الجامعة التقنية الوسطى
كلية التقنيات الصحية والطبية/ بغداد
قسم : قسم تقنيات الاشعة المرحلة: الرابعة
المادة: التصوير المقطعي المحوسب للصدر والبطن والحوض

العنوان: **Title:**

CT liver imaging phases

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

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الفئة المستهدفة: **Target population:**

طلبة المرحلة الرابعة لكلية التقنيات الصحية والطبية في قسم تقنيات الاشعة

Introduction: المقدمة:

The liver is a highly vascular organ with a complex dual blood supply. For this reason, single-phase CT imaging may be insufficient to fully demonstrate variations in liver appearance. Multiphase CT imaging provides a structured approach that allows visualization of hepatic parenchyma and vascular structures at different time points following contrast administration.

This lecture aims to help students:

- **Understand the concept of multiphase liver CT imaging**
- **Recognize how liver appearance varies between imaging phases**
- **Appreciate the technical value of phase comparison**
- **Develop visual awareness of enhancement-related changes**

Pretest: الاختبار القبلي:

1. **What's Multiphase CT imaging of the liver?**

Scientific Content: المحتوى العلمي:

Concept of Multiphase

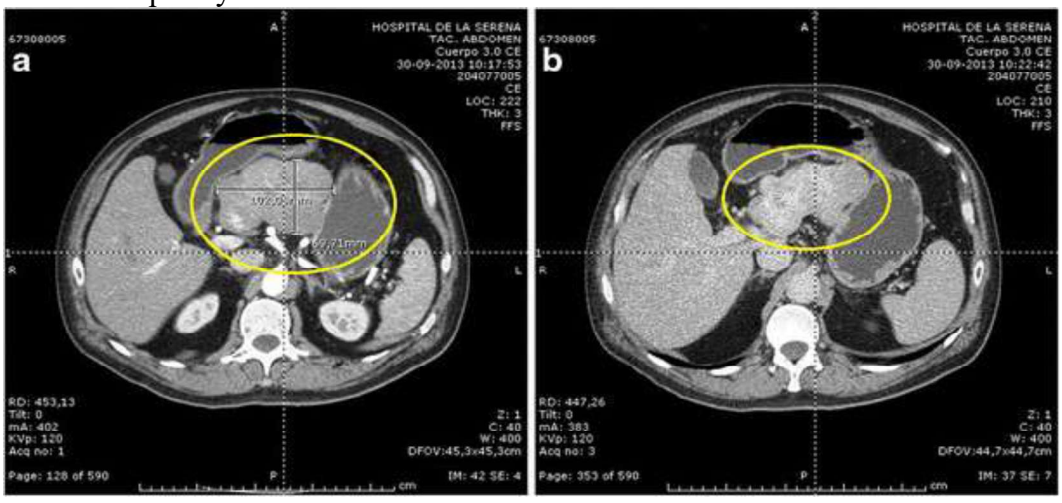
Multiphase CT imaging of the liver involves acquiring images at different time intervals following intravenous contrast administration. Each phase demonstrates characteristic vascular and parenchymal enhancement patterns. Typical contrast administration parameters may include approximately 80–100 mL of non-ionic contrast injected at a rate of 3–5 mL/s, although values may vary according to patient factors and scanner technology.

