College of Health and Medical Technologies
Department of Radiology Technologies
Radiological Procedures

Intravascular contrast media
Adverse effect of Intravenous (IV) water soluble contrast media on specifc organs

2nd stage

By

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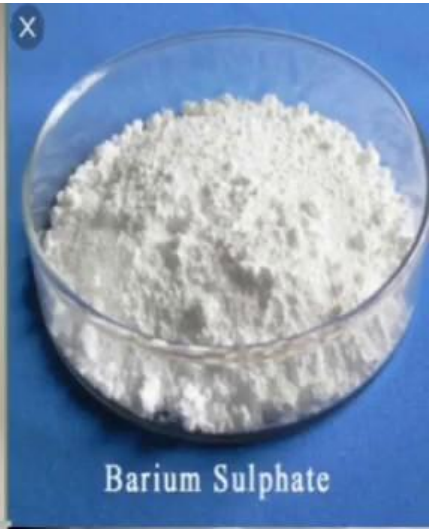
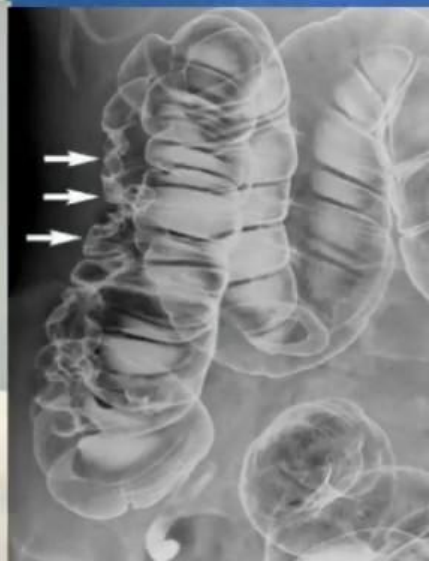
Contrast Media Used In Radiology





HISTORICAL DEVELOPMENT OF RADIOGRAPHIC AGENTS

- The first report of opacification of the urinary tract by renal excretion rather than by retrograde introduction of a contrast agent appeared in 1923 when Osborne et al. took advantage of the fact that i.v. injected 10% sodium iodide solution, which was used in the treatment of syphilis, was excreted in the urine.'

- Swick suggested some modifications to the molecule and in 1928 and 1929 the first i.v. urograms with the compound Uroselectan were performed.2-4 This mono-iodinated compound was developed further into the di-iodinated compounds, Uroselectan-B (Neo-ipax) and diodone (Diodrast) and in 1952 the first tri-iodinatcd compound, sodium acetrizoate (Urokon), was introduced into clinical radiology. Sodium acetrizoate was based on a 6-carbon ring structure, tri-iodo benzoic acid, and was the precursor of all modern water-soluble contrast media. In 1955 a much safer derivative became available - diatrizoate (Urografin, Hypaque).

ADVERSE EFFECTS OF INTRAVENOUS WATER-SOLUBLE CONTRAST MEDIA

TOXIC EFFECTS ON SPECIFIC ORGANS

Vascular toxicity

Venous

1. Pain at the injection site - usually the result of a perivenous injection.

2. Pain extending up the arm - due to stasis of contrast medium in the vein. May be relieved by abducting the arm.

3. Delayed limb pain - due to thrombophlebitis as a result of the toxic effect . on endothelium

Arterial

endothelial damage and vasodilatation are mostly related to hyperosmolality. Contrast medium injected during peripheral arteriography causes a sensation of heat or pain. These symptoms are considerably reduced when LOCM are used and particularly so when non-ionic dimers are used.

Soft tissue toxicity

Pain, swelling, erythema and even sloughing of skin may occur from extravasated contrast medium. The risk is increased when pumps are used to inject large volumes of contrast medium during CT examinations. Treatment should consist of the application of cold packs and elevation of the limb should be considered. Systemic steroids, non-steroidal anti-inflammatory drugs and antibiotics have all been shown to be useful. Cardiovascular toxicit

- **Cardiovascular toxicity**
- 1. Intracoronary injection of contrast media may cause ventricular fibrillation, ventricular tachycardia, asystole, sinus bradycardia, heart block, increased QT interval, QRS prolongation, ST depression and increased T wave amplitude.
- 2. Increased vagal activity may result in depression of the sinoatrial and atrio-ventricular nodes, resulting in bradycardia or asystole.

- 3. The injection of a hypertonic contrast medium causes significant fluid and ion shifts. Immediately after injection there is a significant increase in serum osmolality. This causes an influx of water from the interstitial space into the vascular compartment, an increase in blood volume, an increase in cardiac output and a brief increase of systemic blood pressure. Peripheral dilatation causes a more prolonged fall of blood pressure. Injection into the right heart or pulmonary artery causes transitory pulmonary hypertension and systemic hypotension; injection into the left ventricle or aorta causes brief systemic hypertension followed by a more prolonged fall.

