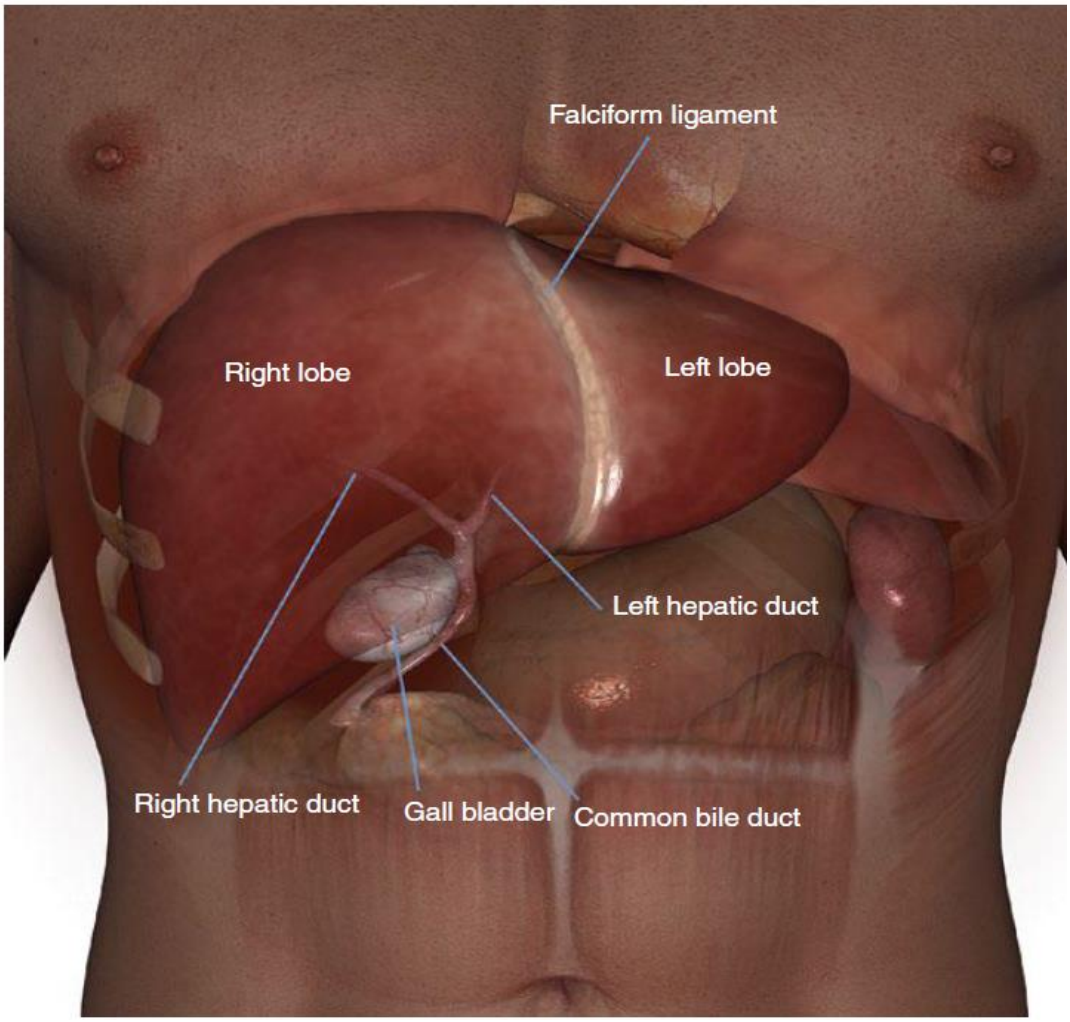
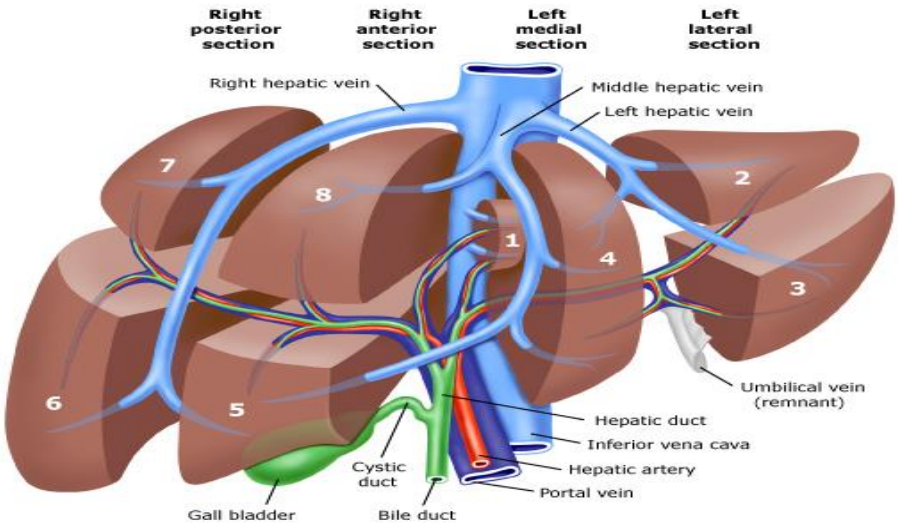
Liver and biliary system

