

## Resovist® Summary

### Resovist® is safe and well tolerated:

- good cardiovascular tolerance side effects after fast bolus injection
- backache uncommon
- no relevant clinical lab changes

### Resovist® is highly efficient:

- improves the detection of liver lesions significantly
- is superior compared to CTAP
- enables early and accumulation phase imaging (T1-, T2- and T2\*-weighted)
- improves the characterisation of most liver lesions significantly

### Resovist® is easy to use:

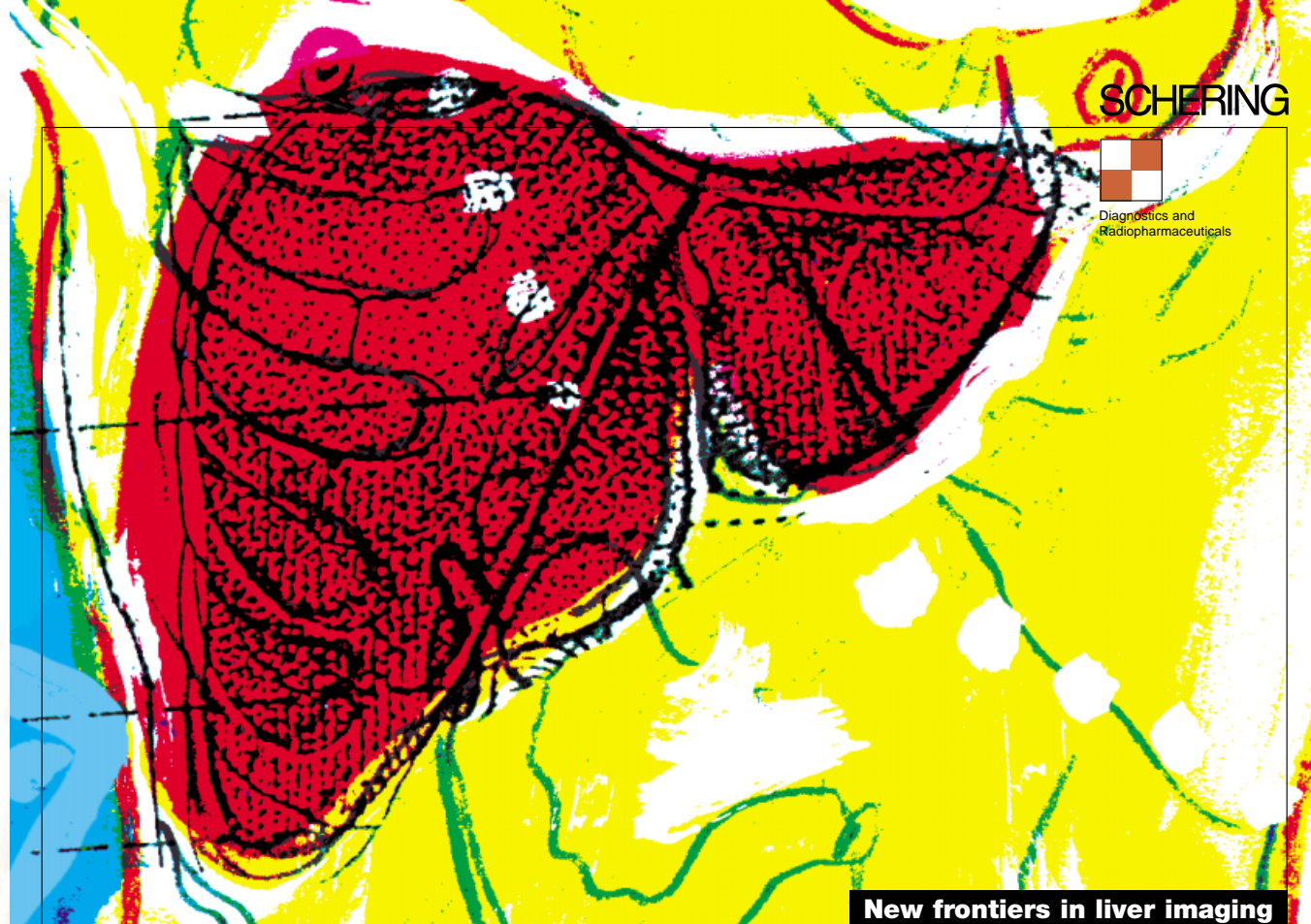
- ready to use solution, pre-filled syringe, fast injection
- patient does not need to be removed from the scanner
- total investigation only takes a few minutes longer than with extracellular gadolinium-chelates
- very convenient for the patient

**Resovist® 0.5 mmol Fe/ml, solution for injection, pre-filled syringe, Active ingredient:** Ferucarbotran Composition: **Pharmacologically active ingredients:** 1 ml of solution for injection contains 540 mg ferucarbotran, corresponding to 0.5 mmol (28 mg) iron. **Excipients:** Lactic acid, mannitol, sodium hydroxide, water for injection. **Indications:** Resovist® is a contrast agent to be used for magnetic resonance imaging (MRI) of focal liver lesions when examination without contrast media has given uncertain findings. **Contraindications:** Hypersensitivity to ferucarbotran or to any of the excipients, Hypersensitivity to dextran. The usual safety requirements for magnetic resonance imaging, especially the exclusion of ferromagnetic materials (e.g. pacemaker, vascular clips), also apply when using Resovist®. **Special warnings and special precautions for use:** No clinical experience is available with patients under 18 years of age. Usage of Resovist® in these patients can therefore not be recommended. Diagnostic procedures that involve the use of contrast agents should be carried out under the direction of a physician with the requisite training and a thorough knowledge of the procedure to be performed. It has been observed that Resovist® induces anaphylactoid (hypersensitivity) reactions in dextran-sensitized dogs. Those reactions comparable to the Dextran Induced Anaphylactic Reaction (DIAR) might also occur in humans with hypersensitivity to dextran Appropriate drugs and equipment in order to deal with such adverse events should be at hand when Resovist® is used. In patients with an allergic disposition including a history of asthma, special caution should be exercised because among them a two-fold higher incidence of adverse events has been observed. In patients with disorders associated with iron overload (e.g. hemosiderosis) it should be noted that a high iron content in the liver affects the signal intensity of the liver, therefore the benefit of Resovist® might be limited. To avoid paravenous injections which may lead to long-lasting local discolouration of the skin it is necessary to ensure the correct placement of the injection needle by flushing with sterile 9 mg/ml (0.9%) saline solution before injection of Resovist® No clinical information is available about repeated use with Resovist®. Resovist® should not be readministered before the signal loss in the liver has returned back to the baseline levels. This will take at least 14 days. **Use during pregnancy and lactation:** Resovist® should not be used during pregnancy unless it is considered absolutely necessary. It is not known if Resovist® is excreted into breast milk in humans. Therefore Resovist® should only be given during lactation after special consideration. Breast feeding should be interrupted while milk should be drawn and discarded for a few days following Resovist® administration. **Undesirable effects:** Common ( $\geq 1\%$  to  $< 10\%$ ): pain at the injection site ( $< 2\%$ ), vasodilatation ( $< 2\%$ ), paresthesia ( $< 2\%$ ). Uncommon ( $\geq 0.1\%$  to  $< 1\%$ ): Asthenia, back pain, injection site reactions, chest pain, nausea, vomiting, headache, taste perversion, pruritus, rash. Rare ( $\geq 0.01\%$  to  $< 0.1\%$ ): Hypersensitivity and anaphylaxis, hypertension, phlebitis, hyperesthesia, anxiety, dizziness, convulsion, parosmia, dyspnea, cough increased, rhinitis, eczema, urticaria. **Interactions:** No interactions with other medicaments have been observed. Formal drug interaction studies have not been carried out. **Dosage:** The recommended dose of Resovist® to adults is: For patients weighing less than 60 kg: 0.9 ml Resovist® (equivalent to 0.45 mmol iron). For patients weighing 60 kg or more: 1.4 ml Resovist® (equivalent to 0.7 mmol iron). **Additional information:** Please note! For current prescribing information refer to the package insert and/or contact your local Schering organization. Schering AG, 13342 Berlin, Germany, Status: February 2002

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EU2002.0158



**New frontiers in liver imaging**

Ferucarbotran

**Resovist®**

**Liver-specific contrast agent for MRI of focal liver lesions: Detection and characterisation in a single diagnostic work-up.**

**Information for radiologists**

## Product characteristics

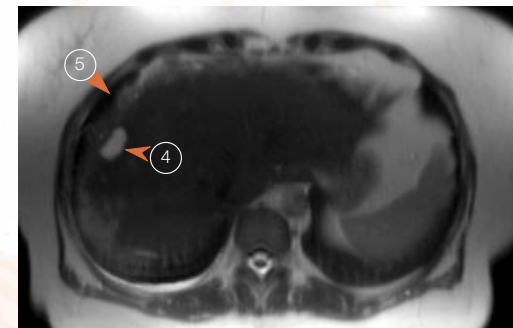
Resovist® is a liver-specific magnetic resonance (MR) contrast agent. The active ingredients are carboxydextran-coated superparamagnetic iron oxide (SPIO) particles (ferucarbotran). The coating prevents the iron-oxide particles from aggregating and makes the compound highly hydrophilic.

