

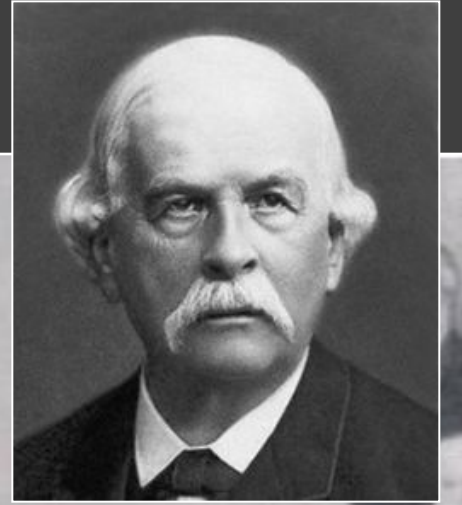
KARACİĞER HASTALIKLARINDA GÖRÜNTÜLEME YÖNTEMLERİ



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fdapaydin68@gmail.com



Yeni Bir Işın Üzerine



İKTİSADİ RÜHİCİ
YÜZBAŞI DOKTOR
ESAT FEVZİ

BURADA YATAR
1874 - 1901

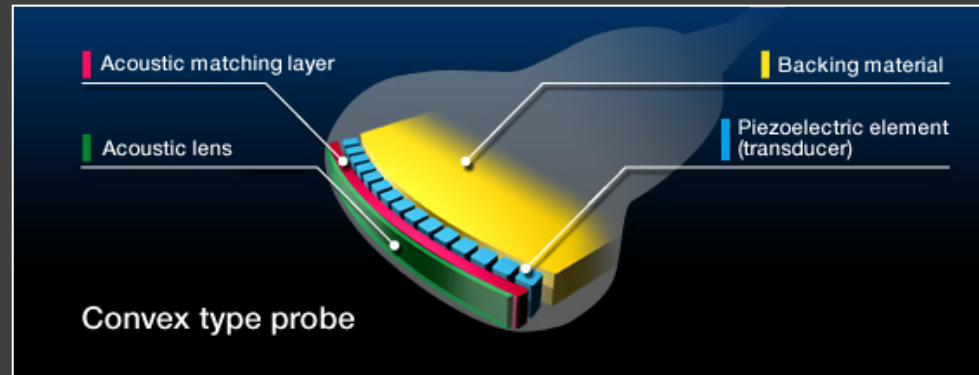
ALLAH
CUMHURİYET
HÜSNÜ
ARSAN
1884 - 1944

Görüntüleme Yöntemleri

- Ultrasonografi (US)
- Renkli Doppler US
- Bilgisayarlı tomografi (BT)
- Manyetik rezonans görüntüleme (MRG)

US

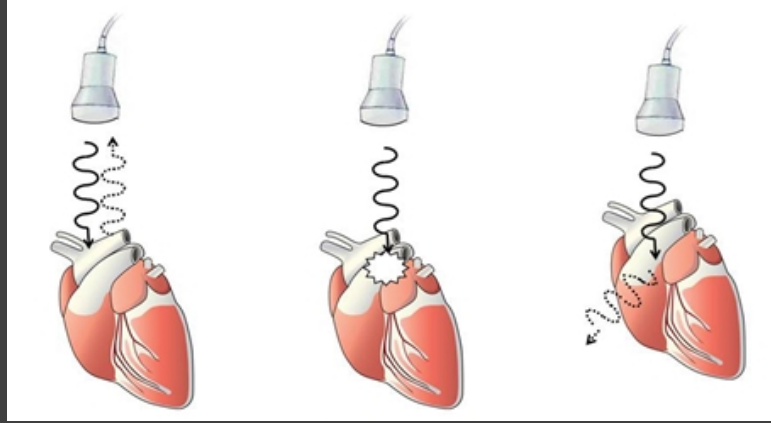
- Kesitsel görüntüleme yöntemi
- Enerji kaynağı olarak yüksek frekanslı ses dalgaları
- Transduser
 - Hasta cildi ile temas eder
 - Özel yapıdaki kristaller sayesinde elektrik enerjisi $\leftrightarrow$ mekanik enerji



US

- Paketler şeklinde vücuda gönderilen ses dalgalarında;

- Absorbsiyon
- Yansıma
- Kırılma
- Saçılma



- Transdusere dönen veya dönemeyen veya değişerek dönen ses dalgaları → özel bilgisayar programları → gri tonlardan oluşan görüntü

US

Avantaj

- Radyasyon $\emptyset$
- Non-invaziv
- Nispeten ucuz bir teknoloji
- Tekrar edilebilir
- Taşınabilir
- Girişimsel işlemlere kılavuzluk

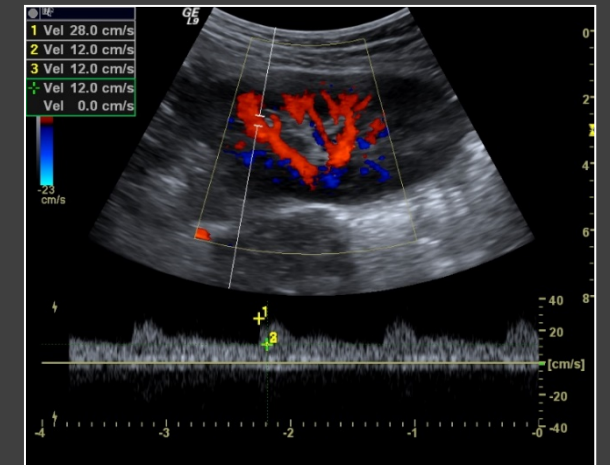
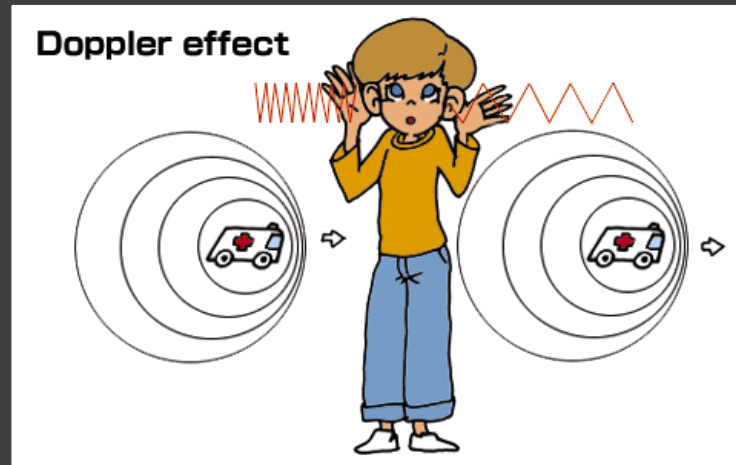
Dezavantaj

- Hasta ve uygulayıcıya bağımlı
- Morfolojik bilgi (+)
- Fonksiyonel bilgi ?

Renkli Doppler US

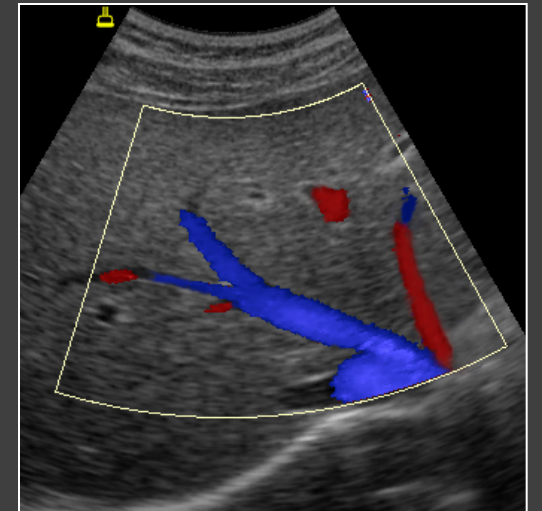
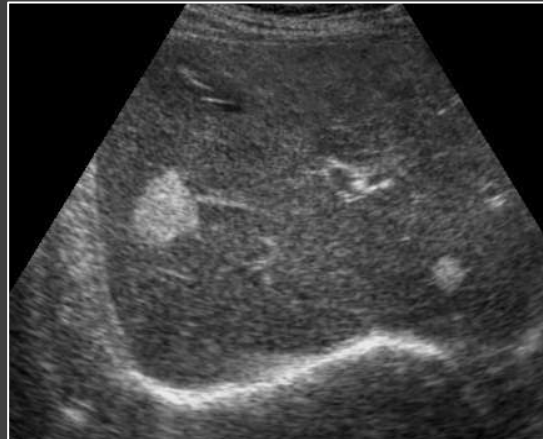
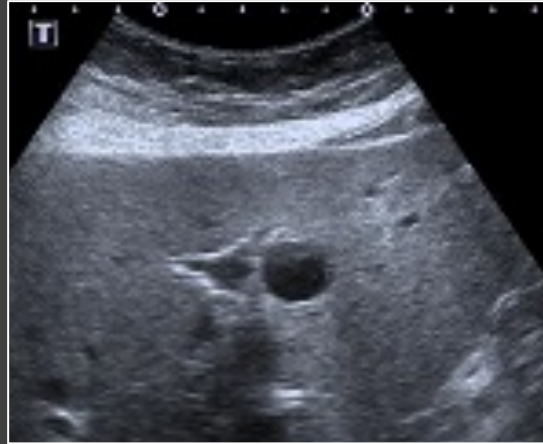


- Temel fiziksel prensip → hareketli bir yapıdan yansıyan-saçılan ses dalgalarının frekans ve dalga boyunun değişimi
- Bu prensip + gelişmiş bilgisayar programları →
 - Akım yön ve hızına göre değişen renklerle kodlanabilen vasküler yapılar
 - Spektral inceleme adı altında akımın nicel özellikleri