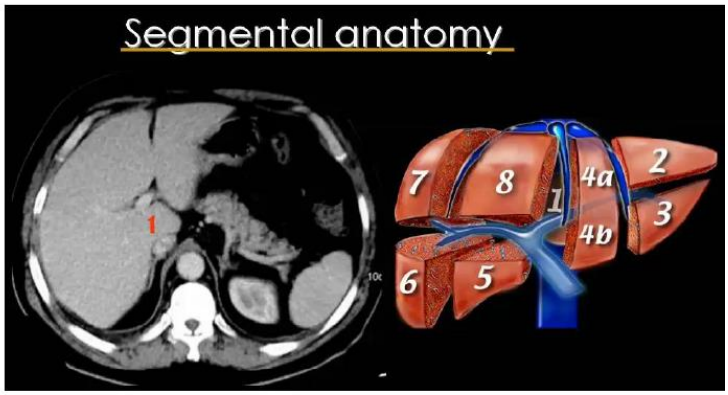
Basic anatomy

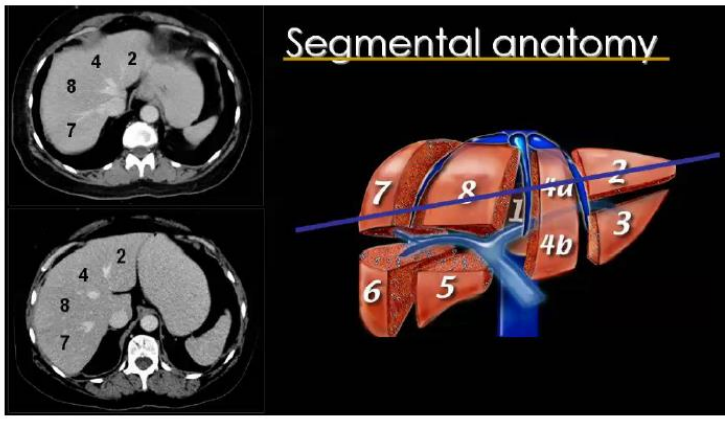


Common indications

- Focal lesions and staging of neoplasms
- Benign hepatic disease, especially haemangioma and focal nodular hyperplasia
- Haemochromatosis
- Gallbladder disease
- Biliary duct obstruction
- Evaluation of liver infiltrants such as iron or fat


Right posterior section
Right anterior section
Left medial section
Left lateral section
Right hepatic vein
Middle hepatic vein
Left hepatic vein
7
8
1
4
2
3
6
5
Umbilical vein (remnant)
Hepatic duct
Inferior vena cava
Hepatic artery
Portal vein
Cystic duct
Gall bladder
Bile duct


