

Contrast agents

Dr.hashemian

substance, such as barium, iodine or air, used in radiography to increase the contrast of an image. A positive contrast medium absorbs x-rays more strongly than the tissue or structure being examined; a negative contrast medium, less strongly.

Contrast is used in medical imaging to make normal structures and some lesions look more conspicuous.

Contrast can be positive (e.g. the use of iodinated **contrast** in CT) or negative as in the use of air in double **contrast** barium studies.

Contrast media is usually specific to the imaging modality and organ systems

* X-ray contrast agents:-

- A) Intravascular contrast agents (iodinated)
- B) Barium .

A) Intravascular contrast agents (iodinated)

- 1- High osmolar contrast They are organic acids consisting of:
 - agents (HOCA)
 - - Anion (radiodense iodinated benzoic acid derivative)
 - - Cation (Sodium or meglumine)
 - - They are in clinical use since 1950s.
 - - The osmolarity depends on the concentration (30-76 %)
 - - Examples:
 - Diatrizoate (Hypaque)
 - Iothalamate (Conray)

A) Intravascular contrast agents (iodinated)

- Low osmolar contrast agents (LOCA) – non-ionic
- Have a lower incidence of adverse reactions.
- Equally effective . Contains 300- 370 mg I/mL
- In clinical use since 1986.
- Higher cost than HOCA.
- Examples:
 - Iopamidol (Isovue)
 - Iohexol (Omnipaque)
 - Ioprmide (Ultravist)

Pharmacology of iodinated contrast agents

- Plasma level depends on:
 - Rate of administration.
 - Blood half-life.
 - Distribution:
 - rapid exchange between plasma & extracellular fluid .
 - Agents do not cross intact blood brain barrier.
 - Excretion:
 - Glomerular filtration.
 - Hepatic (vicarious) excretion in renal failure.

Most often they are used intravenously, but for various purposes they can also be used intraarterially, intrathecally (the spine) and intraabdominally - just about any body cavity or potential space.

Side effects:

- Mucocutaneous reactions – flushing- rhinorrhea- urticaria- angioneurotic edema.
- Nausea & vomiting.
- Headache
- Thrombophlebitis & venous thrombosis – Sloughing of skin.
- Abdominal pain.
- Bronchospasm.
- Hypotension & tachycardia.
- Convulsions.
- Cardiac arrest – coronary artery spasm during anaphylactoid reaction.
- Mortality rate: - 1/ 40,000 with HOCA
- 1/ 200,000 with LOCA

- Risk factors for developing side effects:
 - Allergies , Asthma , Atopy.
 - Cardiac disease.
 - Previous reaction to contrast agents.

- High risk patients should either:
 1. Premedicated with steroids.
 2. Receive non-ionic agents.
 3. Evaluate by U/S or MRI.

- Mechanism of contrast induced nephrotoxicity:
- Incidence of 5% with predisposing factors:
 1. Pre-existing renal impairment.
 2. DM & old age.
 3. Very large dose.
 4. Multiple myeloma.
- The mechanisms:
 - 1) Impaired renal perfusion.
 - 2) Glomerular injury (chemotoxic effect)
 - 3) Tubular injury (acute tubular necroses)

❖ Other iodinated agents: Gastrografin

- Oral contrast agent for opacification of GI tract.
- Safe in cases of perforation.
- Causes chemical pneumonitis if aspirated.
- Also diarrhea & hypovolemic shock in pediatrics.

barium sulfate, an insoluble white powder. This is mixed with water and some additional ingredients to make the contrast agent. As the barium sulfate doesn't dissolve, this type of contrast agent is an opaque white mixture. It is only used in the digestive tract; it is usually swallowed or administered as an enema. After the examination, it leaves the body with the feces.

B. Barium.

- **Micronized Barium (BaSO_4)** particle size 5-10 μm
- Thin Barium for upper GI studies & small bowel follow through 40%
- Thick Barium for double contrast studies , large bowel enema 85%
- Additives to barium suspensions:
 1. Agents to prevent flocculation.
 2. Anti foam agents.
 3. Sweetening , flavoring & coloring.
 4. Preservatives .
 5. Tannic acid to improve mucosal coating.

Complications:

- Exacerbation of large bowel obstruction.
- Intraperitoneal extravasation through perforation results in extensive fibrosis.

Contrast agents are also used in MRI (Magnetic Resonance Imaging). Although MRI is usually considered a branch of radiology, it is not based on X-rays. MRI contrast agents are usually gadolinium-based, and work not by being radioopaque, but rather by altering the magnetic properties of nearby hydrogen nuclei.

MR contrast agents:

- A) Paramagnetic agents (Gadolinium DTPA) Magnevist
 - Enhances the relaxation rates of protons in it`s vicinity
 - Dosage 0.1 mmol/kg
 - Excretion 95% by glomerular filtration & 5% hepatobiliary.
 - Half-life: 90 minutes.
 - Incidence of minor side effects 1.5 % like:
 - Headache – Nausea - seizures

- B) Super paramagnetic agents:
- Large supramagnetic iron oxide: Ferridex
- Ultrasmall supramagnetic iron oxide: Ferrumoxtran.

