الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي

المرحلة: الرابعة

العنوان: **Title: MRI of the biliary tree and pancreas.**

اسم المحاضر: **Name of the instructor:**

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

الفئة المستهدفة: **Target population:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

المقدمة: Introduction:

MRI of the biliary and pancreas is typically performed using a magnetic resonance cholangiopancreatography (MRCP) sequence. MRCP is a special type of MRI that produces images of the bile ducts and pancreatic duct. MRCP images are created by using a contrast dye that is injected into the bloodstream and travels to the bile ducts and pancreatic duct.

Pretest: الاختبار القبلي:

Define the MRCP

Scientific Content: المحتوى العلمي:

Indication

• For the evaluation of biliary system in cases of obstructive jaundice
• Pancreas divisum
• For the evaluation of intrahepatic biliary ducts in the postoperative conditions
• For the evaluation of pancreatic duct abnormalities

Equipment

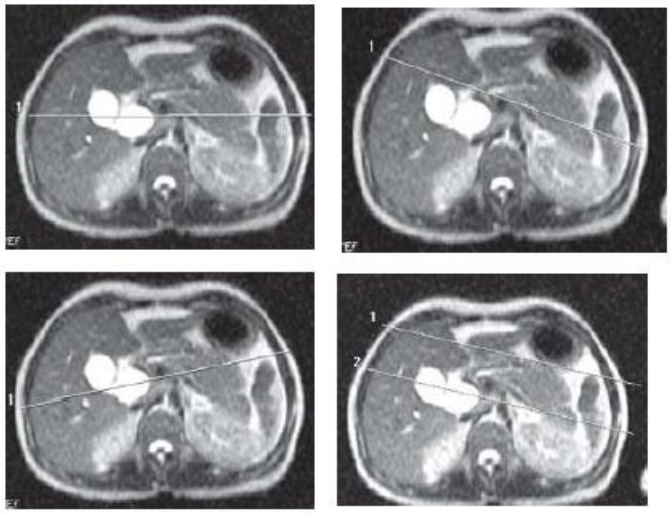
•• Body coil/volume torso array or multi-coil
•• RC bellows
•• Earplugs/headphones
•• Pe gating leads if required

Patient Position: Torso phased array coil

• Position the patient supine, feet first on the table.
• Place the arms at the sides or under the head.

Placement of the respiratory compensation (RC) bellows

Patient Position: Torso phased array coil



SSFSE- single shot breath hold technique

Pancreas

Common indications

•• Pancreatic tumours
•• Pancreatic duct obstruction

Equipment

•• Body coil/multi-phased array/multi-array coil
•• RC bellows
•• Earplugs/headphones

Patient positioning

The patient lies supine on the examination couch with the RC bellows 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.

Common MRCP Sequences:

1. Single Shot Fast Spin Echo (SSFSE) Sequence:
    - Parameters:
        - Slice thickness: 2-3 mm
        - TR (Repetition Time): 2000-4000 ms
        - TE (Echo Time): 500-1000 ms
    - Use: This sequence provides high-resolution images of the biliary and pancreatic ducts. It is useful for detecting and characterizing ductal abnormalities, such as strictures, stones, and dilations.
2. 2D Thick Slab Half-Fourier Acquisition Single Shot Turbo Spin Echo (HASTE) Sequence:
    - Parameters:
        - Slice thickness: 10-15 mm (thicker slices)
        - TR: 800-2000 ms
        - TE: 60-120 ms
    - Use: This sequence is often used for acquiring a rapid overview of the biliary and pancreatic ducts, especially in cases where a larger field of view is needed.
3. 3D T2-Weighted Sequence:
    - Parameters:
        - Slice thickness: 1-2 mm (high-resolution)
        - TR: 1000-2000 ms
        - TE: 500-1000 ms
    - Use: This sequence offers excellent spatial resolution and provides detailed 3D images of the biliary and pancreatic ducts. It is particularly valuable for assessing the entire course of the ducts and identifying small abnormalities.

Specific Uses:

- Pancreatic Duct Assessment: MRCP helps assess the pancreatic duct for conditions such as pancreatitis, ductal dilations, and tumors that may involve the pancreas.
- Preoperative Planning: MRCP is valuable for preoperative planning, especially before procedures like cholecystectomy (gallbladder removal) or pancreatic surgery, where a detailed understanding of the biliary and pancreatic anatomy is essential.
- Screening for Pancreatic and Biliary Tumors: MRCP can aid in the detection and characterization of tumors within the pancreas or biliary system.
- Diagnosis of Pancreatic and Biliary Diseases: MRCP is used to diagnose various diseases and conditions affecting the pancreas and bile ducts, including chronic pancreatitis and biliary strictures.
- Assessment of Postoperative Complications: MRCP is employed to evaluate postoperative complications, such as bile duct injury or leaks, after abdominal surgeries.

MRCP is a non-invasive and relatively safe imaging technique that provides valuable information for the diagnosis and management of conditions involving the biliary and pancreatic ducts. The choice of sequence and parameters may vary depending on the specific clinical indication and the patient's condition. Always consult with a radiologist or healthcare provider for the most appropriate MRCP protocol for your needs.

Posttest: الاختبار البعدى:

Numerate the indication of the MRCP?

References: المصادر:

Handbook of MRI Technique Catherine Senior 5TH EDITION 2022
Step by step MRI Jaganmohan Reddy v parsed

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الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي
المرحلة: الرابعة

العنوان: **Title: MRI of the male pelvis**

اسم المحاضر: **Name of the instructor:**

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

الفئة المستهدفة: **Target population:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

المقدمة: **Introduction:**

learning about MRI of the male pelvis is essential for MRI technicians to perform MRI exams effectively, interpret MRI results accurately, ensure patient safety, understand anatomy and pathology, and collaborate with other healthcare professionals. MRI technicians can acquire this knowledge through specialized training programs, continuing education courses, and on-the-job experience.

Pretest: الاختبار القبلي:

Which coil we will need for the pelvis exam and for which indication we need to do it?