Segmental anatomy
7
8
1
4a
2
3
4b
6
5


Segmental anatomy
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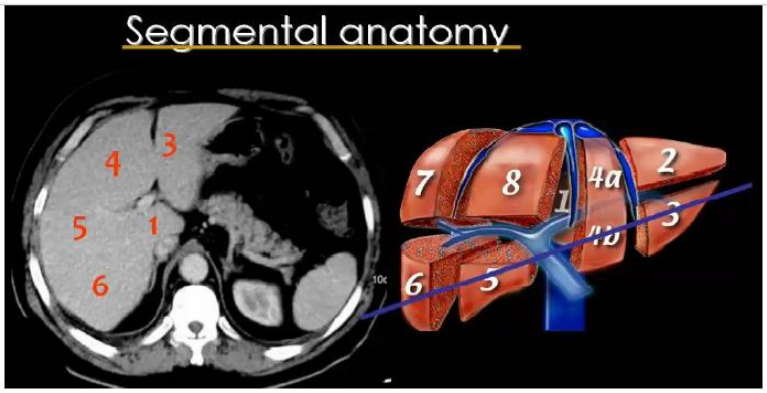
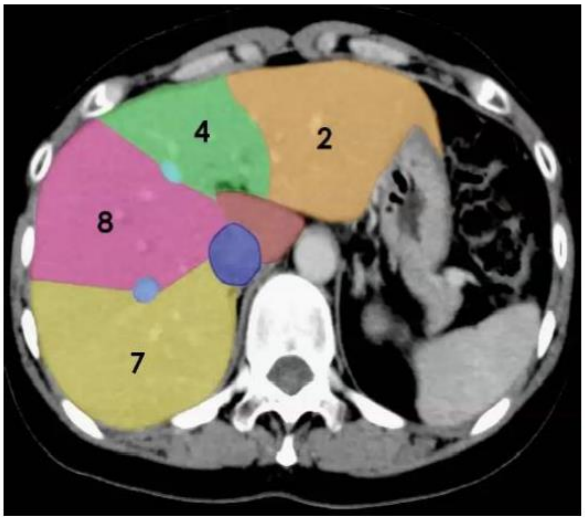
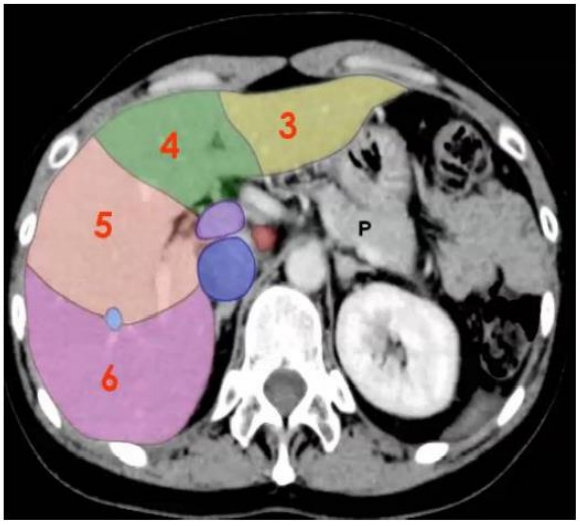




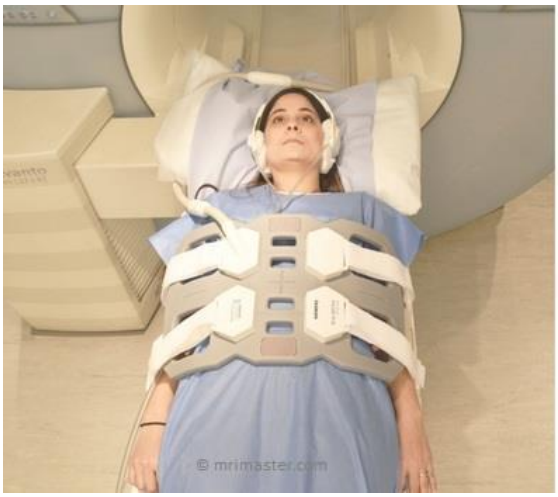


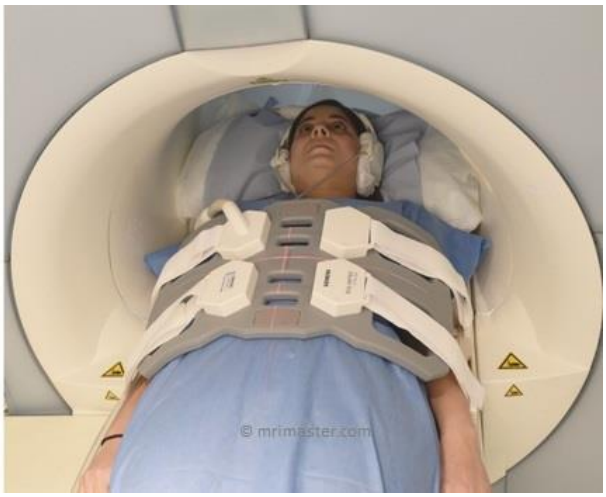
Equipment

- Body coil/volume multi-coil
- RC bellows
- Earplugs/headphones

Patient positioning

The patient lies supine on the examination couch with the RC bellows (if required) securely attached. The patient is positioned so that the longitudinal alignment light lies in the midline, and the horizontal alignment light passes through the level of the third lumbar vertebra, or the lower costal margin.