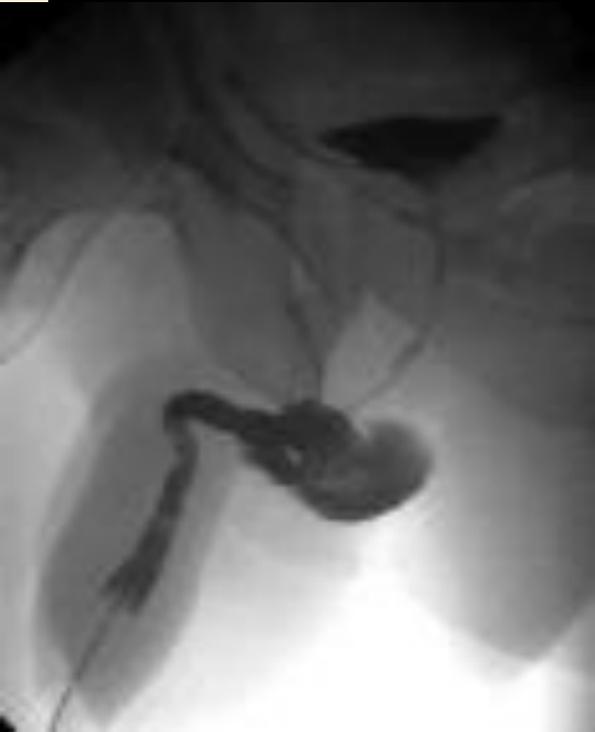
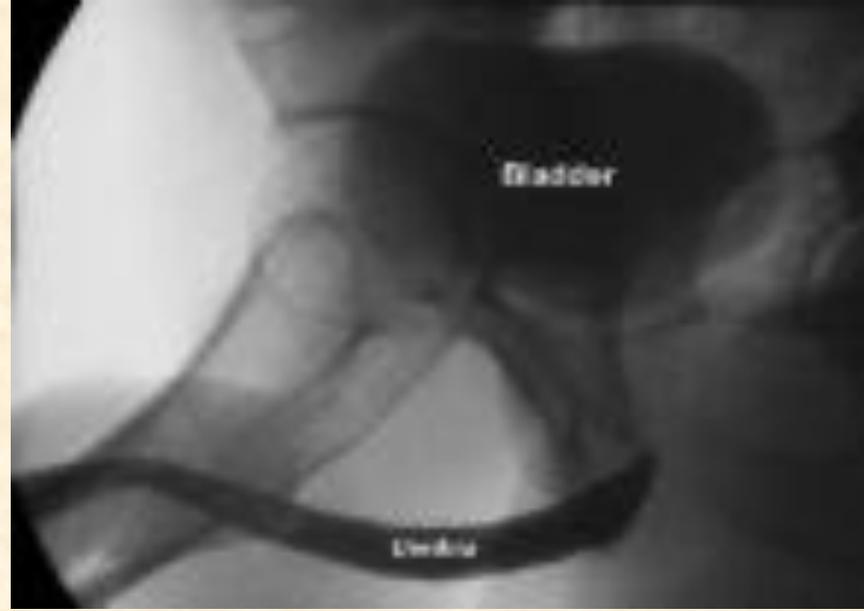
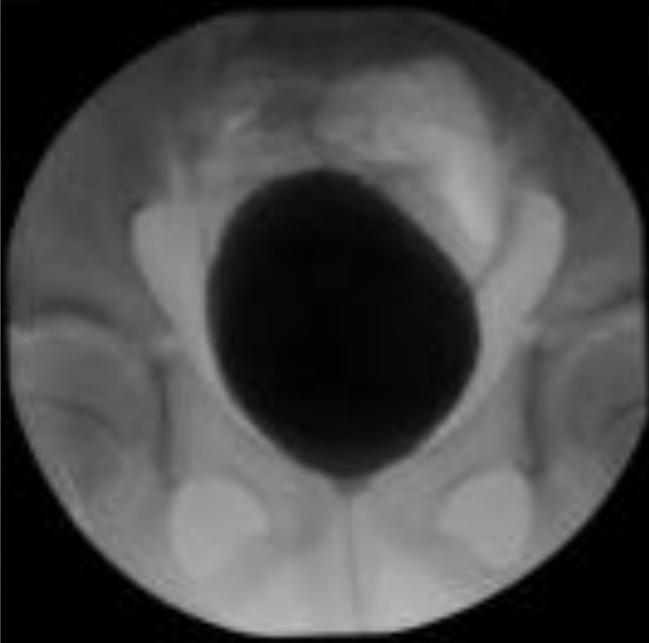
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10 MIN





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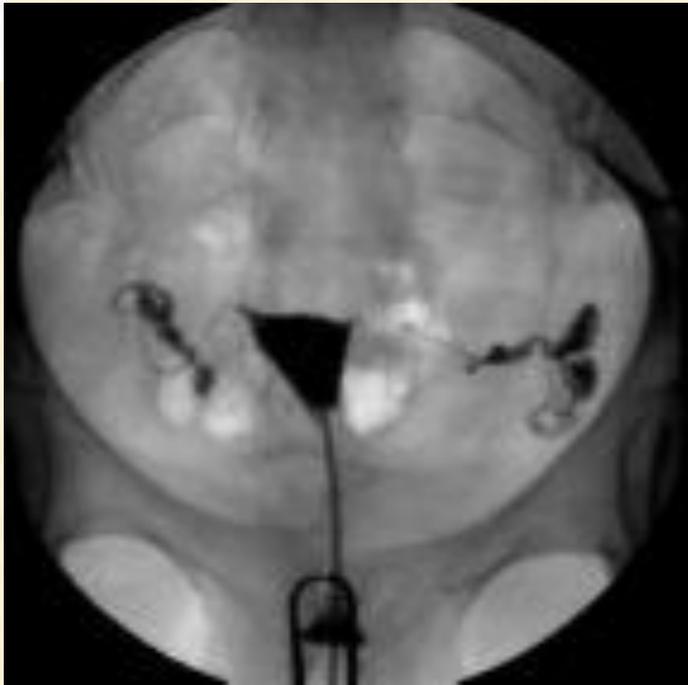




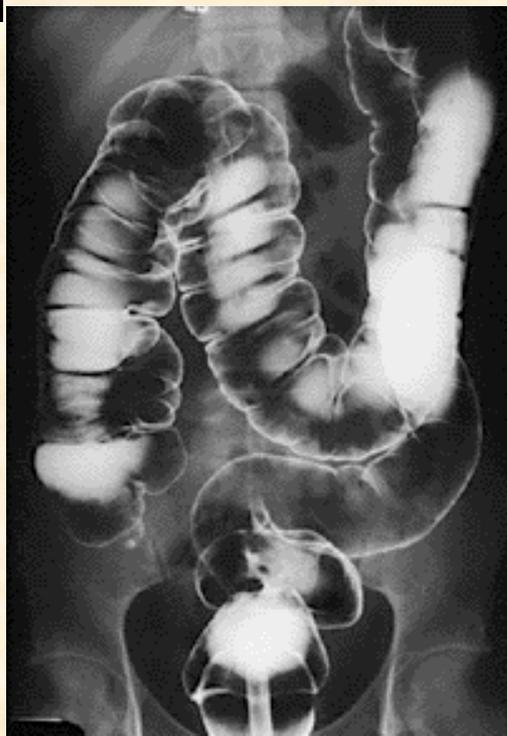
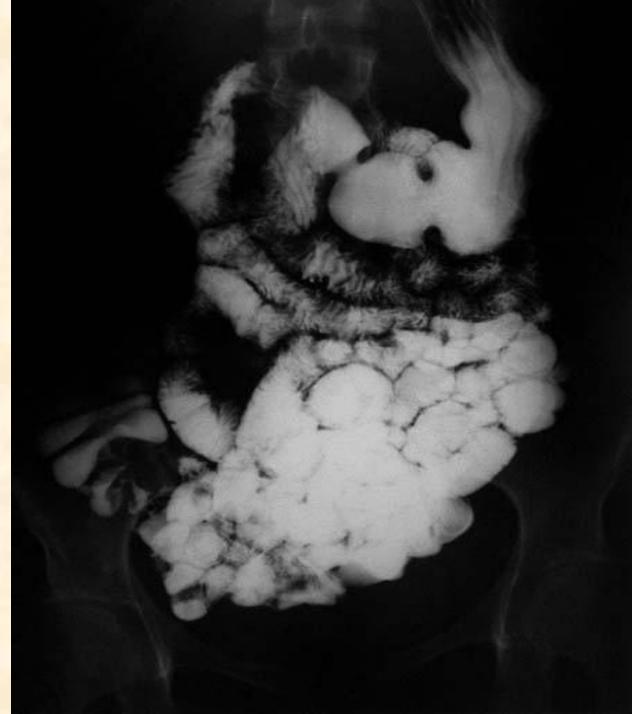
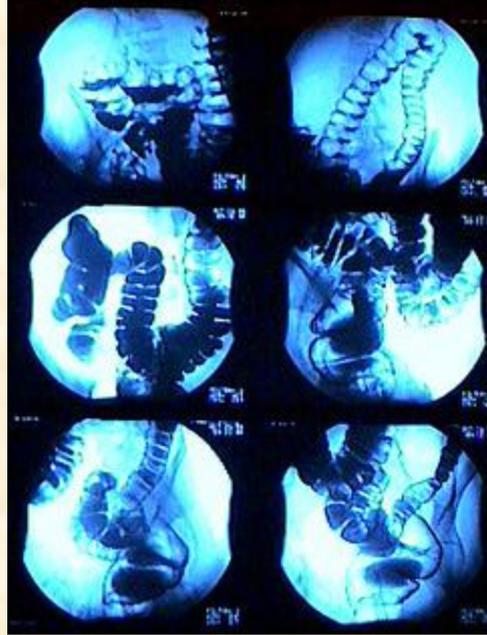
This is the standard, basic way study of the uterus.

