



## كلية المأمون الجامعة قسم تقنيات الأشعة

المرحلة الثانية

### Special radiological procedures of gastrointestinal tract and bones

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MSc Medical Imaging / MRI Applications

Contrast agent & adverse effect

#### Lecture one

*Contrast agents enhance the ability of tissues to absorb X-rays, thereby improving image contrast. These agents are typically administered orally or intravenously to create a temporary density difference between various tissues, making their contrasts more visible in the image. Substances like Iodine (Iodine-51) or Barium (Barium-65) are particularly useful as contrast agents due to their relatively high atomic numbers, which increases their ability to highlight fine details in tissues. In radiologic pathology, contrast agents help detect tumors, obstructions, and abnormalities, by this means improving diagnosis.*

## ► Classification of contrast media

### i- **Positive contrast media**

A positive contrast agent means that it absorbs more x-ray than the surrounding tissue. Today's contrast agents are mostly positive, and their further classification is based on their physical characteristics.

#### 1- **iodinated contrast media:**

**a- Ionic contrast media:** Ionic contrast media have higher osmolarity, they are excreted by the kidney, and cause more side effects, therefore it is not in use intravenously anymore, however, it is used for enterography routinely. Due to its hyper-osmolarity ionic contrast media exert laxative effect.

#### **b- Nonionic contrast media:**

Ionic contrast media are hypo or iso-osmolar compared to blood. These types of contrast media are also excreted by the kidney. They are generally used for intravenous and intra-arterial administration because they are safer.

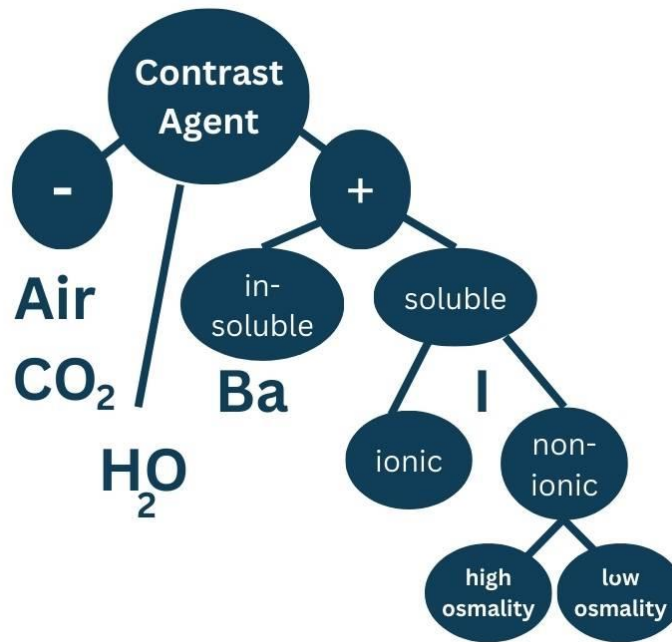
#### 2- **Non-iodinated contrast media:**

Most frequently used non-iodinated contrast agent is barium sulphate. It can be used orally or rectally, as a suspension of fine particles in aqueous solution. Barium-sulphate is insoluble in water.

### ii- **Negative contrast media**

Negative contrast agent means that it absorbs less x-ray than the surrounding tissue: air and carbon-dioxide are most frequently used in conventional x ray. Air or water as a **Negative** contrast agent in CT scan is used to create better contrast by fixing the borders of the tissue near the **GIT**.





### **Adverse effect of Contrast agent**

▶ Radiographic contrast media are a group of medical drugs used to improve the visibility of internal organs and structures( visualize vessels, tissues, organs, and the urinary tract. Differentiating between normal and pathological area) in X-ray based imaging techniques such as radiography and computed tomography (CT )

▶ The currently used contrast media are based on the chemical modification of tri-iodinated benzene ring / A dose of contrast media used in typical radiological procedure contains about 13500 µg of free iodide and 15 to 60 g of bound iodide.

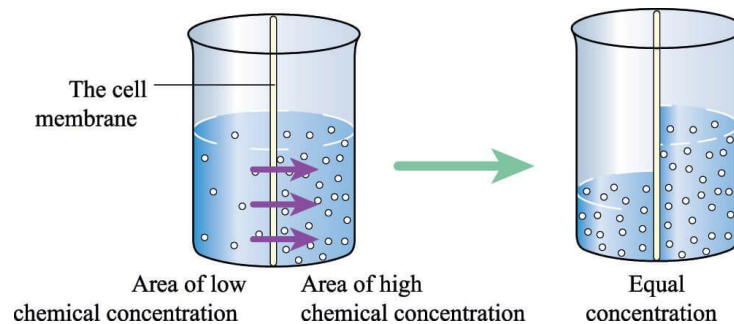
▶ Iodine in contrast media is directly related to osmolarity. Osmolarity refers to the concentration of solutes, in this case, iodine molecules, in the solution. The higher the amount of iodine, the higher the osmolarity.