Resovist® exhibits a low viscosity and is isotonic to blood plasma. The hydrodynamic diameters of the coated particles range between 45 and 60 nm. The differing particle sizes determine the velocity of their uptake by cells of the RES (reticulo-endothelial system) – especially the Kupffer cells in the liver – as well as their relaxivity-related effects.

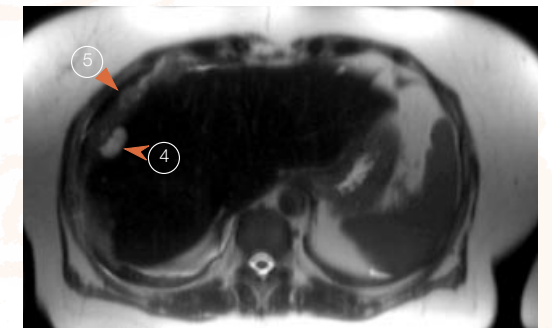
Resovist® has a strong effect on the shortening of both T1 and T2 relaxation times. The R1 and R2 relaxivities in blood (at 1.5 Tesla and 37°C) are  $7.2 \pm 0.1$  and  $82.0 \pm 6.2$  L/(mmol x sec) respectively. Due to the high R2 relaxivity, Resovist® is particularly suited to T2- and T2\*-weighted imaging. Additionally, Resovist® enables T1-weighted imaging, with a tenth of the standard dose of Gd-DTPA ensuring a valuable although less pronounced T1-effect. Resovist® is ideal for the differentiation of benign versus malignant lesions as well as for proving or excluding multifocal liver lesions.



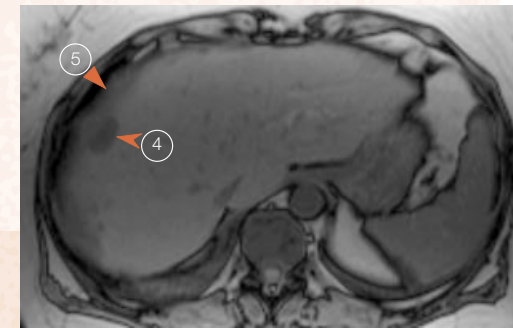
## Case study



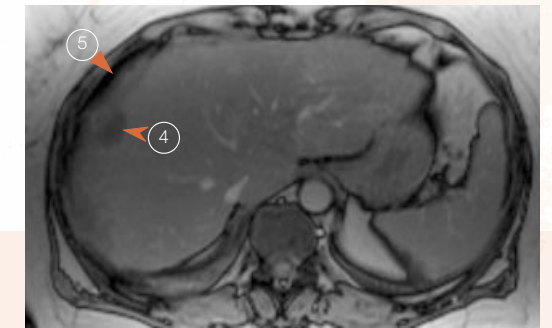
(g) HASTE-sequence: native



(h) HASTE-sequence: post Resovist®



(i) T1-GRE opposed phase: native



(j) T1-GRE opposed phase: post Resovist®

Courtesy of: Hammerstingl, MD, Vogl, MD; Frankfurt, Germany

**Answer:**  
**Liver metastases (lesions 1 and 2)**  
**Hemangioma (lesion 3)**  
**Hepatic cyst (lesion 4)**  
**Peritoneal carcinosis (lesion 5, multiple lesions at the liver periphery)**

Produced by:  
 Schering AG, Region Europe MBD, 13342 Berlin, Germany

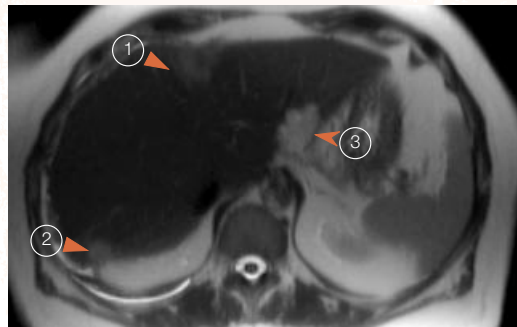
Scientific advice kindly provided by:  
 Dr. Renate Hammerstingl, MD, Dr. Wolfram Schwarz, MD, Prof. Thomas Vogl, MD,  
 Johann-Wolfgang-Goethe University, Frankfurt, Germany  
 Dr. Dominik Weishaupt, MD, University Hospital, Zurich, Switzerland  
 Dr. Stephan Schmitz, MD, Benjamin-Franklin University Hospital, Berlin, Germany

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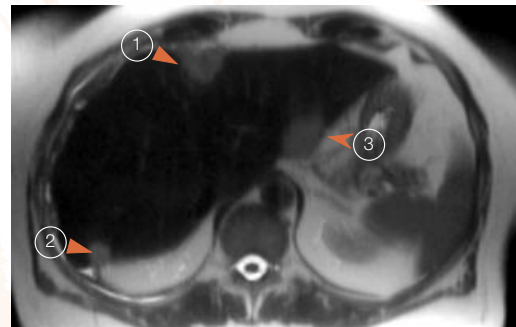
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## Case study

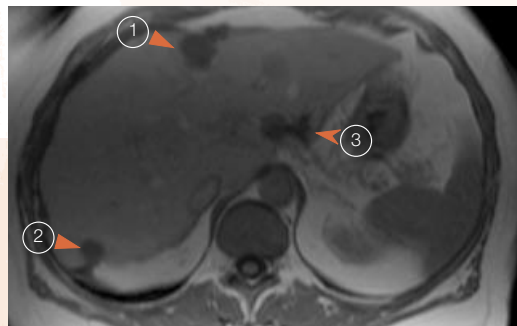
### Female patient with breast carcinoma and multiple liver lesions



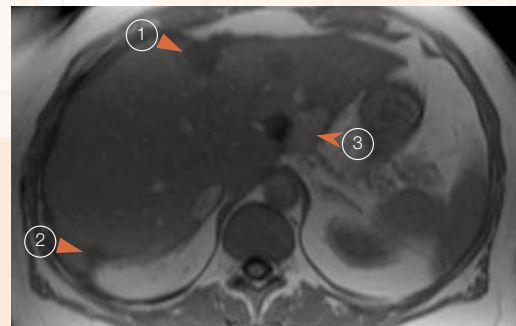
(a) HASTE-sequence: native



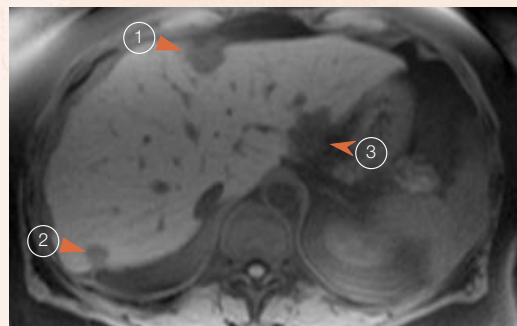
(b) HASTE-sequence: post Resovist®



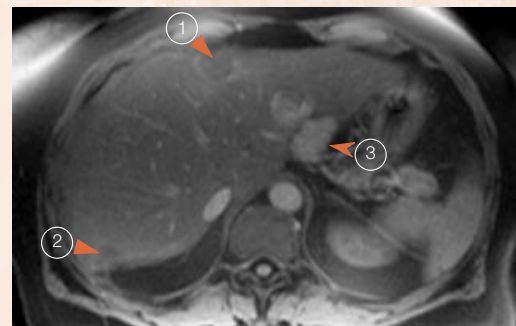
(c) T1-GRE in phase: post Resovist®  
- arterial phase