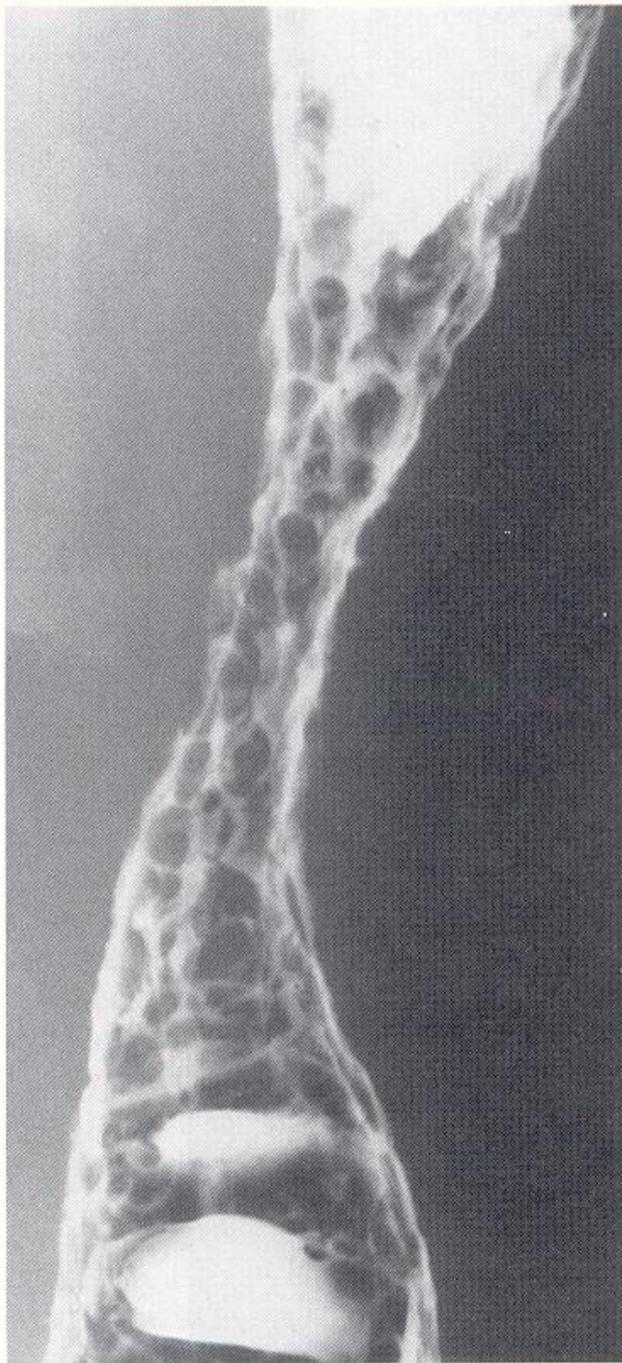


HYSTEOSALPINGIOGRAM



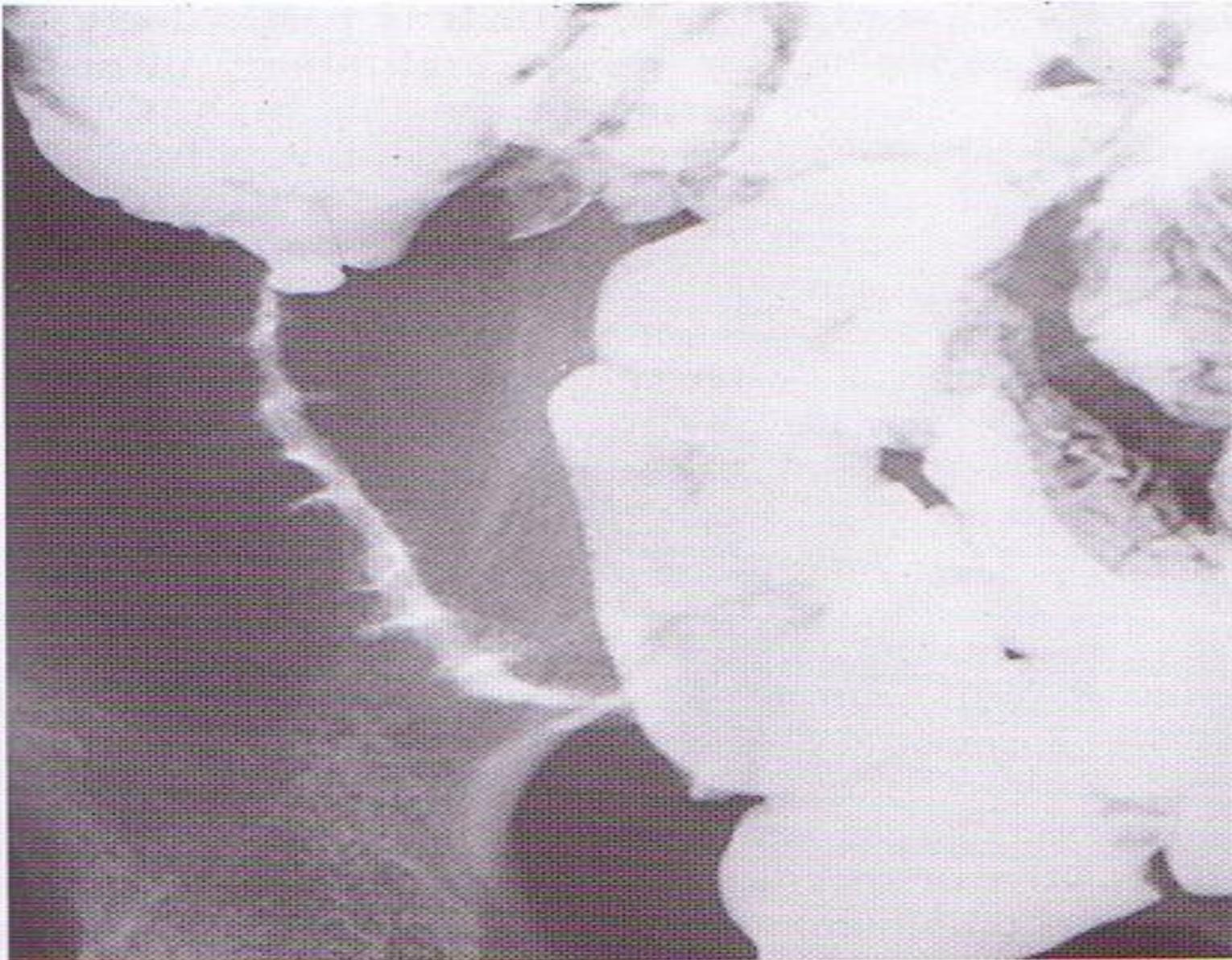
B





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FIGURE 54-24. Crohn's disease: cobblestone mucosa. Longitudinal and transverse ulcers at the descending colon produce a cobbled appearance