

جامعة الانبار
كلية العلوم التطبيقية – هيت
قسم الفيزياء الحياتية
المرحلة الرابعة

Medical Devices

Contrast Media (CM)

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Contrast Media Concept

- It is a chemical substance of very high or very low atomic number or weight, there for it increase or decrease the density of the organ under examination.
1. CM Types
 2. How to use it
 3. Areas of Use
 4. Causes and Effects
 5. Reactions



“Contrast Media”

- substance placed in the body to provide added contrast when subject contrast is low
- increases the radiographic contrast between the area containing the CM & areas not containing CM



Without
CM



With
CM



Requirements of a Contrast Agent

1. Easy to administer
2. No toxicity
3. Stable compound. – Will not dissociate into toxic ions when injected the media concentrates in area(s) required
4. The agent's physical features allow the organ to be properly demonstrated
 - even barium coating of the stomach in the presence of an acid environment



Requirements of a Contrast Agent

5. The agent should have rapid elimination.
6. The agent should not be carcinogenic. (having the potential to cause cancer)
7. The agent should have a viscosity appropriate to the patient when introduced.
8. The agent should cause minimal distress to the patient when introduced.
9. The agent should be cost-effective.



Methods of administration

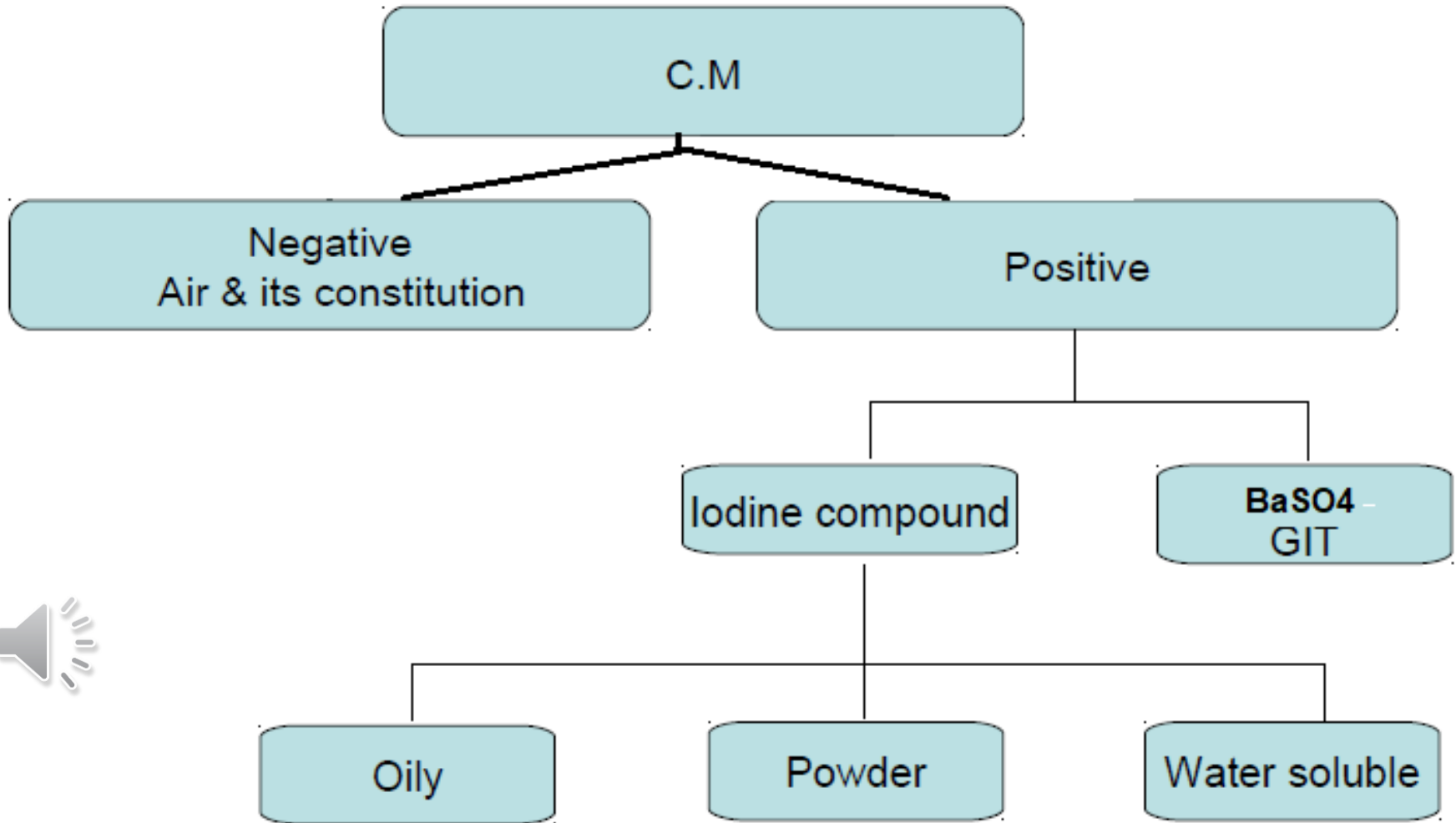
1. Orally
2. Rectally
3. Intravenously – (injection / infusion)
4. Mechanically – Filling of a body cavity or potential space
5. Intra-muscularly