(d) T1-GRE-sequence: post Resovist®  
- portal-venous phase



(e) T1-GRE-FS: native



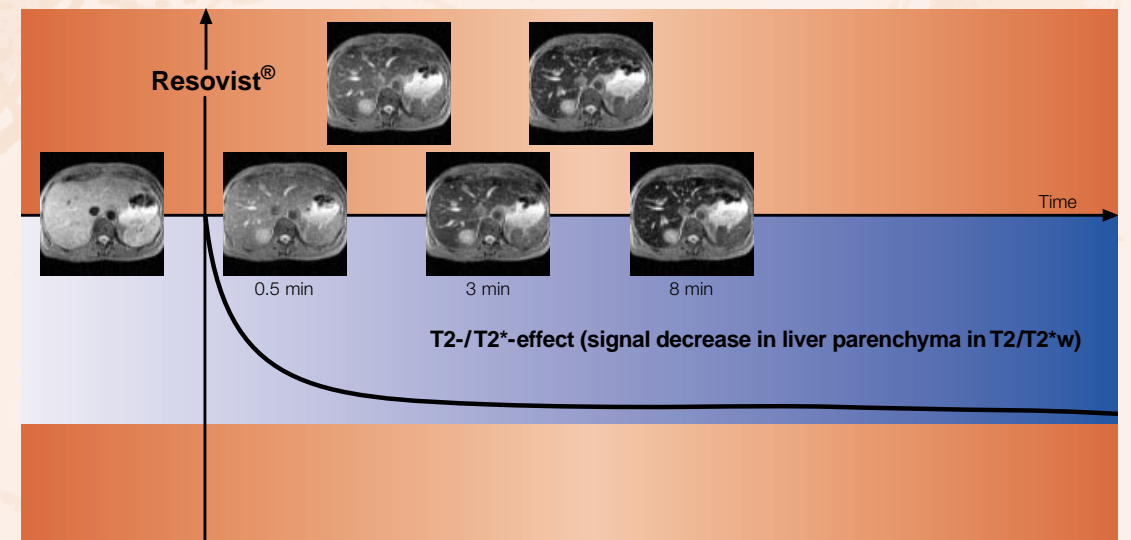
(f) T1-GRE-FS: post Resovist®

## Resovist®: Mode of action

After intravenous injection, about 85% of the administered Resovist® dose is taken up by Kupffer cells (the remaining amount is taken up by other RES cells). The larger particles are taken up faster than the smaller particles (with plasma half-lives of ~5 minutes and up to ~100 minutes respectively). Because the smaller particles stay in the vessels for longer they display a "blood-pool" characteristic.

### T2/T2\*-weighted imaging

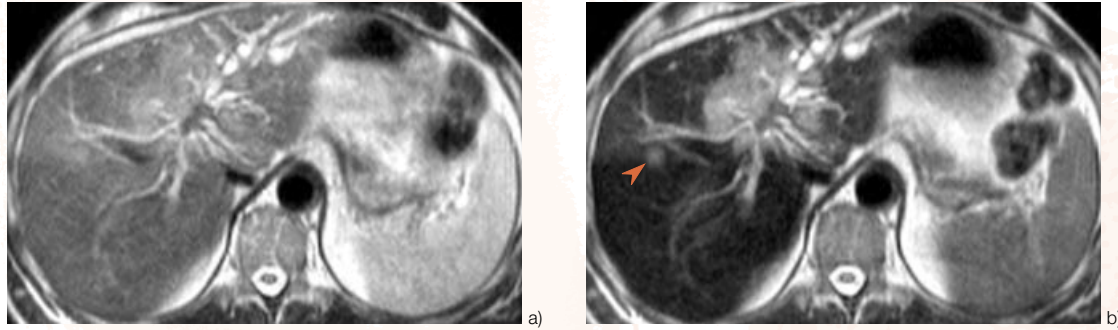
By virtue of the superparamagnetic properties of iron oxide, Resovist® shortens the T2 relaxation time very effectively and causes distortion of local magnetic fields (susceptibility effects). The effect of both mechanisms increases after the particles have been phagocytosed by the RES and stored in Kupffer cells (compartmentalisation). This results in a pronounced signal loss, particularly on T2- and T2\*-weighted images, and to a lesser extent on some T1-weighted techniques (e.g. gradient echo sequences). Using T2- or T2\*-weighted scans, a dramatic signal intensity (SI) decrease can be seen in tissues that take up Resovist®.



Time-dependent changes of signal intensities (SI) in liver parenchyma in T2/T2\* weighted scans (black line). T2\*-weighted images of the early and accumulation phase in a patient with liver metastasis. As early as 30 seconds after the injection of Resovist®, a signal intensity decrease of the liver can be noted. Further signal intensity decrease is displayed in this patient until 8 minutes post injection. Courtesy of: Brambs, MD; Ulm, Germany.

## Resovist®: Mode of action

As most malignant tumours like metastases or hepatocellular carcinoma do not contain Kupffer cells or have impaired cell activity, Resovist® affects their native signal intensity to a lesser extent, if at all. This results in an improvement of the lesion to liver contrast.



Patient with a cholangiocellular carcinoma in the hepatic bifurcation. On the native T2-weighted image (a) the lesion is almost isointense and not clearly demarcated. Demarcation is clearly improved 10 minutes after fast intravenous bolus injection of 1.4 ml Resovist® (b). In addition, the Resovist® -enhanced MR image depicts a small satellite tumour nodule (arrow).  
Courtesy of: Blakeborough et al., Radiology 1997, 203:759-765.

## T1-weighted imaging

Shortening of the T2-relaxation time and susceptibility effects caused by the aggregation of iron oxide nanoparticles in the Kupffer cells result in a decrease in signal intensity of the liver parenchyma on T1-weighted images. In addition, as long as Resovist® particles are freely dispersed in the blood, a signal intensity increase from the vessels can be seen on T1-weighted images.

The signal from healthy liver tissue depends on the time post injection. It decreases in T1-weighted imaging due to the susceptibility of the clustered larger Resovist® particles, whereas the signal in the vessels stays bright – due to the smaller particles that are still circulating. Consequently the contrast between liver tissue and vessels is improved. Due to the specific pharmacodynamic properties of Resovist®, the peak of this contrast is at about 5 to 10 minutes post injection.

## Typical changes of signal intensity

### Benign lesions

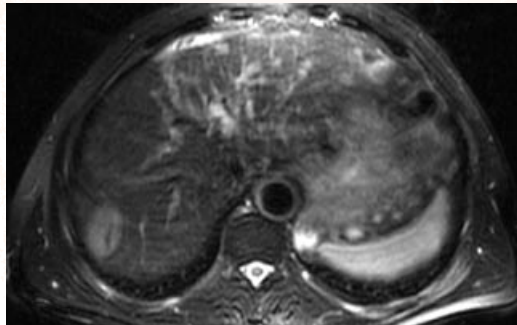
Sequence	FNH	Adenoma	Hemangioma
<b>T2-native</b>	iso- to mildly hyperintense nidus: hyperintense	heterogeneous signal due to blood, necrosis, lime	hyperintense, fibrous areas: hypointense
<b>T2-post</b>	signal decay homogeneous pattern iso- mildly hyperintense nidus: hyperintense	signal decay mildly hyperintense peripheral emphasis no nidus	signal decay more discrete than with FNH and adenoma
<b>T1-native</b>	iso- to mildly hypointense nidus: hypointense	heterogeneous signal due to blood, necrosis, lime pseudo capsule: hypointense	hypointense
<b>T1 early phase</b>	hypervascularized mildly hyperintense	mildly hypervascularized iso- hypointense	contrast take up increasing from the outside to the inside Iris aperture phenomenon
<b>T1 accumulation phase</b>	mildly hyperintense (according to degree of perfusion)	iso- hyperintense	homogeneously hyperintense

### Malignant lesions

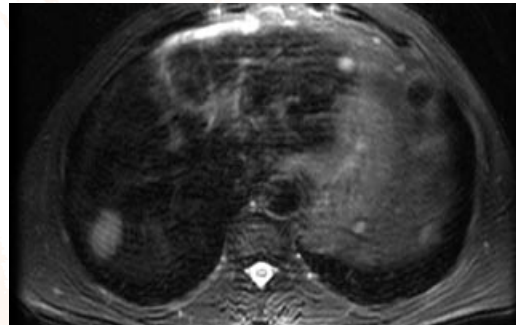
Sequence	HCC	CCC	Liver metastasis	
<b>T2-native</b>	hyper- to isointense inhomogeneous pattern central necrosis capsule: hyperintense	hyperintense inhomogeneous	often moderately hyperintense	
<b>T2-post</b>	no signal loss hyperintense	no signal loss hyperintense	no signal loss, hyperintense	
<b>T1-native</b>	iso- to hypointense central inhomogeneity	hypointense inhomogeneous	often hypointense	
<b>T1 early phase</b>	mostly hypervascularized in the beginning hyperintense followed by wash-out effect	rim-enhancement: peripheral hyper- vascularization central hypointensity	<b>hypovasc.</b> rim enhancement: periph. hyper- vascularization wash-out effect otherwise hypointense	<b>hypervasc.</b> hyperintensi- ty due to vasculari- zation
<b>T1 accumulation phase</b>	mildly hyper- to isointense	mostly iso- to hypointense peripheral rim enhancement	mostly iso- to hypointense With peripheral rim enhancement	

