MRI PROTOCOLLING FOR SARCOMA IMAGING

Bone tumor

1. image entire involved bone with adjacent joints in T1 cor or sag to evaluate entire tumor length/extension in bone and skip lesions

2. make sure that the same sequences are chosen for f-up MRI imaging, which allows 1:1 comparison

3. transverse images of entire tumor with good in-plane-resolution with 3 different contrasts: T2, T1, T1 after i.v. contrast media injection. Calculate subtraction images (contrast minus non-contrast). Sequence parameters should be equivalent for all 3 sequences

4. T1 FS (= t1-weighted images with fat saturation) in coronal and/or sagittal plane

5. T2-weighted images in coronal or sagittal plane, optional with fat saturation

Soft tissue tumors

1. STIR cor to show tumor size and extent

2. T2, T1, T1+cm in transverse plane

3. T1 FS cor +- sag planes

4. T2 additioinal plane(s)

Follow-up after surgery

- TIRM cor

- T2 sag

- T1 tra

- T1 tra w/wo fatsat after contrast media injection (Gadolinium)

General remarks

- make sure that imaging includes tumor in all 3 planes

- T1 shows tumor extent in bone marrow. Normal bone marrow contains fat and has high signal in T1. Tumor replaced normal fat marrow and has lower signal. Skip lesions in bone marrow are detected

- T2 is excellent for soft tissue components of tumor and relation of tumor to vessels and nerves, especially in transverse plane

- T1 after administration of i.v. contrast medium (Gadolinium) leads to signal rise in tumor due to contrast accumulation (= contrast enhancement). Degree of enhancement depends on vascularity of tumor.

- MR angiography may be useful in highly vascularized tumors for planning of interventions or surgery.

- Tumor perfusion can be evaluated by T1-weighted MR imaging and has been used for pre- and post-chemotherapy evaluation of osteosarcomas, but postprocessing of images requires dedicated software which is not everywhere available

- cortical bone gives no signal in MRI. Trabecular structures can not be seen very well. CT is preferred for these structures

- metal implants cause artifacts and may obscure tumor recurrence, even if metal artifact reduction techniques (MARS) are used

Other imaging modalities

- CT imaging is mandatory for bone tumors to show osteolytic and osteosclerotic changes. MR imaging is not reliable in assessing bone destruction

- catheter angiography and pretherapeutic embolization of tumors maybe helpful immedately before surgery

- Chest CT is preferred method to exclude lung metastases

FDG-PET/CT

- Used only for selected situations

- best method for staging for certain sarcoma types (e-g- vascular lesions, EWS, etc)

- allows for identification of foci with highest dedifferentiation

- imaging pre and post chemotherapy may give good information about tumor response for certain sarcoma types

→ **MAKE SURE THAT THE IMAGING INCLUDES THE COMPLETE TUMOR IN ALL 3 PLAINES.**

Explanation:

T1=   good for anatomy of joints and soft tissues, good resolution of vessels and nerves. Most important for assessment of bone marrow. Tumors which invade fat marrow and thereby affect T1 signal, which is measured as spinecho- or turbo spinecho (TSE) . Effect of contrast media application is seen on T1-weighted images (= contrast enhancement). Tumors can have low, intermediate or high contrast enhancement, depending on vascularity.

T2=   good for the anatomy of tendons-, ligaments- and vertebral discs. Not very sensitive without fatsat (FS; therefore most often used), but very specific.

PD-fatsat, STIR, TIRM or T2-fatsat=   working horses of musculoskeletal imaging for screening. All mentioned sequences are sensitive for liquid, which is often shown bright. Nearly all pathologic processes go along with a signal increase.

MRA 3D Centra=   dynamic KM-sequence, with as of now still unclear benefit.

MARS, Semac and VAT represent metallic artifacts reducing algorithms.

ADAPTED FOR TUMOR MEGAPROSTHESES WITH MARS SEQUENCES:

T1_TSE_TRA_Mars

T2_TSE_TRA_Mars

T2 Mars_TSE_cor or sag

STIR Semac/Vat_TSE_cor or sag

T1_KM_tra_Mars