in this patient with severe Crohn's colitis. (Courtesy of Keith C. Simpkins, M.D., Leeds, England.)



20.16 Crohn's disease. Neoterminal ileal recurrence at right hemicoectomy site.

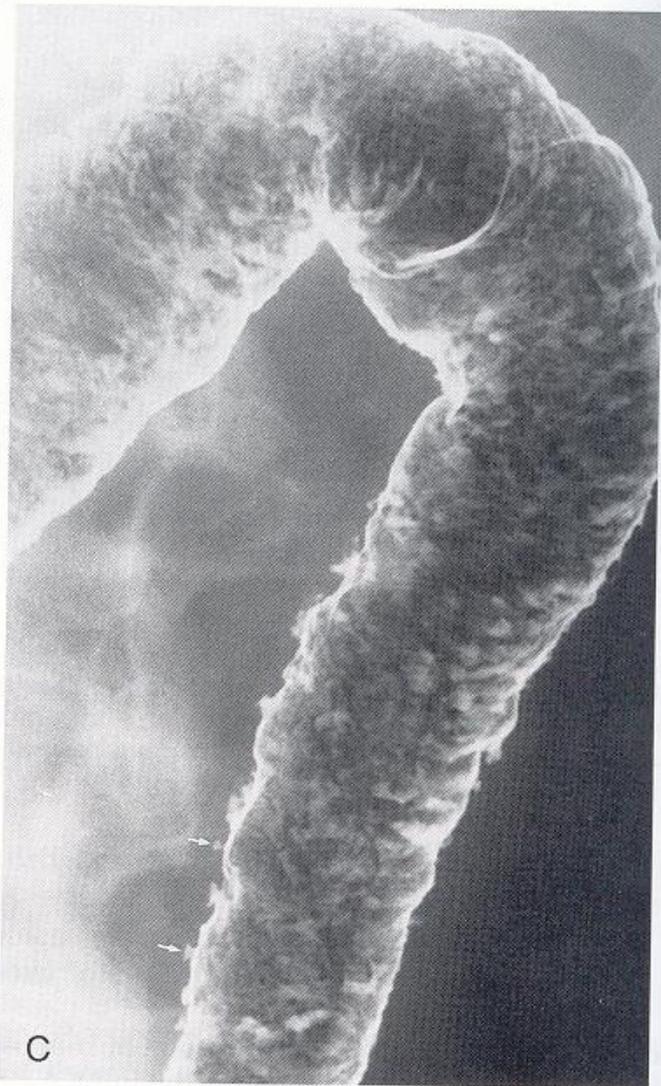
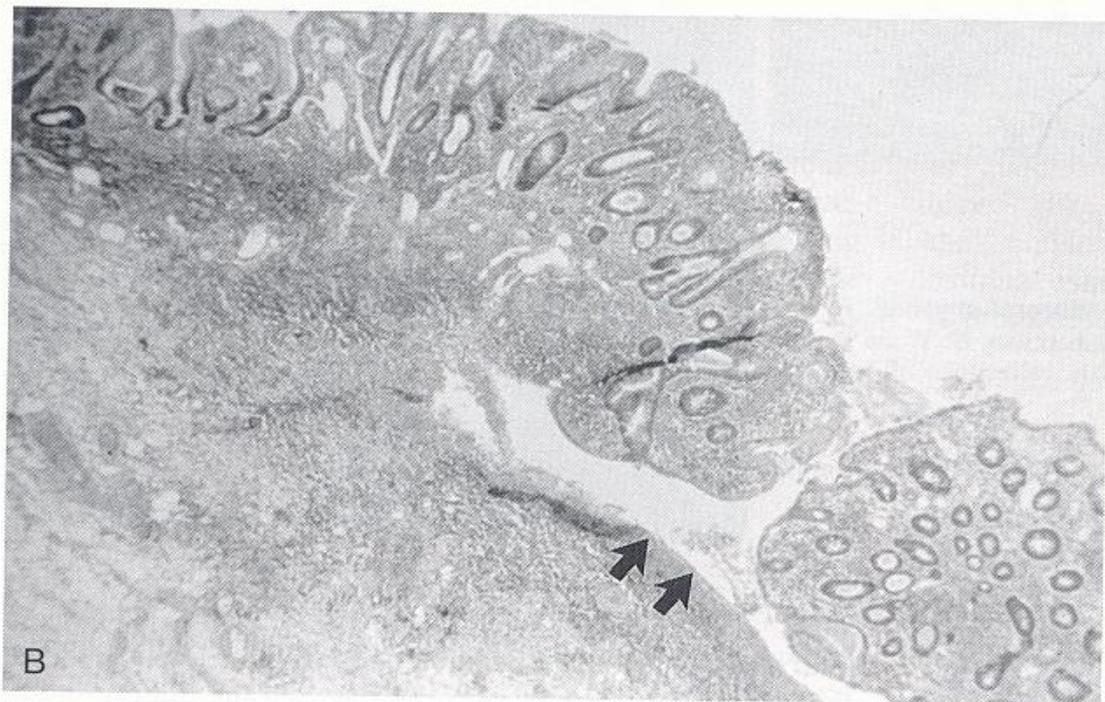
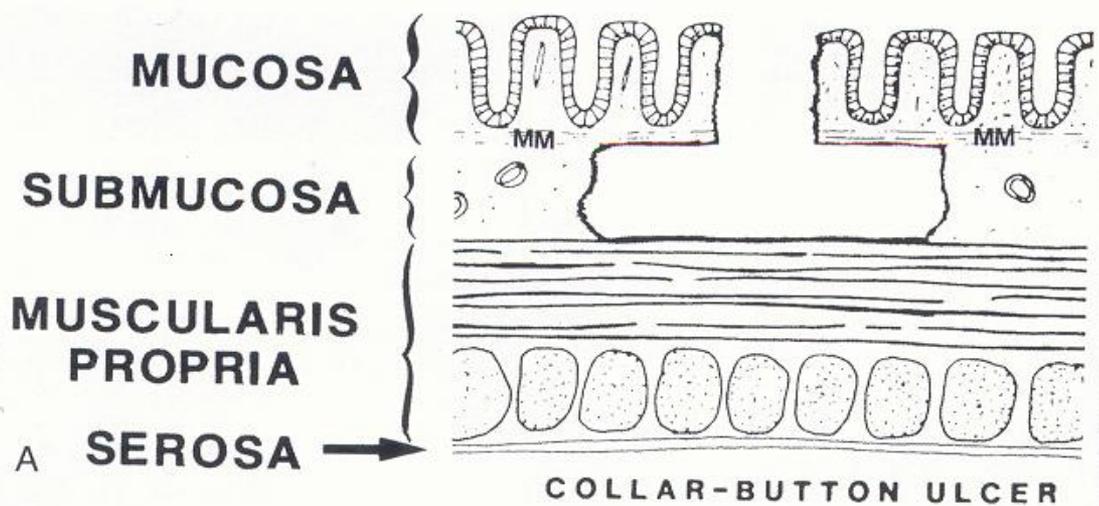