Nephrotoxicity

Contrast-induced nephropathy (CIN) is one of the most serious adverse effects associated with the use of intravascular contrast media and is defined as an impairment of renal function (urine output 25 µmolesL−1 within 48 h, and/or increase in serum creatinine >50% baseline value within a week of administration)4,5 in the absence of an alternative aetiology. In those affected, the serum creatinine concentration starts to rise within the first 24 h, reaches a peak by 2–3 days, and usually returns to baseline by 3–7 days. In rare cases patients may need temporary or permanent dialysis. It was hoped that the iso-osmolar contrast agents might be less nephrotoxic than LOCM; however, clinical trials have so far yielded conflicting results.6 CIN has a complex aetiology, and the positive benefit of reduction in osmolarity achieved with iso-osmolar contrast medium may be negated by other factors.

There are a number of predisposing factors in CIN:

1. The single most important risk factor is preexisting impairment of renal function; patients with normal renal function are at very low risk.
2. Heart failure
3. Hypovolaemia
4. Sepsis
5. Age >75 years
6. High dose of contrast medium
7. Renal transplan
8. Intraarterial administration of contrast

Thyroid function

Iodinated contrast media may rarely cause thyroid dysfunction, and intravascular contrast should not be administered in hyperthyroidism.7 The administration of contrast will preclude the use of radioiodine in the treatment of thyroid cancer for 2 months, and similarly radioiodine imaging should be avoided for 2 months after iodinated contrast administration.

IDIOSYNCRATIC REACTIONS

Adverse reactions can be classified in terms of severity as:

1. mild: Nausea, vomiting, urticaria
2. moderate: Mild bronchospasm, vasovagal reaction, tachycardia, diffuse erythema
3. severe: Cardiovascular collapse, moderate or severe bronchospasm, laryngeal oedema, loss of consciousness or seizure

Mild and moderate reactions are uncommon; major adverse reactions are very rare for both LOCM8 and iso-osmolar iodinated contrast.9 Adverse effects of low osmolar iodinated contrast are found in approximately 0.15% of all patients. In a large study of LOCM contrast doses,10 the adverse effects were categorized (Table 2.3).

The vast majority of adverse effects were managed with patient reassurance or antihistamine treatment, and only one death was presumed caused by LOCM (0.0003% of total patient group)

Table 2.3 Categories of Adverse Effects of Low Osmolar Contrast Medium Contrast Doses[12]		
Category of Adverse Effect[12]	**Proportion of Adverse Effect Events (*n*= 458) (%)**	**Proportion of Total Patient Group (*n*= 298,000) (%)**
Mild	81.6	0.125
Moderate	15.1	0.02
Severe	3.3	0.005

- **Fatal reactions**
- Deaths caused by iodinated contrast agents are very rare, occurring at a rate of 1.1–1.2 per million contrast media packages distributed. Most are attributed to renal failure, anaphylaxis, or allergic reaction. Other than renal failure, almost every fatal reaction will occur in the minutes following injection, and all patients must be under close observation during this time. The fatal event may be preceded by trivial events, such as nausea and vomiting, or may occur without warning. The majority of deaths occur in those over 50 Table 2.3 Categories of Adverse Effects of Low Osmolar Contrast Medium Contrast Doses12 Category of Adverse Effect12 Proportion of Adverse Effect Events (n= 458) (%) Proportion of Total Patient Group (n= 298,000) (%) Mild 81.6 0.125 Moderate 15.1 0.02 Severe 3.3 0.005 2 years of age.
- **Causes of death include cardiac arrest, pulmonary oedema, respiratory arrest, consumption coagulopathy, bronchospasm, laryngeal oedema, and angioneurotic oedema**.

Non-fatal reactions

1. Flushing, metallic taste in the mouth, nausea, sneezing, cough and tingling are common and related to dose and speed of injection, Ioxaglate is associated with a higher incidence of vomiting and anaphylactoid reactions, whereas LOCM in general are associated with a lower incidence.

2. Perineal burning, a desire to empty the bladder or rectum and a spuriousfeeling of having been incontinent of urine are more common in women.

3. Urticaria.

4. Angioneurotic oedema. Most commonly affects the face. May persist for up to 3 days and its onset may be delayed.

5. Rigors.

6. Necrotizing skin lesions.

7. Bronchospasm. **Mechanisms for contrast medium-induced bronchospasm include:**

a. Direct histamine release from mast cells and platelets

b. Cholinesterase inhibition

c. Vagal overtone

d. Complement activation

e. Direct effect of contrast media on bronchi.

8. Non-cardiogenic pulmonary oedema.

9. Arrhythmias.

10. Hypotension.

1 1. Abdominal pain.

12. Delayed-onset reactions - rashes, headaches, itching and parotid gland swelling.

reference

Watson, N. & Jones, H. chapman& Nakielnys ‘’Guide to Radiological procedures’’ , 7th edition, Elsevier Health Sciences, 2017.