CT and MRI Findings in Testicular Cancer

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84.1 Introduction

Ultrasonography (US) remains the primary imaging method for detecting testicular masses. Magnetic resonance imaging (MRI) of the scrotum is an efficient diagnostic tool, but it is usually used when the US findings are equivocal. Computed tomography (CT) is the standard imaging modality for the staging and follow-up evaluation of testicular tumors, while MRI may be helpful in patients with an inconclusive CT study.

84.2 Diagnosis

In general, the diagnosis of testicular cancer is made pathologically at surgery. The US is the imaging method of choice for confirming the presence of a testicular mass which has been detected in clinical examination. MRI is mainly used as a problem-solving tool. The diagnostic accuracy of MRI in the preoperative characterization of malignant testicular tumors is higher than 96% [1].

The differentiation of seminomatous from nonseminomatous testicular neoplasms is clinically important as treatment and prognosis differ

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between the two tumor types. MRI may be helpful in the histologic subtyping of testicular cancer [2], but this has little clinical value because orchidectomy is mandatory for primary treatment.

On MRI, seminomas are usually well defined and homogeneous and appear as hypointense lesions within the high-signal normal testicular parenchyma on T2-weighted images (Fig. 84.1). On the other hand, nonseminomatous tumors are typically more heterogeneous masses on both T1-weighted and T2-weighted images, with areas of hemorrhage or necrosis showing heterogeneous enhancement after intravenous gadolinium administration.

84.3 Staging

Once the diagnosis of testicular cancer has been established, assessment of disease extent must be performed. The TNM staging system is mainly used [3]. MRI seems to be more efficient than US in evaluation of local tumor extension, but it is of little significance as every patient with a testicular cancer must undergo orchidectomy, and thus the histological analysis of the specimen is taken into account in determining the T stage (postoperative T staging) [4].

Testicular cancer lymphatic spread follows the testicular veins to para-aortic lymph nodes up to the level of the renal hila reflecting the retroperitoneal embryological origin of the tes-
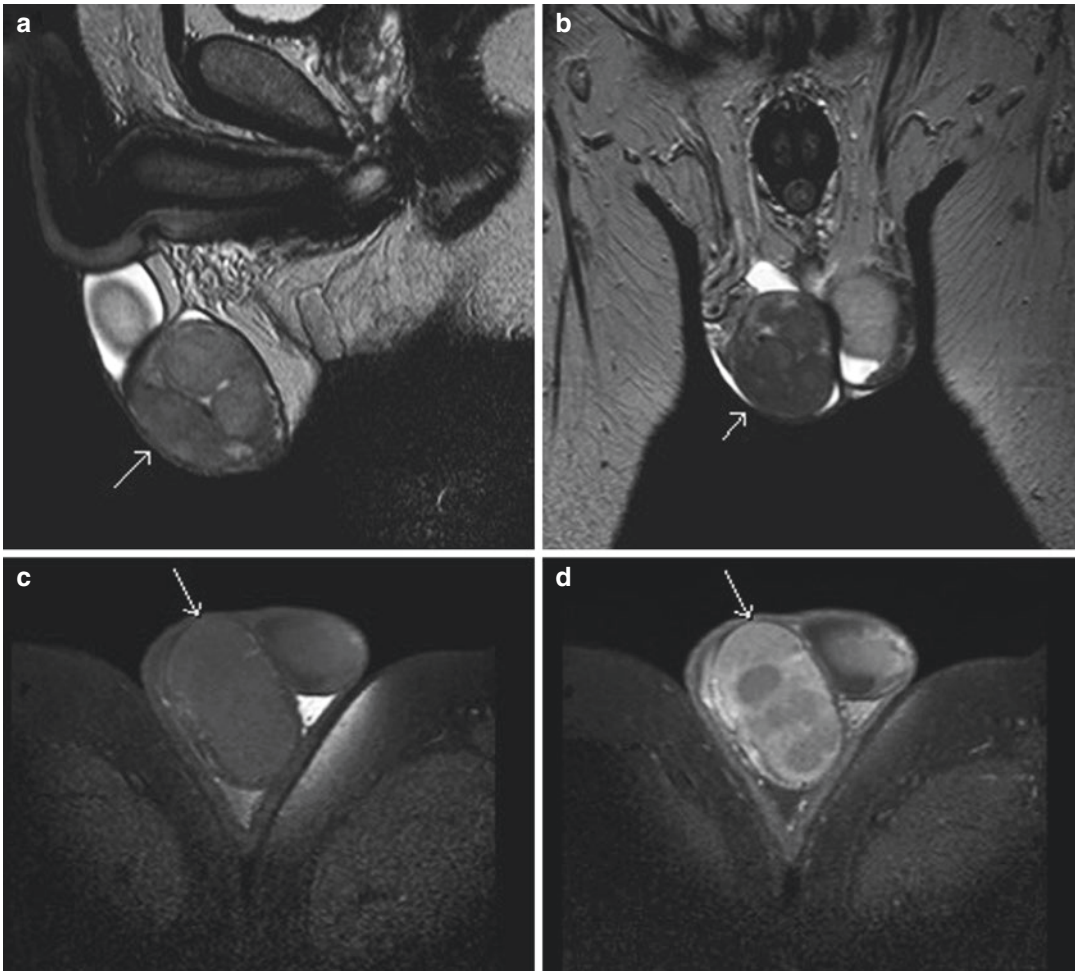
Fig. 84.1 A 29-year-old man with seminoma of right testicle. Sagittal (**a**) and coronal (**b**) T2-weighted MR images show multinodular right testicular lesion (*arrow*) of low signal intensity compared with normal testicular paren- chyma. Transverse T1-weighted MR images before (**c**) and after (**d**) gadolinium administration show enhancement of the mass (*arrow*)