▶ Osmolarity is a measure of the number of dissolved particles in one liter of solution. In other words, it refers to the concentration of solutes (such as salts, sugars, or other molecules) in a specific volume of fluid. Osmolarity is measured in milliosmoles per liter (mOsm/L).

Dissolved substances, such as salts (sodium and potassium), help regulate the movement of water between the inside and outside of cells. When there is a difference in solute concentration between two

sides, water moves across the cell membrane from areas of lower concentration to areas of higher concentration in a process called osmosis.

In the case of radiographic contrast media, dissolved particles (like iodine) affect the osmolarity of the solution. High osmolarity can draw water from surrounding tissues, potentially leading to tissue dehydration or vascular irritation.



*Types of iodine CM:*

- *High Osmolar Contrast Media (HOCM): Contains high concentrations of iodine, increasing osmolarity. It is less commonly used due to potential side effects like kidney damage and vascular irritation.*
- *Low Osmolar Contrast Media (LOCM): Contains less iodine, reducing osmolarity and minimizing side effects.*
- *Iso-Osmolar Contrast Media (IOCM): Balanced iodine concentration, iso-osmolar with blood plasma, safer for patients at risk of kidney complications.*

*Higher osmolarity increases the risk of tissue dehydration or vascular damage, particularly in the kidneys.*

▶ *The most important adverse effects of contrast media include :*

#### **1- Hypersensitivity Reactions**

▶ *mild hypersensitivity reactions (incidence <3%) consist of : skin rashes , prickle ,rhinorrhea, nausea, vomiting, diffuse, headache, bronchospasm. Mortality is less than one death per 100000 patients*

▶ *Asthma, history of multiple allergies, and therapy with beta blockers increase the risk of bronchospasm.*

▶ *The pathophysiology of mild hypersensitivity reactions represents a spectrum of T cell reaction .*

▶ *Allergic reactions to contrast material increase the risk of developing adverse reactions, can we use to decrease these reactions : **diphenhydramine or hydrocortisone after appear the hypersensitivity reactions.***

## **2- Contrast-Induced Thyroid Dysfunction**

▶ *Iodinated contrast media exposure may be associated with development of either hyperthyroidism or hypothyroidism, presumably due to the effect of free, biologically active iodide ions present in the contrast media preparation .*

▶ *long-term storage and exposure to light may lead to photolytic degradation of contrast media and hence an increased concentration of free iodine in solution.*

## **3- Contrast-Induced Nephropathy (CIN)**

▶ *When radiographic contrast media are injected intravenously or intra-arterially, they pass from the vascular compartment through capillaries into the extracellular space. Thereby visualizing the urinary tract.*

▶ *Pre-existing renal disease with an high level of serum creatinine is the most crucial risk factor in the development of CIN*

▶ *Suggested pathophysiology mechanism :Renal medullary hypoxia due to either a decrease or increase blood vessels capillaries diameters .*





▶ *The American College of Radiology suggests using the term post contrast acute kidney injury (PC-AKI) rather than CIN*

## **Creatinine with CM**

*Elevated creatinine levels in the blood are one of the most important indicators of impaired kidney function and are used to assess the kidney's ability to filter waste from the bloodstream. When creatinine levels are high, the kidneys' filtering capacity is reduced, making the body more susceptible to complications from stressors like the injection of contrast media.*

### **Why is elevated creatinine a major risk ?**

- 1- Poor filtration: Impaired kidneys struggle to remove contrast agents efficiently, prolonging their presence and increasing the risk of further kidney damage.*
- 2- Renal ischemia: Contrast media can disrupt blood flow, particularly in the sensitive renal medulla, leading to oxygen deprivation and potential permanent damage.*
- 3- Inflammatory response: Elevated creatinine reflects kidney dysfunction, and contrast agents can trigger an inflammatory response, exacerbating kidney injury.*
- 4- Direct toxicity: Contrast agents can be directly toxic to kidney cells, especially in patients with pre-existing kidney impairment.*
- 5- Preventative measures include adequate hydration before and after contrast administration, using the lowest contrast dose, and carefully monitoring creatinine levels, particularly in high-risk patients.*

Men		0.6 to 1.2
Women		0.5 to 1.1
Teenager		0.5 to 1.0
Children		0.3 to 0.7

THANKS !