Scientific Content: المحتوى العلمي:

Common indications

•• Localization of undescended testicles
•• Prostatic lesions
•• Carcinoma of the bladder
•• Rectal lesions
•• Infertility
•• Impotence

Equipment

•• Body coil/phased array pelvic coil/multi-array coil and local rectal coil for prostate imaging (can be used in conjunction with a phased/ multi-array coil)

•• Compression bands and foam immobilization pads
•• Earplugs/headphones

Patient positioning

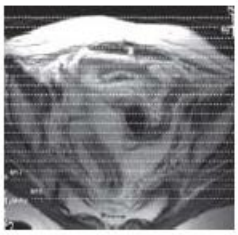
The patient lies supine on the examination couch. Foam pads and compression bands can be applied across the patient's lower pelvis to reduce respiratory and bowel motion (unless the patient cannot tolerate this).

The patient is positioned so that the longitudinal alignment light lies in the midline, and the horizontal alignment light passes through a point midway between the pubis symphysis and the iliac crests. If a local rectal coil is used, it should be carefully inserted prior to the examination.

Ensure that it is correctly positioned and fully inflated. An empty bladder can minimize motion artifacts from urine. However, a full bladder can aid visualization

of bladder wall anatomy and pathology by improving definition between anatomy, (e.g. differentiating prostate from bladder wall).

Patient Position- Pelvic Array Coil



Axial localizer for coronal slices

Coronal localizer for axial slices

Coronal localizer for sagittal slices

Common Male Pelvis MRI Sequences:

1. T1-Weighted Imaging:
    - Parameters:
        - Slice thickness: 3-5 mm
        - TR (Repetition Time): 400-800 ms
        - TE (Echo Time): 5-20 ms
    - Use: Provides detailed anatomical information and helps in visualizing the structures within the male pelvis, including the prostate, bladder, rectum, and seminal vesicles.
2. T2-Weighted Imaging:
    - Parameters:
        - Slice thickness: 3-5 mm
        - TR: 2000-5000 ms
        - TE: 80-120 ms
    - Use: Highlights differences in tissue water content and is valuable for assessing soft tissues within the pelvis, such as the prostate, muscles, and pelvic organs.

3. Diffusion-Weighted Imaging (DWI):
    - Parameters:
        - Slice thickness: 3-5 mm
        - b-values: Typically 0 and 800-1000 sec/mm²
    - Use: Measures the diffusion of water molecules in tissues and can be helpful in identifying and characterizing lesions within the prostate and pelvic organs, particularly in the detection of prostate cancer.
4. Dynamic Contrast-Enhanced Imaging:
    - Parameters:
        - Slice thickness: 3-5 mm
        - Temporal resolution: 5-10 seconds
        - Contrast agent: Gadolinium-based contrast agent
    - Use: Evaluates perfusion and vascularity within the prostate and surrounding tissues, aiding in the detection and characterization of prostate tumors.
5. MR Spectroscopy (MRS):
    - Parameters:
        - Acquires spectra from specific regions of interest, often the prostate.
    - Use: Measures biochemical information within the prostate tissue and can assist in characterizing prostate lesions, differentiating between benign and malignant tissue.
6. Pelvic Floor Imaging:
    - Parameters:
        - Specialized sequences for pelvic floor assessment.
    - Use: Helps evaluate pelvic floor disorders, such as pelvic organ prolapse and fecal incontinence, by assessing the position and integrity of pelvic floor structures.

Specific Uses:

- Prostate Imaging: MRI of the male pelvis is commonly used for prostate cancer detection, staging, and assessment of treatment response. It helps visualize the prostate gland and any abnormalities within it.
- Pelvic Organ Assessment: MRI can assess the bladder, rectum, seminal vesicles, and other pelvic organs for abnormalities, tumors, or inflammatory conditions.
- Evaluation of Pelvic Pain: MRI is used to investigate the cause of pelvic pain, including conditions like prostatitis, cysts, and inflammation of pelvic organs.
- Pelvic Trauma: MRI can be employed to assess pelvic trauma and injuries, such as fractures or soft tissue injuries in the pelvis.
- Pelvic Inflammatory Disease (PID): MRI helps detect and assess the severity of PID, an infection of the female reproductive organs, which can also affect male partners.

The choice of MRI sequences and parameters may vary depending on the clinical indication and the specific pelvic condition being evaluated. Consultation with a radiologist or healthcare provider is essential to determine the most appropriate MRI protocol for your specific needs.

Posttest: الاختبار البعدى:

What are the common sequences of the male pelvis?

References: المصادر:

Handbook of MRI Technique Catherine Senior 5TH EDITION 2022
Step by step MRI Jaganmohan Reddy v parsed

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الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي
المرحلة: الرابعة

العنوان: **Title: MRI of the female pelvis**

اسم المحاضر: **Name of the instructor:**

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

الفئة المستهدفة: **Target population:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

المقدمة: **Introduction:**

learning about MRI of the female pelvis is essential for MRI technicians to perform MRI exams effectively, interpret MRI results accurately, ensure patient safety, understand anatomy and pathology, and collaborate with other healthcare professionals. MRI technicians can acquire this knowledge through specialized training programs, continuing education courses, and on-the-job experience.

Pretest: الاختبار القبلي:

What we need to prepare for the female pelvis exam?

Scientific Content: المحتوى العلمي:

Common indications

•• Assessment of congenital abnormalities of the urogenital tract
•• Cervical lesions
•• Uterine lesions
•• Benign uterine tumours, for example, leiomyoma and fibroids
•• Bladder lesions
•• Rectal lesions
•• Infertility

Equipment

•• Body coil/phased array pelvic coil/multi-array coil
•• Compression bands and foam immobilization pads if using the body coil
•• Earplugs/headphones

Patient positioning

The patient lies supine on the examination couch. Foam pads and compression bands can be applied across the patient's lower pelvis to reduce respiratory and bowel motion (unless the patient cannot tolerate this). The patient is positioned so that the longitudinal alignment light lies in the midline, and the horizontal alignment light passes through a point midway between the pubis symphysis and the iliac crest. If a local rectal coil is used, it should be carefully inserted prior to the examination. Ensure that it is correctly positioned and fully inflated.

