Multiple myeloma imaging

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Abstract Imaging myeloma is often performed when complications occur which may reveal the disease. Since the malignant plasma cell proliferation characteristic of this disease can affect the whole of the bony skeleton to various degrees, examination of the bones should be as complete as possible. The radiographic images must be studied for lytic lesions or signs of diffuse osteopenia, as well for fracture complications such as vertebral compression. Slice imaging has the advantage of being more sensitive and showing extra-osseous extension well. With a CT scan and MRI, spinal compression can be detected or a surgical procedure planned, while MRI or a PET scan can be used to assess extension of the disease and the response to treatment.

Multiple myeloma is a malignant haematological disease defined as the proliferation of malignant plasma cells in the bone marrow secreting a monoclonal immunoglobulin found in the serum and/or urine. It is an incurable disease of the elderly (the median age on diagnosis is 70) with a low incidence; about 5000 new cases are diagnosed per year in France. Myeloma is very frequently preceded by an indolent phase, before clinical signs appear. The myeloma becomes symptomatic and then requires treatment by chemotherapy. The most common clinical symptoms (in 80% of patients) are related to bone lysis, resulting in refractory pain, fracture, vertebral collapse or spinal cord compression. Other signs of its clinical evolution are anaemia, hypercalcaemia, renal impairment, repeated infections and hyperviscosity. Before any treatment, the patient must have a complete radiological examination of the bones.

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Conventional radiology

Lytic lesions on conventional X-rays are typically circular punched-out lesions, without reconstruction, clearly visible on the cranial vault, the iliac bone or on the long bones, essentially the femur and humerus. Vertebral compression is common, as it is an appearance of diffuse osteopenia.

A complete examination may be necessary once symptomatic myeloma has been diagnosed. It consists of frontal and lateral images of the skull and of the cervical, dorsal and lumbar spine, frontal views of the pelvis, images of the rib cage and long bones (humerus and femur only).

On radiological examination, nearly 80% of patients have obvious bone lesions, principally affecting the spine, in 65% of cases, the ribs, in 45% of cases, the skull, in 40% of cases, the shoulder, in 40% of cases, the pelvis, in 30% of cases and the long bones in 25% of cases. It is unusual to find lesions of the elbows or knees or distal lesions. This explains why distal sites are not systematically imaged. It must be remembered that bone lesions are not seen in 10 to 20% of patients despite a complete radiological examination. This emphasizes the limitations of conventional radiology: certain areas are not visualised, sensitivity is relatively poor and 10 to 20% of lesions are not seen, specificity is limited relative to other benign causes of osteopenia, and it is difficult to pick out a response to treatment. Moreover, the large number of images necessary for diagnosis may be an obstacle in patients in extreme pain who cannot remain lying on the examination table for very long.

CT scan

CT can detect small osteolytic lesions in myeloma, which are not seen on standard X-rays. CT imaging is quicker than conventional radiology and allows excellent reconstruction of images in three dimensions. In addition, CT scans can show precisely the extent of extra-osseous lesions (extra-medullary plasmacytomas), and fine needle biopsies can be taken using it, to obtain histological evidence of the nature of these lesions. CT has the following advantages over conventional radiology: the examination is rapid relative to standard X-rays; several lesions can be rapidly evaluated in one go, without having to reposition the patient, particularly if he or she is in pain; a CT scan is more sensitive than a standard X-ray; CT examination reveals more lesions, particularly in areas poorly visualised by standard radiology such as the shoulders, ribs, or sternum; CT is also more effective for estimating a risk of fracture or instability, and can pick out extra-medullary lesions; CT also helps plan radiotherapy or a surgical procedure. One of the negative points of CT is the dose of radiation delivered to the patient which is 1.5 to three times higher than for a conventional radiograph.

MRI

This examination has become very important in evaluating myeloma lesions. The advantages of MRI compared with conventional X-ray imaging are greater sensitivity, extremely precise imaging of the axial skeleton, discrimination between normal and invaded bone marrow, very precise diagnosis where spinal cord or neurological compression is suspected, with very good visualisation of extra-medullary masses, visualisation of other conditions associated with the myeloma such as cardiac amyloidosis, and also an important plus value concerning evaluation of the therapeutic response, even if the lesions may persist for a long time in a patient with an excellent therapeutic response.

The prognostic value of MRI has been evaluated in several studies. The number of lytic lesions is an important prognostic factor, as is the appearance in an MRI of diffuse infiltration, which has a poorer prognosis than more focal infiltration. The largest study in the literature was reported by the group in Little Rock, Arkansas, and concerned 611 patients treated identically. The MRI appearance and a number of lesions more than or equal to 7 were major prognostic factors, more important than the cytogenetics, and allowed patients with a high risk of evolution to be distinguished more easily.

PET imaging

PET imaging in myeloma is still not totally validated. Nevertheless, more and more data suggest that this technique will grow considerably in importance in the coming years. Indeed, several groups have shown that PET could be more sensitive than MRI. An Italian group has shown that the number of lesions found at the time of diagnosis is an important prognostic factor. The therapeutic response can also be evaluated with PET. The same Italian group showed that a negative PET signal predicted progression-free survival and better overall survival for patients who had an excellent response to treatment. PET can also give much more precise measurement of the quality of the response. In patients in complete biochemical remission, PET scans discriminate between two populations: those who remain PET positive despite negative biochemical results and have a poorer clinical future than the second group who are both biochemically and PET negative at the end of treatment.

A national STIC (Support for Techniques which are Innovative and Costly) programme is underway to evaluate the MRI/PET comparison prospectively and systematically in the context of an intensive treatment programme.

Conclusion

In conclusion, the reference imaging technique for evaluating a myeloma at the time of diagnosis is still conventional radiology. CT and MRI have better sensitivity and specificity, and are used above all in cases of menacing medullary lesions. In the future, a PET scan will perhaps be the standard examination for both diagnosis and prognosis.

Disclosure of interest

The authors declare that they have no conflicts of interest relating to this paper.
Further reading