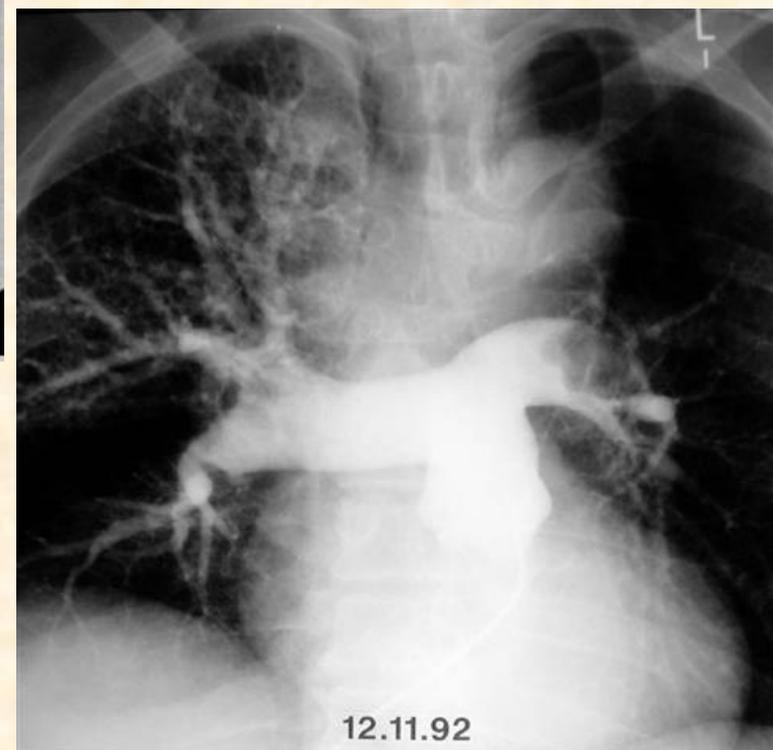
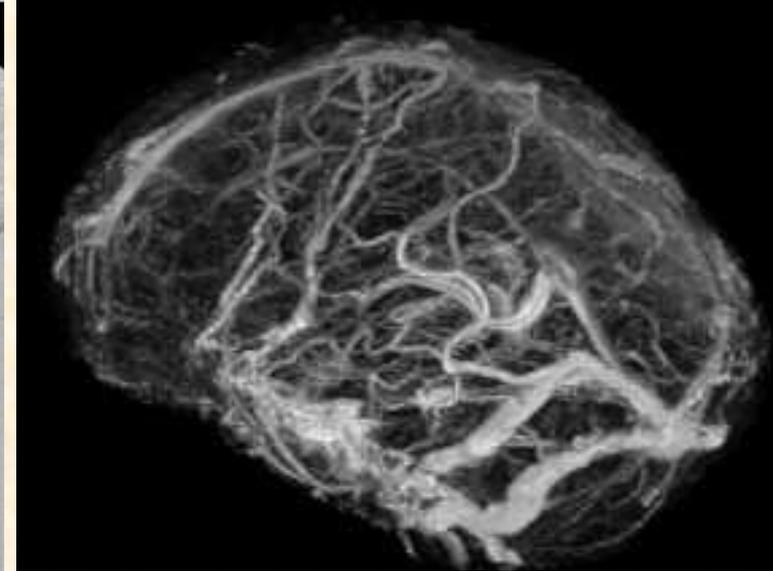
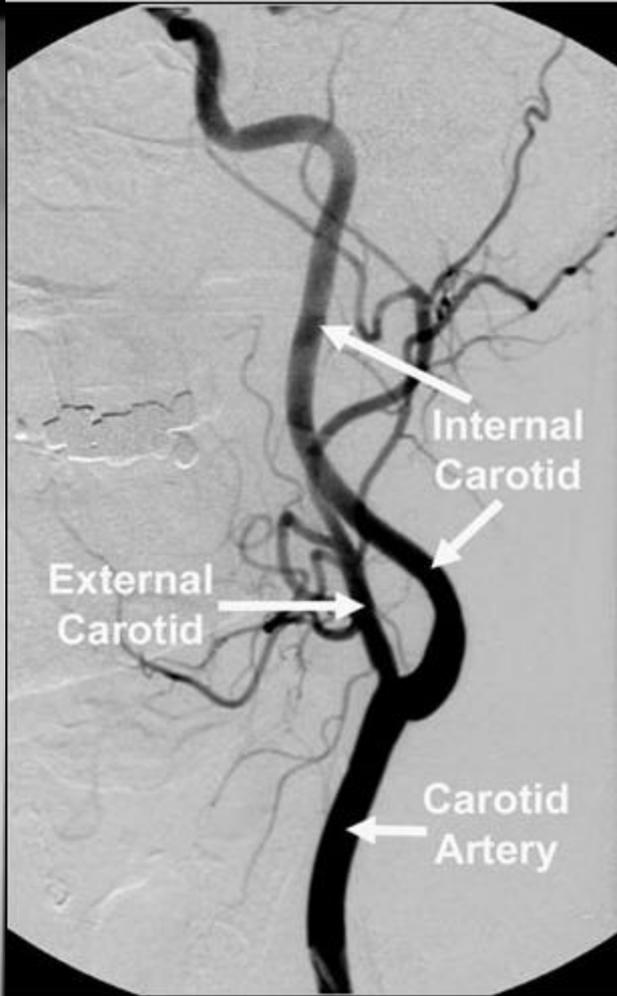
FIGURE 54-5. Ulcerative colitis: "collar button" ulcers. A. Diagram shows the narrow neck of the crypt abscess that erodes through the muscularis mucosae (MM) into the submucosa. The ulcer spreads laterally through the submucosa and is contained with a flat base by the resistant inner circular layer of the muscularis propria. B. Low-power photomicrograph shows characteristic undermining with a flat base (arrows). C. Spot film of the splenic flexure shows multiple flasklike ulcers (arrows) with a flat base. The ulceration is limited to the layers superficial to the muscularis propria. (A from Lichtenstein JE: Radiologic-pathologic correlation of inflammatory bowel disease. *Radiol Clin North Am* 25:324, 1987.)