US - Renkli Doppler US

- Karaciğer;
 - Büyüklüğü
 - Konturları
 - Parankim yapısı
- Vasküler yapılar
- Fokal lezyon;
 - Saptanması
 - Karakterizasyonu



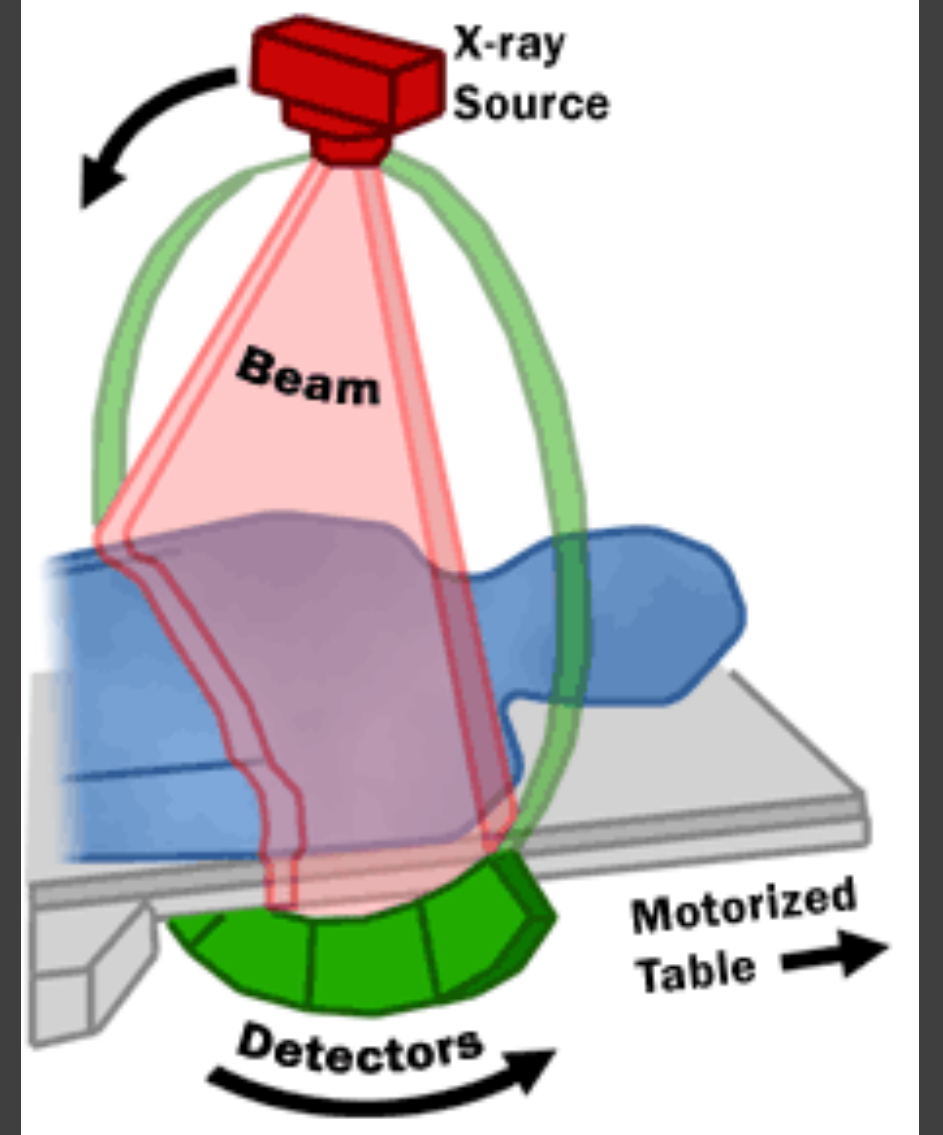


BT

- Kolime edilmiş X ışını
- Kesitsel görüntüleme



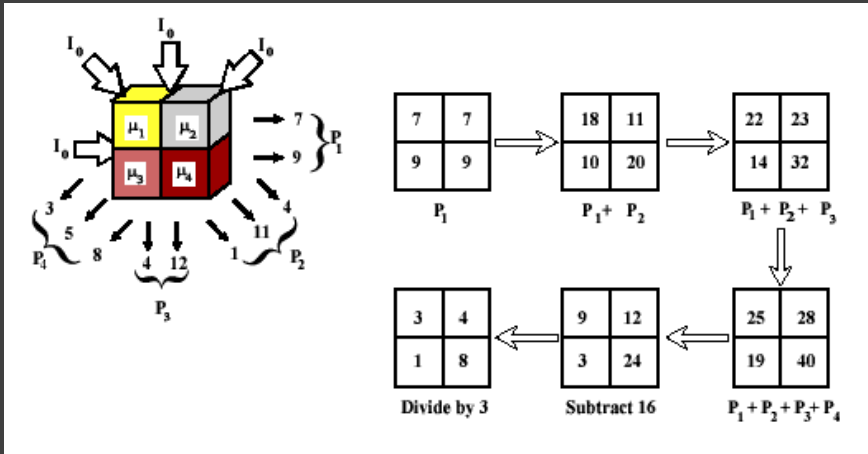
X ışını tüpü + tüple senkronize hareket eden dedektör sistemi



BT

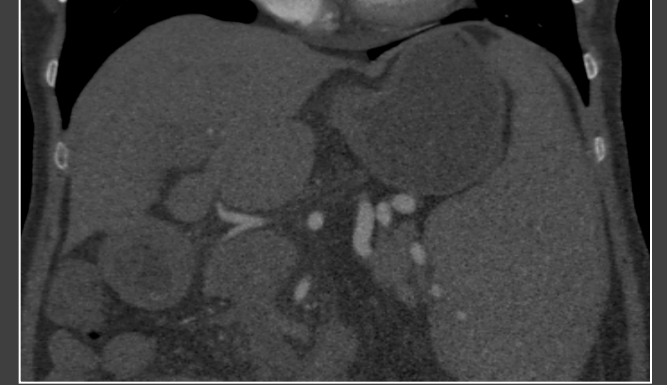
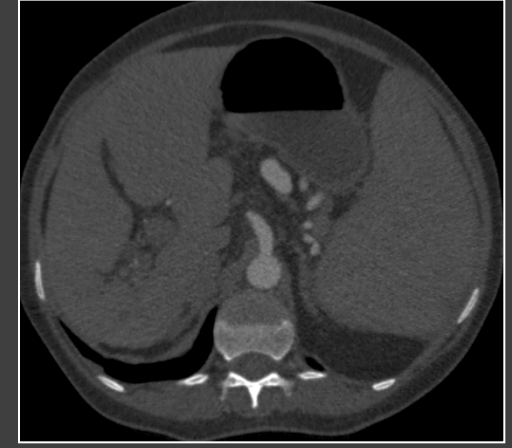


- Kolime edilmiş X ışını - hasta etkileşimi → doku özellikleriyle ilişkili olarak X ışınında zayıflama
- Taranan hacmin her bir noktasında farklı zayıflama değerleri → algılayıcı dedektörler → bir dizi karmaşık matematiksel işlemi → gri noktalardan oluşan kesit görüntüsü

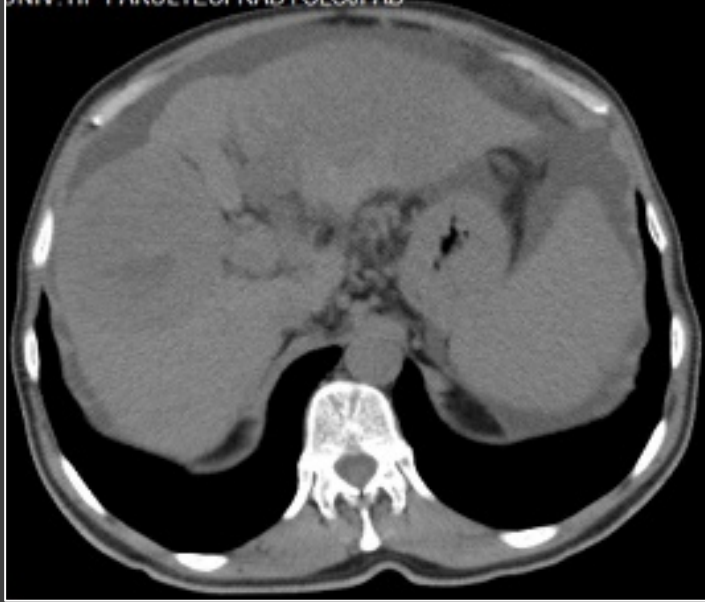


Çok Kesitli BT

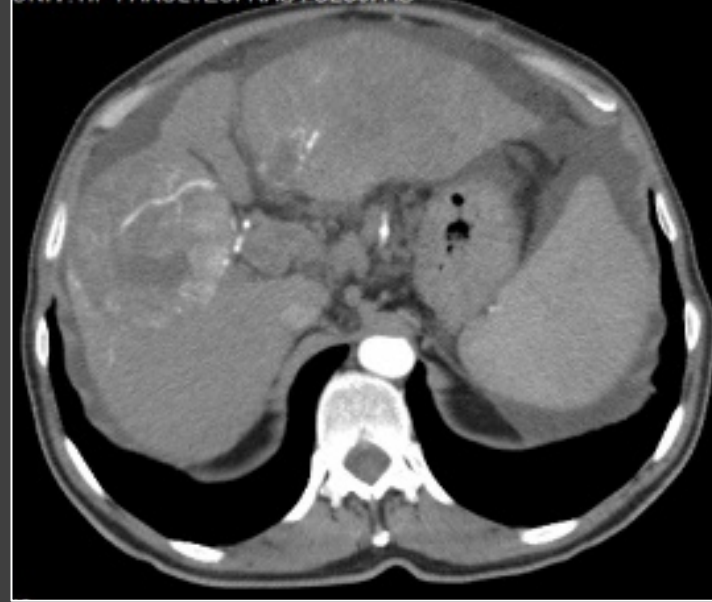
- Geniş alanlar (baş ayak)
- İnce kesit kalınlığı (0.5 mm)
- Kısa süre ($\approx$ 20 - 30 sn)