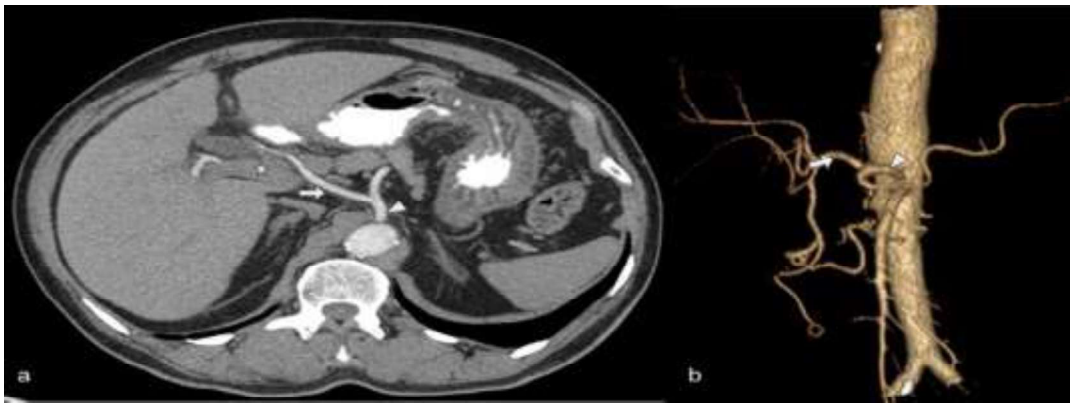
Image acquisition is commonly performed during a late arterial phase (approximately 35–45 seconds), a portal venous phase (approximately 60–75 seconds), and a delayed phase (approximately 2–5 minutes after injection). Could be adjusted as radiologist recommendation and technical factors. Scanning is usually performed during a breath-hold at full inspiration, with slice thickness typically equal to or less than 5 mm for routine evaluation.

Triple-phase liver CT refers to acquisition of late arterial, portal venous, and delayed phases. In an educational context, multiphase imaging supports understanding of contrast distribution and vascular relationships rather than serving as a diagnostic protocol.

Late Arterial Phase Imaging

In the late arterial phase, CT images demonstrate prominent enhancement of hepatic arterial structures with the beginning of contrast enhancement within the liver parenchyma. During this phase, contrast material is predominantly visualized within the hepatic arterial system, while early parenchymal enhancement becomes apparent.
From a technical perspective, late arterial phase imaging highlights:
• Hepatic arterial anatomy
• Early parenchymal enhancement patterns
• Contrast differentiation between hypervascular lesions and background liver tissue
This phase allows combined assessment of arterial supply and early parenchymal enhancement rather than purely vascular visualization.





Simple hepatic cyst

1- Sharply defined margin *2-Paper thin wall* *3-Clear water contents*
4-No septations *5- No calcifications* *6- No enhancement* *7-No mural nodules*

Abscess

1-*Marginal enhancement* *2- peripheral zone of edema*
3- Gas containing abscesses uncommon

Hemangioma

U.S: Typically well defined hypodense lesion
CT Arterial phase: peripheral nodular discontinous enhancement
CT Portal-delayed phases: continued filling in of the hemangioma

Hydatid cyst

1- Central and peripheral calcification *2-* Floating shadows
3-Daughter cysts can be inside the large cyst

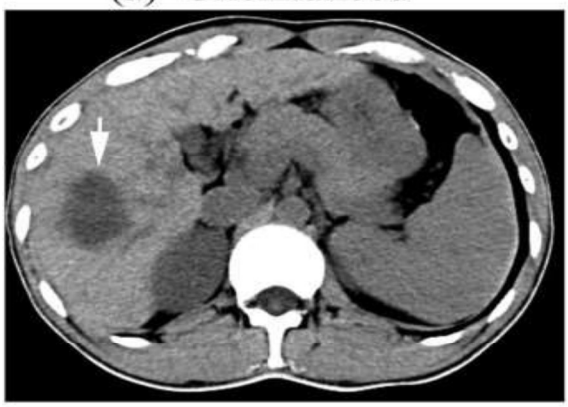
Portal Phase Imaging

I In the portal venous phase, contrast material becomes more evenly distributed within the liver parenchyma as a result of portal venous inflow. During this phase, the liver typically demonstrates homogeneous parenchymal enhancement.

Portal venous phase imaging allows evaluation of:
• Overall hepatic parenchymal enhancement
• Portal venous anatomy and its relationship to liver tissue
• Differences in lesion appearance compared to arterial phase images

This phase provides a comprehensive anatomical overview of liver enhancement and is considered the primary phase for routine assessment of liver parenchyma.