tis [5]. Lymph nodes in the aortocaval chain at the level of the second lumbar vertebral body are considered as the primary sites of spread for right-sided tumors, while left-sided tumors typically spread to lymph nodes left para-aortic nodal group just below the left renal vein. Isolated contralateral nodal metastases (without the presence of the ipsilateral nodes) are uncommon. Moreover, metastases to the pelvic and inguinal lymph nodes are also rare in the absence of bulky retroperitoneal disease or previous scrotal or inguinal surgery (because the normal lymphatic drainage pathways are disrupted by surgery) [5]. Mediastinal nodal involvement may also occur in patients with metastatic retroperitoneal lymph nodes. Hematogenous spread most commonly occurs to the lungs. Other common sites of disseminated disease include the brain, bones, and liver, although essentially any organ may be involved mainly in the setting of advanced disease [6].

Multidetector CT (MDCT) remains the most widely available and primary imaging modality for testicular cancer staging. Metastatic lymphadenopathy varies in size from small lymph nodes to bulky masses (Fig. 84.2). On CT, nodal masses from seminoma frequently appear of soft tissue attenuation, whereas ret-
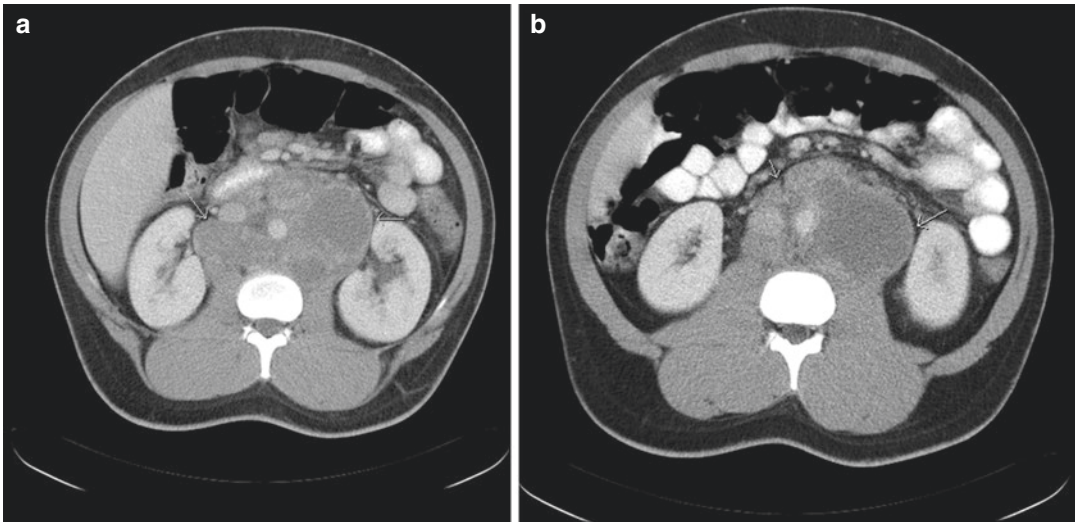
Fig. 84.2 A 24-year-old man with metastatic nonseminomatous germ cell tumor. CT images (**a**, **b**) show a large heterogeneous retroperitoneal nodal mass (*arrows*)

roperitoneal masses from nonseminomatous tumors tend to be heterogeneous in density, with areas of cystic change and soft tissue elements [6]. In large-volume disease, the diagnosis of metastatic lymphadenopathy is readily made; however, the assessment of small-volume metastatic disease (which is critical for patient staging and management) is often inaccurate, as a substantial proportion of lymph nodes with microscopic invasion are not enlarged to an abnormal size. Taking the standard lymph node size criterion (short axis diameter larger than 1 cm), the CT specificity for retroperitoneal metastatic lymphadenopathy is high (up to 100%); however, its sensitivity is low (ranges from 24% to 78%) [4, 7]. MRI is comparable to CT for detecting lymph nodes [8] and has the same limitation of using size criteria (inability to detect microscopic invasion in normal-sized lymph nodes and differentiate malignant from reactive lymphadenopathy). Therefore, MRI is proposed as an alternative method for retroperitoneal nodal evaluation, especially in young adults to whom radiation exposure should be avoided. Moreover, new MRI techniques such as lymphotropic nanoparticle-enhanced MRI are being explored in detecting lymph node metastasis [9].