Areas where contrast agents are used

1. Arteriography
2. Angiography (DSA) – Cardiology
3. Venography (replaced by ultrasound-Doppler)
4. IVU (Intravenous Urography)
5. Fluoroscopy – Alimentary tract
6. Computed Tomography (CT)
7. Magnetic Resonance Imaging (MRI)
8. Ultrasound – Liver, kidney
9. Myelography (replaced by MRI): **Imaging the spinal needle into the spinal canal**
10. Arthrography – Knee joints

Contrast Mediums Classifications



BaSO₄: Barium Sulfate

Types of Contrast Media

- 1. Negative Contrast Agents:** are gases of low density (air, oxygen, carbon dioxide) which appear radiolucent in Digestive system
- 2. Positive Contrast Agents:** *The positive contrast agents increase the atomic number of the area to be demonstrated in relation to the surrounding tissue.*
 - a) Barium based**
 - b) Iodine based agents**
 - Water soluble (Niopam): clear, colorless solutions
 - Non soluble (Lipiodol, Myodol)
 - Powder contrast in a form of tablets e.g. Biloptin, Cistobil.
 - Oily contrast e.g. myodil, dinosil & lipidol.
 - Water soluble (addition of sugar).



Iodinated Contrast Media Properties

1. High-osmolality contrast media (HOCM) have an iodine to molecule ratio of 1.5 : 1
2. Low-osmolality, nonionic contrast media (LOCM) have an iodine to molecule ratio of 3 : 1
3. Iso-osmolar contrast media (IOCM) have an iodine to molecule ratio of 6 : 1

Double Contrast

Incorporates the use of both positive & negative contrast media.

e.g. during a double contrast Barium enema examination.

Co₂ + BaSo₄ = Double Contrast

HOCM

- HOCA are in use since the 1950.
 - * Urovist
 - * Urografin
 - * Angiovist
 - * Conray
 - * Renografin
 - * Renovist
 - * Hypaque



LOCA

Non-ionic	Ionic
<ol style="list-style-type: none"><li data-bbox="150 439 517 502">1. Ultravist<li data-bbox="150 545 614 608">2. Omnipaque<li data-bbox="150 651 517 714">3. Visipaque<li data-bbox="150 756 448 819">4. Oxilan	<ol style="list-style-type: none"><li data-bbox="989 439 1356 502">1. Hexabrix

LOCA have a lower incidence of adverse reactions by a factor of 6 for all reactions , and by a factor of 9 for the severe reactions.



Toxic effects

1. Vascular toxicity
2. Soft tissue toxicity
3. Cardiovascular toxicity
4. Haematological changes
5. Thyroid function problems
6. Nephrotoxicity

Nephrotoxicity



- Incidence of contrast induced nephrotoxicity 5%,
In the majority, renal impairment is temporary
- **Predisposing factors :**
 1. impairment of renal function
 2. Diabetes mellitus
 3. dehydration
 4. old age
 5. large doses of CM
 6. multiple myeloma (malignant manifest in adults)

*Excluding death, adverse reactions can be classified in terms of severity as:

1- major reactions: those that interfere with the examination and require treatment.