Common Female Pelvis MRI Sequences:

1. **T1-Weighted Imaging**:
   - Parameters:
     - Slice thickness: 3-5 mm
     - TR (Repetition Time): 400-800 ms
     - TE (Echo Time): 5-20 ms
   - Use: Provides detailed anatomical information and helps visualize the structures within the female pelvis, including the uterus, ovaries, bladder, and rectum.
2. **T2-Weighted Imaging**:
   - Parameters:
     - Slice thickness: 3-5 mm
     - TR: 2000-5000 ms
     - TE: 80-120 ms
   - Use: Highlights differences in tissue water content and is valuable for assessing soft tissues within the pelvis, including the pelvic organs, muscles, and ligaments.
3. **Diffusion-Weighted Imaging (DWI)**:
   - Parameters:
     - Slice thickness: 3-5 mm
     - b-values: Typically 0 and 800-1000 sec/mm²
   - Use: Measures the diffusion of water molecules in tissues and can assist in identifying and characterizing lesions within the pelvis, such as ovarian cysts or uterine fibroids.
4. **Dynamic Contrast-Enhanced Imaging**:
   - Parameters:
     - Slice thickness: 3-5 mm
     - Temporal resolution: 5-10 seconds
     - Contrast agent: Gadolinium-based contrast agent
   - Use: Evaluates perfusion and vascularity within the pelvic organs, aiding in the detection and characterization of tumors, endometriosis, and other gynecological conditions.
5. **MR Pelvic Floor Imaging**:
   - Parameters:
     - Specialized sequences for pelvic floor assessment.
   - Use: Helps evaluate pelvic floor disorders, such as pelvic organ prolapse, stress urinary incontinence, and defects in the pelvic floor musculature.
6. **MR Urography**:
   - Parameters:

- Specific sequences for urinary tract assessment.
- Use: Visualizes the urinary tract, including the kidneys, ureters, and bladder, and helps identify conditions like hydronephrosis or urinary tract obstruction.

Specific Uses:

- **Gynecological Conditions**: MRI is commonly used to evaluate and stage gynecological conditions such as uterine fibroids, ovarian cysts, endometriosis, and adenomyosis.
- **Pelvic Pain**: MRI helps investigate the cause of chronic pelvic pain by assessing the pelvic organs and identifying abnormalities or lesions.
- **Cancer Staging**: MRI plays a crucial role in the staging of gynecological cancers, including cervical, uterine, and ovarian cancers.
- **Fertility Assessment**: MRI can assess the uterine cavity and fallopian tubes to evaluate factors that may impact fertility.
- **Pelvic Inflammatory Disease (PID)**: MRI can help detect and assess the severity of PID, an infection of the female reproductive organs.
- **Preoperative Planning**: MRI is valuable for preoperative planning before gynecological surgeries, including myomectomy or hysterectomy.

The choice of MRI sequences and parameters may vary depending on the clinical indication and the specific pelvic condition being evaluated. Consultation with a radiologist or healthcare provider is essential to determine the most appropriate MRI protocol for your specific needs.

Posttest: الاختبار البعدي:

Why pelvic MRI valuable for preoperative exam?

References: المصادر:

Handbook of MRI Technique Catherine Senior 5TH EDITION 2022
Step by step MRI Jaganmohan Reddy v parsed

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الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي
المرحلة: الرابعة

Title: MRI of the shoulder joint. **العنوان:**

Name of the instructor: **اسم المحاضر:**

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

Target population: **الفئة المستهدفة:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

Introduction: المقدمة:

MRI of the shoulder is an important imaging technique that MRI technicians need to learn for several reasons:

1. **Detailed imaging of shoulder structures: MRI of the shoulder provides detailed images of structures within the shoulder joint, including bones, tendons, muscles, and vessels, from any angle**

. This allows for a comprehensive evaluation of the shoulder and its surrounding tissues.

2. **Diagnosing and evaluating various conditions: MRI is an excellent choice for examining the shoulder joint and can be used to diagnose or evaluate degenerative joint disorders, fractures, rotator cuff tears, injuries to the biceps tendon, damage to the glenoid labrum, and more**

It can also help in the assessment of post-surgical progress.

3. **Differentiating between normal and abnormal findings: MRI can help differentiate between normal and abnormal shoulder structures, aiding in the diagnosis of various conditions such as rotator cuff tendinitis, frozen shoulder, tumors, labral tears, and cysts**
4. **Guiding treatment decisions: The information obtained from a shoulder MRI can help surgeons decide if surgery is needed and assist in planning the appropriate treatment for the patient**
5. **No radiation exposure: MRI uses no radiation, making it a safe imaging option for patients**

Pretest: الاختبار القبلي:

How to use the MRI shoulder as guidelines treatment dictions

Scientific Content: المحتوى العلمي:

Common indications

•• Evaluation of shoulder pain
•• Diagnosis of impingement syndrome
•• Suspected rotator cuff tear
•• Evaluation of recurrent dislocation (instability, subluxation, dislocation)
•• Hill–Sachs lesion, Bankart lesion, labrum lesion
•• Frozen shoulder syndrome

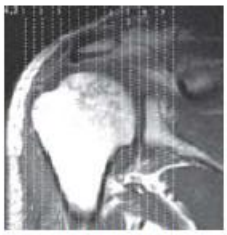
Equipment

•• Dedicated shoulder coil or flexible surface coil
•• Immobilization pads and straps
•• Earplugs/headphones

Patient positioning

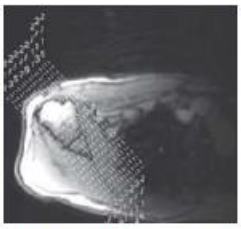
The patient lies supine with the arms resting comfortably by the side. Slide the patient across the table to bring the shoulder under examination as close as possible to the centre of the bore. Relax the shoulder to remove any upward 'hunching'. The arm to be examined is strapped to the patient, with the thumb up (neutral position) and padded so that the humerus is horizontal. Place the coil to cover the humeral head and the anatomy superior and medial to it. If a surface or flexible coil is used, care must be taken to ensure that the flat surface of the coil is parallel to the Z axis when it is placed over the humeral head (Figure 1.1). Centre the FOV on the middle of the glenohumeral joint. Patient and coil immobilization are essential for a good result. If possible, instruct the patient to breathe abdominally rather than with the thorax and place sandbags on the upper chest. This reduces movement artefact. Instruct the patient not to move the hand during sequences. The patient is positioned so that the longitudinal alignment light and the horizontal alignment light pass through the shoulder joint.