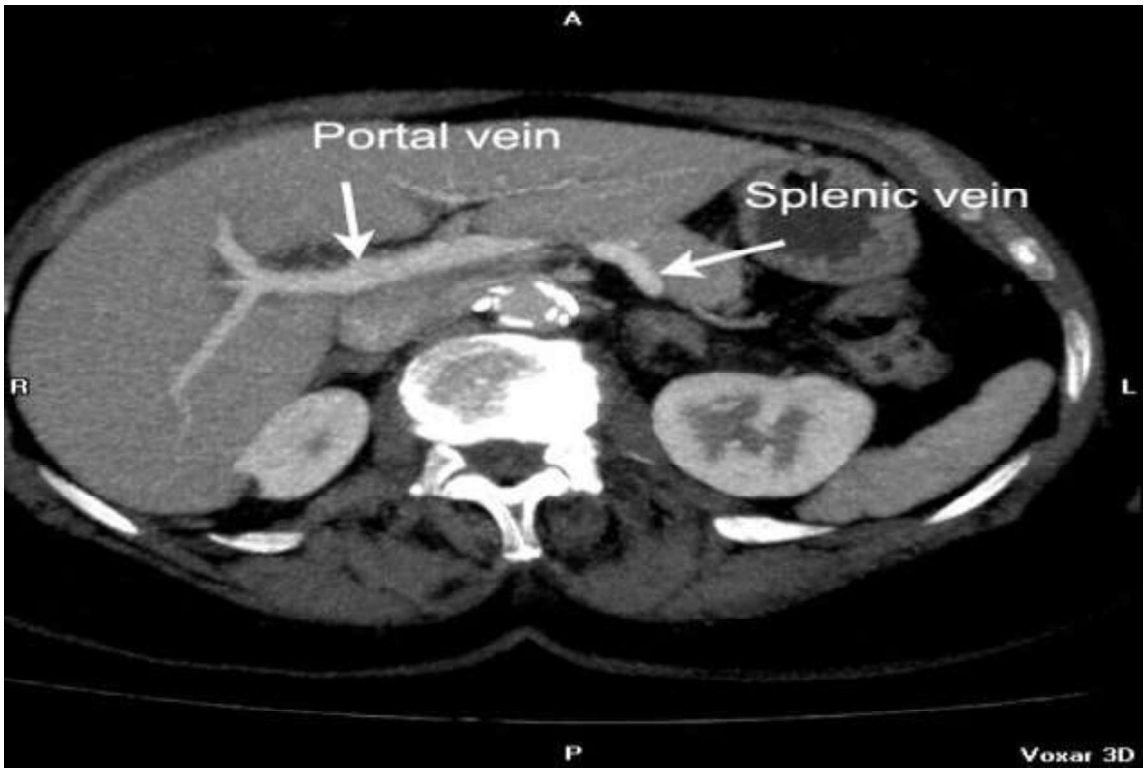
(a) Unenhanced



(b) Arterial phase

(c) Portal phase

(d) Delayed phase

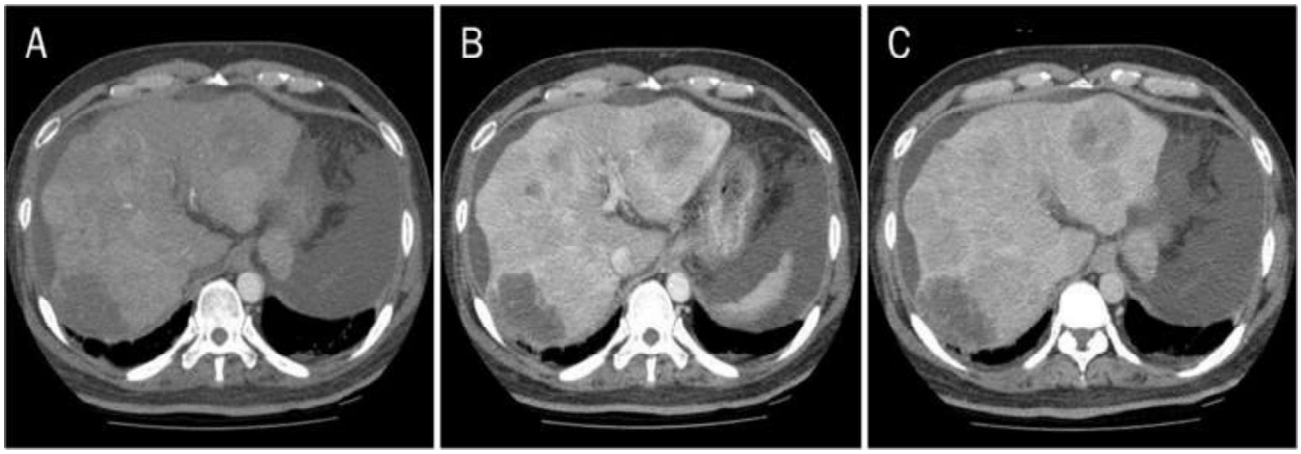


Delayed Phase Imaging

Delayed phase imaging is acquired after further redistribution and partial washout of contrast material from the vascular system. During this phase, contrast retention or delayed enhancement within certain tissues becomes more apparent due to differences in tissue composition and vascular permeability.