2- intermediate reactions: those that interfere with the examination but do not require treatment.

3- minor reactions: those that do not interfere with the examination and require only assurance


High risk patients should either:

1 – be premedicated with steroids


2- to be evaluated with other modality (U/S – MRI)

Types of Reactions

1- Fatal reactions (death)

1. 1/140,000 for HOCM
2. 1/300,000 for LOCM 
3. Occur in minutes
4. Old age cause more reaction
5. Causes (cardiac arrest – pulmonary problems – respiratory arrest – coagulopathy – laryngeal problems- bronchospasm)

2. Non-fatal reactions

- 1- flushing, metallic taste in the mouth, nausea, sneezing, cough—common & related to dose and speed of injection.
- 2- urticaria (itchy red welts) 
- 3- angioneurotic problems
- 4- bronchospasm
- 5- pulmonary edema
- 6- arrhythmia (irregular heartbeat)
- 7- hypotension
- 8- delayed reactions: rashes , headaches, itching

Risk factors

1. **allergy , asthma**
2. **Cardiac disease**
3. **Hepatic (liver) failure**
4. **Poor hydration**
5. **Co-administration of Glucophage** (an oral diabetes medicine that helps control blood sugar levels)
6. **Previous reaction to contrast media**
 - HOCM----- 20%
 - LOCM ----- 5 %
7. **pheochromocytoma**: small vascular tumor of the adrenal medulla, causing irregular secretion of epinephrine and norepinephrine, leading to attacks of raised blood pressure, palpitations, and headache.
8. **Sickle cell disease**
9. **Multiple myeloma**