Patient Position-Flex coil



Coronal localizer for sagittal slices

Coronal localizer for axial slices



Axial localizer to obtain oblique coronal slices

Common Shoulder MRI Sequences:

1. T1-Weighted Imaging:
    - Parameters:
        - Slice thickness: 3-4 mm
        - TR (Repetition Time): 400-800 ms
        - TE (Echo Time): 10-20 ms
    - Use: Provides detailed anatomical information and helps visualize the structures within the shoulder joint, including bones, tendons, and ligaments. T1-weighted images are good for assessing anatomy.

2. T2-Weighted Imaging:
    - Parameters:
        - Slice thickness: 3-4 mm
        - TR: 2000-5000 ms
        - TE: 80-120 ms
    - Use: Highlights differences in tissue water content and is valuable for assessing soft tissues within the shoulder, including muscles, tendons, and ligaments. T2-weighted images are useful for detecting inflammation and pathology.

3. Proton Density (PD)-Weighted Imaging:
    - Parameters:
        - Slice thickness: 3-4 mm
        - TR: 1500-3000 ms
        - TE: 20-40 ms
    - Use: Provides a balance between T1 and T2 contrast and is often used to assess the shoulder's soft tissues, including tendons and ligaments.
4. Gradient Echo (GRE) Sequences:
    - Parameters:
        - Slice thickness: 3-4 mm
        - TR: 300-500 ms
        - TE: 10-20 ms
    - Use: Sensitive to blood products and hemorrhage, GRE sequences are useful for detecting vascular lesions or bleeding within the shoulder joint.

The choice of MRI sequences and parameters may vary depending on the clinical indication and the specific shoulder condition being evaluated. Consultation with a radiologist or healthcare provider is essential to determine the most appropriate MRI protocol for your specific shoulder issue.

Posttest: :الاختبار البعدي

- **Explain the specific uses of the shoulder MRI**

References: :المصادر

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Step by step MRI Jaganmohan Reddy v parsed

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الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي

المرحلة: الرابعة

العنوان: **Title: MRI of the hip joint.**

اسم المحاضر: **Name of the instructor:**

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

الفئة المستهدفة: **Target population:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

المقدمة: **Introduction:**

MRI of the hip is an important imaging technique that MRI technicians need to learn for several reasons:

1. **Detailed imaging of hip structures: MRI of the hip provides detailed images of the hip joint, including bones, cartilage, labrum, tendons, and muscles, from multiple angles**

This allows for a comprehensive evaluation of the hip and its surrounding tissues.

2. **Diagnosing and evaluating various hip conditions: MRI is the modality of choice for investigating painful hip conditions due to its multiplanar capability and high contrast resolution**

It can help diagnose or evaluate conditions such as hip osteoarthritis, labral tears, femoroacetabular impingement, avascular necrosis, and hip joint infections

3. **Differentiating between normal and abnormal findings: MRI can help differentiate between normal and abnormal hip structures, aiding in the diagnosis of various conditions**

For example, in hip osteoarthritis, MRI can show joint narrowing, subchondral sclerosis (increased white/bright location surrounding the joint), and osteophyte formation

4. **Guiding treatment decisions: The information obtained from a hip MRI can help healthcare professionals, including surgeons and physical therapists, decide on the appropriate treatment for the patient**
5. **No radiation exposure: MRI uses no radiation, making it a safe imaging option for patients**

Pretest: الاختبار القبلي:

Who the MRI examination would give us comprehensive evaluation of the hip and its surrounding tissues?

Scientific Content: المحتوى العلمي:

Common indications

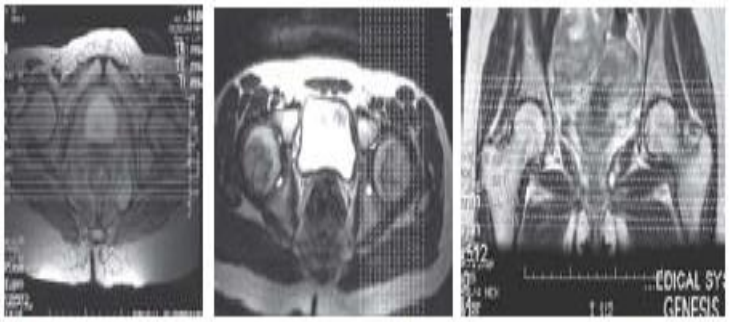
•• Evaluation of unexplained unilateral or bilateral hip pain
•• Suspected occult fracture
•• Muscle tears
•• Labral tears, chondral damage or other joint soft tissue pathology
Note: Bilateral and unilateral examinations of the hips are described in this section. The causes of generalized hip pain include AVN, metastatic deposits and occult fractures, which may affect both hips. Specific unilateral joint pathologies such as suspected labral tears or chondral damage require high-resolution imaging of the hip in question. However, due to the prevalence of AVN in patients presenting with hip pain, it is advisable to include a bilateral sequence in unilateral hip protocols.

Equipment
Bilateral hip imaging
•• Body phased array/multi-coil array/general-purpose flexible coil/ body coil
•• Immobilization pads and straps
•• 20° wedge sponges
•• Earplugs/headphones
Single hip imaging
•• Small/large flexible coil/multi-coil array/pelvis phased array/small Helmholtz pair
•• Immobilization pads and straps
•• 20° wedge sponges
•• Earplugs/headphones

Patient positioning
The patient lies supine on the examination couch with their legs straight and both feet parallel to each other. This ensures that the angle of both femoral necks is the same, although they do not necessarily have to be internally rotated as in radiography of the hips. The legs are immobilized with the use of pads and straps wrapped around both feet. This enables the patient to maintain the position in a relaxed fashion.
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 femoral heads. They are localized by palpating the femoral pulse,

which is typically found 3 cm inferiorly and laterally to the midpoint of the line joining the anterior superior iliac spine (ASIS) and the pubic symphysis. If only one hip is imaged, the FOV will be offset from isocentre and image quality may be affected.