UNIV.TIP FAKULTESİ RADYOLOJİ AD



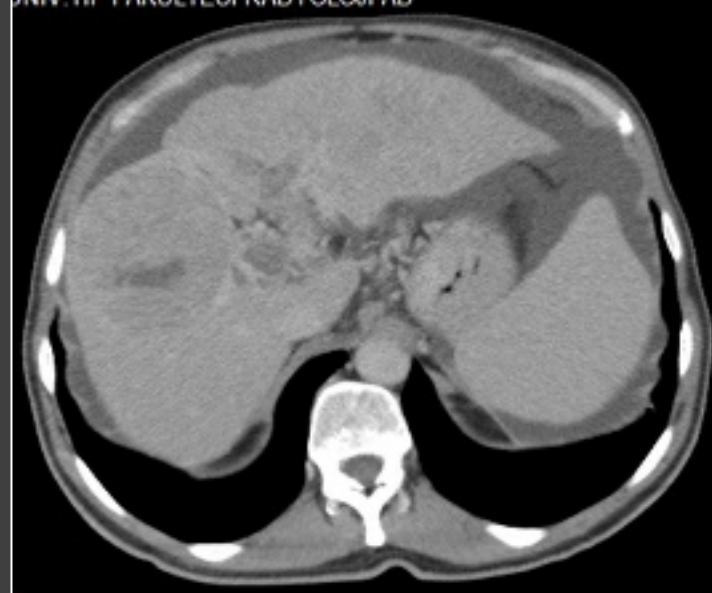
UNIV.TIP FAKULTESİ RADYOLOJİ AD



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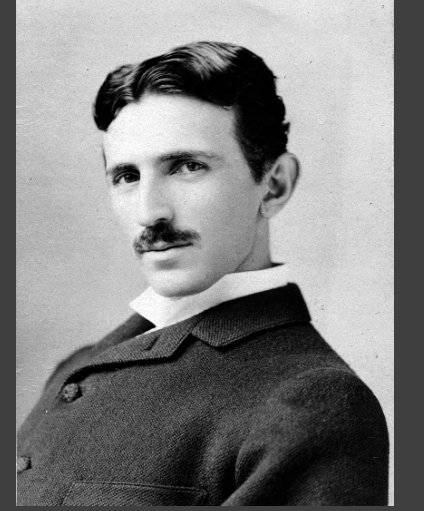


Rutin abdominal BT →
genel değerlendirme

Lezyon karakterizasyonu →
dinamik BT

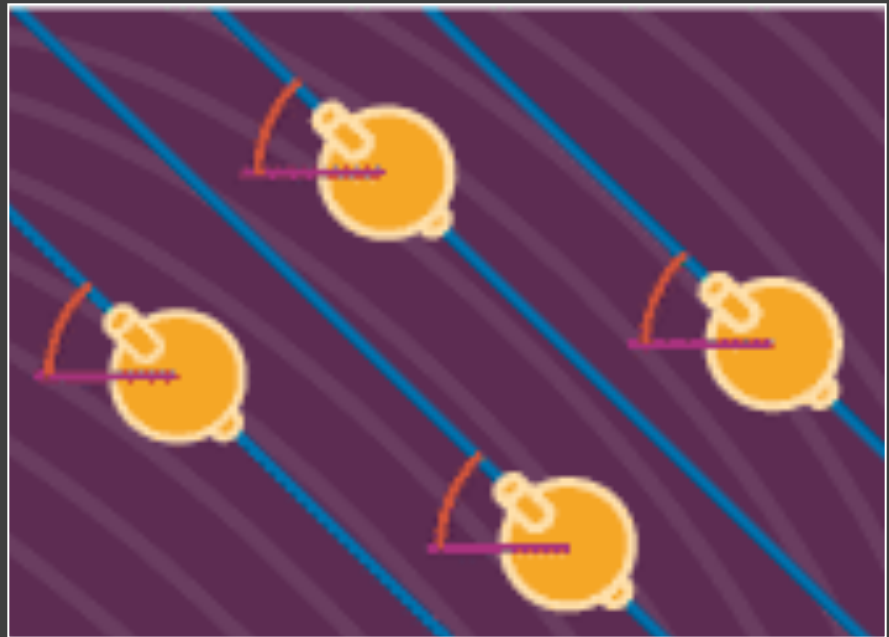
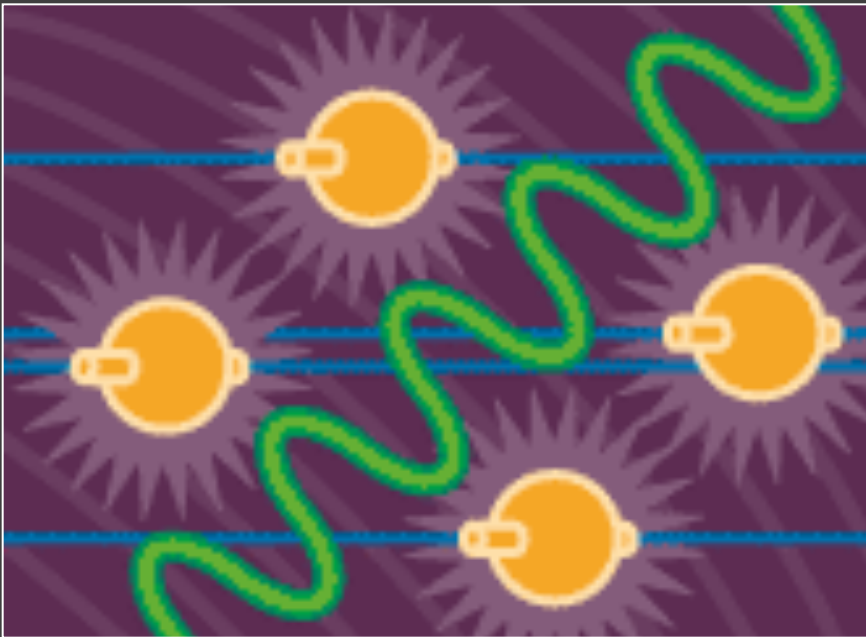
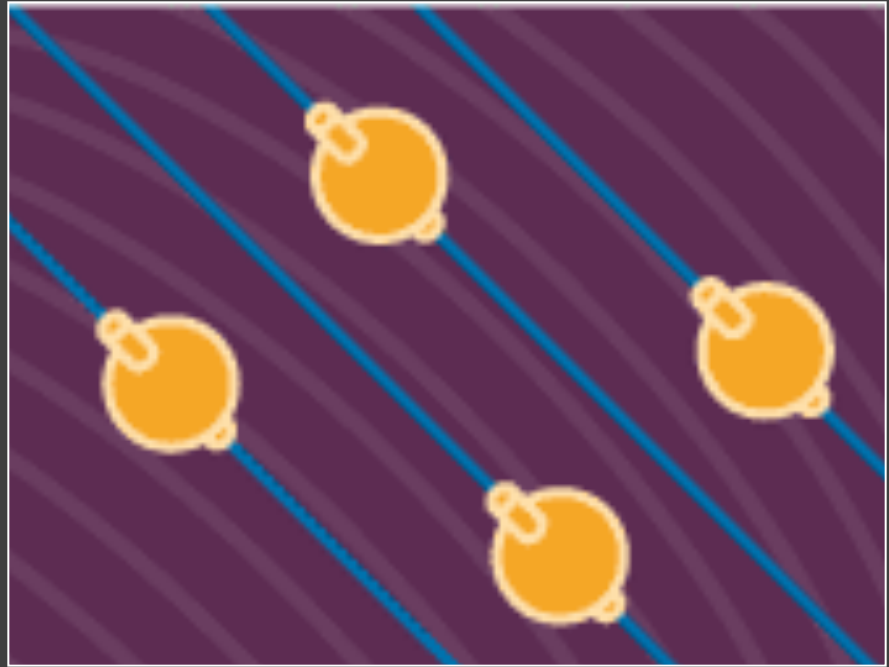
Kontrastsız
Arteriyel faz
Portal faz
Hepatik venöz faz

MRG

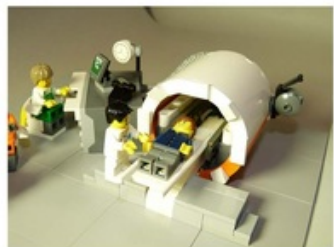


- Manyetizma temelli
 - MRG cihazı → dev bir mıknatıs
- Kesitsel görüntüleme
- Görüntü kaynağı → vücuttaki hidrojen atomları