Suggested protocol

Coronal breath-hold incoherent (spoiled)

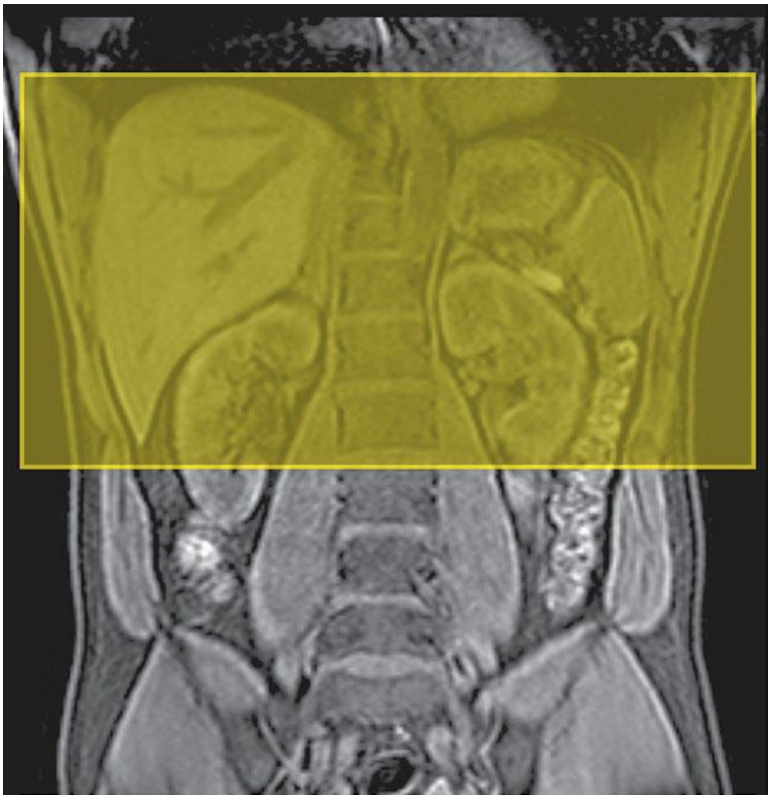
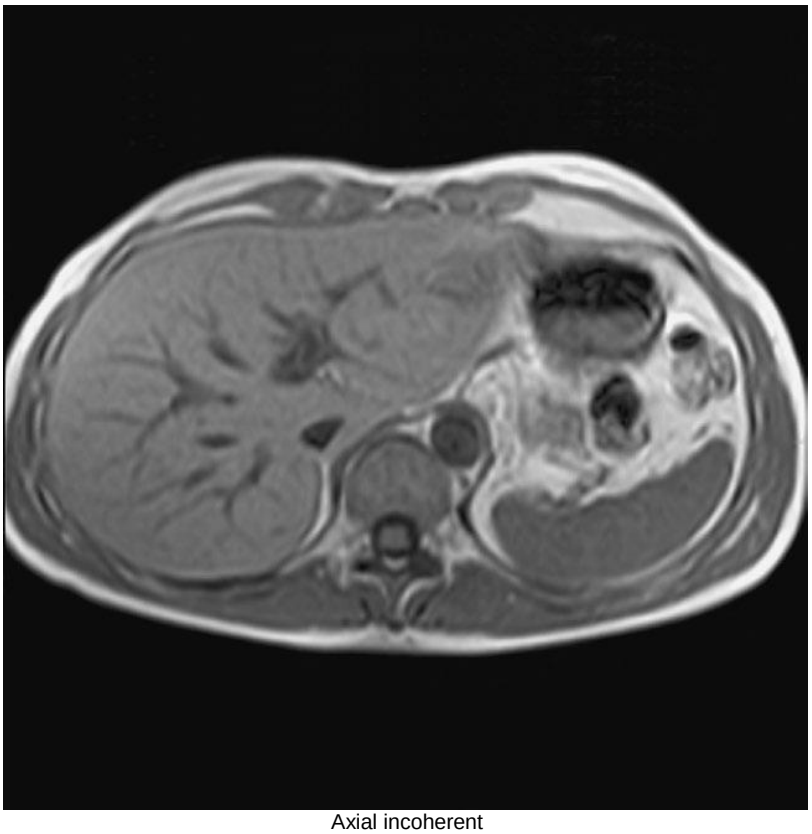


Figure Coronal incoherent (spoiled) T1-weighted image through the abdomen demonstrating slice prescription boundaries and orientation for axial imaging of the liver.

