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## Role of Nuclear Medicine in Combination with Magnetic Resonance Imaging

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MRI, bone scintigraphy, MIBG scintigraphy and FDG-PET are diagnostic imaging modalities that allow visualization of morphological as well as functional features of different diseases in childhood. MRI and nuclear medicine methods are often used separately or even in competition. Some of the most important indications for both PET and MRI lie in the field of pediatric oncology. The malignant diseases in children are leukemia, brain tumors, lymphomas, neuroblastoma, soft tissue sarcomas, Wilms' tumor, and bone sarcomas. Apart from leukemia, correct assessment of tumor expansion with modern imaging techniques, mainly consisting of ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET), is essential for cancer staging, for the choice of the best therapeutic approach, and for restaging after therapy or in recurrence [1, 2].

MRI is an excellent tool for noninvasive evaluation of tumor extent and has become the study of choice for evaluating therapy-induced regression in size of musculoskeletal sarcomas. It directly demonstrates the lesion in relationship to surrounding normal structures with exquisite anatomical detail. [3, 4]

Especially in children, MRI offers several fundamental advantages compared to computed tomography (CT) examinations and other whole-body imaging modalities, such as the absence of radiation exposure, non-use of iodinated, potential nephrotoxic contrast agents, a high intrinsic contrast for soft tissue and bone marrow, and accurate morphological visualization of internal structure, all of which are decisive factors in tumor staging. Due to its much higher intrinsic soft tissue contrast compared to CT, MRI has been shown advantageous in neuroradiological, musculoskeletal, cardiac, and oncologic diseases [2]. On the other hand, CT plays a major role in the assessment of thoracic lesions and masses due to a lower frequency of movement artifacts.

Because structural abnormalities are detected with high accuracy, MRI generally has a high sensitivity for detecting structural alterations, but a low specificity for further characterization of these abnormalities. Frequently, these structural abnormalities are not reliable indicators of viable tumor tissue, especially after treatment [4].

It is important to emphasize that MRI and nuclear medicine methods are not competing modalities. Instead, these methods in combination can produce a synergy between function and morphology. For planning of biopsies and resective surgery the knowledge of function (i.e. tumor viability) provided by PET and MIBG scintigraphy, and of the exact morphology of the tumor provided by MRI is often crucial.

In patients with cerebral lesions, the whole spectrum of digital image fusion with direct superimposition of several modalities with subsequent three-dimensional reconstruction should be applied. Direct image superimposition is not necessary for extracranial questions because information from individual modalities may partially be lost during fusion. The simultaneous evaluation of both modalities is to be emphasized. Very useful is the synchronized evaluation of corresponding slices from both modalities displayed at a single workstation. This is the most reliable method of immediately and efficiently correlating pathological and especially unclear findings with the corresponding slice on the other imaging method.

Because of MRI's low specificity in oncological staging and especially at follow-up monitoring, the application of PET and/or MIBG scintigraphy for evaluating tumor vitality is essential.

**References**

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