CM in Radiology

1- Urography



2. Cystogram



3. Urethrogram

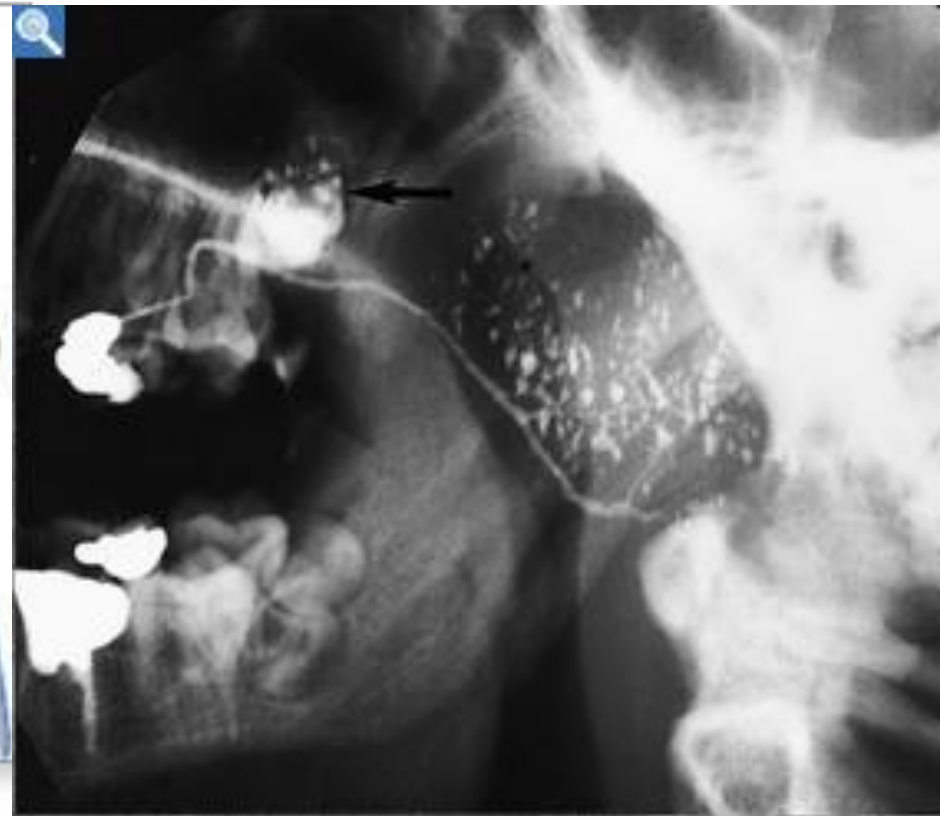
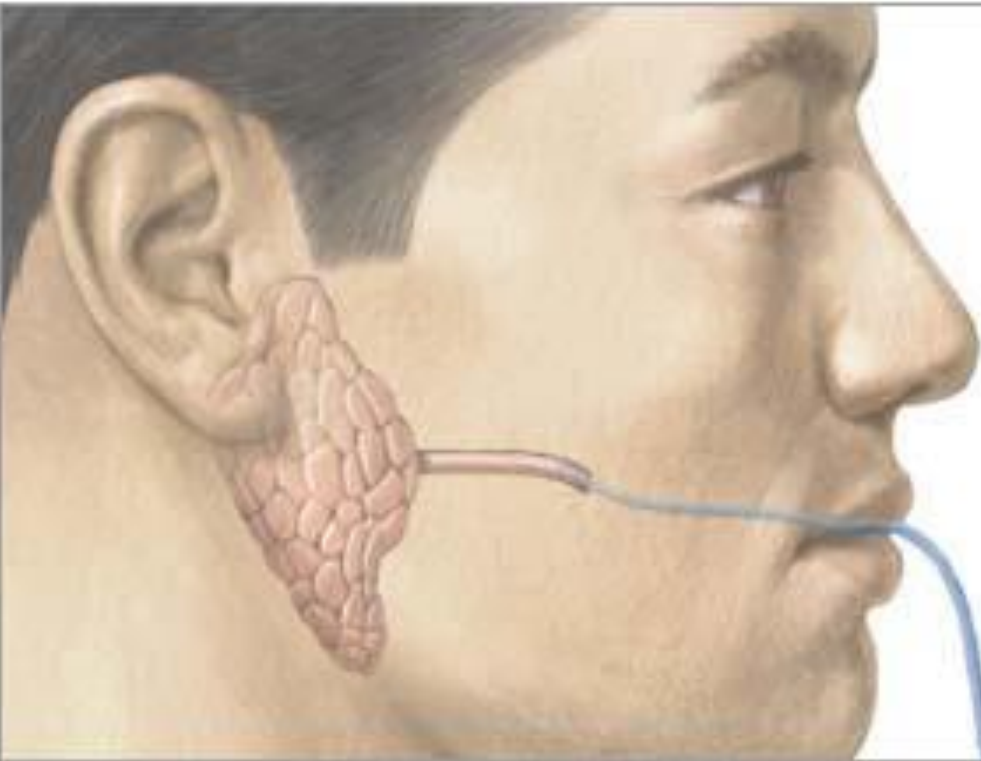