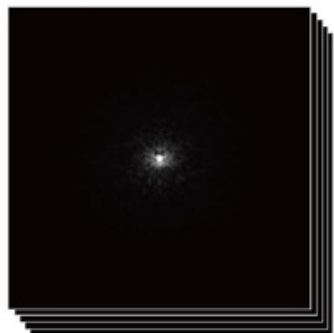




MRI

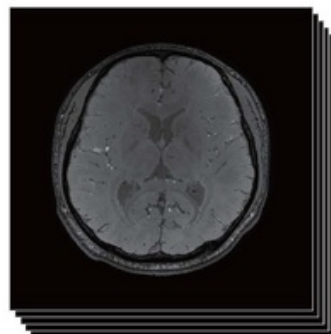


MRI-Scanning
 k -space data



Inverse
Fourier Transform

Magnitude



Phase



Phase Unwrapping
Background Removal

RDF ψ



Dipole
Inversion



MRG



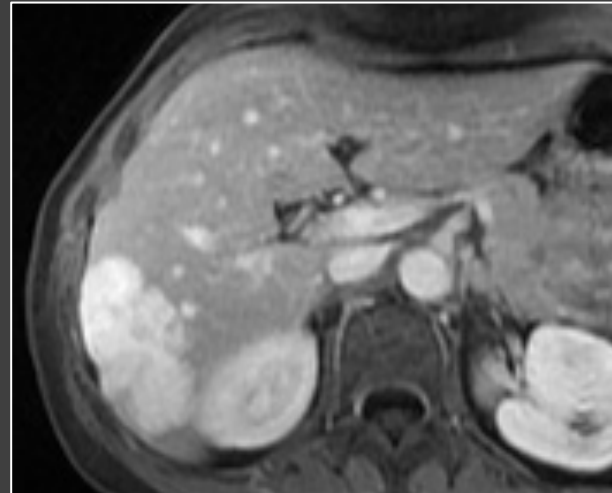
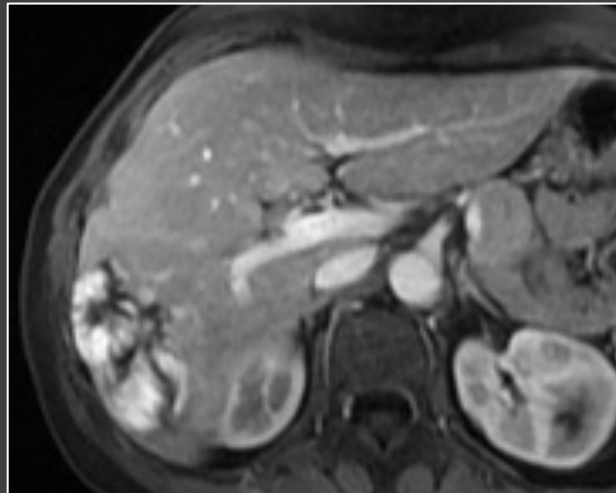
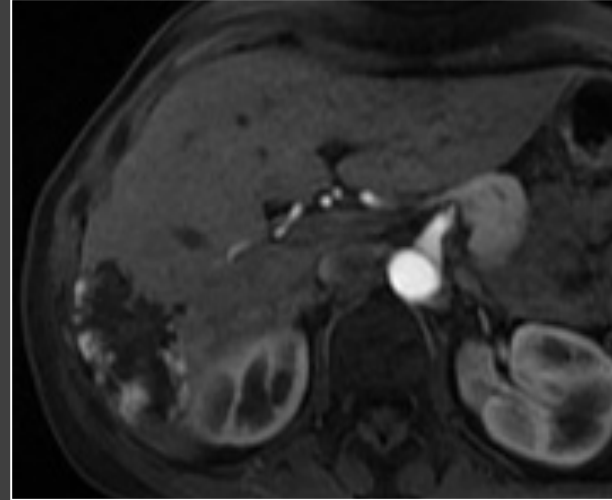
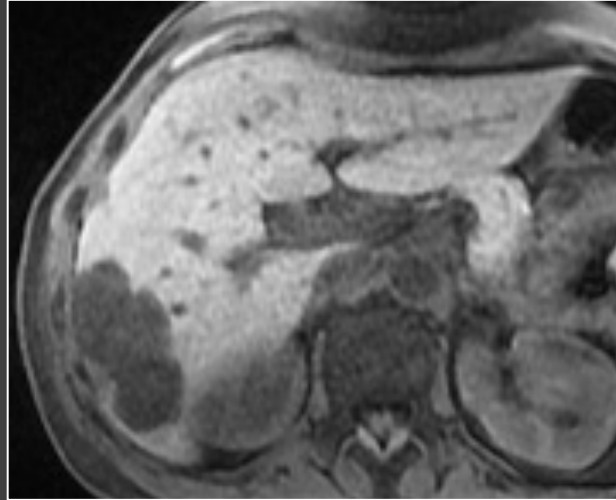
Dezavantaj

lülüğü ↑
eden farklı
lde etme
sızın vasküler

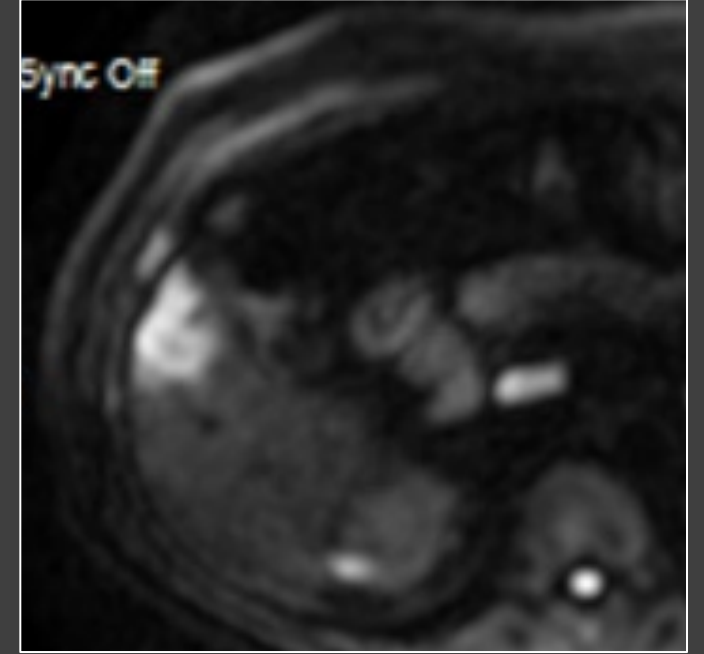
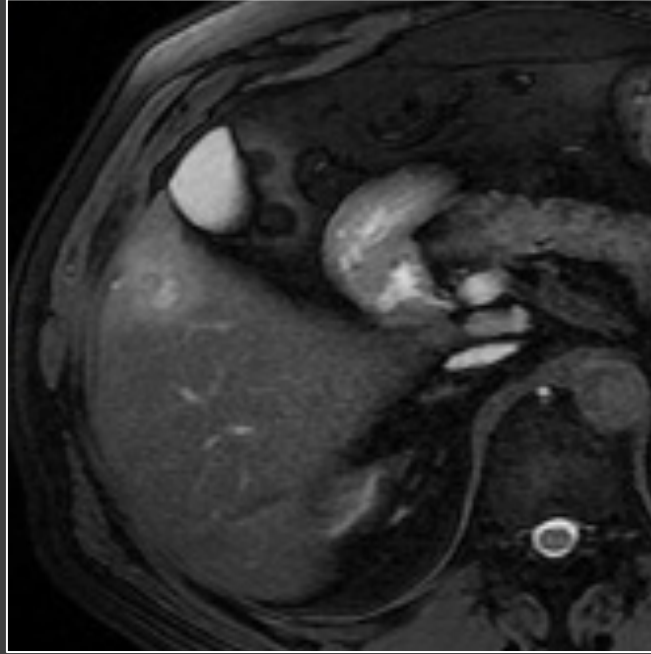
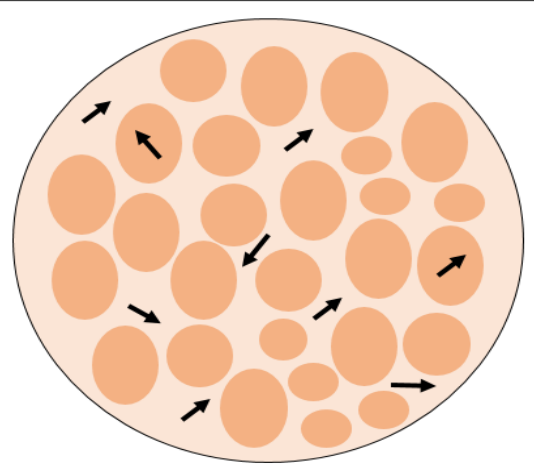
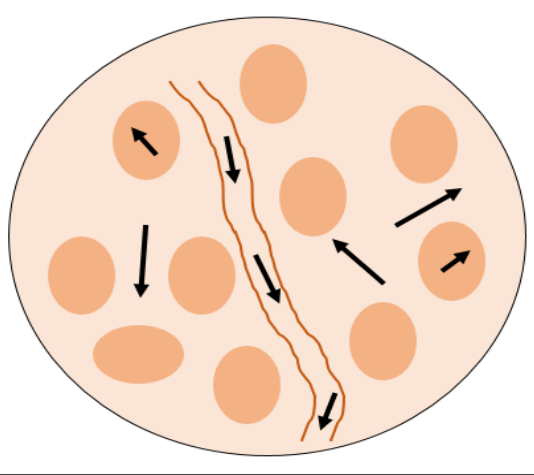
- Pahalı bir teknoloji
- Uzun bir inceleme yöntemi
- Hareket artefaktlarına duyarlılık

