

69. Adrenal Disease

The normal adrenal gland appears hypointense to surrounding perinephric fat and hypo- or isointense to the liver on both T1 and T2WI. Breath-hold imaging techniques include HASTE for T2WI and 2D GRE or 3D VIBE sequences for T1WI, with this approach important to eliminate respiratory artifact. MRI is useful in localizing and characterizing masses of the adrenal gland due to its multiplanar capabilities and ability to detect fat content of a lesion. The latter results in part from the ability to obtain in and out-of-phase GRE T1WI. Like spectral fat suppression techniques, such sequences exploit differential resonance frequencies of fat and water protons. Within a given voxel immediately following an initial radiofrequency excitation pulse (i.e. the factor enabling T1 and T2 relaxation) both lipid and water protons are aligned (i.e. in phase). Due to their differing resonance frequencies, however the relative phases of water and fat protons begin to immediately change. Since the relative resonance frequencies of fat and water protons are known, the time to echo (TE) can be selected such that water and fat protons are completely in or out-of-phase with each other. In the latter case, the SI from such protons cancel, manifesting as low SI on out-of-phase images. Voxels solely possessing water or fat protons, however, appear relatively unchanged on out-of-phase images. In practice, in and out-of-phase images are typically obtained as part of a double-echo sequence, an approach for which clinical utility rests on the selection of a relatively short TE for out-of-phase images: GRE is sensitive to T2* effects which will be more pronounced at longer TEs. Thus, losses in SI from T2* decay may masquerade as SI dropout from fat on out-of-phase images obtained with a long TE.

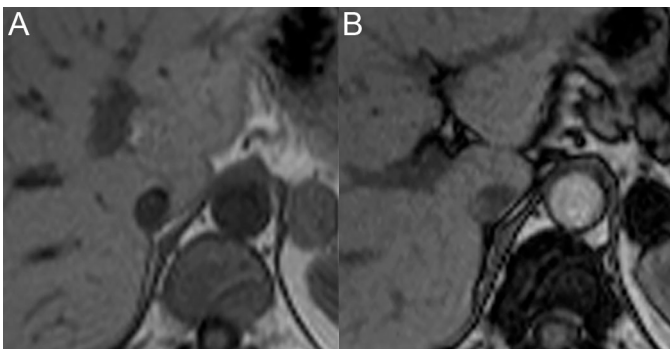


Fig. 69.1

Figures 69.1A,B illustrates a round, sharply demarcated, homogeneous lesion within the left adrenal gland on in and out-of-phase GRE T1WI, respectively. On the former, the lesion is isointense to the liver, while lesion SI decreases significantly on (B) out-of-phase

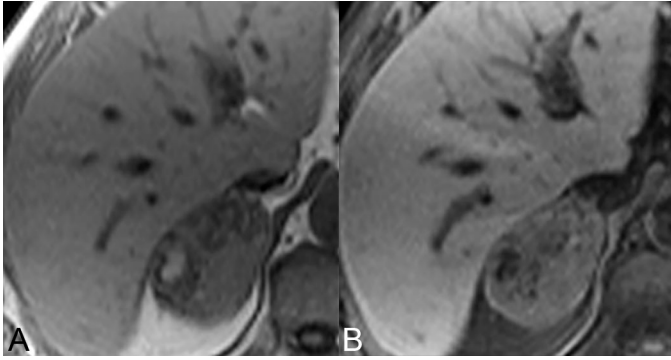


Fig. 69.2

GRE T1WI owing to SI dropout—due to the presence of fat and water within the same voxel as described above. These features are characteristic of a benign adrenal adenoma. Out-of-phase images may be identified by the prominent outlining of masses or organs at their interface with fat by a thin artificial low signal intensity line ('etching' artifact). This is appreciable in the out-of-phase GRE T1WI of Fig. 69.1B at the medial edge of the liver. On FSE T2WI fatty adrenal adenomas may appear hyper- or isointense to the liver, while enhancement is less prominent than that of more ominous lesions, often washing out rapidly on dynamic CE imaging. Nonfatty adenomas represent a diagnostic conundrum, the solution to which may be provided by delayed enhanced CT or confirmation of stability on followup imaging. Adrenal myelolipomas are slow-growing, benign masses characteristically possessing macroscopic fat, the presence of which is better detected by SI dropout on FS T1WI than on out-of-phase imaging. This is illustrated in the T1 and FS T1WI of Figs. 69.2A,B, respectively, with focal areas of fat suppressed within the adrenal lesion in the latter sequence. Increasing myeloid content increases the propensity of such lesions to enhance.