4. Angiography



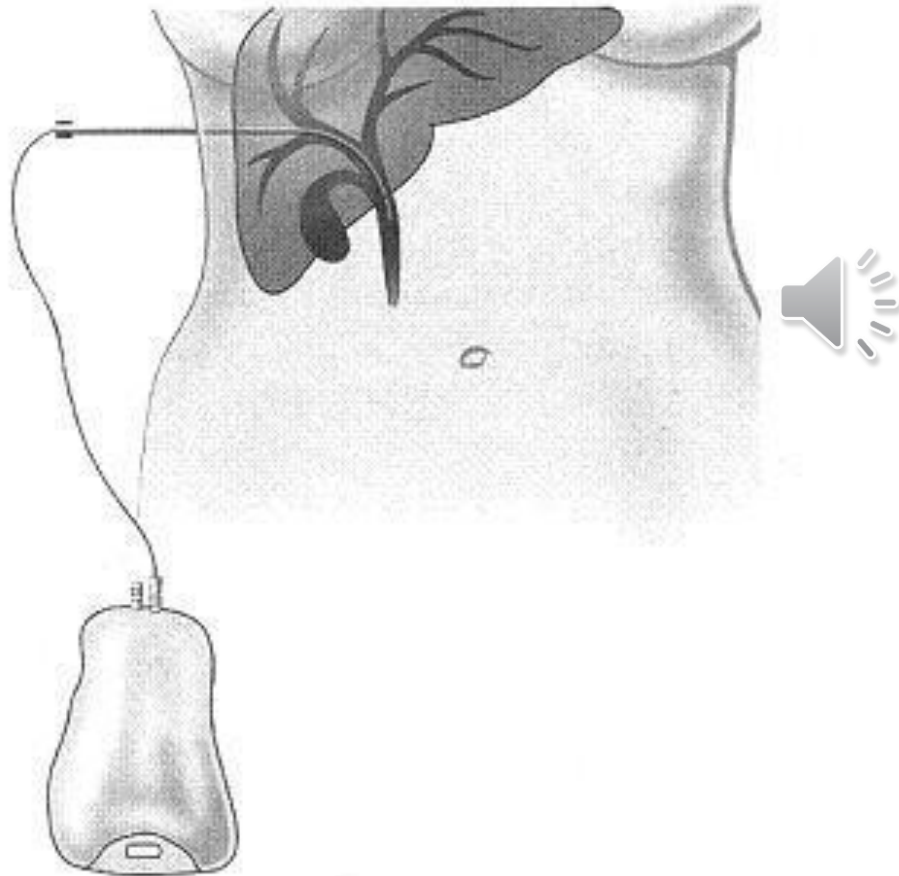


5. Sialography



Contrast medium is injected into the salivary gland duct

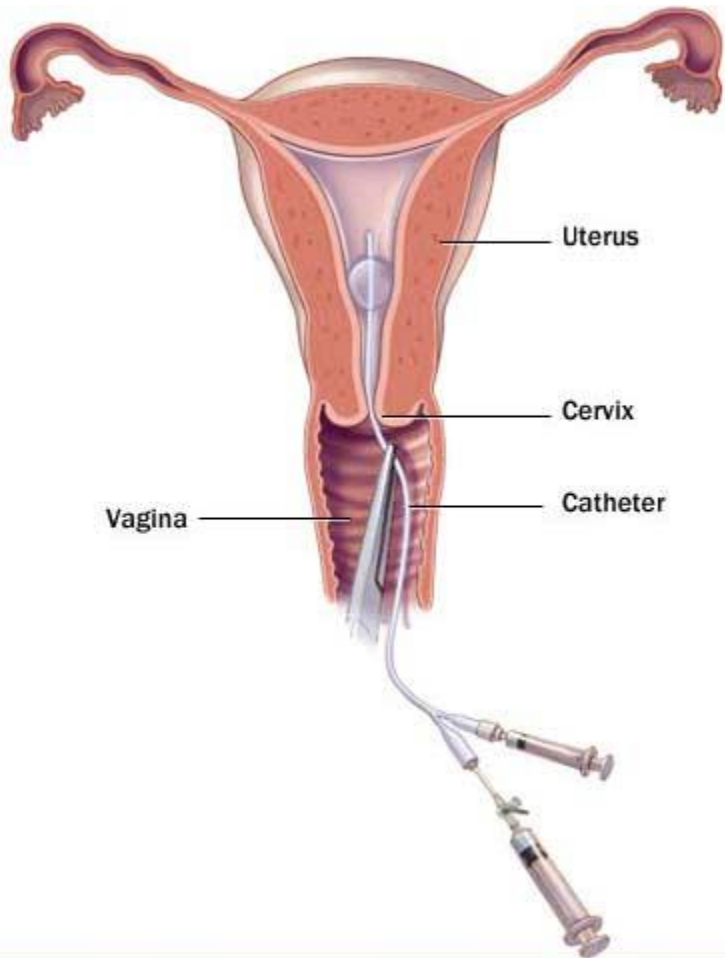
6. PTC test: Percutaneous transhepatic cholangiography: Imaging the bile ducts inside the liver



7. ERCP: Endoscopic Retrograde Cholangiopancreatography: is a procedure used to diagnose diseases of the gallbladder, biliary system, pancreas, and liver.