MDCT is the most useful imaging method for assessing metastatic disease in the chest, abdomen, and pelvis. Concerning hematogenous spread to lungs, CT is the ideal method. For the detection of liver metastases, MRI is a sensitive technique; however, it is used as problem-solving tool when CT findings are inconclusive. Brain imaging (CT or MRI) and bone scanning are generally performed only in the presence of symptoms suggesting disease at these sites and in patients with multiple metastases and poor prognosis. Concerning cerebral metastases, MRI is more sensitive for the detection of smaller lesions than CT.

84.4   Follow-Up Evaluation: Response to Therapy

Another important use of radiologic imaging is for early detection of tumor recurrence. In testicular cancer, recurrence mainly occurs in the retroperitoneal lymph nodes and within the first year after orchidectomy [4]. Early detection of tumor relapse is clinically important because it is associated with a very high survival rate after treatment. CT remains the mainstay of imaging in the follow-up protocols. Some authors still

recommend that chest radiography can be sufficient for assessment of the lung, especially in low-risk groups of metastatic disease, despite the fact that it is far less sensitive than chest CT. Brain imaging is indicated in cases where there is clinical suspicion of brain metastases. The abdominopelvic MRI is mainly used when iodinated contrast agent is contraindicated, such as in the cases of compromised renal function and severe allergy. However, abdominopelvic MRI could be used as an alternative method for the assessment of abdominal metastatic disease in order to reduce radiation exposure. The frequency of monitoring varies depending on the type of the tumor, stage, and initial treatment. As the relapses mainly occur within the first year after orchidectomy, follow-up should be more intensive in the first year.

CT is the primary imaging method for monitoring the response to therapy, mainly by measuring the change in size of metastases. Reduction in the size of metastases shows a response to the treatment, while increase in the size or appearance of new lesions indicates progression of the disease. However, a retroperitoneal persistent nodal mass frequently remains after therapy. The observation of retroperitoneal residual mass does not always indicate the presence of viable tumor cells, as this residual mass after therapy may consist of only fibrotic and necrotic tissues. It is impossible to distinguish necrotic remnants from residual vital tumor tissue preoperatively. PET is more accurate than conventional imaging modalities for assessing the success of treatment in the presence of residual masses, especially in pure seminoma [10].

Conclusion

For diagnosis of testicular cancer, US confirms the presence of a testicular tumor, while MRI is a valuable problem-solving tool. CT is the standard imaging technique for staging, monitoring during treatment, and follow-up of patients with testicular cancer, although other imaging methods (chest radiograph, MRI, and PET) are also helpful playing a supportive role.

References

1. Tsili AC, Argyropoulou MI, Giannakis D et al (2010) MRI in the characterization and local staging of testicular neoplasms. AJR 194(3):682–689
2. Tsili AC, Tsampoulas C, Giannakopoulos X et al (2007) MRI in the histologic characterization of testicular neoplasms. AJR 189(6):331–337
3. Albers P, Albrecht W, Algaba F et al (2011) European association of urology. EAU guidelines on testicular cancer: 2011 update. Eur Urol 60(2):304–319
4. Brunereau L, Bruyère F, Linassier C et al (2012) The role of imaging in staging and monitoring testicular cancer. Diagn Interv Imaging 93(4):310–318
5. Paño B, Sebastià C, Buñesch L et al (2011) Pathways of lymphatic spread in male urogenital pelvic malignancies. Radiographics 31(1):135–160
6. Sohaib SA, Koh DM, Husband JE (2008) The role of imaging in the diagnosis, staging, and management of testicular cancer. AJR 191(2):387–395
7. Dalal PU, Sohaib SA, Huddart R (2006) Imaging of testicular germ cell tumours. Cancer Imaging 6:124–134
8. Sohaib SA, Koh DM, Barbachano Y et al (2009) Prospective assessment of MRI for imaging retroperitoneal metastases from testicular germ cell tumours. Clin Radiol 64(4):362–367
9. Hilton S (2009) Contemporary radiological imaging of testicular cancer. BJU Int 104:1339–1345
10. Becherer A (2011) PET in testicular cancer. Methods Mol Biol 727:225–241