Genel anlamda,
problem çözücü bir görüntüleme yöntemi

Dinamik Kontrastlı MRG

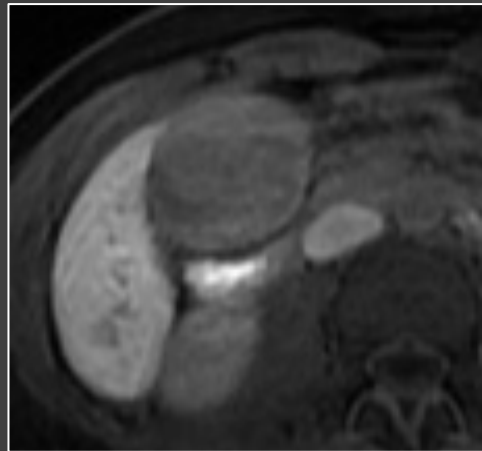
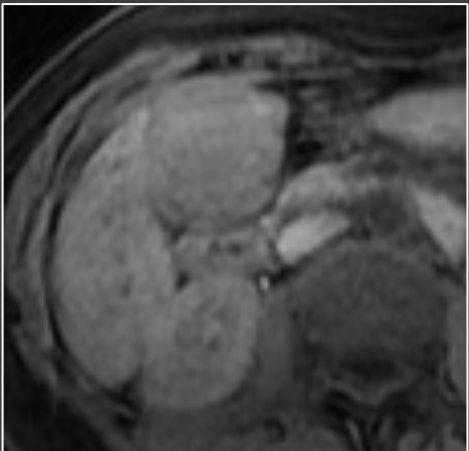
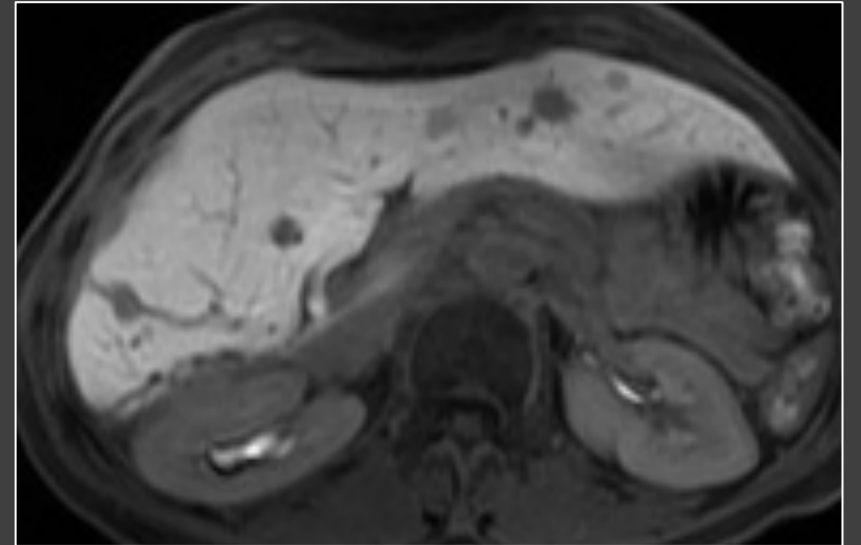
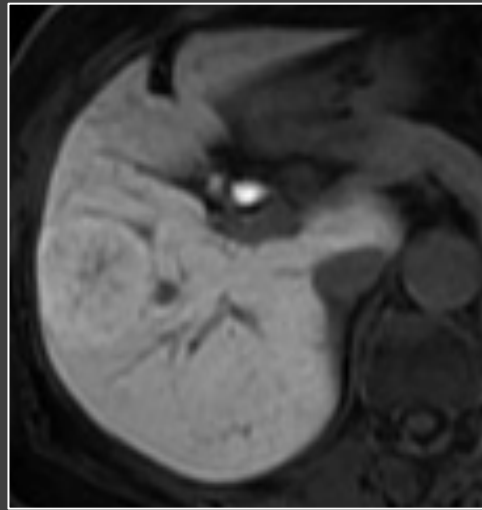
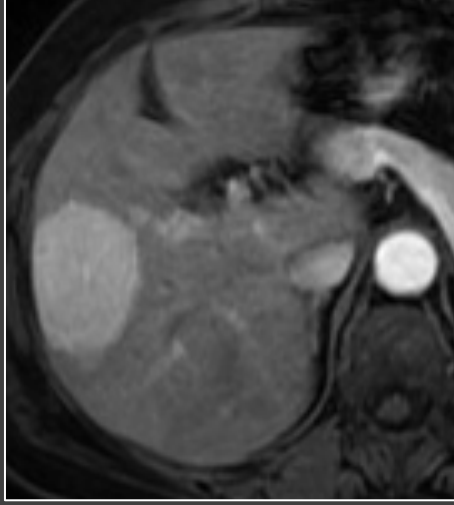
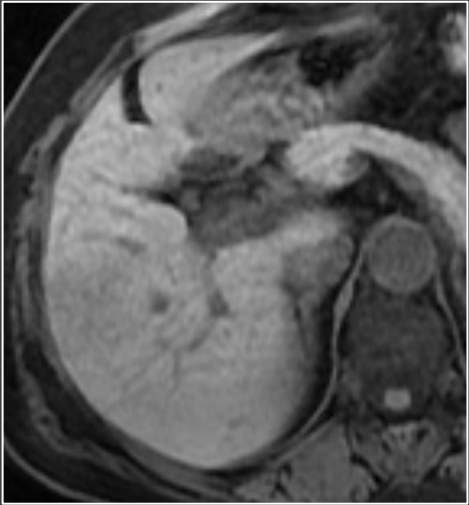


Difüzyon Ağırlıklı Görüntüleme



Benin - malin lezyon ayrımı ???

Hepatosit Spesifik Kontrast Madde





Yağlanma
Demir birikimi
Fibrozis

Yağlanma - US ve BT



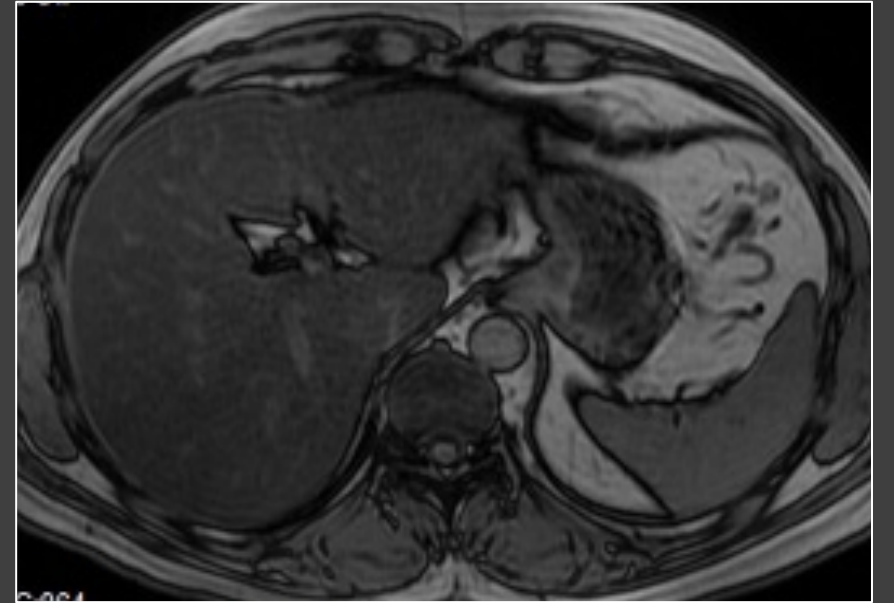
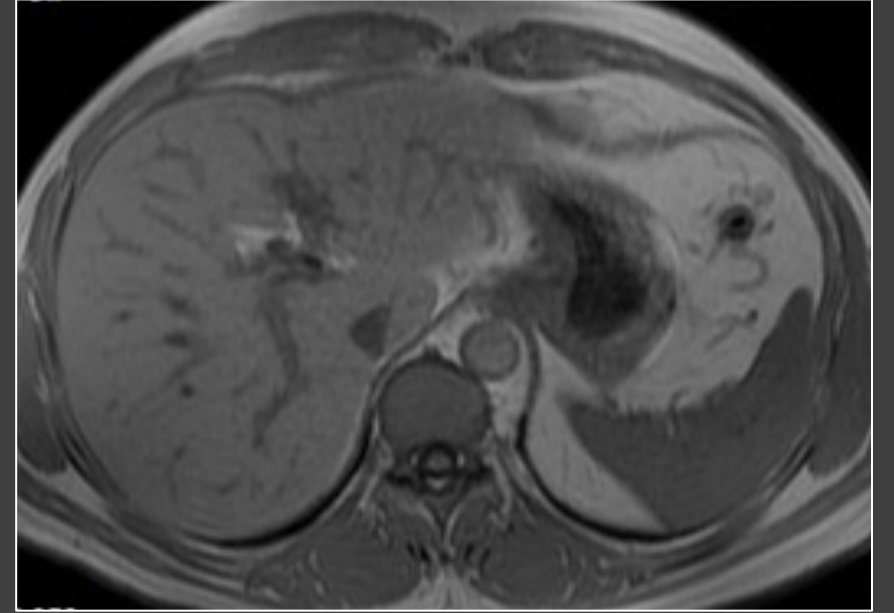
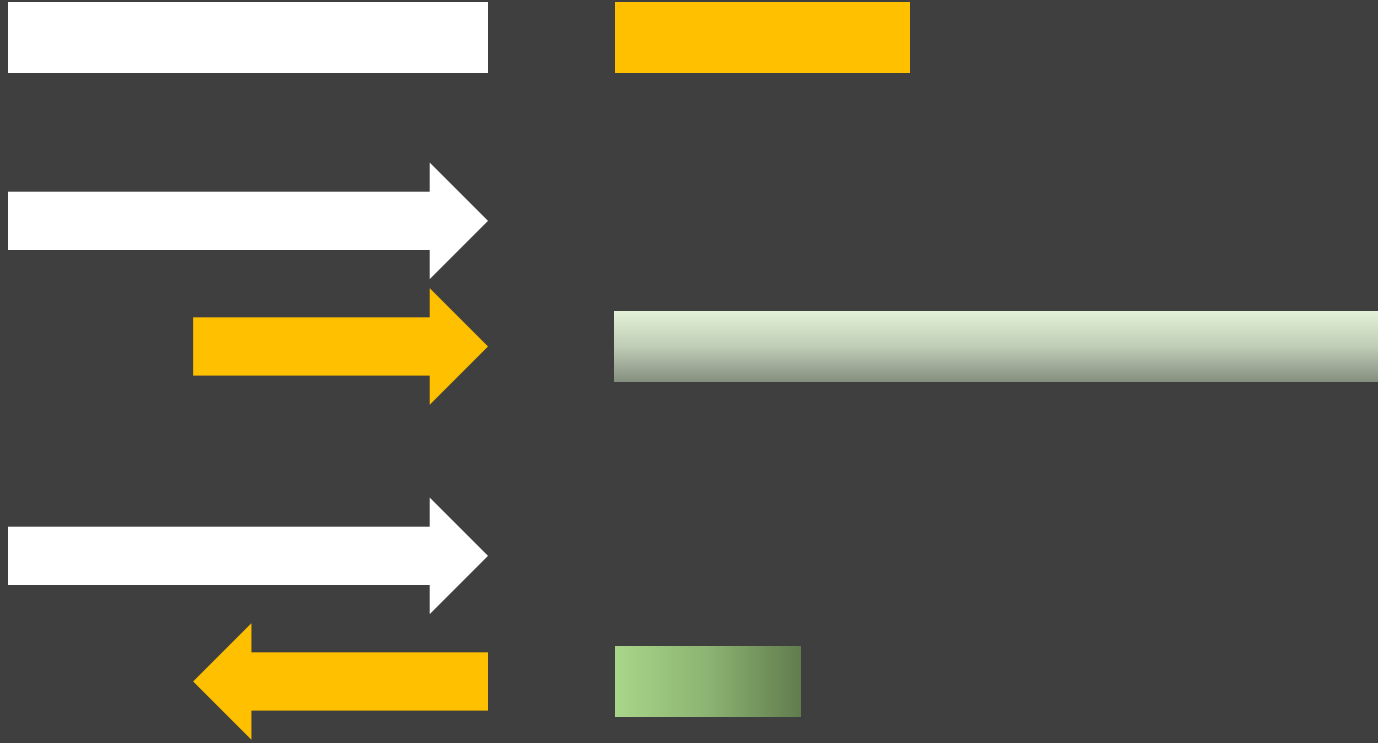
Yağlanma - MRG