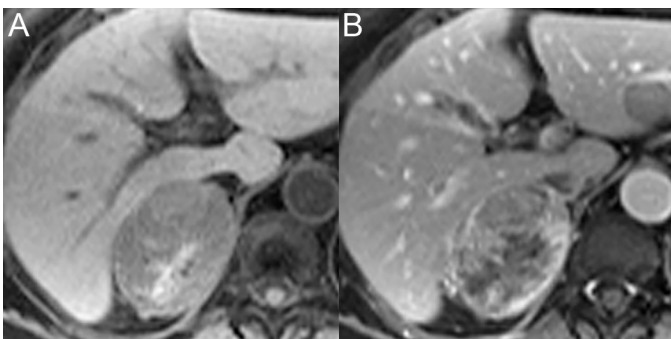


Fig. 69.3

Although adrenocortical carcinomas may contain fatty elements, lesions lacking SI dropout on out-of-phase images are concerning for malignancy. The characteristic appearance of an

adrenocortical carcinoma is demonstrated in Fig. 69.3: a large, heterogenous, partially hypointense mass is seen on (A) T1WI. Opposed phase images (not shown) showed no significant SI dropout. (B) FS CE T1WI demonstrates diffuse, heterogenous enhancement of this large lesion—changes consistent with malignant degeneration. The tumor illustrated in Fig. 69.3 also exhibited delayed contrast washout—another characteristic of adrenal carcinoma. MRI accurately detects the spread of adrenal carcinoma to the inferior vena cava, demonstrating loss in the normal flow voids of that structure on FSE imaging.

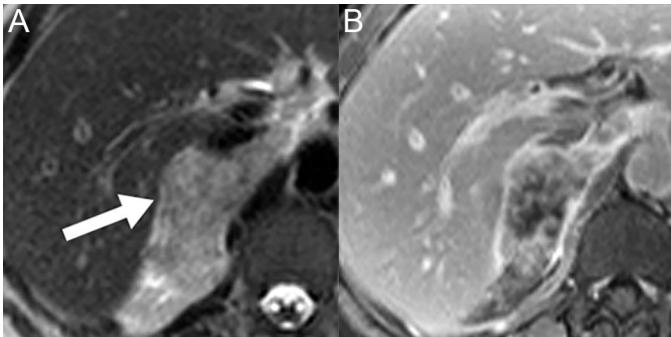


Fig. 69.4

Correlating with its high vascularity, the adrenal gland is overall the fourth most common site of metastatic disease. However benign hyperplastic adrenal enlargement is not uncommon in cancer patients, which combined with the high prevalence of adenomas overall further complicates evaluation. Adrenal biopsy in cancer patients is thus reserved only for masses with imaging characteristics atypical for adenoma. Other than those of clear cell renal carcinoma, adrenal metastases are typified by a lack of SI dropout on out-of-phase GRE T1WI. Figure 69.4 demonstrates the typical appearance of a metastasis, revealing a large, heterogenous adrenal mass (white arrow) on (A) T2WI. (B) FS CE T1WI show heterogenous lesion enhancement with irregular, enhancing margins.

Pheochromocytomas are potentially malignant tumors for which MR is both sensitive and relatively specific for diagnosis. These medullary tumors are devoid of fat, exhibiting classically, due to high water content, marked hyperintensity on T2WI. This is shown in the T2WI of Fig. 69.5A. Simple adrenal cysts typically demonstrates higher SI than pheochromocytomas on T2WI, the definitive distinction lying in the early, bright CE with delayed washout seen in the latter. The enhancement of the lesion illustrated in the FS T1WI of Fig. 69.5B is less typical, being heterogeneous in nature. Ten percent of pheochromocytomas are bilateral and the same percentage calcify—the latter feature better detected with CT. Tuberculosis, also often bilateral, is a further differential concern, along with histiocytosis, both of which may appear as cystic or rim-enhancing masses. Adrenal

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hemorrhage demonstrates SI characteristics varying with the stage of the hemorrhagic blood products. GRE images are especially sensitive to the detection of hemorrhage. A large adrenal hematoma may present as a mass-like lesion, although hematomas will usually resolve over time, not enhance, and possibly develop into a pseudocyst over time. Considerations for an adrenal mass in a pediatric patient are described in Chapter 72.

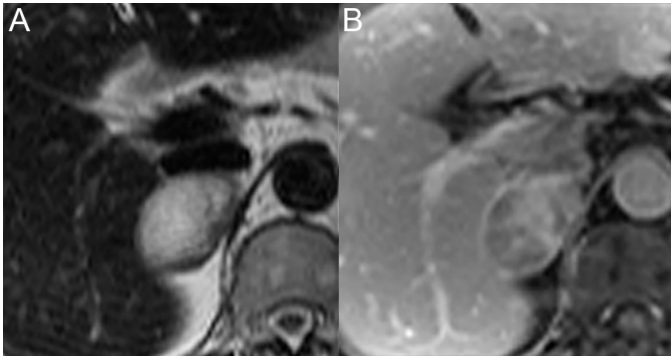


Fig. 69.5