8. HSG: Hysterosalpingography: imaging the uterus and the Fallopian tubes, most commonly used in the investigation of infertility or recurrent spontaneous abortions



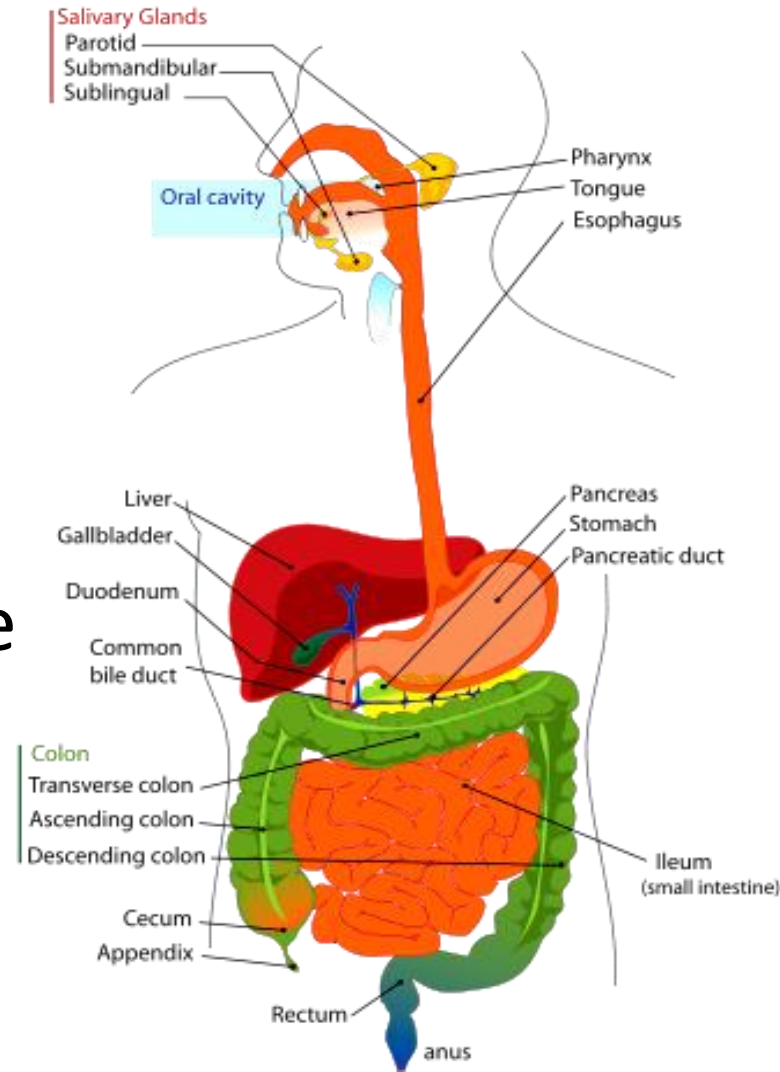
9. Gastrointestinal (GIT) Contrast Agents



1. Barium Sulphate
2. Water Soluble Contrast Medium (Gastrografin)

- ***Barium Sulphate Advantages for GIT:***

- excellent coating, allowing the demonstration of normal and abnormal mucosal patterns.
- Low cost



Barium Sulphate in GIT



- ***Thin barium*** : for upper GI studies, small bowel follow through, barium enema
-40% BaSO₄ solution.
- ***Thick barium*** : for double contrast studies
-85% BaSO₄ solution



Water soluble contrast medium (Gastrografin)

1. Oral contrast medium for opacification of GIT
2. Undiluted or diluted
3. Can be used as a substitute for barium if GI perforation is suspected.
4. In CT , used diluted by 1:40



Complications

- Aspiration can cause chemical pneumonitis
- Diarrhea
- Hypovolemic shock if used undiluted