Patient Position-Pelvic array coil



Axial localizer for coronal slices | Axial localizer for sagittal slices | Coronal localizer for axial slices

Common Hip MRI Sequences:

1. **T1-Weighted Imaging**:
   - Parameters:
     - Slice thickness: 3-4 mm
     - TR (Repetition Time): 400-800 ms
     - TE (Echo Time): 10-20 ms
   - Use: Provides detailed anatomical information of the hip joint, including bones, cartilage, and soft tissues. T1-weighted images are good for assessing the hip's anatomy.
2. **T2-Weighted Imaging**:
   - Parameters:
     - Slice thickness: 3-4 mm
     - TR: 2000-5000 ms
     - TE: 80-120 ms
   - Use: Highlights differences in tissue water content and is valuable for assessing soft tissues within and around the hip, including muscles, tendons, ligaments, and detecting inflammation.
3. **Proton Density (PD)-Weighted Imaging**:
   - Parameters:
     - Slice thickness: 3-4 mm
     - TR: 1500-3000 ms

- TE: 20-40 ms
- Use: Provides intermediate contrast between T1 and T2 and is useful for evaluating soft tissue structures in the hip, including the labrum, tendons, and ligaments.

4. **Short Tau Inversion Recovery (STIR)**:
   - Parameters:
     - Slice thickness: 3-4 mm
     - TR: 3000-5000 ms
     - TE: 40-60 ms
     - Inversion Time (TI): 150-200 ms
   - Use: Suppresses fat signal and enhances the visibility of fluid, which can be helpful in detecting edema, bone marrow abnormalities, and soft tissue lesions.

5.Vascular Assessment: In certain cases, MRI angiography may be performed to assess the blood vessels in the hip region, particularly if vascular abnormalities are suspected.

The choice of MRI sequences and parameters may vary depending on the clinical indication and the specific hip condition being evaluated. Consultation with a radiologist or healthcare provider is essential to determine the most appropriate MRI protocol for your specific hip issue.

References: المصادر:

Handbook of MRI Technique Catherine Senior 5TH EDITION 2022
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الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي
المرحلة: الرابعة

Title: MRI of the knee joint. **العنوان:**

Name of the instructor: **اسم المحاضر:**

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

Target population: **الفئة المستهدفة:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

Introduction: المقدمة:

learning about MRI of the knee is essential for MRI technicians to perform MRI exams effectively, interpret MRI results accurately, ensure patient safety, understand anatomy and pathology, and collaborate with other healthcare professionals. MRI technicians can acquire this knowledge through specialized training programs, continuing education courses, and on-the-job experience.

Pretest: الاختبار القبلي:

What the uses of the T1 and T2 with knee joints?

Scientific Content: المحتوى العلمي:

Common indications

•• Internal derangement of the joint (meniscal tears, cruciate ligament tears, post-repair cruciate ligament tears, bursae)
•• Chondromalacia patella and patella tracking
•• Bone tumours and bony damage within the knee joint
•• Almost all other knee disorders can also be visualized

Equipment

•• Knee phased array coil/extremity knee coil/pair of small circular coils combined as a phased/multi-coil array/large flexible coil
•• Immobilization pads
•• Earplugs or headphones

Patient positioning

The patient lies supine on the examination couch with their knee in a relaxed, slightly flexed position within the coil. The knee is well immobilized with pads. The coil can be offset so that the other leg rests comfortably at the side. The patient is positioned so that the longitudinal alignment light lies either along the midline of the leg under examination, or displaced from it if the knee has been offset. The horizontal alignment light passes through the centre of the coil. The knee is placed within the coil so that the centre of the coil corresponds to the lower border of the patella.

A clear display of the anterior cruciate ligament is essential in knee examinations for pain, trauma or suspected joint damage. The ligament is best seen in oblique sagittal scans oriented to the appropriate anatomical plane. If your equipment is not capable of oblique imaging, or oblique scan prescription compromises other

significant technical choices, thepatient’s knee should be positioned with a slight (5–10°) external rotation(under-rotation is better than over-rotation). If the scanner can only employ a single-plane oblique, the sagittal scan plane can be prescribed along the internal margin of the lateral femoral condyle from an axial localizer. A more accurate approach is described within the Suggested protocol section.

Patient Position-Extremity coil

Coronal localizer for sagittal slices

Sagittal localizer for coronal slices

Coronal localizer for axial slices

Common Knee MRI Sequences:

1. T1-Weighted Imaging:
    - Parameters:
        - Slice thickness: 3-4 mm
        - TR (Repetition Time): 400-800 ms
        - TE (Echo Time): 10-20 ms
    - Use: Provides detailed anatomical information of the knee joint, including bones, cartilage, and soft tissues. T1-weighted images are good for assessing the knee's anatomy.
2. T2-Weighted Imaging:
    - Parameters:
        - Slice thickness: 3-4 mm
        - TR: 2000-5000 ms
        - TE: 80-120 ms
    - Use: Highlights differences in tissue water content and is valuable for assessing soft tissues within and around the knee, including ligaments, tendons, muscles, and detecting inflammation.

3. Proton Density (PD)-Weighted Imaging:
    - Parameters:
        - Slice thickness: 3-4 mm
        - TR: 1500-3000 ms
        - TE: 20-40 ms
    - Use: Provides intermediate contrast between T1 and T2 and is useful for evaluating soft tissue structures in the knee, including ligaments, tendons, and menisci.
4. Short Tau Inversion Recovery (STIR):
    - Parameters:
        - Slice thickness: 3-4 mm
        - TR: 3000-5000 ms
        - TE: 40-60 ms
        - Inversion Time (TI): 150-200 ms
    - Use: Suppresses fat signal and enhances the visibility of fluid and edema, which can be helpful in detecting injuries, such as ligament tears and bone marrow abnormalities.