## Characterisation of lesions with Resovist®

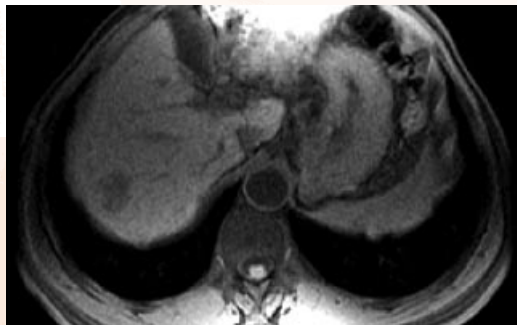
### Hypervascular HCC



**T2-FSE (TR/TE/flip angle = 3500 ms/100 ms/90°)**  
Hyperintense lesion in cirrhotic liver parenchyma.



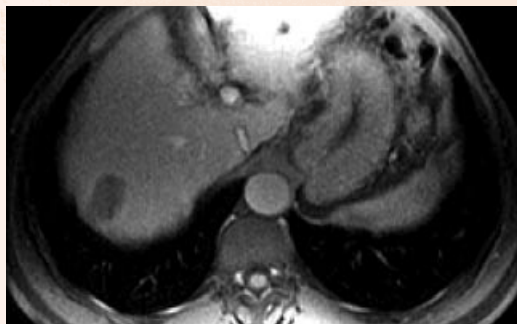
**Post Resovist®**  
10 min after administration of Resovist® the lesion conspicuity is improved



**T1-GRE (TR/TE/flip angle = 150 ms/1.4 ms/60°)**  
Hypointense signal of the HCC in the native scan.

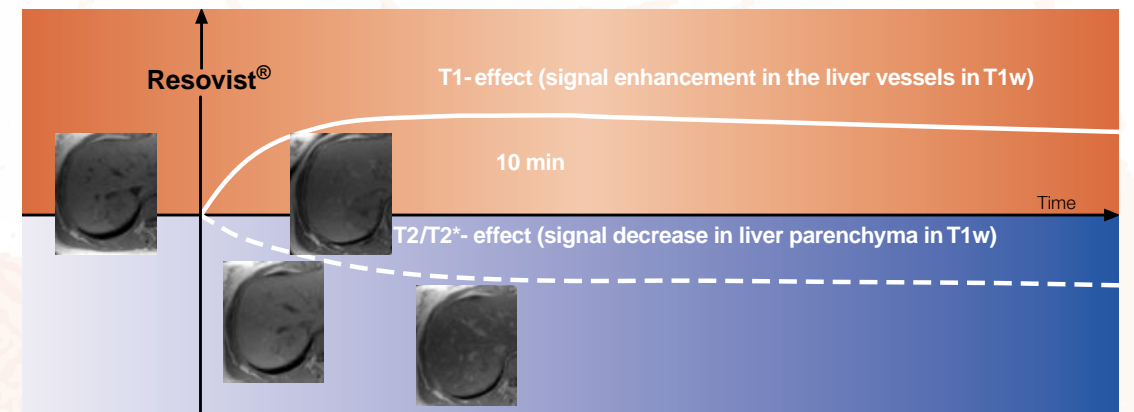


**T1-GRE (TR/TE/flip angle = 150 ms/1.4 ms/60°)**  
During **arterial phase** (20 sec after administration of Resovist®), the hypervascular lesion shows marginal signal enhancement compared to the native scan.



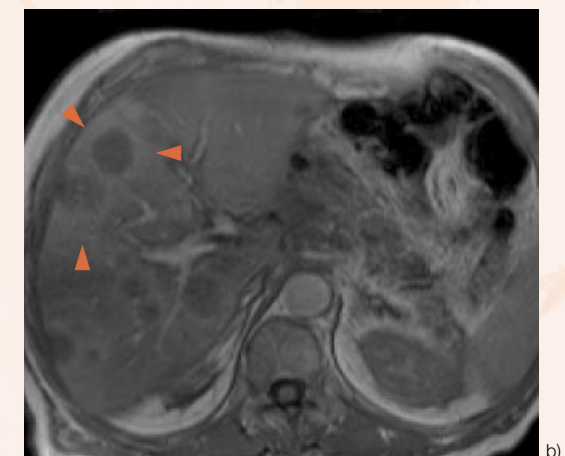
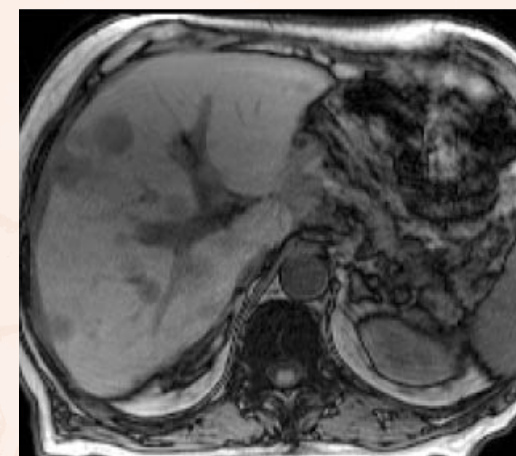
**T1-GRE (TR/TE/flip angle = 150 ms/1.4 ms/60°)**  
In the corresponding image during **portal-venous phase** (60 sec after administration of Resovist®), the hypervascular lesion shows a rapid wash-out. Note the enhancement of the vessels due to the T1-effect of Resovist®.

## Resovist®: Mode of action



Time-dependent changes of signal intensities (SI) in liver vessels (white line) and liver parenchyma (white dotted line) in T1-weighted scans. In the arterial phase scan (20 sec p.i.) the SI of the parenchyma is slightly increased compared to the pre-contrast scan. (This is the perfusion effect i.e. all the Resovist® particles are still in the vessels). At 90 sec p.i. the SI of the parenchyma is slightly decreased compared to the pre-contrast scan due to the overlying T2/T2\*-effect of the larger particles (fast uptake). Smaller particles are circulating in (and enhancing) the vessels. Images 10 min p.i. display further SI decrease of the parenchyma. Due to the enhancement of the vessels, the contrast between parenchyma and vessels is improved. As a result, the liver tissue accumulation and blood-pool distribution generates a "contrast inversion." That is, the high signal intensity of liver and low signal intensity of vessels of the unenhanced images change to a low signal intensity of liver and a high signal intensity of vessels on T1-weighted images 10 minutes p.i. of Resovist®. Courtesy of: Hammerstingl, MD; Frankfurt, Germany.

Early (arterial and portal-venous) and accumulation phase imaging (approximately 10 min p.i.) add helpful information regarding the characterisation of focal liver lesions and assessment of the vascular situation. For example, due to the blood-pool characteristics of the smaller Resovist® particles, the well known "ring enhancement" and "wedge sign" in metastatic lesions can be detected much more frequently than with liver imaging using extracellular contrast agents.



Patient with colon cancer and multiple liver metastases. Native (a) and Resovist®-enhanced (b) T1-weighted images. Note the ring enhancement and wedge sign (arrows) on the T1-weighted image 10 min after administration of Resovist®. Courtesy of: Huppertz, MD, Munich, Germany.

## Safety

Resovist® proved to have a very good safety profile in its class of contrast agents. Resovist®, is well tolerated when given by fast bolus injection. No significant cardiovascular side effects have been reported. The quantity and quality of adverse events is comparable to those seen with gadolinium agents. The following adverse events have been reported most frequently during the clinical development programme: paresthesia, headache, feeling of warmth, nausea, pain, anxiety, vomiting, backache and pain at injection site. All of these adverse events were of mild intensity and short duration.

Backache occurred in only 3 out of 1053 patients (0.3% – mild (2) and moderate (1) intensity) after administration of Resovist®. No backache required any treatment or interruption of the injection or scanning session.

