Spinal versus whole body MRI in patients with multiple myeloma and monoclonal gammopathy of undetermined significance

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Introduction. Multiple myeloma (MM) is a B-cell malignancy of monoclonal plasma cells expanding in bone marrow and monoclonal gammopathy of undetermined significance (MGUS) its pre-malignant condition with the possibility of transformation into MM. The most widely used clinical staging system of Durie and Salmon is based upon laboratory parameters as well as on radiological findings. For the recently proposed Durie and Salmon PLUS staging system imaging modalities such as MRI and FDG-PET were included and used to determine the degree of bone marrow infiltration as well as the number of focal lesions [Durie BG et al., Hematol J 2003]. In most centers MRI of the spine is the standard technique to determine the infiltration pattern as well as the number of focal lesions. With fast imaging techniques MRI nowadays allows whole body imaging of MM patients within less than one hour so that all focal lesions of these patients can be detected. The aim of our study was therefore to evaluate if a spinal MRI is sufficient for evaluation of patients with newly diagnosed MM or MGUS or if a whole body MRI is necessary to detect all focal lesions.

	Normal	Diffuse (moderate/ severe)	Salt and Pepper	Total
No focal lesion	**27**	**28 (23/5)**	**4**	59
Focal lesion	**2**	**38 (34/4)**	**1**	41
Total	29	66 (57/9)	5	100

Table 1: *Distribution of spinal bone marrow patterns in patients with and without focal lesions.*

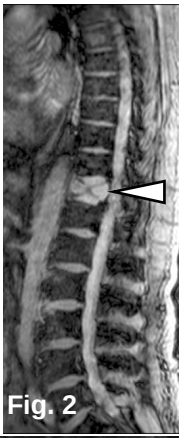
	Axial location of lesion			Extra-axial location of lesion		
	Number of lesions in bone	Number of lesions exceeding cortical bone	**Total**	Number of lesions in bone	Number of lesions exceeding cortical bone	**Total**
Number of patiens with focal lesion (% of patients with focal lesion)	24 (58.5)	14 (34.1)	**29 (70.7)**	35 (85.4)	11 (26.8)	**36 (87.8)**
Number of lesions (% of total number of focal lesions)	122 (35.4)	17 (4.9)	**139 (40.3)**	190 (55.1)	16 (4.6)	**206 (59.7)**

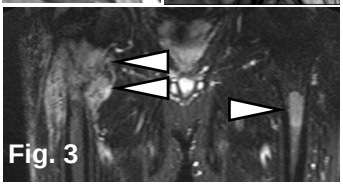
Table 2: *Distribution (axial or extra-axial location) and growth pattern (lesion within bone or exceeding cortical bone) of focal lesions.*

Materials and Methods. Whole body MRI was performed on a 1.5 Tesla Siemens Avanto in 100 patients with newly diagnosed MM or MGUS (T1 TSE coronal of the head, thorax, abdomen, pelvis and leg, slice thickness 5 mm; T2 TIRM coronal of the head, thorax, abdomen and pelvis, slice thickness 5 mm; T2 STAR FLASH 2D sagittal of the spine, slice thickness 5 mm; T1 TSE sagittal of the spine, slice thickness 3,5 mm). For all patients the MRI pattern of the spine was defined as „normal", „moderate diffuse", „severe diffuse", „salt and pepper" and „focal" as described before [Baur et al., Eur J Radiol 2005 and Stäbler et al. Am J Roentgenol 1996]. All focal lesions were counted separately for the „axial skeleton" (spine and sacral bone) and the „extra-axial skeleton" (all other osseous sites). Furthermore, each lesion was defined as „in bone" (osteolysis confined to cancellous or cortical bone) and „exceeding bone" (lesion is exceeding the cortical bone with infiltration of adjacent tissue). For all these lesions the biggest for each group were recorded. MRI data have been evaluated by two radiologists in consensus.

Results. In 100 patients with newly diagnosed MM or MGUS 29 patients (29%) were diagnosed with a „normal" bone marrow pattern, 66 patients (66%, Fig. 1) with a „diffuse" and 5 patients (5%) with a „salt and pepper" pattern (Table 1). In 59 of 100 patients (59%) no focal lesions were found on whole body MRI whereas in 41 patients (41%) focal lesions were detected. In these 41 patients 29 (70.7%) had lesions in the axial skeleton (Fig. 2) in comparison to 36 patients (87.8%) who showed lesions in the extra-axial skeleton (Fig. 3). Consequently, 12 patients (29.3%) had lesions exclusively in an extra-axial location, 5 patients (12.2%) exclusively in an axial location and 24 patients (58.5%) in both locations. Of the 29 patients with lesions in the axial skeleton in 24 (58.5%) a lesion was diagnosed within bone and in 14 patients (34.1%) the lesion exceeded cortical bone (versus 35 (85.4%) in bone and 11 patients (26.8%) exceeding bone for patients with extra-axially located lesions). In total 345 lesions were found in 41 patients, 139 lesions (40.3%) in an axial and 206 (59.7%) in an extra-axial location. The mean value for the lesions occurring in bone was 5.7 cm^2 and for those exceeding the cortical bone 20.9 cm^2 (data not shown).

Discussion. In patients with newly diagnosed MM or MGUS the majority of focal lesions was detected in the extra-axial skeleton which would not have been seen in spinal MRI only. With a MRI of the spine lesions in an extra-axial location would not have been detected in almost ninety percent of patients. In more than one quarter of patients with focal lesions osteolysis exceeding cortical bone would have been missed, assuming a high risk for pathologic fractures in these patients. Whole body MRI might not be necessary if a „normal" pattern is found in the spinal MRI as almost all patients with this pattern had no focal lesions. In conclusion, whole body MRI is a valuable tool for detection of focal lesions in patients with newly diagnosed MM and MGUS as the majority of lesions are located extra-axially and therefore would not have been diagnosed with spinal MRI only.





Figures 1-3: *MRI in patients with MM.* ***Fig. 1*** *(T2 TIRM coronal)****:*** *Extra-axial location of a focal lesion in the right femur exceeding cortical bone (hyperintense, double arrow) and a focal lesion within the bone marrow of the left femur (hyperintense, arrow).* ***Fig. 2*** *(T1w TSE sagittal)****:*** *Diffuse infiltration of all vertebrae (hypointense bone marrow).* ***Fig. 3*** *(T2 STAR sagittal)****:*** *Focal lesion in a verteba of the thoracic spine (hyperintense, arrow).*