MRG ve yağ

Yağ sinyaline göre

Yağdaki mobil protonların yoğunluğuna göre

Faz İçi - Faz Dışı Görüntüleme



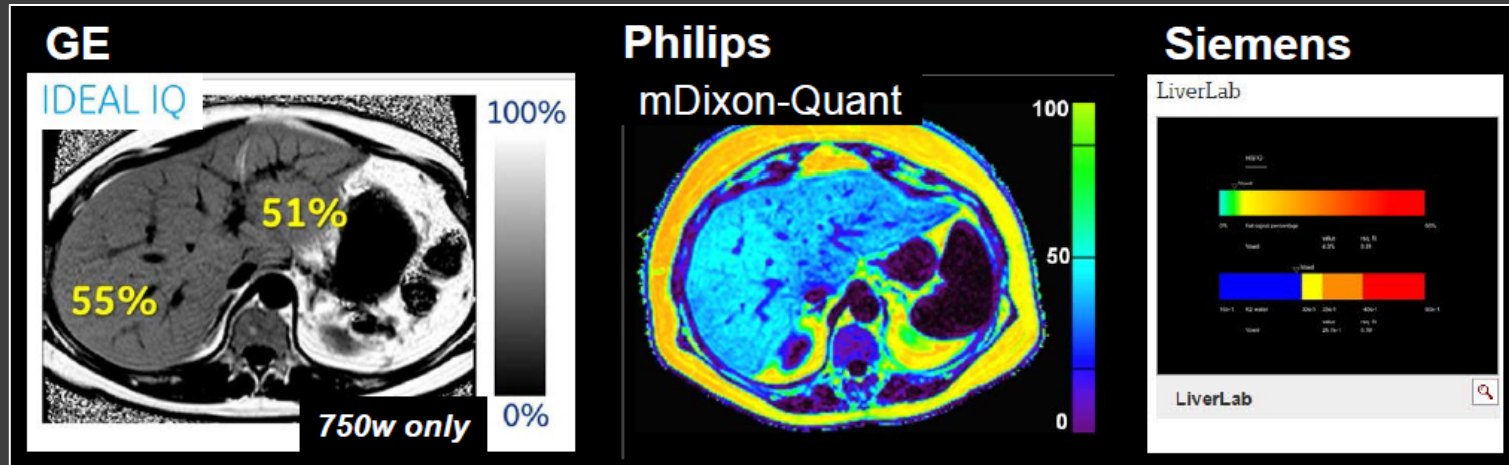
Yağlanma - MRG

SORUN

Sinyali etkileyen biyolojik, fiziksel, teknik faktörler var.

ÇÖZÜM

Bu faktörleri minimize ederek sinyalin sadece proton yoğunluğunu yansıtmasını sağlamak...

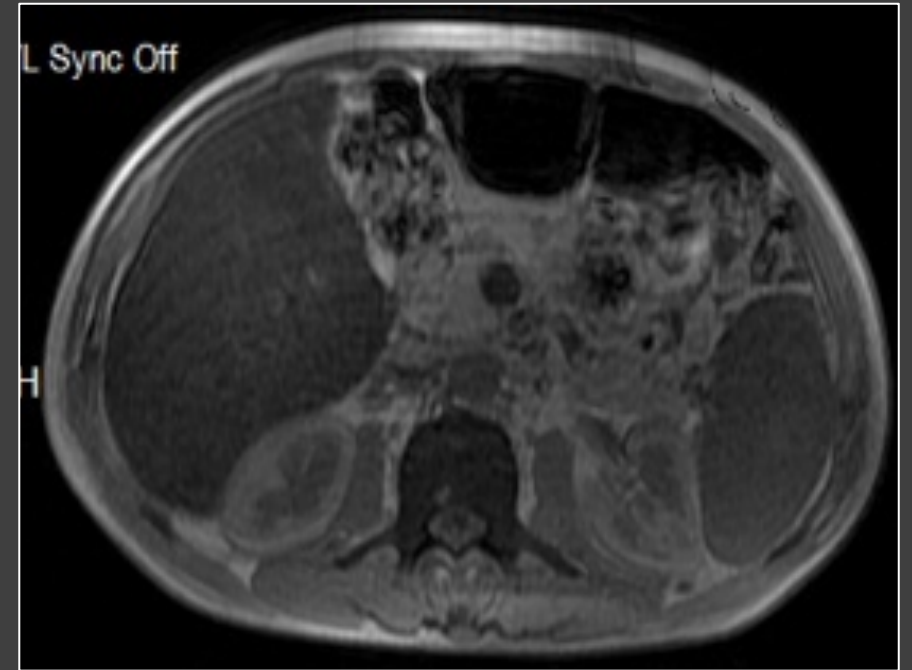
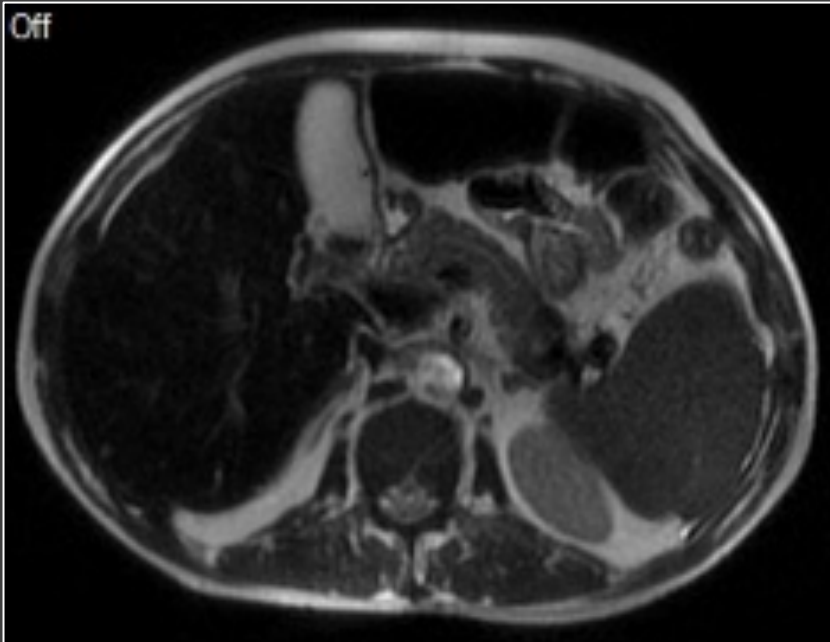


Demir Birikimi - BT

- Parankimal dansite artışı
- Başka difüz hastalıklar (Wilson hastalığı), uzun süreli amiodaron kullanımında da benzer görünüm

Demir Birikimi - MRG

- Demir ferromanyetik özellikte
- Lokal distorsiyon
- Sinyal kaybı



Demir birikimi - MRG kantitatif

Sinyal intensite
oranı

T2
relaksometri

Liver iron quantification by MRI (1.5 Tesla)

Patient:

Type in the mean values of MR signal given by ROIs, up to three for the liver and one or two for the paraspinal muscles. Do not put decimal values, measure is not so precise !