Reactions comparable to Dextran Induced Anaphylactic Reaction (DIAR) might occur in patients with hypersensitivity to dextran. Appropriate drugs and equipment to deal with such adverse events should be at hand when Resovist® is used.

There is no contraindication to administer Resovist® to patients with impaired renal or liver function. No significant changes in urine chemistry or creatinine clearance were recorded in clinical studies. There is no evidence of any systematic effect of Resovist® on liver function.

The amount of iron in the recommended dose of Resovist® (0.9 ml in patients < 60 kg body weight, 1.4 ml in patients ≥ 60 kg body weight, corresponding to 5.8 –12.9 µmol Fe/kg BW) is equivalent to about 1% of normal whole-body iron content. This is equivalent to the normal dietary intake of iron in 2-3 days. Administration of this amount of iron will result in transient changes in serum iron, ferritin, and iron-binding capacity, but there is no danger of iron overload.

## How to use Resovist®

Resovist® is a ready-to-use solution for intravenous injection and is provided in a pre-filled glass syringe.

- 1.4 mL prefilled syringe for patients with ≥ 60 kg body weight
- 0.9 mL prefilled syringe for patients with < 60 kg body weight

A 5 µm filter must be used for injection because visual inspection of the brownish solution before injection is not possible. The filter is included in the box.

Resovist® can be injected without restriction to injection speed. Immediately after Resovist®'s injection a volume of 20–30 ml saline solution (0.9%) should be administered to flush the connecting line and veins.

There are several ways to prepare the injection of Resovist®. In order not to move the patient out of the magnet, a connecting line for the injection may be used. This line can be pre-filled with Resovist® and then be flushed with saline either by hand or by injector. Using a Medrad Spectris® Injection System, the saline cartridge must be in position "A." Then cartridge "B" on the display can be disabled. Injection volume, speed and start of the injection can be carried out in the usual way.

The unique properties of Resovist® enable a comprehensive pre- and post-contrast examination to be performed with a liver-specific contrast agent in a reasonable time period for the first time. The whole examination will only last a few minutes longer than a liver examination performed with an extracellular contrast agent.

## Characterisation of lesions with Resovist®

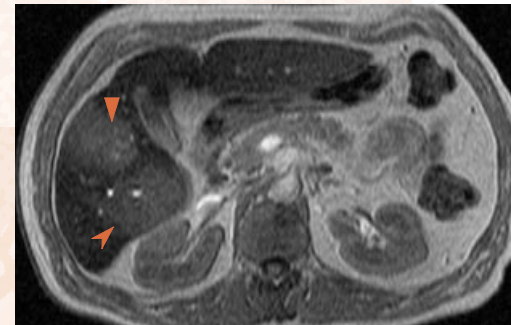
### HCC and adenoma in the case of liver cirrhosis



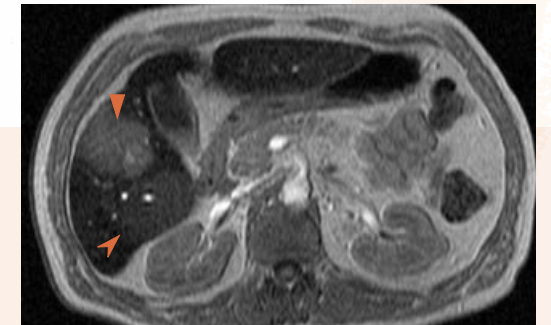
**T2-TSE-FS: native**  
(TR/TE/Flip angle = 2000 ms/90ms/130°)  
Hyperintense lesion in the right liver lobe segment 5. ▶  
Additional lesion of lower intensity detected. ▶



**Post Resovist®**  
Unchanged hyperintense signal pattern of HCC ▶ without contrast agent uptake and signal loss respectively as an indication for malignancy. Typical signal decay of the adenoma. ▶



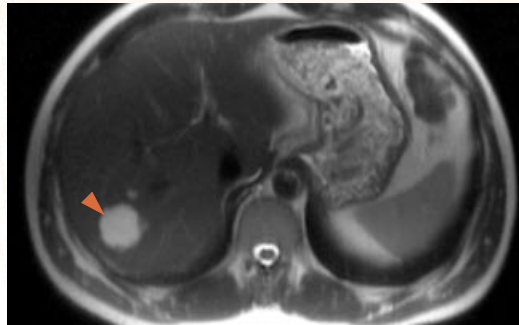
**T1-GRE: native**  
(TR/TE/flip angle = 150 ms/4.8ms/80°)  
Hyperintense signal of HCC and adenoma.



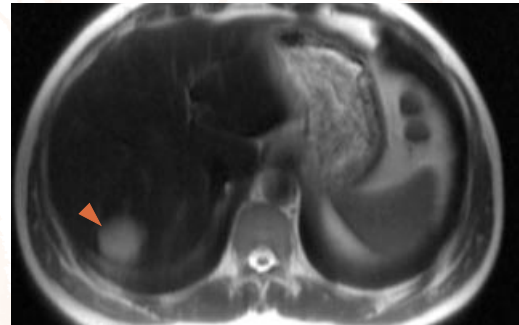
**Post Resovist®**  
Unchanged signal texture of HCC-node. ▶  
Slight signal decay of adenoma. ▶

## Characterisation of lesions with Resovist®

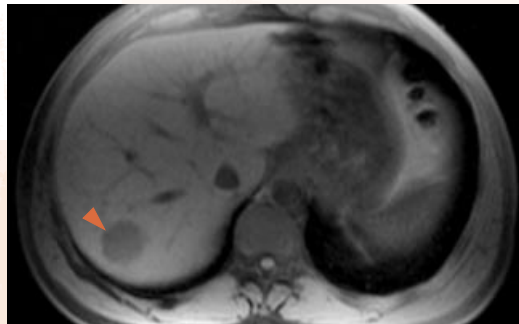
### Hemangioma



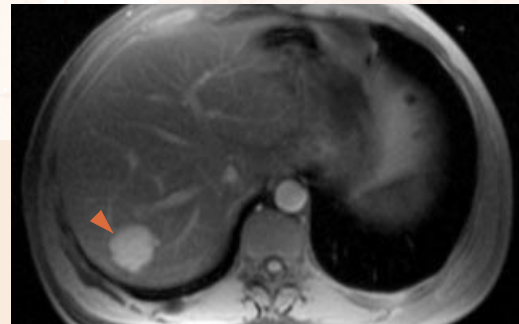
**HASTE-Sequence: native**  
(TR/TE/flip angle = 1200 ms/63 ms/150°)  
Hyperintense lesion in liver segment 6.



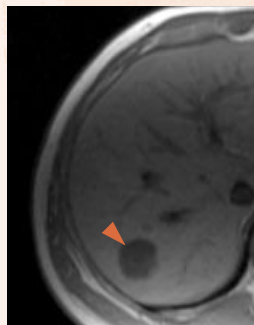
**Post Resovist®**  
Typical signal loss of the lesion as a sign of the bloodpooling effect is an indication for a hemangioma.



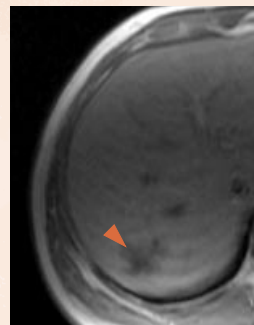
**T1-GRE-FS: native**  
(TR/TE/flip angle = 150 ms/4.8 ms/80°)  
Hypointense lesion precontrast.



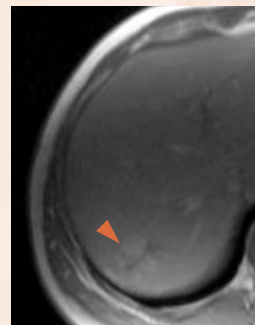
**Post Resovist®**  
Typical change of signal intensity from hypointense to hyperintense as an indication for a hemangioma.



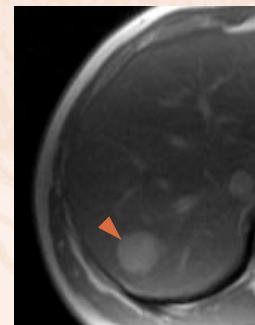
Native



15 s p.i.



45 s p.i.



120 s p.i.

**Early T1-weighted GRE sequence: bolus injection of Resovist®**  
(TR/TE/flip angle = 160 ms/4.8 ms/80°)  
Centripetal filling of the lesion (iris phenomenon).