From a technical standpoint, delayed phase imaging demonstrates:
- **Persistence or reduction of contrast enhancement within liver parenchyma**
- **Temporal changes in enhancement intensity compared to earlier phases**
- **Visualization of structures with delayed contrast uptake, such as fibrotic tissue**

This phase emphasizes the time-dependent behavior of contrast material and allows comparison of enhancement patterns across different imaging phases, supporting anatomical assessment rather than serving as a standalone diagnostic phase.



Importance of Phase Comparison

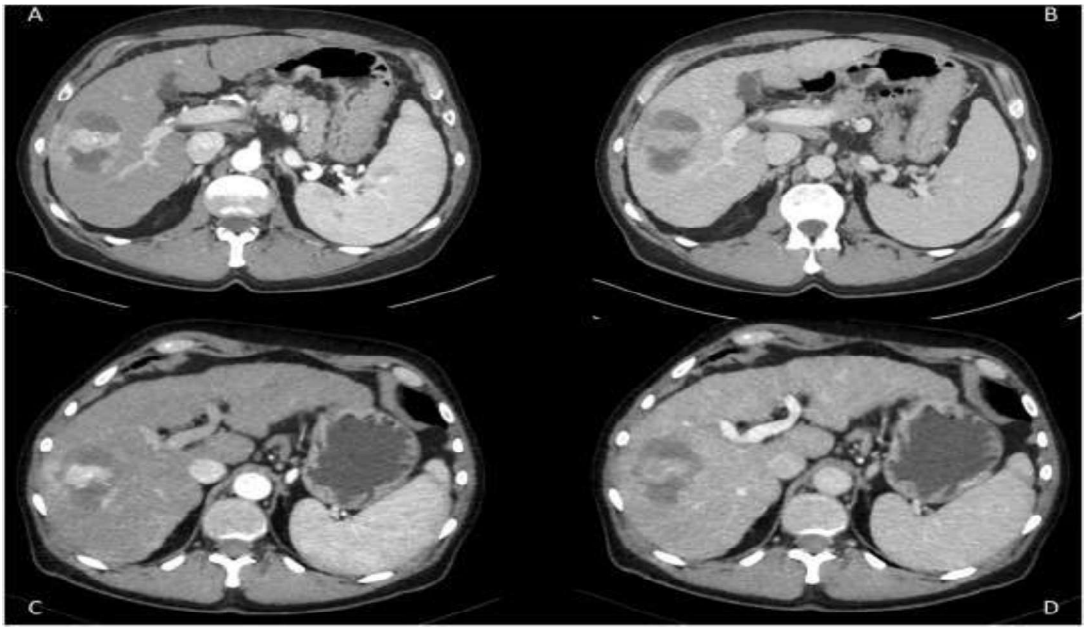
A fundamental technical principle of multiphase liver CT imaging is direct comparison between imaging phases. The same hepatic region may demonstrate different appearances across arterial, portal venous, and delayed phases as a result of contrast enhancement dynamics.