Posttest: :الاختبار البعدي

- Numerate the slice thickness for each sequence?

References: :المصادر

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الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي

المرحلة: الرابعة

العنوان: **Title: MRI in obstetric.**

اسم المحاضر: **Name of the instructor:**

م. حيدر عبد القادر طاهر

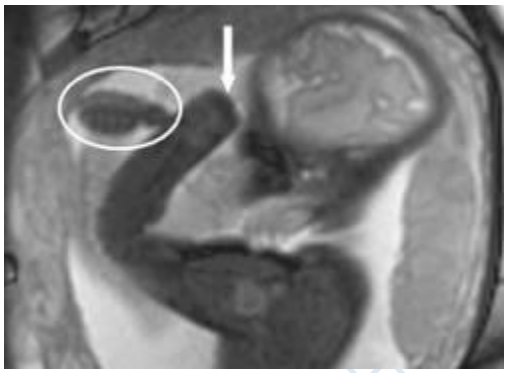
lecturer. Haydar Abdul Kader Taher

الفئة المستهدفة: **Target population:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

Introduction: المقدمة:

MRI in obstetrics is a non-invasive imaging technique that uses a strong magnetic field and radio waves to produce detailed images of the fetus and placenta. It is a valuable tool for diagnosing and monitoring a variety of conditions, including:



MRI in obstetrics is typically performed between 20 and 32 weeks of gestation. This is when the fetus is large enough to be clearly visualized, but the amniotic fluid volume is still high enough to allow the fetus to move freely.

Pretest: الاختبار القبلي:

Explain Why we need MRI with pregnant women?

Scientific Content: المحتوى العلمي:

Common indications

•• Evaluation of pelvic–cephalic disproportion in the second or third trimester of pregnancy, or post-delivery
•• Placenta previa
•• Evaluation of pelvic disease incidental to pregnancy and foetal Abnormalities

•• Multiple pregnancy: MRI can be used to assess the health and well-being of each fetus in a multiple pregnancy.

Equipment
•• Body coil/multi-coil array
•• Compression bands (if tolerable post-partum)
•• Earplugs/headphones

Patient positioning
The patient lies supine on the examination couch. The patient is positioned so that the longitudinal alignment light lies in the midline, and the horizontal alignment light passes through a point midway between the pubis symphysis and the iliac crest. Compression should not be applied in pregnancy or immediately post-Caesarean section.

Common Obstetrics MRI Sequences:

1. **Single Shot Fast Spin Echo (SSFSE) Sequence**:
    - Parameters:
        - Slice thickness: 3-5 mm
        - TR (Repetition Time): 1000-2000 ms
        - TE (Echo Time): 100-150 ms
    - Use: SSFSE is used for high-resolution imaging of the fetus and maternal pelvis. It provides detailed anatomical information.
2. **T2-Weighted Imaging**:
    - Parameters:
        - Slice thickness: 3-5 mm
        - TR: 2000-5000 ms
        - TE: 80-120 ms
    - Use: T2-weighted images help visualize the fetal anatomy, including the brain, spine, and organs. They are valuable for assessing fetal development.

3. **Diffusion-Weighted Imaging (DWI)**:
    - Parameters:
        - Slice thickness: 3-5 mm
        - b-values: Typically 0 and 500-1000 sec/mm²
    - Use: DWI can provide information about fetal tissue microstructure and can be used to assess fetal brain development and detect abnormalities.
4. **Dynamic Contrast-Enhanced (DCE) Imaging**:
    - Parameters:
        - Slice thickness: 3-5 mm
        - Temporal resolution: 5-10 seconds
        - Contrast agent: Gadolinium-based contrast agent (used cautiously in pregnancy)
    - Use: DCE imaging can assess placental perfusion and fetal blood flow, aiding in the evaluation of placental insufficiency and fetal well-being.
5. **Fast Imaging with Steady-State Precession (FISP) Sequence**:
    - Parameters:
        - Slice thickness: 3-5 mm
        - TR: 3-5 ms
        - TE: 1-3 ms
    - Use: FISP sequences offer high-speed imaging and are suitable for capturing fetal cardiac motion and dynamic studies.
6. **Multiplanar Reconstructions (MPR)**:
    - Parameters:
        - Used for creating 2D images in various planes (sagittal, coronal, axial) from the acquired 3D data.

- Use: MPR is used for detailed evaluation of fetal structures and orientation in multiple planes.

Posttest: الاختبار البعدي:

Explain Steady-State Precession sequence with pregnant female exam?

References: المصادر:

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الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي
المرحلة: الرابعة

العنوان: **Title: MRA and MRV.**

اسم المحاضر: **Name of the instructor:**

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

الفئة المستهدفة: **Target population:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

Introduction: المقدمة:

MRA and MRV stand for magnetic resonance angiography and magnetic resonance venography, respectively. Both are non-invasive imaging techniques that use a strong magnetic field and radio waves to produce detailed images of blood vessels.

MRA is used to visualize arteries, while MRV is used to visualize veins. Arteries carry oxygen-rich blood from the heart to the rest of the body, while veins carry oxygen-depleted blood back to the heart.

Pretest: الاختبار القبلي:

What are the advantages of the MRA in the brain.