## Scanning Recommendations

Fast bolus injection of Resovist® makes it possible to observe the early perfusion characteristics of the liver using T1- or T2\*-weighted sequences. The accumulation phase imaging can be performed as early as 10 minutes p.i. utilising T1, T2 and T2\*-weighted sequences. The T2 and T2\*-weighted accumulation phase imaging improves lesion detection by improving the visualisation, delineation and conspicuity of the lesions. Accumulation of Resovist® – or the lack of it – provides additional information regarding lesion characterisation.

As some of the benign tumors like focal nodular hyperplasia (FNH) contain functioning RES cells, this is helpful in differential diagnosis. Resovist®'s typical imaging properties result in specific time-dependent changes of signal intensities in T1-, T2- and T2\*-weighted images.

The following recommendations should be regarded as starting points for your individual experience.

To achieve the optimal signal-to-noise ratio it is recommended to use body phased array coils, if available.

### Pre-contrast imaging

- Localiser
- T1 gradient echo (with fat saturation) and breath-hold
- T2 turbo spin echo (with fat saturation) and respiratory triggering (preferable), or breath-hold

### Post-contrast early phase imaging

- Early T1 gradient echo – or optional T2\* gradient echo – (with fat saturation) and breath-hold (shortest possible TE). Scan times eg 15–20 sec (arterial phase) and 50–60 sec (portal-venous phase) p.i.

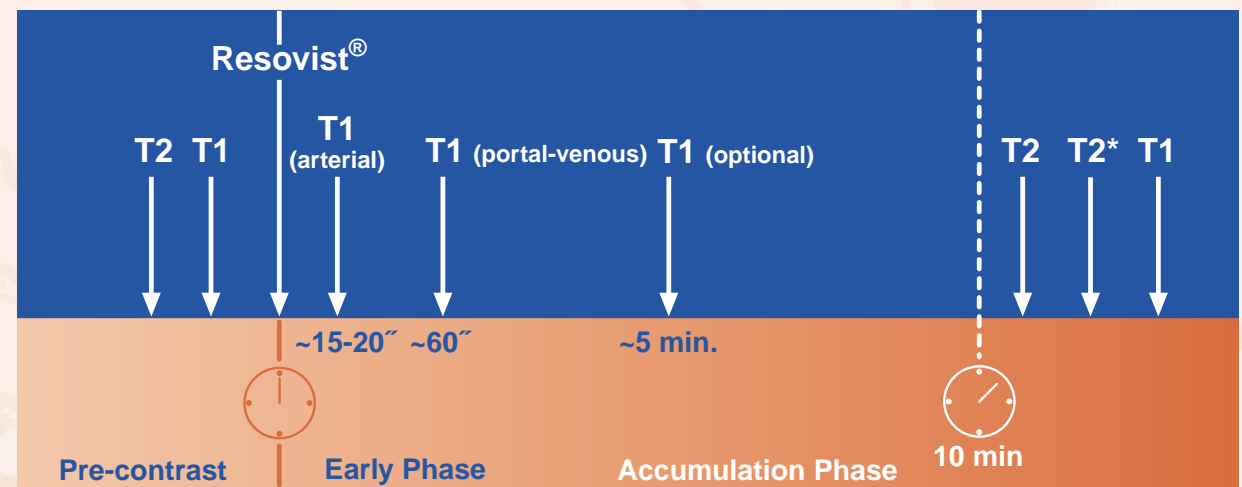
### Post-contrast accumulation phase imaging

Optional 3-5 min after administration:

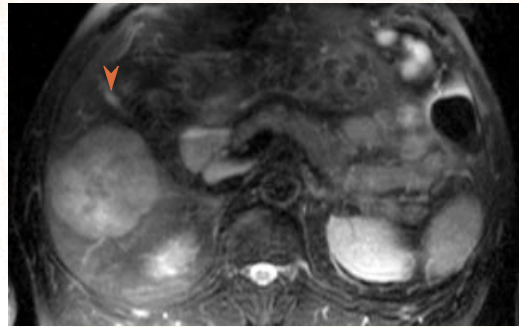
- T1 gradient echo (with fat saturation) and breath-hold (shortest possible TE)

10 min after administration

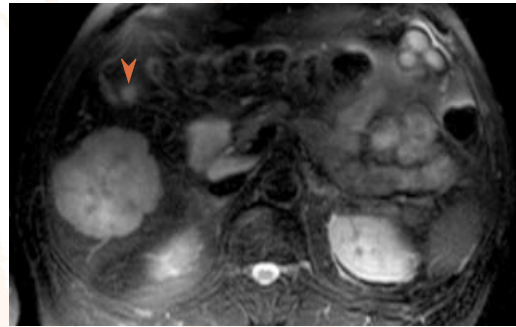
- T2 turbo spin echo (with fat saturation) and respiratory triggering (preferable) or breath-hold
- T1 gradient echo (with fat saturation) and breath-hold (shortest possible TE)
- T2\* gradient echo (with fat saturation) and breath-hold



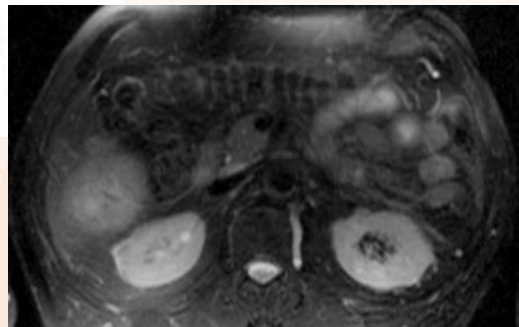
**Leiomyosarcoma of the liver with satellites**



**T2-TSE-FS: native**  
(TR/TE/flip angle = 2790 ms/90 ms/130°)  
Hyperintense lesion in the right liver lobe, segment 6 with suspected satellite lesion ventrally (arrow).



**Post Resovist®**  
No change of signal intensity post Resovist®. Typical sign of malignancy. Confirmation of the additional satellite lesion.

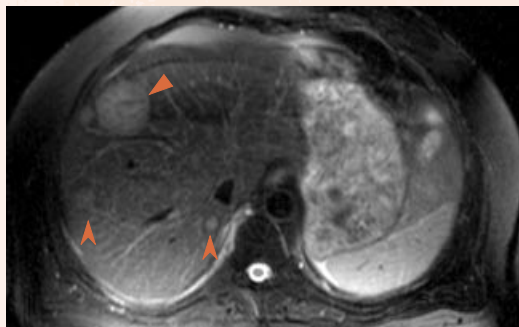


**T2-TSE-FS: native**  
(TR/TE/flip angle = 2790 ms/90 ms/130°)

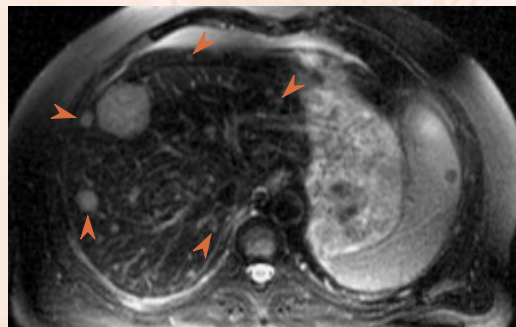


**Post Resovist®**  
Better demarcation of lesion as compared to the native scan. Detection of an additional satellite lesion.

**Liver metastases of a neuro-endocrine tumour**



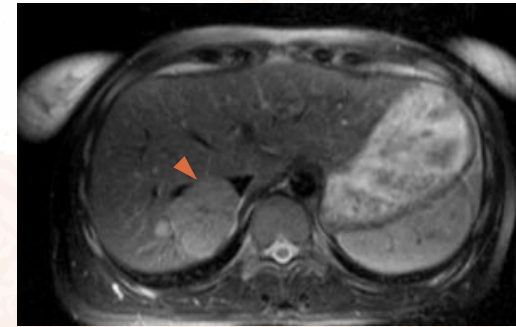
**T2-TSE-FS: native**  
(TR/TE/flip angle = 2790 ms/90 ms/130°)  
Neuro-endocrine tumour. Suspicion of further satellites.



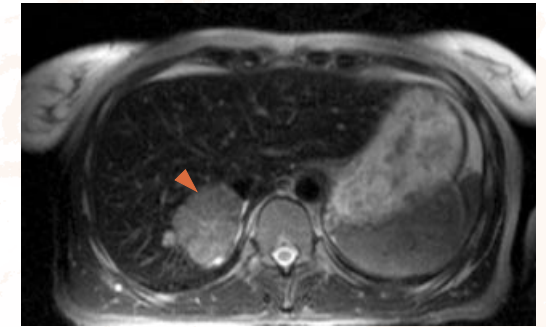
**Post Resovist®**  
Clear demarcation of multiple satellites. Additionally, detection of a cyst in the spleen.