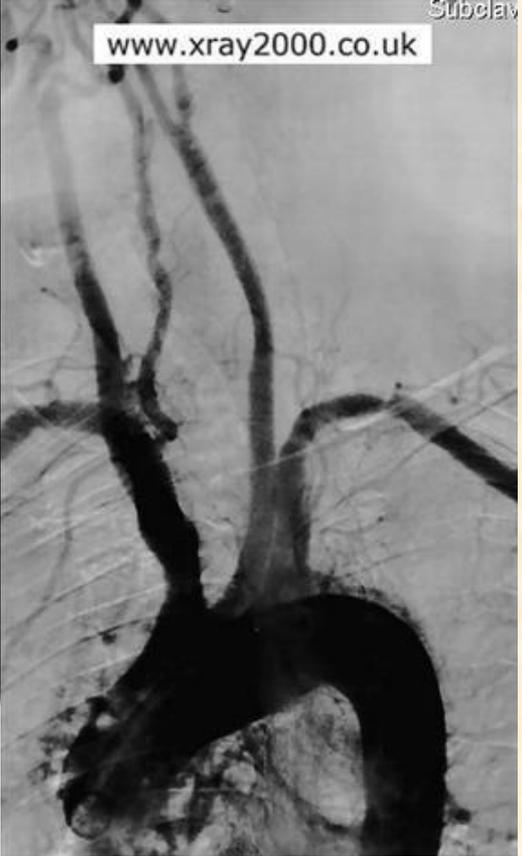
Cancer of the colon Double contrast barium enema shows an apple-core lesion surrounding the lumen of the descending colon. Courtesy of Jonathan Kruskal, MD.



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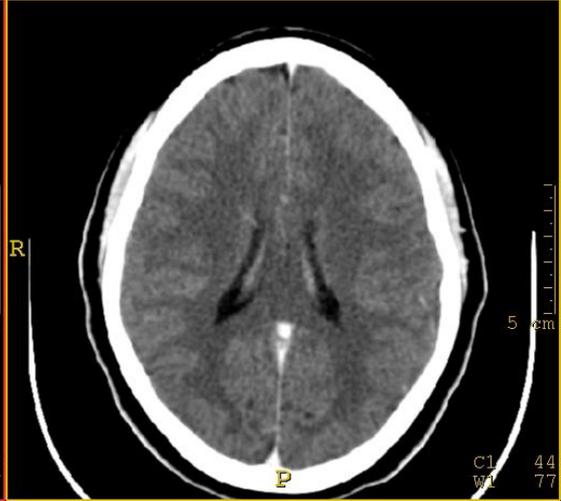
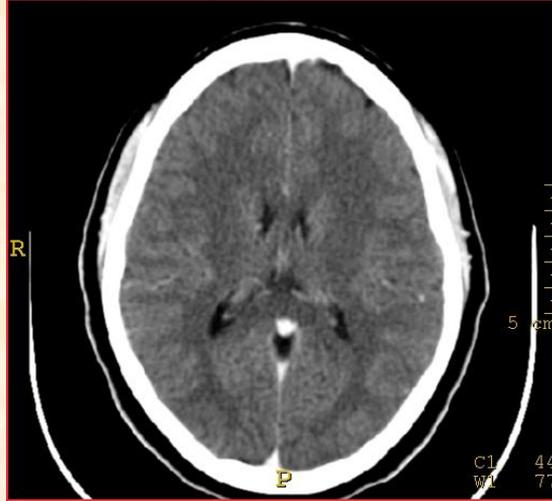
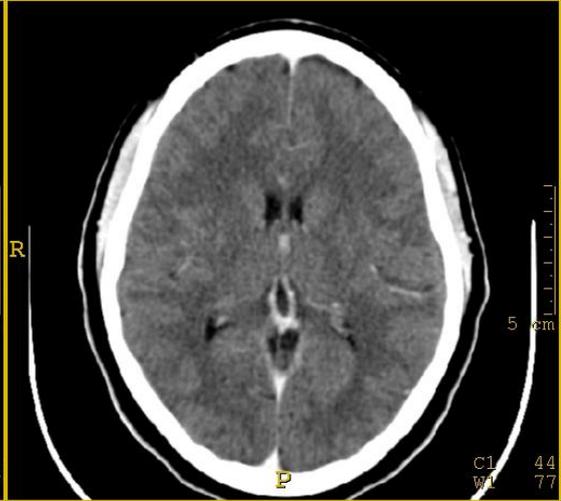
PAIRED ANTERIOR TIBIAL VEINS

