Prostate Cancer: Dynamic Contrast-enhanced MR Imaging

Lopes Dias, João; Fialho, Joana; Alves, Pedro; Almeida, Cristina; Cordeiro, Ana Rosa; Mateus Marques, Rui
Serviço de Radiologia – CHLC – Hospital de S. José

The tumor angiogenesis and the characteristic surrounding interstitial environment can be used as a diagnostic marker of disease, since it changes the tissue’s enhancement pattern after contrast administration. The cancerous tissue has an increased number of vessels due to the production and release of angiogenic factors (vascular permeability factor or vascular endothelial growth factor) and its permeability is greater than normal vessels.

DCE MR imaging provides direct depiction of tumor vascularity and may avert the use of an endorectal coil. A full dose (0.1 mmol/ kg) of gadolinium is generally injected at 3 mL/sec, and serial 3D acquisitions are obtained every 2–5 seconds through the prostate. That way, it is possible to display quantitative kinetic parameters reflecting contrast washin and washout, including onset time, time to peak enhancement, peak enhancement, relative peak enhancement (comparing to normal tissue), and washout time.

Tumors often demonstrate early nodular enhancement before the rest of the parenchyma and early washout of signal intensity, a pattern which is highly predictive of prostate cancer despite being non pathognomonic. Engelbrecht et al demonstrated that the relative peak enhancement was the most accurate perfusion parameter for cancer detection in the peripheral zone and central region of the gland. The detection of areas of enhancement on early postcontrast images (within the first 30–60 seconds after contrast material injection) may also be used to detect cancer.

DCE was considered a useful technique for cancer detection and tends to obtain higher sensitivity values than that of T2WI. One study reported sensitivity of 73% and specificity of 81% for dynamic contrast-enhanced MRI at 1.5 T in defining prostate cancers and another found comparable values at 3T. However, it is important to note that some prostate tumors are only mildly or moderately hypervascular and thus are not detectable through this technique. Moreover, smaller and low grade tumors may not demonstrate abnormal enhancement on DCE-MRI.

DCE MRI can also be used for determining the effectiveness of hormone deprivation therapy which tends to reduce the tumor permeability and to change the tissue washout pattern.

LIMITATIONS

DCE MRI has an important limitation (Fig 2): the insufficient depiction of transitional zone cancer in patients with hypervascular benign prostatic hyperplasia because abnormal enhancement patterns may be seen in both tumors and benign nodules.

Some studies like that of Kim et al demonstrated that dynamic contrast-enhancement analysis was more accurate for the detection of prostate cancer in the peripheral zone than conventional T2-weighted imaging alone.