Scientific Content: المحتوى العلمي:

Common indications

•• Evaluation of the carotid arteries especially at the bifurcation
•• Intracranial vascular assessment of aneurysms and infarcts
•• Arteriovenous malformation (AVM)
•• Intracranial vessel occlusion including sagittal sinus thrombosis
• Circle of Willis (stroke or TIA)

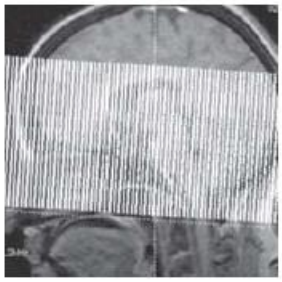
Equipment

•• Quadrature or phased array head coil (brain imaging)
•• Anterior neck coil (neck imaging)
•• Immobilization foam pads and straps
•• Earplugs/headphones

Patient positioning

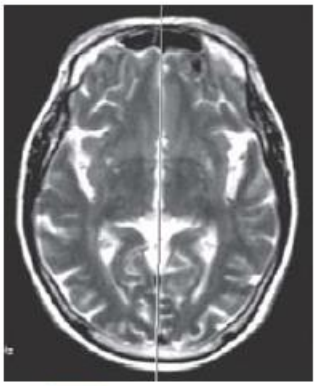
Brain imaging

The patient lies supine on the examination couch with their head within the head coil. The head is adjusted so that the inter-pupillary line is parallel to the couch and the head is straight. The longitudinal alignment light lies in the midline, and the horizontal alignment light passes through the nasion. Straps and foam pads are used to immobilize the patient as much as possible.



MRA 3D TOF single slab

MRV 2D TOF



MRV 2D -PC (Sagittal)

Common Brain MRA Sequences:

1. **Time-of-Flight (TOF) MRA:**
    - **Parameters:**
        - **Slice thickness: 1-2 mm**

- **TR (Repetition Time): Short (typically <30 ms)**
- **TE (Echo Time): Short (typically <5 ms)**

- **Use: TOF MRA is commonly used for non-contrast imaging of the brain's arterial vasculature. It relies on the inflow of unsaturated blood into the imaging slice to create high signal intensity in arteries.**

2. **<u>Phase-Contrast (PC) MRA</u>:**
   - **Parameters:**
     - **Slice thickness: 1-2 mm**
     - **TR: Varies**
     - **TE: Varies**
   - **Use: PC MRA measures the velocity of blood flow and can be used to assess blood flow direction and velocity in both arteries and veins. It is often used for flow quantification and to assess conditions like arteriovenous malformations (AVMs).**
3. **<u>Contrast-Enhanced MRA (CE-MRA):</u>**
   - **Parameters:**
     - **Slice thickness: 1-2 mm**
     - **TR: Short to moderate (varies)**
     - **TE: Short (typically <5 ms)**
     - **Contrast agent: Gadolinium-based contrast agent**
   - **Use: CE-MRA uses contrast agents to enhance the visualization of blood vessels. It is useful for detailed imaging of the cerebral arteries, particularly smaller vessels and the venous system.**
4. **<u>3D MRA:</u>**
   - **Parameters:**
     - **Slice thickness: 0.6-1 mm (high spatial resolution)**
     - **TR: Short to moderate (varies)**

- **TE: Short (typically <5 ms)**

- **Use: 3D MRA acquires a volume of data, providing high-resolution images of the brain's vascular anatomy. It is especially useful for assessing complex vascular structures and anomalies.**

5. **Balanced Steady-State Free Precession (bSSFP) MRA:**

   - **Parameters:**

     - **Slice thickness: 1-2 mm**
     - **TR: Short (typically <5 ms)**
     - **TE: Short (typically <2 ms)**

   - **Use: bSSFP MRA offers high signal-to-noise ratio (SNR) and excellent blood-tissue contrast. It is often used for visualizing the circle of Willis and evaluating vascular pathology.**

Common Brain MRV Sequences:

1. **Time-of-Flight (TOF) MRV:**

   - **Parameters:**

     - **Slice thickness: 1-2 mm**
     - **TR (Repetition Time): Short (typically <30 ms)**
     - **TE (Echo Time): Short (typically <5 ms)**

   - **Use: TOF MRV is often used for non-contrast imaging of the brain's venous vasculature. Similar to TOF MRA, it relies on the inflow of unsaturated blood into the imaging slice to create high signal intensity in veins.**

2. **Contrast-Enhanced MRV (CE-MRV):**

   - **Parameters:**

     - **Slice thickness: 1-2 mm**
     - **TR: Short to moderate (varies)**

- **TE: Short (typically <5 ms)**
- **Contrast agent: Gadolinium-based contrast agent**

- **Use: CE-MRV uses contrast agents to enhance the visualization of veins and dural sinuses in the brain. It provides detailed imaging of the venous system, including the superior sagittal sinus and transverse sinuses.**

3. **3D MRV:**

- **Parameters:**
  - **Slice thickness: 0.6-1 mm (high spatial resolution)**
  - **TR: Short to moderate (varies)**
  - **TE: Short (typically <5 ms)**
- **Use: 3D MRV acquires a volume of data, allowing high-resolution imaging of the brain's venous anatomy. It is useful for assessing venous structures and pathology, including dural venous sinuses and cerebral veins.**

4. **Phase-Contrast (PC) MRV:**

- **Parameters:**
  - **Slice thickness: 1-2 mm**
  - **TR: Varies**
  - **TE: Varies**
- **Use: PC MRV measures venous blood flow velocity and can be used to assess venous flow direction and detect abnormalities in venous flow patterns.**

Posttest: الاختبار البعدي:

Compare between the MRA and MRV in the brain?

References: المصادر:

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الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي
المرحلة: الرابعة

Title: MRI of the trauma and suspected fracture. :العنوان

Name of the instructor: اسم المحاضر:

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

Target population: الفئة المستهدفة:

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

Introduction: المقدمة:

It's important to note that while MRI is excellent for soft tissue and certain types of fractures, it may not always be the first-line imaging modality in acute trauma cases. In cases of suspected fractures, X-rays are typically used as an initial screening tool, and MRI may follow to provide additional information or assess soft tissue injuries. The choice of imaging depends on the clinical scenario, and consultation with a healthcare provider or radiologist is essential to determine the most appropriate imaging approach.