Acts as a localizer if three-plane localization is unavailable, or as a diagnostic sequence. Thick slices/gaps are prescribed relative to the vertical alignment light, from the posterior abdominal muscles to the anterior abdominal wall. The area from the pubis symphysis to the diaphragm is included in the image.
P 60 mm to A 40 mm

Coronal breath-hold SS-FSE
Slice prescription as for coronal T1 P 60 mm to A 40 mm

Axial SE/FSE/incoherent (spoiled) GRE T1 /− in and out of phase As for coronal T1, except prescribe slices from the diaphragm to inferior margin of the liver.

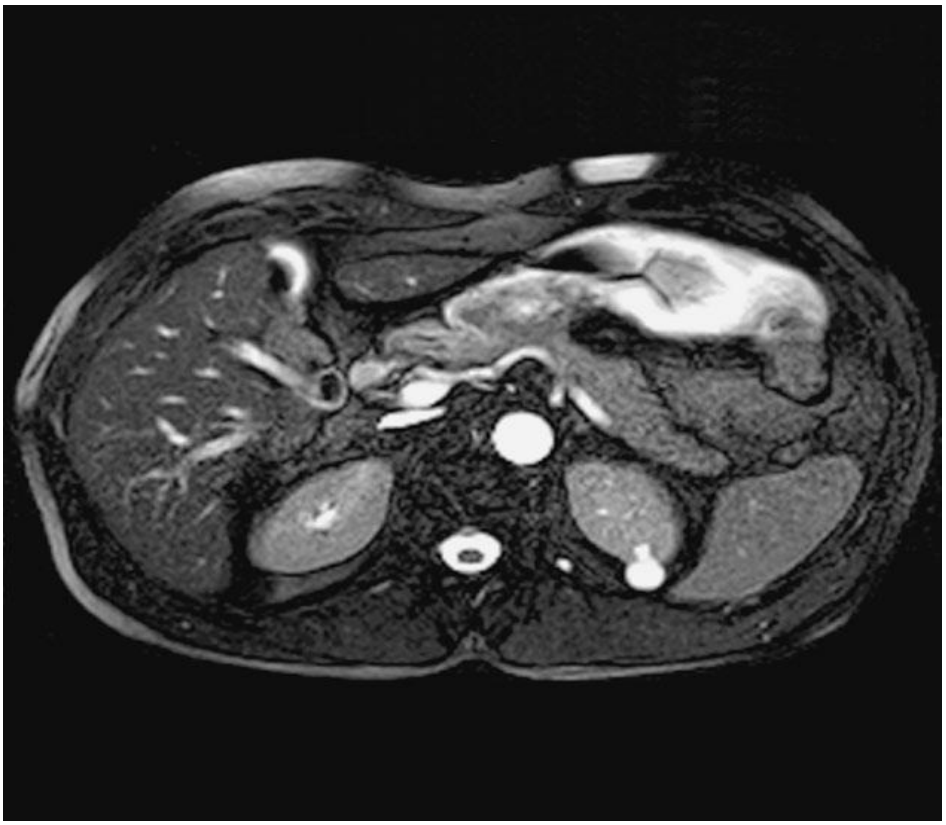


Axial incoherent
(spoiled) T1-weighted breath-hold image of the liver.

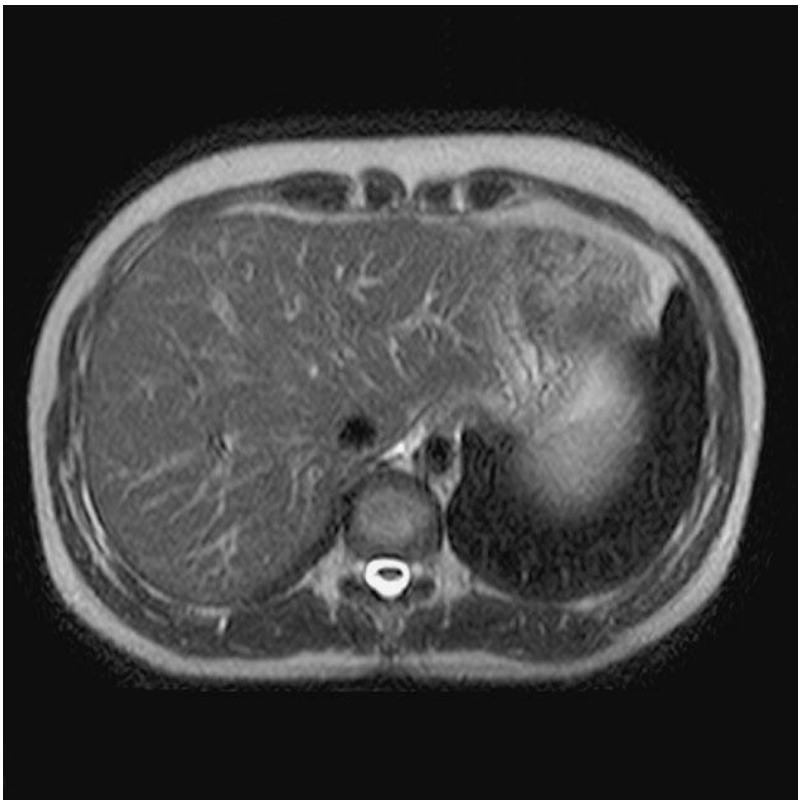
Delayed scans after contrast enhancement using tissue suppression techniques are sometimes necessary to evaluate arterial, venous and equilibrium phases.