POP LITEAL VEIN

PAIRED POSTERIOR TIBIAL + PERONEAL VEINS

R

PELVIS-LOWER LIMB #18
LEG VENOGRAMS

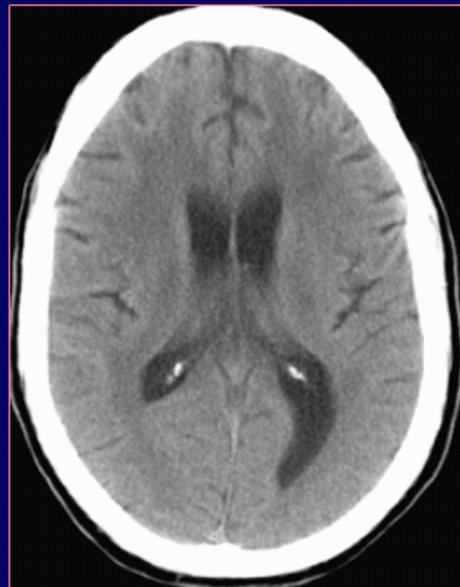
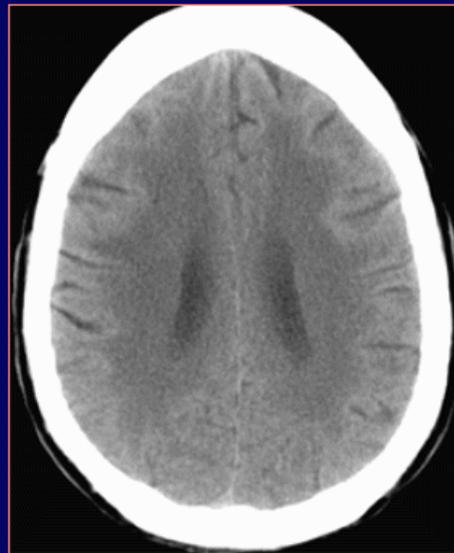
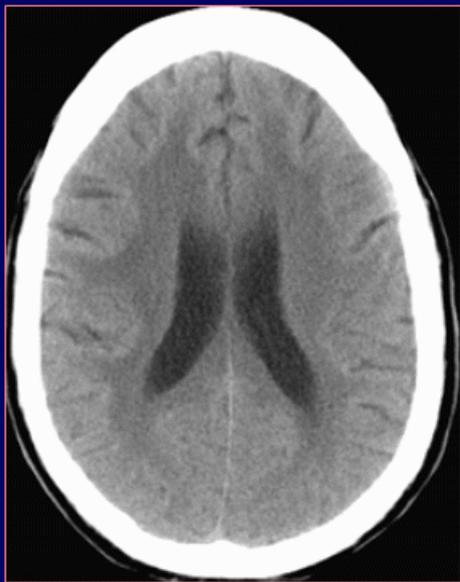




