

RADIOLOGY

Radiology

2

→ Father of x-rays → Roentgen (Nobel prize 1901) for physics
from Germany.

1st recorded Human x-ray → Anna Roentgen Bertha.

Father of radioactivity → Henry Becquerel

Radium discovered → M. Curie.

X-ray discovered :: 8 NOV, 1895 (International day of Radiology)

Father of International Radiology :: Charles Potter

1895 - x-rays discovered

1896 → Radioactivity.

1900 → Quantum physics \leftarrow Neel Bohr many plans.

1901 → Nobel prize for physics, world war-1

Roentgen → Blind one eye

→ Color Blind

→ Refused "Patent" on x-rays

→ He died due to intestinal cancer in poverty.

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α rays
 β rays
 X-rays
 } PARTICULATE RADIATIONS

} WAVES "ELECTROMAGNETIC WAVES" (EM waves).
 X-rays
 R-rays

→ X-rays are best described as

a) Particles b) EM waves
 } particles & EM waves

"waves can act as particles also"
 WAVE - Particle "Dual Theory"

α -rays :: made up of Helium nuclei
 $\begin{matrix} \searrow & \swarrow \\ 2 \text{ Protons} & 2 \text{ neutrons} \end{matrix}$
 He^4_{+2}

β -particles :: electrons

→ which of the following radiation is not emitted by an

isotope ()

a) α b) β c) γ
 } X-rays
 ↑
 not emitted by any isotope

X-rays ::

origin :: Extraneous in origin (not produced from nucleus of atom)

 → not produced by any isotopes

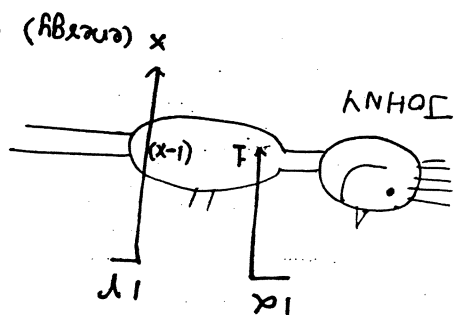
Co^{60} emit
 a) γ -rays
 b) X-rays

→ max. penetrating power. a) \propto b) B \propto c) \propto d) X-rays ③

r → waves (em) → emitted from nucleus of an atom

→ max. Biological Damage →

~~a) \propto b) B~~ c) r d) X-rays



more energy transferred by 'X' rays

LET:-

→ Linear energy transfer (X-rays) more

→ Ionization potential (max for X-rays)

→ Biological damage (max for X-rays)

X-rays:-

Velocity:-

X-rays = light velocity = 3×10^8 m/s

Wave length:- 0.1 to 10^{-10} m

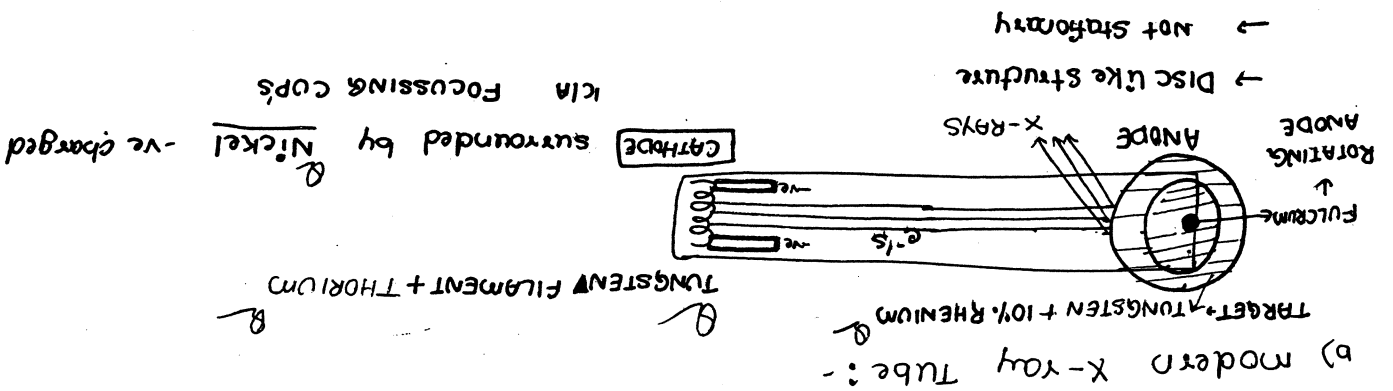
λ^0 → used in Quantum physics

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= Atomic diameter
= 10^{-10} m

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→ Heat loss mechanism in modern Tube is Radiation