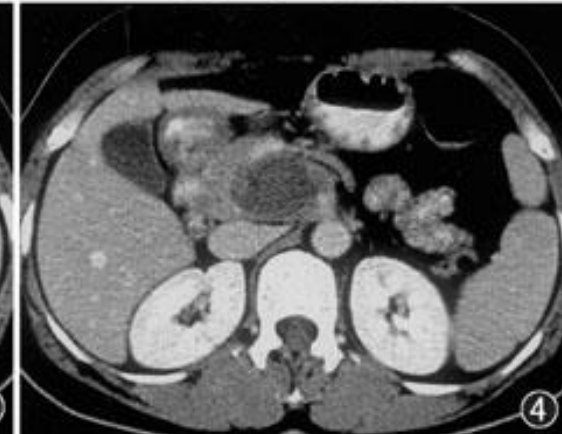
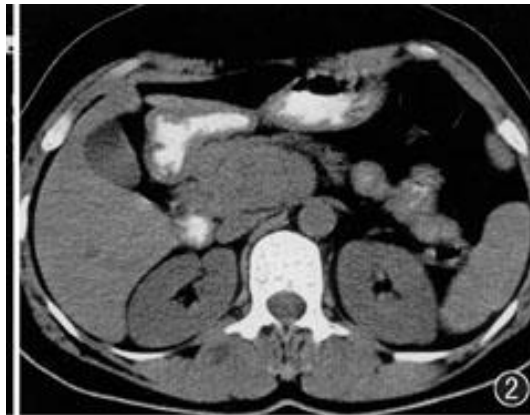


Devices CM

1- CT contrast agents

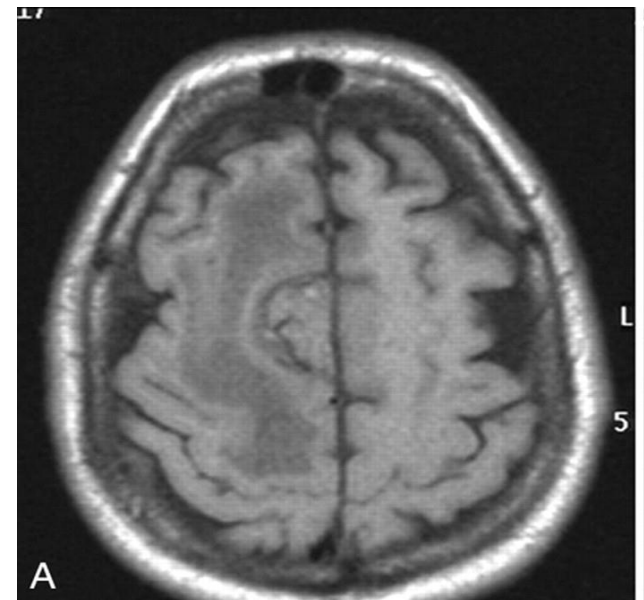
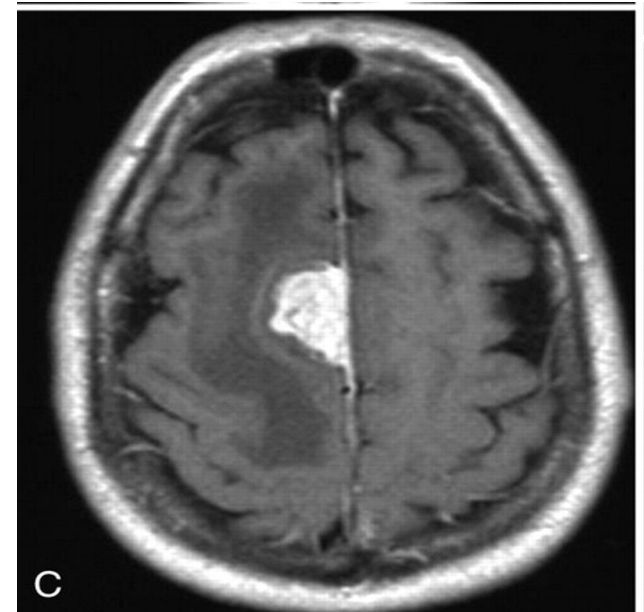


- Intravenous (IV) contrast medium
- Oral water soluble contrast medium (gastrografin)



2- MRI CM

- Gadolinium
- Gd-DTPA
- Intravenous Contrast Medium



3. ULTRASOUND CM

- Levovist / echovist
- IV (Intravenous graphy)