In comparison to native images, T2-weighted images with Resovist® clearly increase the detection of liver lesions.

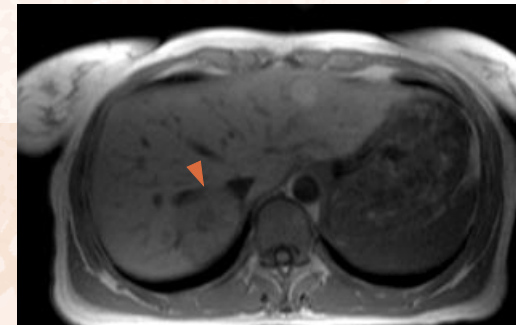
**FNH**



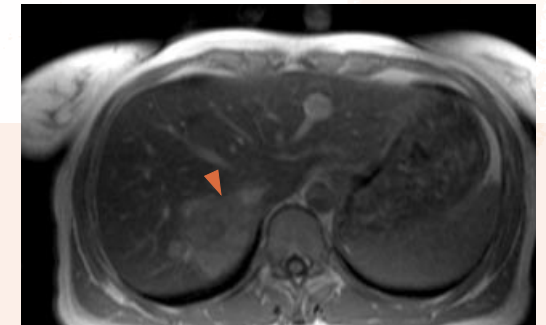
**T2-TSE-FS: native**  
(TR/TE/flip angle = 2800ms/90ms/130°)  
Hyperintense lesion in liver segment 7 with compression of VCI.



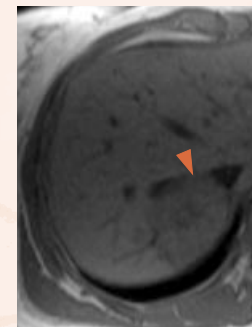
**T2-TSE-FS: post Resovist®**  
(TR/TE/Flip angle = 2800 ms/90ms/130°)  
Signal decay of lesion with improved delineation of central nidus and shifted vascular structures in the right rim area as a typical sign for FNH.



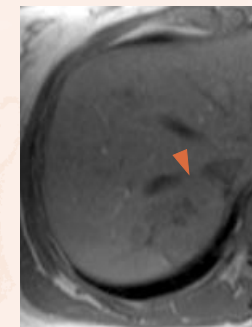
**T1-GRE-FS: native**  
(TR/TE/flip angle = 150 ms/4.8ms/80°)  
Hypointensity of lesion with hypointense centre.



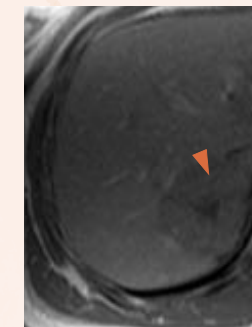
**T1-GRE-FS: post Resovist®**  
Hyperintensity as a classical sign for a hypervascularisation of FNH. Pulsation artifact in the left liver lobe.



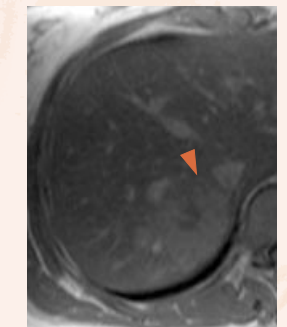
native



15 s p.i.



90 s p.i.



9 min p.i.

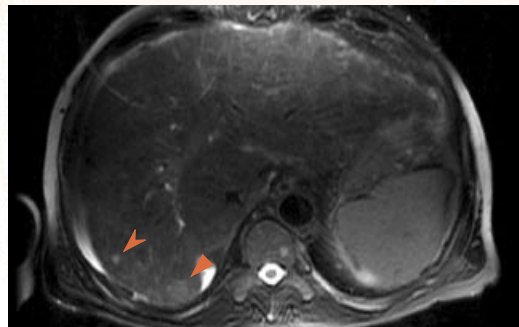
**Early T1-weighted GRE-sequence: bolus injection of Resovist®**  
(TR/TE/flip angle = 160ms/4.8 ms/80°)

Hypervascularised FNH node in the early phase with successive decay of signal intensity and isointensity in the accumulation phase in comparison to the liver parenchyma. 9 min p. i. hyperintensity of FNH due to continuous decay of signal intensity of the liver.

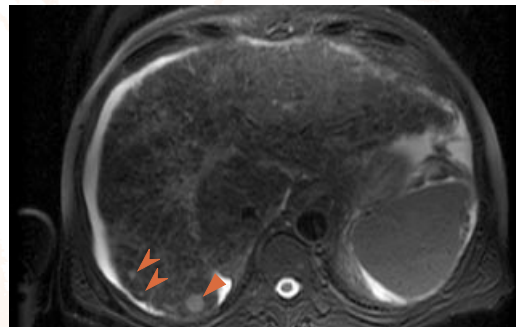
**Improved detection compared to unspecific MR contrast agent**

**Detection**

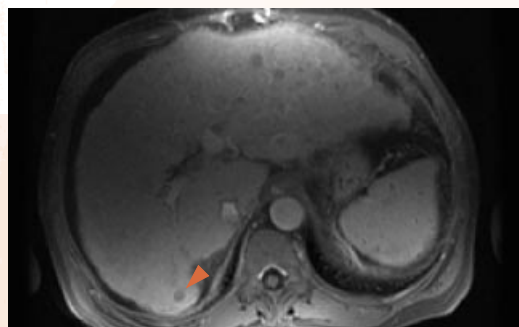
**Multifocal HCC**



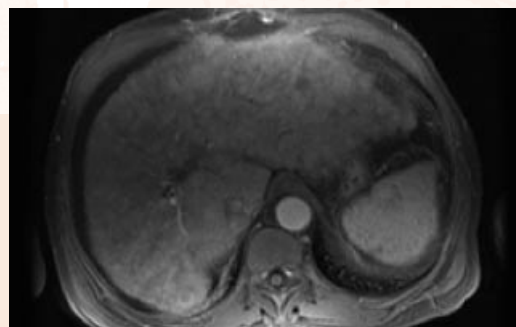
**T2-FSE (R/TE/flip angle = 3500ms/100 ms/90°)**  
 A mildly hyperintense lesion can be seen in segment VII. ▶  
 A second smaller hyperintense lesion ▶ is noted in close proximity. Note the presence of perihepatic ascites.



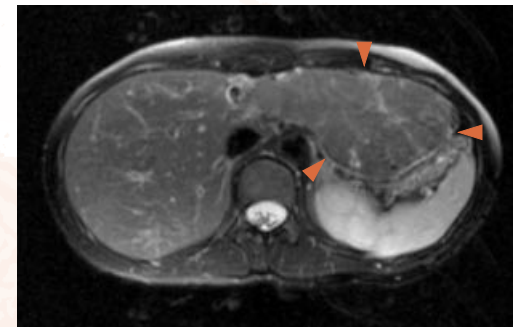
**Post Resovist®**  
 10 min p. i. of Resovist® confirmation of the HCC. ▶  
 In addition, two more HCCs ▶ can be detected which would have been missed on Gd-DTPA-enhanced images (see below).



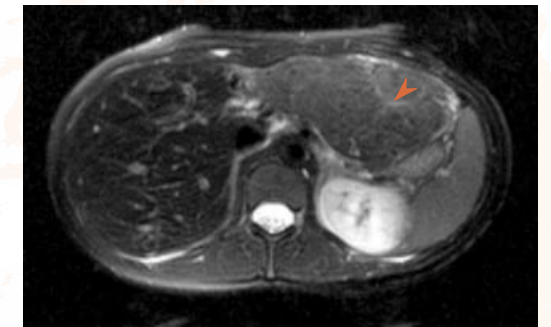
**T1-GRE (TR/TE/Flip angle = 150 ms/1.4ms/60°)**  
 Gd-DTPA-enhanced arterial (a) and portal-venous phase (b) scans. The HCC ▶ shows typical signal enhancement in the arterial phase and wash-out in the portal-venous phase. Further lesions can not be detected.