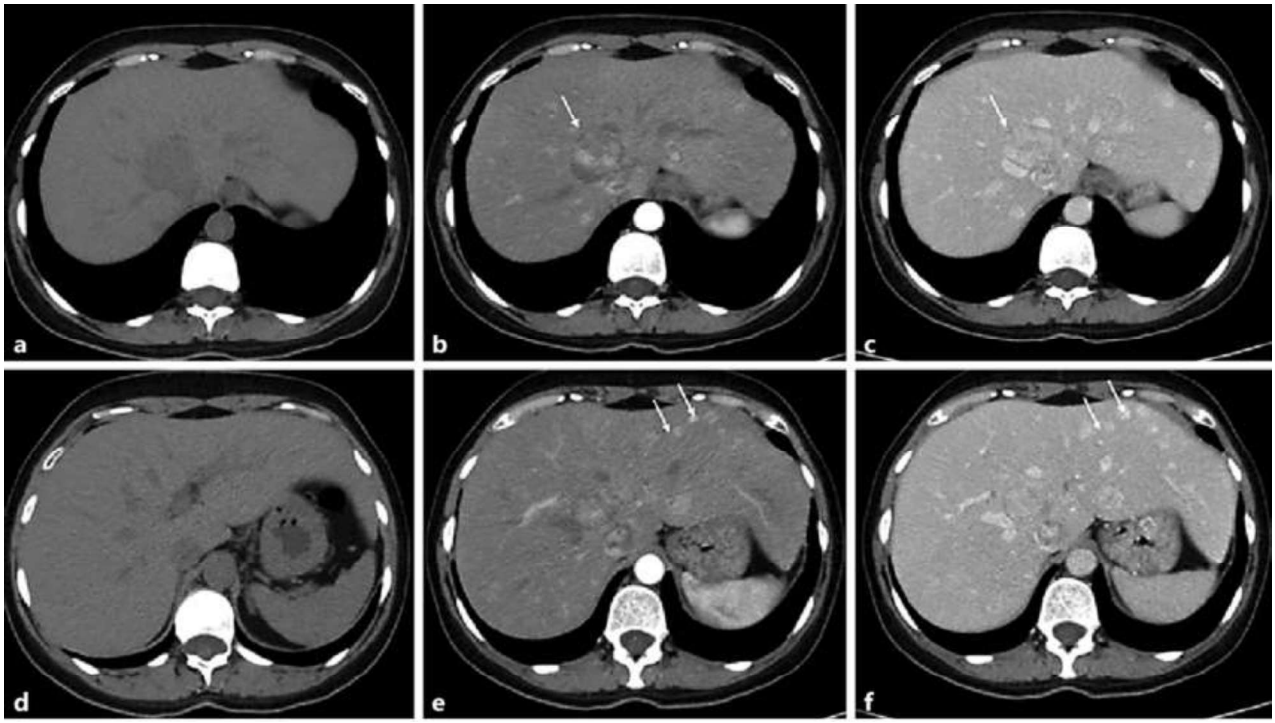
Comparative evaluation between phases allows:
• Improved understanding of enhancement patterns
• Differentiation between normal temporal variation and technical or physiological change
• Appreciation of time-dependent contrast behaviour within liver tissue

Multiphase liver CT emphasizes systematic observation across phases rather than isolated interpretation of a single image set, supporting accurate anatomical assessment and technical understanding.

Image Display and Review Strategy

Multiphase liver CT images are primarily reviewed using axial images as the reference standard, while coronal reformatted images assist in anatomical orientation and overall spatial assessment. Consistent window settings should be maintained when comparing different phases to allow accurate visual evaluation of enhancement-related changes. Side-by-side comparison of multiphase images facilitates recognition of subtle temporal variations in liver appearance and supports systematic assessment of contrast distribution across phases.





Technical Advantages and Limitations

Multiphase CT imaging provides improved visualization of hepatic vascular structures, enhanced understanding of contrast distribution within the liver, and greater confidence in assessing temporal changes in image appearance. This approach strengthens technical image evaluation and supports comprehensive anatomical assessment of the liver.

Despite these advantages, multiphase liver CT imaging has limitations related to patient motion and breath-holding variability, dependence on accurate contrast timing, and increased complexity of image review. These factors emphasize the importance of technical awareness and careful phase-to-phase image comparison.

Posttest: الاختبار البعدي:

1.Mention briefly the technical advantages and limitations of multiphase CT imaging

2. what's importance of phase comparison?

References: المصادر:

References

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17. Seeram, E. *Computed Tomography: Physical Principles, Clinical Applications, and Quality Control*. 4th ed. St. Louis: Elsevier; 2016.
18. Hofer, M. *CT Teaching Manual: A Systematic Approach to CT Reading*. Stuttgart: Thieme; 2010.