TR / TE / PA°

Liver (1)

Liver (2)

Liver (3)

Muscle (1)

Muscle (2)

T1 : GRE 120 / 4 / 90°

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PD : GRE 120 / 4 / 20°

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T2 : GRE 120 / 9 / 20°

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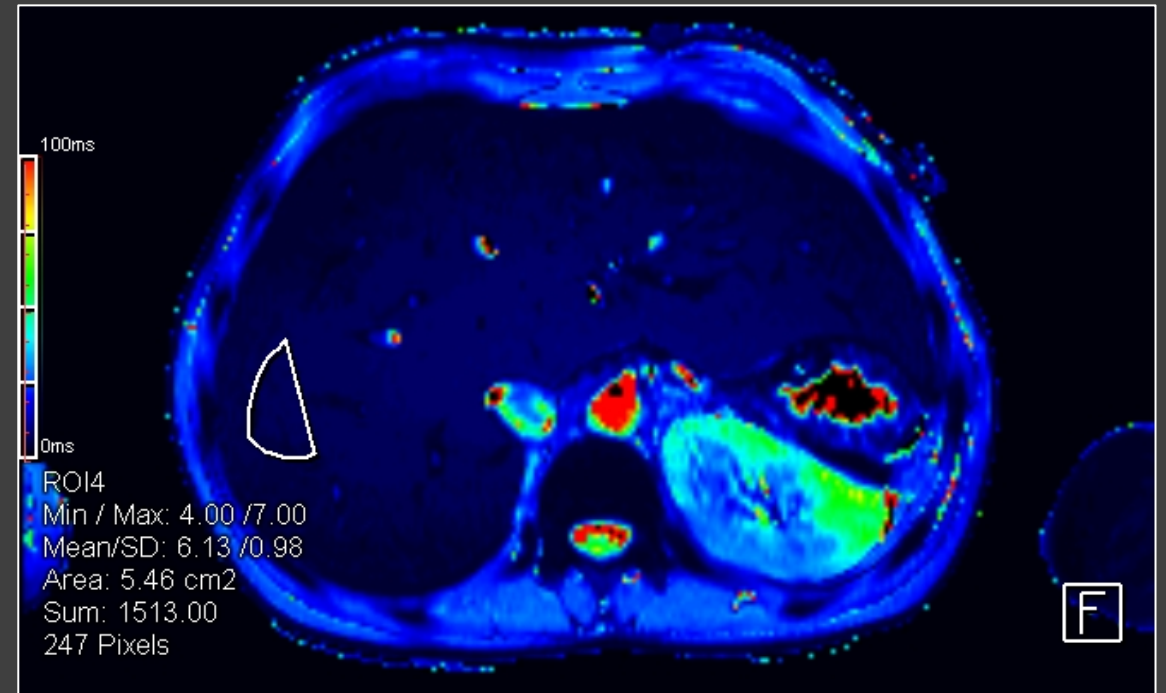
T2+ : GRE 120 / 14 / 20°

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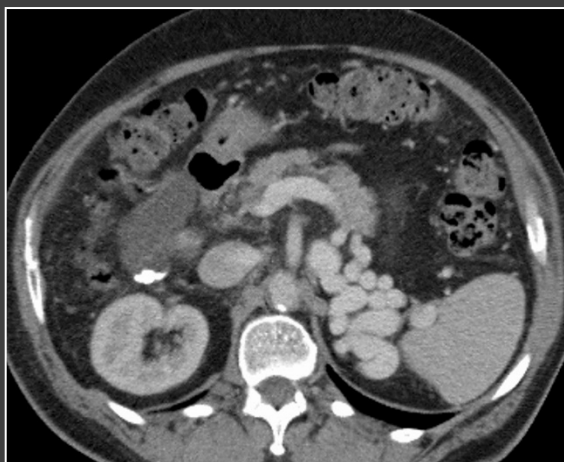
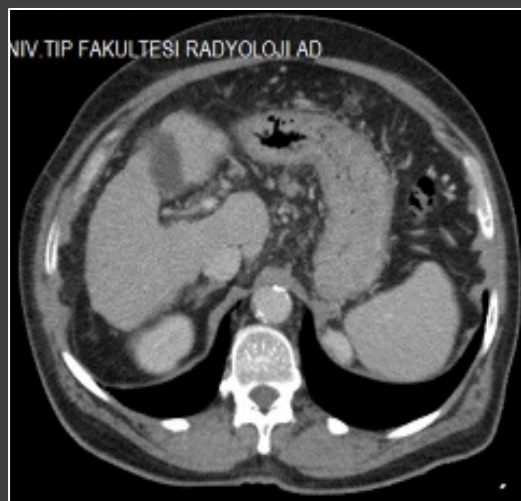
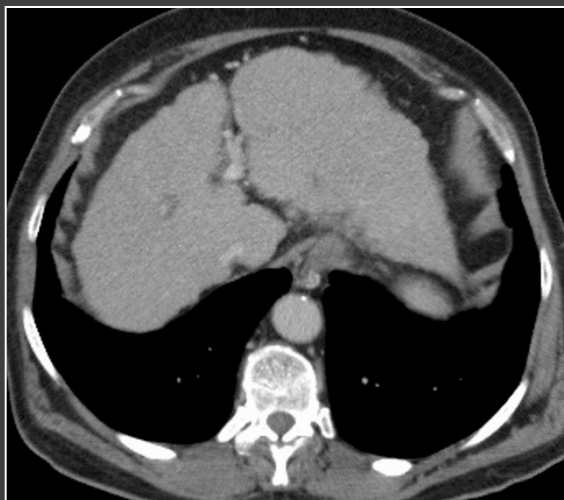
T2++ : GRE 120 / 21 / 20°

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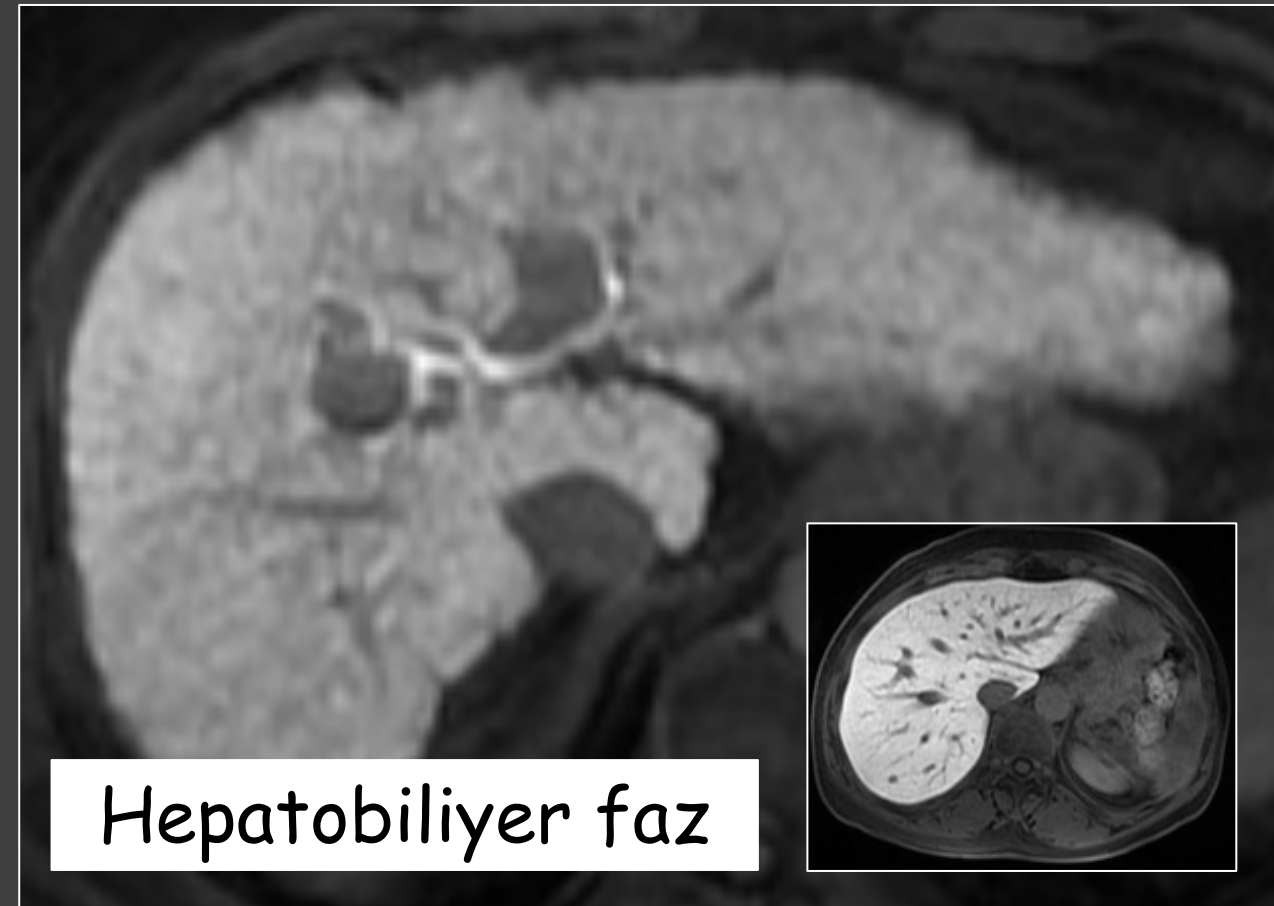
Use Internet Explorer if this function is not working with your web browser



