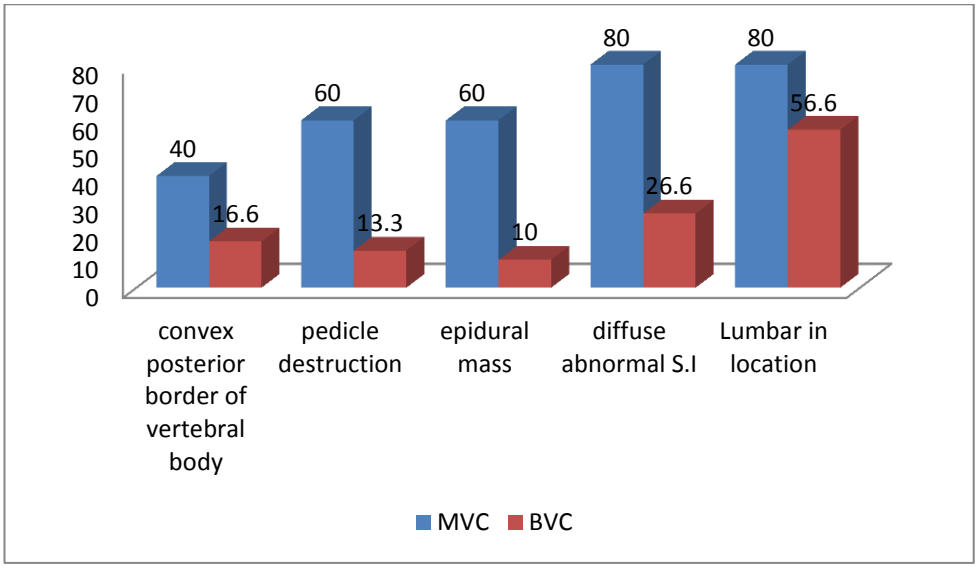

Figure (2) (MRI finding suggestive malignant vertebral collapse)(7)