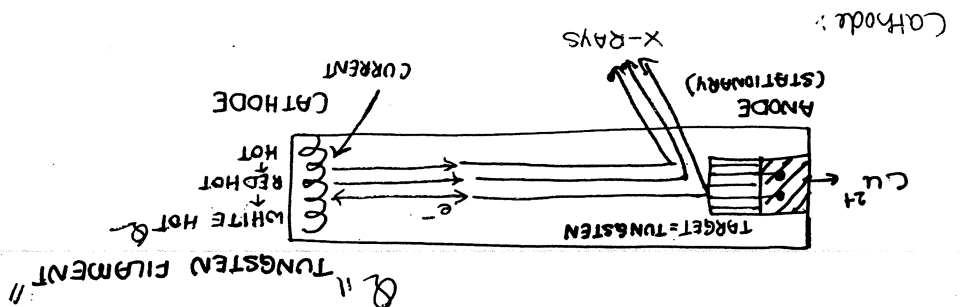


→ HEAT loss was because of "conduct" (by Cu^{2+} in anode)

This white hot emits electrons

hot K/A → THERMOIONIC EMISSION

When current pass through filament till it becomes white



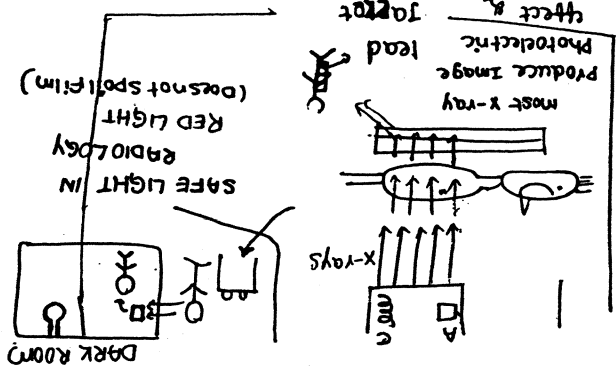
a) Classical X-ray Tube by Roentgen :-

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mammography
"EMULSION ON
ONE SIDE"

→ SINGLE COATED X-RAYS IN :-

Some will
effect & cause biological damage.



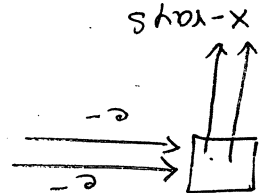
→ Routine x-rays are Double Coated
↑
due to Ag Bromide +
Iodide Emulsion.

→ SINGLE COATED X-RAYS IN :-

PLASTIC
↓
SILVER BROMIDE + IODIDE
(light sensitive)
EMULSION

X-Ray Film :-

Accelerate e's & break & produce x-rays
by deceleration of e's



⇒ BREMSSTRALUNG RADIATION (breaking)

modern X-ray Tube
ROTATING
TARGET :- TUNGSTEN + 10% RHANIUM
HEAT LOSS :- RADIATION
+
TUNGSTEN FILAMENT
THORIUM

Classical X-ray Tube

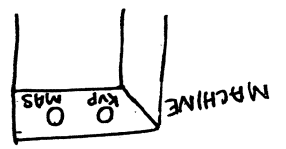
ANODE
STATIONARY

TARGET :- TUNGSTEN
Heat loss :- CONDUCTION

TUNGSTEN FILAMENT

CATHODE

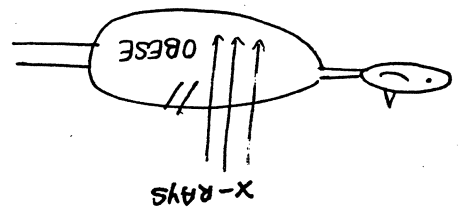
(4)



KVP → KILOVOLT PEAK (Voltage potential b/w cathode & anode)
 MAS → MILLI AMPERE SECOND (amount of current in x-ray
 time x sec)
 (no of e⁻'s flowing in tube)

of ↓ potential difference = ↓ accelerate e⁻ → ↓ KE → x-rays produce
 also have more energy.

↓ MAS → no. of e⁻'s flowing → more x-rays → pt. get
 produce more x-rays
 ↓
 Film get more x-ray



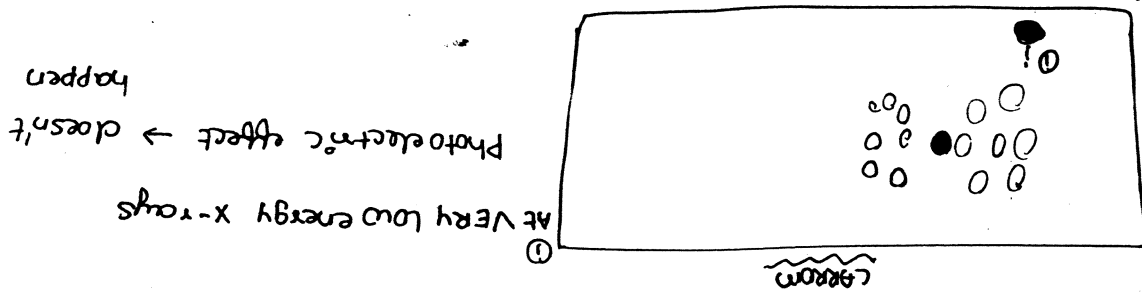
KVP
 determine
 Penetrating power of x-ray beam
 → In obese pt. we have to ↓ KVP.