Pretest: الاختبار القبلي:

Why the MRI is not the first diagnostic tool for the fractures

Scientific Content: المحتوى العلمي:

Indications for MRI in Trauma and Suspected Fracture:

1. **Soft Tissue Injuries**: MRI is highly sensitive for detecting soft tissue injuries, including ligament, tendon, and muscle tears or sprains. It can help assess the extent of soft tissue damage.
2. **Stress Fractures**: MRI is effective in detecting stress fractures, which may not be visible on X-rays. It can provide early diagnosis and help prevent further injury.
3. **Bone Bruises**: MRI can detect bone bruises or contusions, which are often associated with traumatic injuries but may not be visible on X-rays.
4. **Articular Cartilage Injuries**: MRI is valuable for assessing the integrity of articular cartilage in joints, such as the knee, ankle, or shoulder, which is essential for determining the extent of joint damage.

5. **Spinal Cord and Nerve Evaluation**: In cases of spinal trauma, MRI can assess the spinal cord and nerve roots for injury, herniated discs, or compression.

Common MRI Sequences for Trauma and Suspected Fracture:

The choice of MRI sequences may vary depending on the suspected injury and the area being examined. Common sequences include:

1. **T1-Weighted Imaging**: Provides anatomical detail and helps assess bone fractures and the presence of hemorrhage.
2. **T2-Weighted Imaging**: Highlights differences in tissue water content and is sensitive to soft tissue injuries, edema, and inflammation.
3. **Short Tau Inversion Recovery (STIR)**: Suppresses fat signal and enhances the visibility of fluid, making it useful for detecting bone marrow abnormalities, fractures, and soft tissue injuries.
4. **Fat-Suppressed Sequences**: These sequences suppress the signal from fat, making it easier to visualize soft tissue injuries and fractures.
5. **Gradient Echo Sequences**: Sensitive to blood products and hemorrhage, these sequences can be used to detect bleeding or bone bruises.
6. **3D Sequences**: Provide high-resolution images and are useful for assessing complex fractures, joint injuries, or spinal trauma.
7. **Contrast-Enhanced MRI**: Contrast agents may be used to enhance the visibility of vascular injuries, such as arterial or venous injuries.

Specific Uses:

- In cases of suspected ligament or tendon injuries (e.g., ACL tear in the knee), MRI can help assess the integrity of these structures.
- MRI can identify and evaluate meniscus tears in the knee and labral tears in the shoulder or hip.

- It is valuable for assessing the extent of muscle injuries (e.g., strains or tears) and determining the need for surgical intervention.
- In spinal trauma, MRI can detect spinal cord injuries, herniated discs, or fractures of the vertebral bodies.
- MRI can help guide treatment decisions by providing detailed information about the extent and location of injuries.

Posttest: :الاختبار البعدى

Mention the specific use of the MRI with trauma?

References: المصادر:

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MRI questions and answer

الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم: تقنيات الاشعة المادة: التصوير بالرنين المغناطيسي
المرحلة: الرابعة

العنوان: **Title: MRI of the soft tissue tumor.**

اسم المحاضر: **Name of the instructor:**

م. حيدر عبد القادر طاهر

lecturer. Haydar Abdul Kader Taher

الفئة المستهدفة: **Target population:**

طلبه المرحلة الرابعة في قسم تقنيات الاشعة

Introduction: المقدمة:

MRI (Magnetic Resonance Imaging) is a valuable imaging modality for the evaluation of soft tissue tumors. It provides detailed anatomical and functional information about the tumor, helping with diagnosis, characterization, and treatment planning. Here's how MRI is used for soft tissue tumor imaging.

Pretest: الاختبار القبلي:

Give the reasons why the MRI is valuable diagnostic tool with the tumors

Scientific Content: المحتوى العلمي:

Indications for Soft Tissue Tumor MRI:

1. **Characterization**: MRI helps in characterizing soft tissue tumors, distinguishing between benign and malignant tumors, and identifying specific tumor types.
2. **Tumor Size and Extent**: It accurately measures the size and extent of the tumor, including its relationship to nearby structures, which is crucial for surgical planning.
3. **Tumor Location**: MRI can pinpoint the precise location of the tumor within soft tissues, muscles, or organs.
4. **Vascular Assessment**: It assesses blood flow within and around the tumor, which can help determine the vascularity of the lesion and its potential for malignancy.

Common MRI Sequences for Soft Tissue Tumor Imaging:

The choice of MRI sequences may vary depending on the suspected tumor type and location. Common sequences include:

1. **T1-Weighted Imaging**: Provides anatomical detail and helps assess the tumor's location and relationship to nearby structures.
2. **T2-Weighted Imaging**: Highlights differences in tissue water content and is valuable for characterizing soft tissue tumors, detecting edema, and assessing the tumor's extent.
3. **Fat Suppression Sequences**: Suppresses the signal from fat, enhancing the visibility of lesions and improving tumor detection.
4. **Contrast-Enhanced MRI**: The administration of a gadolinium-based contrast agent can help highlight the tumor and assess its vascularity. Dynamic contrast-enhanced sequences can provide information about blood flow dynamics.
5. **Diffusion-Weighted Imaging (DWI)**: Measures the diffusion of water molecules in tissues, which can aid in differentiating between benign and malignant tumors.
6. **Post-Contrast T1-Weighted Imaging**: Images obtained after contrast administration can highlight the enhancement pattern of the tumor and its relationship to nearby structures.

Specific Uses:

- MRI can differentiate between solid tumors, cysts, and necrotic areas within the tumor.
- It helps identify the tumor's exact location and its proximity to critical structures like nerves, vessels, or bone.
- MRI is used to assess the tumor's aggressiveness, its invasion into adjacent tissues, and the presence of satellite lesions.
- It is essential for evaluating tumors in areas where tissue planes are not well defined, such as the pelvis or retroperitoneum.
- MRI-guided biopsy can be performed to obtain tissue samples for definitive diagnosis.

In cases of suspected soft tissue tumors, MRI is often the imaging modality of choice due to its ability to provide excellent soft tissue contrast and detailed anatomical information. However, the interpretation of MRI findings typically involves collaboration between a radiologist and a pathologist to establish a definitive diagnosis and determine the appropriate treatment plan, which may include surgery, radiation therapy, or chemotherapy.

Posttest: الاختبار البعدى:

Define the Post-Contrast T1-Weighted Imaging with the tumers?

References: المصادر:

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