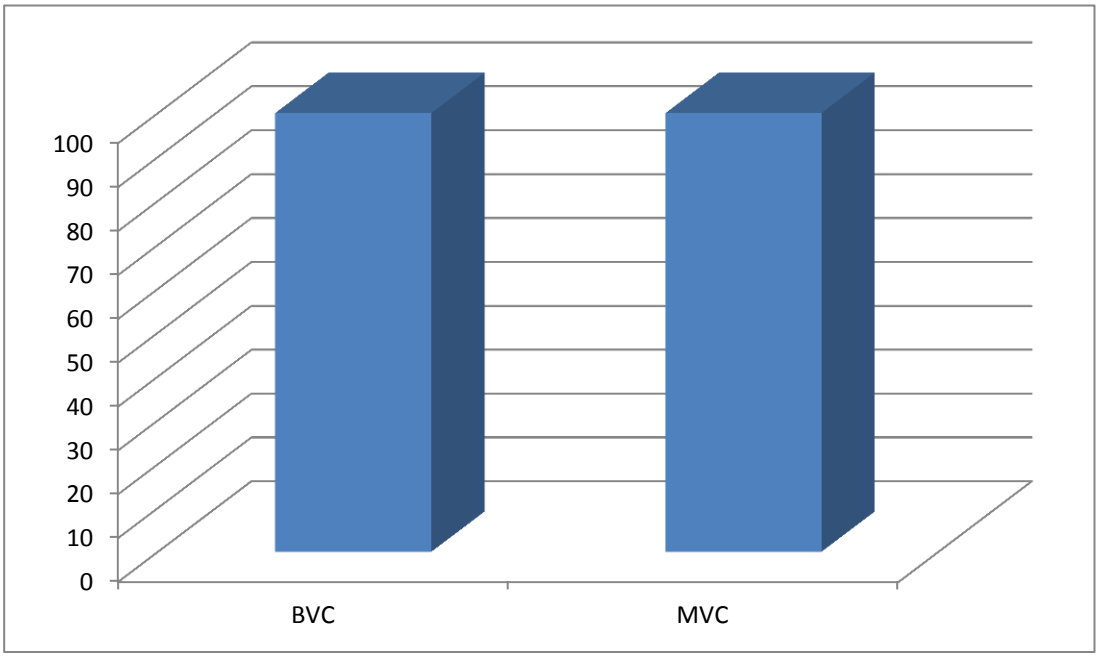

Fig. (3)
Pattern of Gd. Enhancement((Gd : gadolinium contrast media)

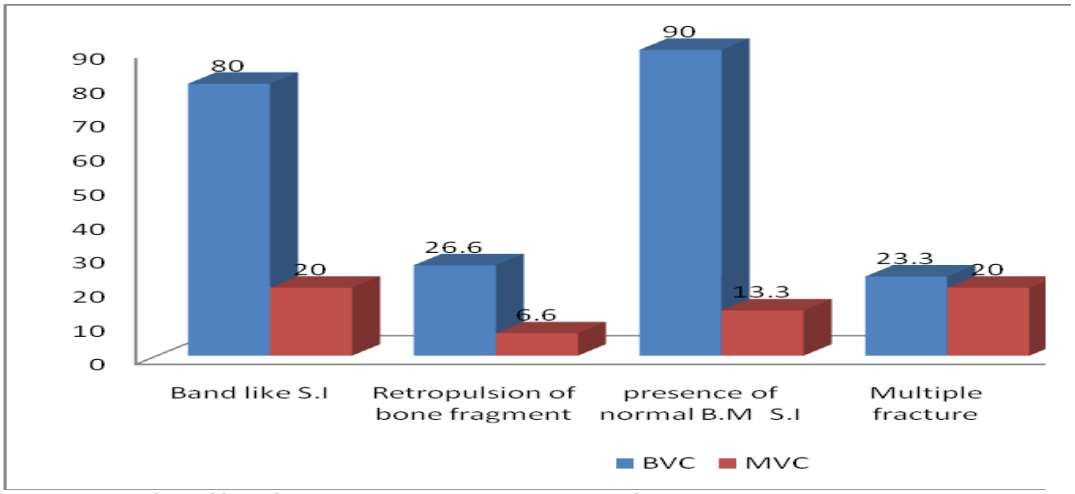

Fig. (4)(MRI finding suggestive of BVC)BVC : Benign vertebral collapseS.I : signal intensity

Discussion:

A- MRI Findings Suggestive of benign vertebral collapse:

1.Band of low S.I :Is seen in T1WI and T2WI, our study showed that was highly sign of BVC (80%) while in MVC (20%).

Hee-Sun Jung etal (4) found that it form (93% in BVC and 44% in MVC) , so it is highly suggestive of BVC.

2. Retropulsion of bone fragment : Was more frequent in BVC (26%) than in MVC (6.6%).In prior study (Hee-Sun Jung et al) (4)found retropulsion bone fragment in BVC (60%) and (11% in MVC).

3.Preservation of normal B.M S.I : spared normal B.M S.I of vertebral body was highly sign of acute benign collapse (90%) Vs (13.3%) for MVC. While (Hee-Sun Jung et al)found that spared normal S.I in BVC (85%)and in MVC (19%).

4.Level of Vertebral Collapse :

Regarding the level collapse in our study we found that lumbar level constituting the highest percentage (56.5%), followed by thoracic level (33.3%). lumbar level is common site in MVC(80%) which is the same result found by (Moulopoulos etal (13) that: lumbar location were more frequently observed in malignant fracture.

5.Multiple Vertebral Collapse :

In previous study (Rupp RE , (8) the finding of multiple fractures was not useful in differentiation osteoporotic from metastatic compression fracture. In our study we found that BVC (23.3%) and MVC (20%) . In conclusion multiple fracture vertebrae is not a useful criteria for differentiation between the 2 conditions.