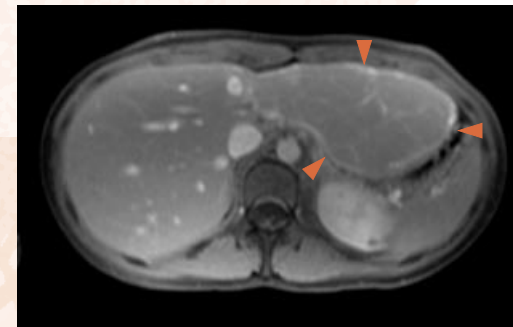
**FNH (focal nodular hyperplasia)**



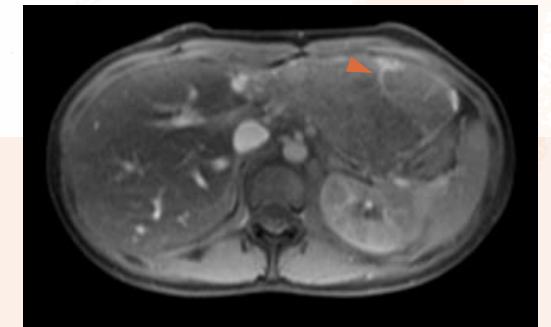
**T2-TSE-FS: native**  
**TR/TE/flip angle = 2790ms/90ms/130°**  
 Isointense lesion in the left liver lobe with shifting of vascular structures and stomach compression.



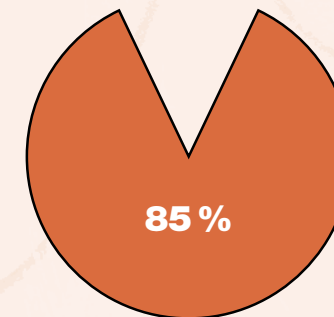
**Post Resovist®**  
 Significant decrease of signal intensity of the lesion with central nidus, typical for FNH.



**T1-GRE-FS: Gd-DTPA**  
**TR/TE/flip angle = 150ms/4.8ms/80°**  
 Isointense lesion in the left liver lobe with shifting of vascular structures and stomach compression.



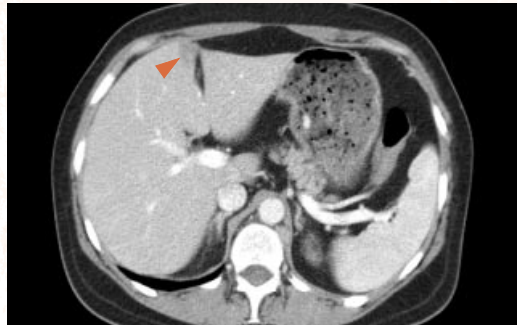
**Post Resovist®**  
 Discrete hypervascularisation of the FNH with enhanced display of vascular structures and central nidus.



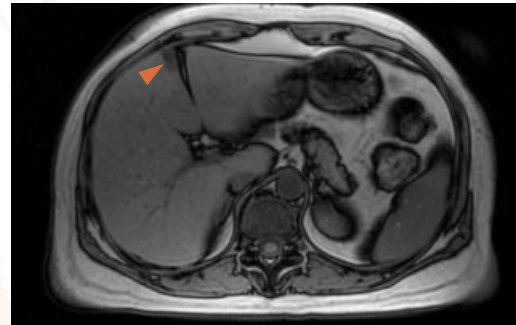
**Accumulation of Resovist®  
 in the Kupffer cells  
 of the liver.**

**Improved detection compared to CT**

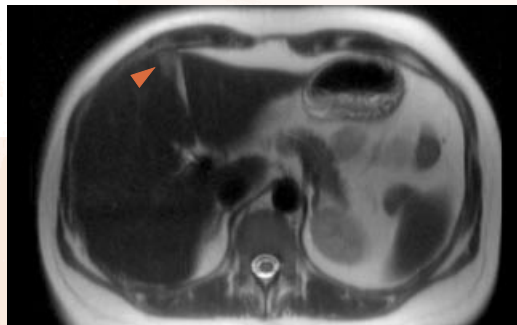
**Focal fatty degeneration**



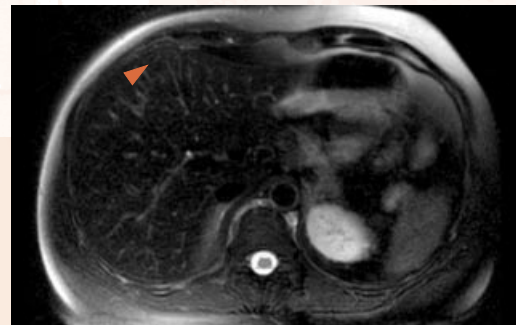
**Spiral-CT: Portal phase**  
Hypodense lesion in the right liver lobe segment 4B. Distinct central enhancement.



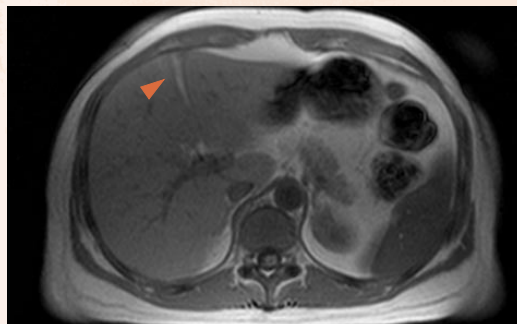
**T1-GRE-opposed phase: native**  
(TR/TE/flip angle = 150ms/2.4 ms/70°)  
Hypointense lesion in the right liver lobe segment 4B.



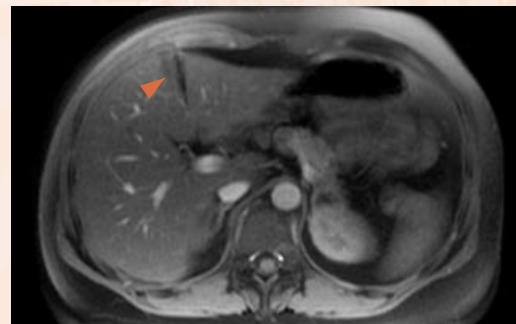
**Haste: post Resovist®**  
(TR/TE/flip angle = 1200 ms/63ms/150°)  
Discrete hyperintense lesion.



**T2-TSE-FS: post Resovist®**  
(TR/TE/flip angle = 2800 ms/90ms/130°)  
Homogeneous signal loss of liver parenchyma due to Resovist® uptake. No proof of a metastasis.



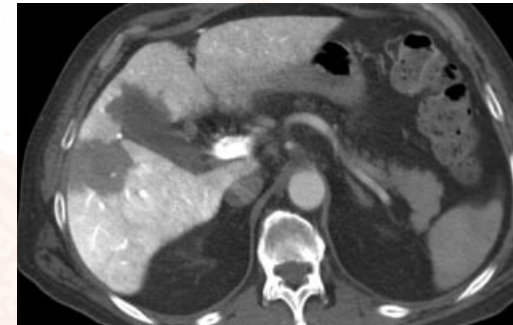
**T1-GRE-in phase: native**  
(TR/TE/flip angle = 150 ms/4.8 ms/70°)  
Discrete hyperintense lesion.



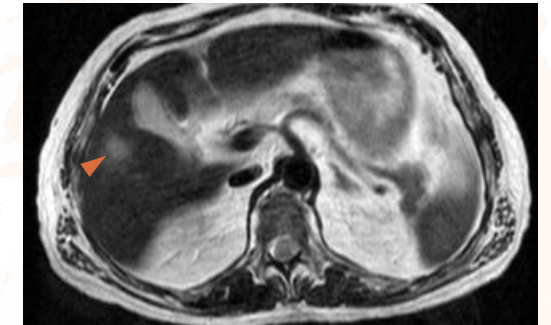
**T1-GRE-in phase: post Resovist®**  
(TR/TRE/flip angle = 150 ms/4.8 ms/70°)  
Homogeneous marginal drop of signal of liver parenchyma  
Lower signal reduction of the lesion with hyperintensity (focal fatty degeneration).

**Improved detection compared to CTAP**

**Liver cirrhosis and HCC**



**CTAP: portal phase**  
Findings of large lesion in segment 5 with suspected satellites proximal to gall bladder and in segment 4B.



**T2-TSE-FS: post Resovist®**  
(TR/TE/flip angle = 2000 ms/90ms/130°)  
Detection of a solitary HCC focus with micronodular changes of liver parenchyma in a patient with cirrhosis.

**With comparable sensitivity, Resovist® -enhanced MRI is superior to CTAP due to its higher specificity, since it leads to fewer false-positive findings.**