Fibrozis - Siroz



Fibrozis - MRG



Fibrozis - kantitatif deęerlendirme

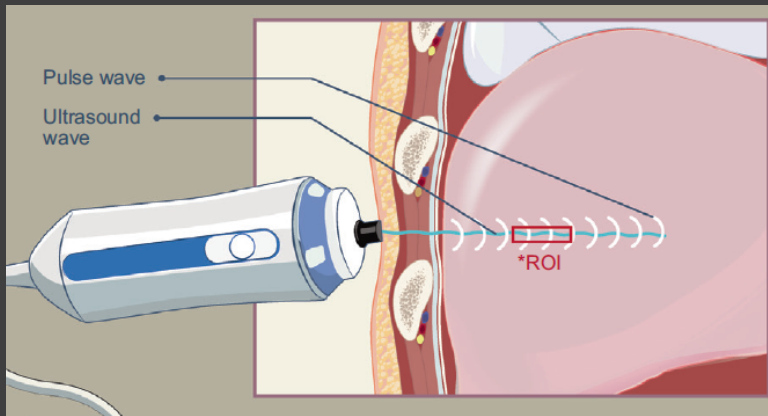
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graph TD; A[Fibrozis - kantitatif deęerlendirme] --> B[US elastografi]; A --> C[MR elastografi];
```

US elastografi

MR elastografi

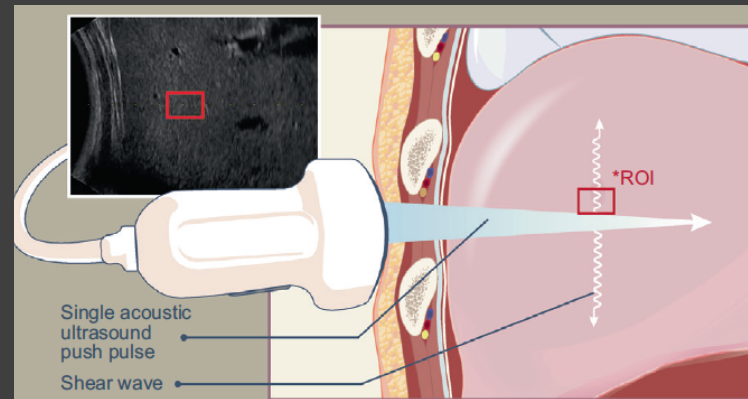
US elastografi

Transient elastografi

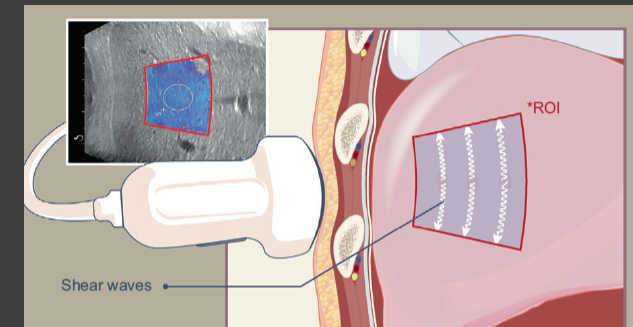


Compression push deformation (hemispherical waves) travels longitudinally through the liver. Ultrasound measures (~~~~~) its travelling speed.

Acoustic Radiation Force Impulse (ARFI) elastografi



*Selected small (10x5 mm) region of interest (ROI). ROI can be freely moved anywhere in the scanning plane up to 8 cm in depth to capture shear wave speed.



Geometrical box as ROI (1-4 cm) to measure tissue stiffness by assessing shear waves speeds generated by multiple stimulating ultrasound beams (specific method depending on the proprietary technology).

They can work as one time emitted push pulse or in real time based on the proprietary technology.

US Elastografi

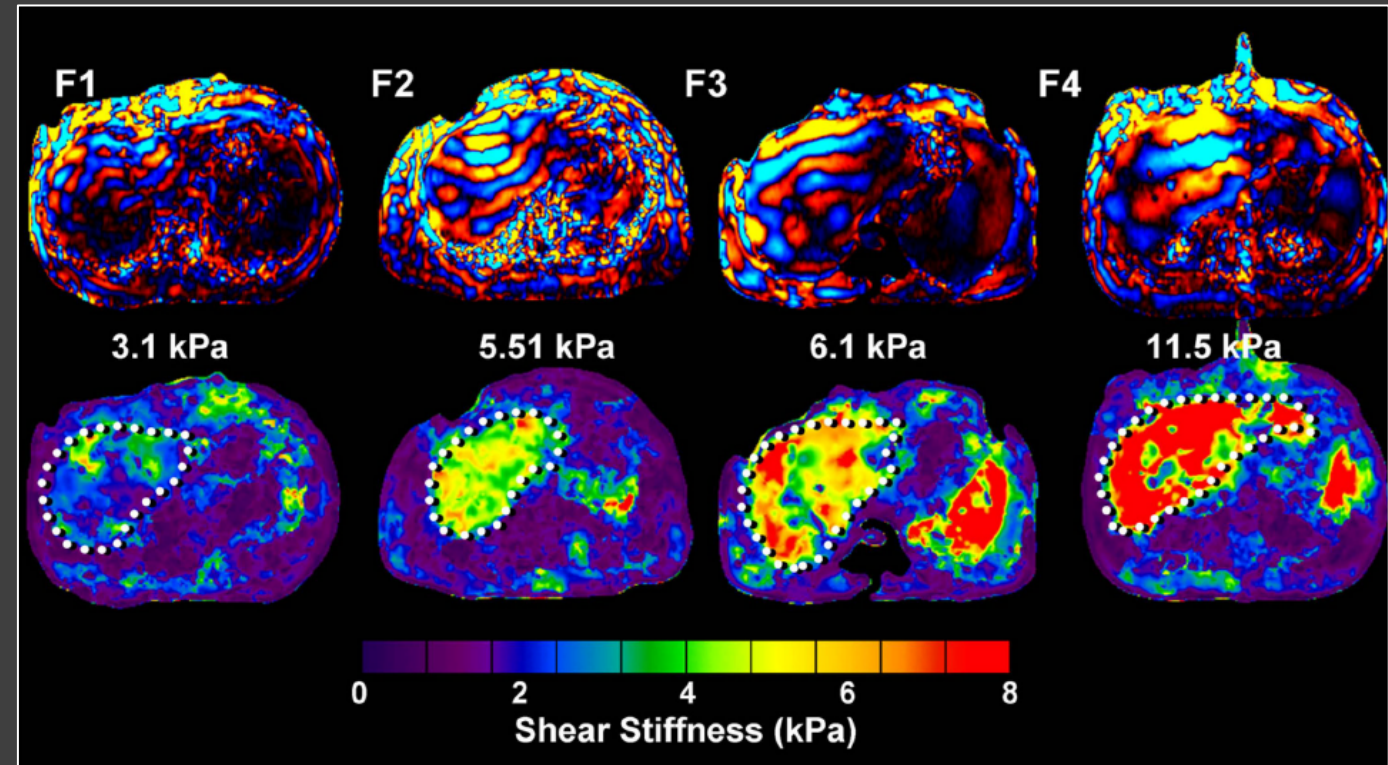
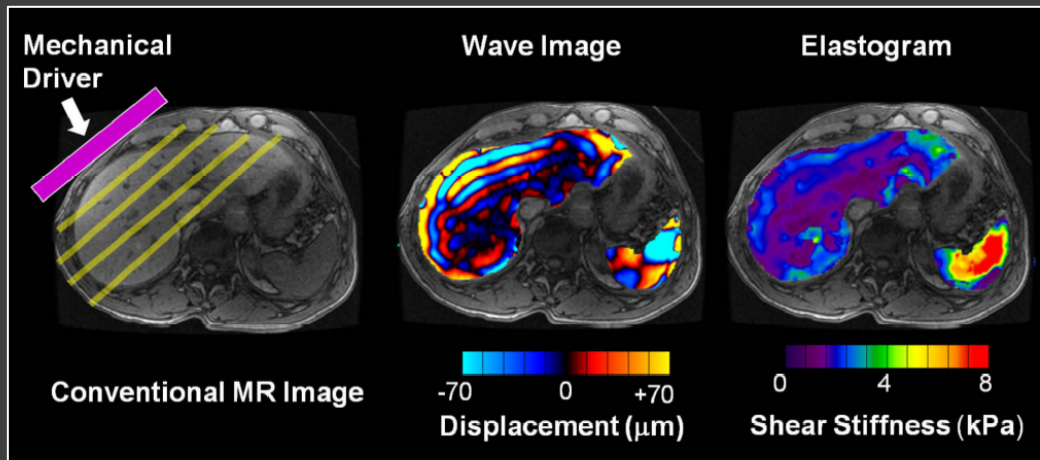
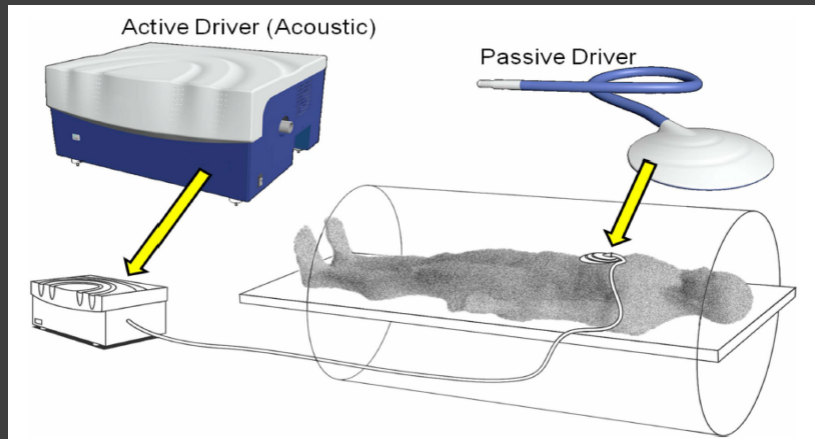
Transient elastografi

- Sık kullanılıyor, denenmiş
- Özellikle belirgin fibrozis ve sirozda faydalı
- Obez hastalarda ???
- Asit varlığında ???
- Ara dereceleri belirlemede ???

ARFI elastografi

- US ile birlikte kullanılabilir
- Obez hastalar ve asit varlığında da faydalı
- Tanısal olmayan inceleme sayısı, *transient* elastografiye göre daha az → daha güvenilir

MR Elastografi



MR Elastografi & US Elastografi

Avantaj

- Obez hastalar ve asit varlığında ✓
- Daha geniş bir parankim alanından veri topluyor
- Ara dereceleri belirlemede ✓
- Uygulayıcıya bağımlılık daha az
- Karaciğeri değerlendirmek ✓

Dezavantaj

- Yeni teknoloji
- Pahalı teknoloji
- Uygulama nispeten zor
- Demir birikimi de varsa doğruluk azalıyor