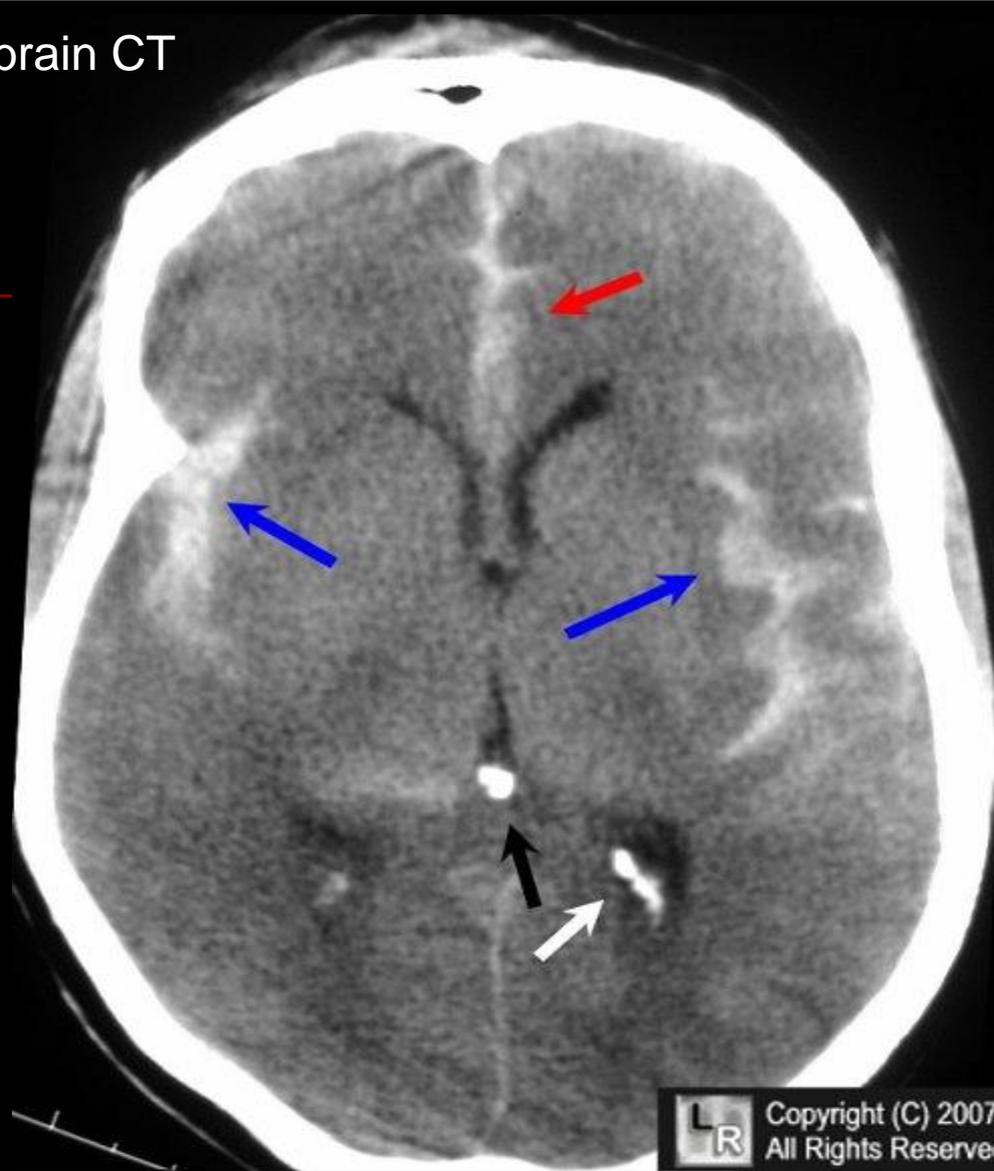
Non-enhanced brain CT
Pre-contrast

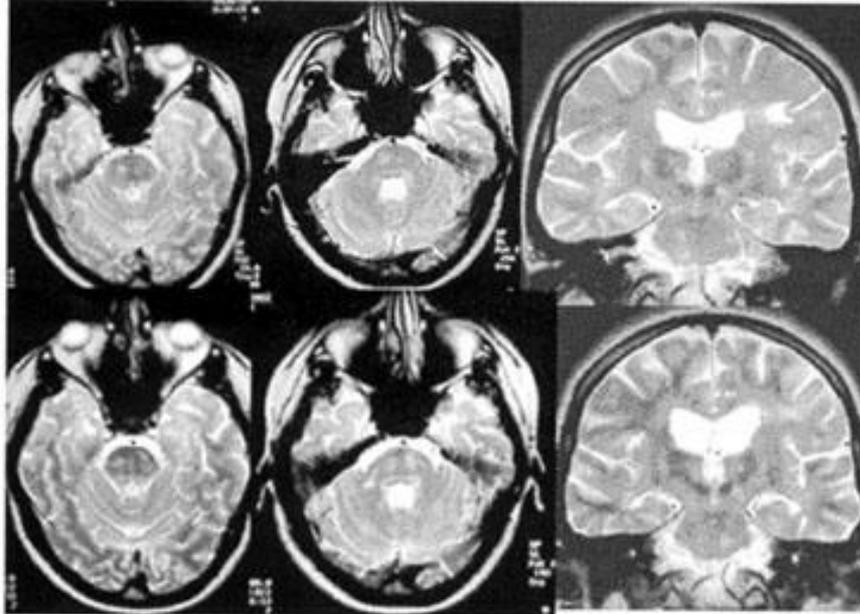


Enhanced brain CT
Post-contrast



Non-enhanced brain CT

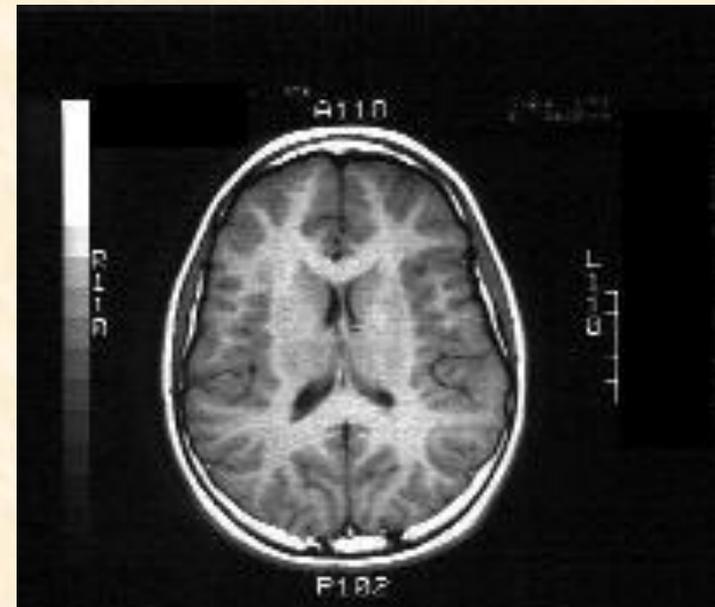


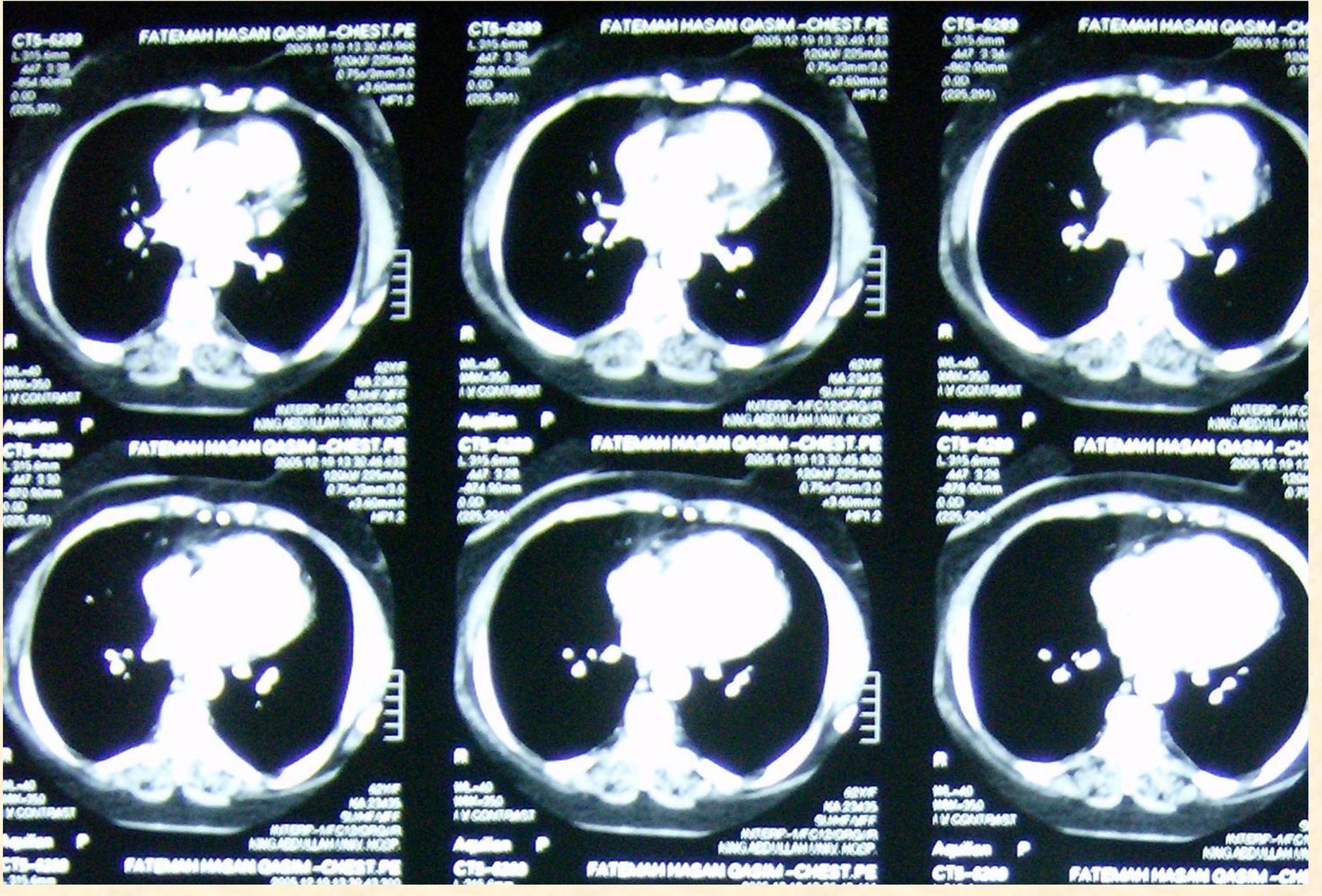


Post-Gd



Fig. 6: Images of a 23 year-old female suffering from MS with a left hemiparesis and ipsilateral facial weakness in April 1998 (above: demyelination foci in pons mainly right) and pictures of the same patient with right side cerebellar ataxia and harsh, husky, slow but not explosive speech in February 2002 (below: improving of the MS-foci right, but worsening on the left side of the pons, as well as the appearance of a new focus in the region of the inferior cerebellar peduncles right).





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