B-MRI Findings Suggestive of malignant vertebral collapse

1. Convex posterior border of vertebral body : Was more frequent in MVC (**40%)** vs. (16.6%) for BVC , these result in comparison to the previous study (4, 6), found that (MVC 74%) and (BVC 20%).this high percent in previous study possibly due to that some or all of the metastatic disease with retropulsion of bone fragment due to preexisting compression fracture that were second involved by metastatic disease.

2.Pedicle Involvement : In our study we found it constitute (60% in MVC) and (13.3% in BVC), while Hee-Sun Jung found that pedicle or posterior element involvement form (85%) in MVC and (51%) in BVC . This high percent found in that study could be due to exclusion of multiple myeloma which showed long T1WI with out destruction of pedicle and epidural mass in compressed vertebrae (7). RUPP et al concluded that pedicle involvement and /or soft tissue mass clinches the diagnosis as they are specific for malignant compression fracture. *(8) (9).* Loss of contour of pedicle s occurs late in metastatic process.(10)

(9)

Involvement of pedicle on MRI even in the obscene of any obvious epidural mass goes strongly in favor of tumor. If the histopathology does not show tumor tissue the patient need to be closely follow up with regular neurological assessment and follow up MRI to look for progress of disease.*(11).*

3.Epidural mass : In the study done by (Hee-Sun Jung) epidural soft tissue mass was suggestive of MVC in (74%) vs (25%) in BVC(14) .In our study we found that epidural mass form (60%) in MVC and (10%) in BVC.

In Al-Daod and ALween et al found that epidural mass said to have (80%)sensitivity and (100%) specifity for MVC.(11)

Epidural soft tissue mass or posterior element involvement was absent in all benign vertebral fracture (12) (Chan et al).

4.Abnormal diffuse Low S.I in T1WI : Regarding this finding in our study we found that MVC form (80%) vs. (26%) in BVC. Which is highly suggestive sign.

HEE-Sun Jung found that MVC form (63%) vs. (5% in BVC)(4)

…..On T1WI a malignant compression fracture shows complete replacement of normal B.M with diffuse low S.I in the whole vertebral body.(15) On T2WI high S.I is seen in collapse vertebral body . the enhancement is

usually inhomogeneous with diffuse or patchy distribution. (11)
B.M infiltration precedes osseous destruction and hence MRI is sensitive in detection early marrow infiltration.
In adult , Spine metastases commonly arise from breast , lung or prostate cancer, other frequent primary tumor are :

lymphoma, melanoma, renal cell carcinoma and multiple myeloma.(14)
2 patterns of vertebral metastasis seen on MRI : lytic and sclerosis, focal or diffuse …Lytic tumor are most common , they are hypo intense on T1wI and hyper intense on T1WI (10), Sclerotic metastasis are hypo intense on both T1WIandT2WI. (10).
All but the sclerotic malignant vertebral body compression fracture were hypo intense on T1WI SE imageand Hyper intense on fast STIR image with respect to normal B.M .The sclerotic compression fracture were markedly hypo intense on both T1WI SE and fast STIR image (12).
5. Lumbar in location , multiple vertebral level collapse (8) andin homogenous (Gd)enhancement found to be not useful in differentiation between BVC and MVC.(15,4)

Conclusions:

- Homogenous and diffuse abnormal S.I , posterior convexity , involvement of pedicle and epidural mass are sign that are strongly suggestion of MVC.
- Conversely , a band of low S.I adjacent to depressed end plate , preservation of S.I of vertebral body, retropulsion of posterior bone fragment, suggest benign nature of collapse.
- When MRI features are atypical or equivocal ; correlation with other imaging techniques , short interval follow up MRI and biopsy may be needed to make correct diagnosis.

A more formal prospective study with a large number of patients is needed to confirm these findings

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