Axial SE/FSE T2 or GRE T2*
Slice prescription as for axial T1.

Axial BGRE T2*
Slice prescription as for axial T1.
Axial SE/FSE/breath-hold incoherent (spoiled) GRE T1 contrast Slice prescription as for axial T1.



Axial fast GRE T2* through the liver.



Axial SS-FSE T2 through the liver.

Additional sequences

SS-FSE MRCP

This sequence provides images in which only fluid-filled spaces such as the gall bladder and biliary ducts return signal. It is necessary to use very long TEs and TRs to effectively nullify the signal from all tissues except those that have long T2 decay times. TEs in excess of 200 ms and TRs of more than 10 s are required (see also *Pancreas* and *Salivary glands*). If SS-FSE is unavailable then an FSE sequence may be substituted.

Coronal SS-FSE image of the gallbladder (MRCP). Very long values of TR and TE were used to acquire images in which only fluid is seen.

the liver have been developed that may negate the use of contrast agents in the future. DWI images are overlaid onto T1-weighted acquisitions.
The DWI image set provides pathology information, whereas the T1-weighted acquisition provides anatomical data. The images produced are not dissimilar to a PET/CT scan. In addition, diffusion tensor imaging used in conjunction with parallel imaging techniques enables differentiation of benign from malignant hepatic lesions and may also assist in the quantification of hepatic fibrosis.

Image optimization

Technical issues

The inherent SNR and CNR of the abdominal contents are usually excellent due to their high proton density, and the use of a torso array coil increases this even further. In addition, parallel imaging techniques using multi-array coils reduce scan time significantly. Due to respiratory artefact, RC or respiratory triggering may be necessary. Alternatively, breath-hold techniques may be used to suspend respiratory motion. In axial T1 sequences, it is necessary to shorten the TR to less than 400 ms in SE sequences as this is considered the optimum value for demonstrating liver contrast.

Artefact problems

The main source of artefact in the liver is motion caused by respiration, flow and peristalsis. RC or respiratory triggering is often required, especially on the superior axial slices, due to the proximity of the diaphragm. However, breath-hold techniques may also be utilized. Pe gating is sometimes used, but it often increases the scan time, especially if the patient's heart rate is slow or cardiac output poor, so that the system cannot

trigger efficiently off each R wave. Commonly,

pre-saturation pulses placed S and I to the FOV are necessary to decrease flow motion artefact in the aorta and IVC. GMN also minimizes flow artefact, but as it increases the signal in vessels and the minimum TE, it is not usually beneficial in T1-weighted sequences. Bowel motion is often a problem on the lower axial slices of the liver Antispasmodic agents, given IV, IM or subcutaneously prior to the examination, effectively reduce this.

Patient considerations

Careful explanation of the procedure is important. Ensure that the patient is as comfortable as possible. Some antispasmodic agents given IM may cause nausea, but fruit juice given after the study can alleviate this.
Due to excessively loud gradient noise associated with some sequences, earplugs or headphones must always be provided to prevent hearing impairment.

Contrast usage

Contrast is often beneficial to demonstrate liver metastases. Weighting depends on the type of contrast media used. T1 shortening agents such as gadolinium require T1-weighted post-contrast scans. These can be acquired in conjunction with tissue suppression pulses and acquired in multiple phases to evaluate the dynamic contrast enhancement characteristics of hepatic lesions.

Scans should be delayed for approximately 1 h after injection to allow time for uptake of contrast by the liver. The use of contrast and dynamic imaging to visualize liver vasculature and the biliary system is gaining in popularity.

GOOD LUCK