↓ MAS = ↓ radiation dose to the pt.
 determine.
 MAS
 → blackening on x-rays (black & white)
 depend on MAS.

Contrast in x-ray depend on KVP.
 ↑
 (difference in density)

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= Inner most (K-shell)

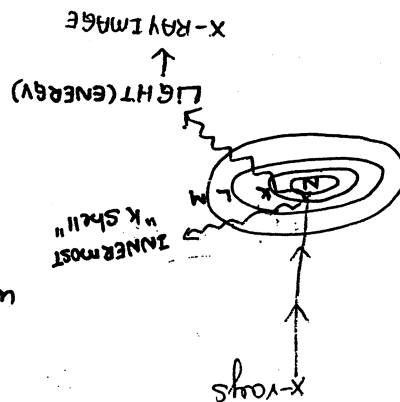
= Photoelectric effect.

Atomic principle responsible generating X-ray image

Q

"Photoelectric effect"

X-rays produced.
when X-rays eject innermost e⁻s
↑
outer e⁻s come inside
↑
extra energy released in form of light
↑
which produce X-ray film



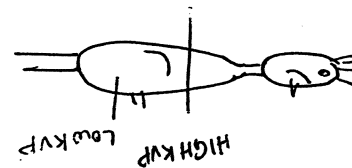
⇒ When X-rays strikes an atom:-

→ Penetrating power \propto KVP.

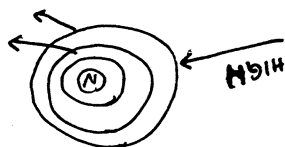
→ Contrast → differentiate b/w bones, m's etc.

Contrast $\propto \frac{1}{KVP}$ (low KVP = more contrast. & vice versa.)

→ Contrast dependent on KVP.



At high level energy of x-rays \rightarrow photoelectric effect doesn't occur



X-ray beam strike body at
OUTER SHELL
outermost shell reflected out.

\rightarrow Compton effect :- HIGH ENERGY

High energy \rightarrow strike atom & randomly scattered.
x-rays

\rightarrow so pt. ④ in x-ray room should wear lead jacket

(Thickness \rightarrow 0.5mm) due to scattered effect / Compton effect which occur in high energy - x-rays.

MAMMOGRAPHY

\rightarrow single coated films

\rightarrow TARGET \rightarrow MOLYBDENUM

\rightarrow x-rays include in mammography are

2 x-rays \rightarrow 1) CC \rightarrow CRANIO CAUDAL

2) MLO \rightarrow MEDIO LAT. OBLIQUE

Routine

\rightarrow what is screening for DCIS I_{OC} \rightarrow MAMMOGRAPHY

Routine screening = women age $>$ 40 yr age should

undergo for Annual mammogram (A.R. recommendations)

→ "HIGH-RISK" SCREENING for DCIS → MRI (I₁OC) (Breast cancer)

MRI → most sensitive I_x for DCIS

→ Mammogram → don't do in young ♀ → due to dense tissue

[MORE GLANDULAR PART]

Routine screening

mammogram

for DCIS → "CLUSTER OF MICRO
CALCIFICATION" is

(> 5 Ca²⁺ particles

of around ~ 0.5 mm

in 1 cm³ of breast)

Think for cancer.

→ Breast Ca. missed in mammogram is Lobular Ca in Situ.

POP CORN CALCIFICATⁿ →

→ mammo graphy → Fibroadenoma.

→ CXR

→ HAMARTOMA.

→

→ MRI BRAIN → CAVERNOUS HEMANGIOMA.

→ Mammogram reports (and nomenclature is

BIRADS :- Breast Imaging Reporting & Data system

(0 → 6)

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→ Cat "0" → Incomplete study. (when seeing mammogram, Technician didn't take all tissue)

Incomplete findings.

→ Cat "1" → "Normal" in both breasts.

→ Cat "2" → "Benign" lesion.

→ Cat "3" → "Probably Benign" → Cat "3" (look like benign but some doubt)

→ Cat "4" → Probably malignant (high suspicion for malignancy)
 may be in lung,
 → Cat "5" → Suspicion malignancy (in lung → high spiculations)

→ Cat "6" → Biopsy proven case

Role of Breast MRI:-

→ High risk screening

→ Most sensitive in DCIS
 test

→ Ixoc for Breast implants

→ Indicate to differentiate
 operative scar from recurrence

Breast Implants:-

→ Best evaluated by Breast MRI (Silicon gel implants) (sgbi)

(For metallic implants → MRI is not done)



→ Sometimes capsule & implant ruptures so the silicon comes out & form granulomas i.e. SILECOMAS

→ Intracapsular Rupture:- capsule intact but implant rupture.

→ Breast become soft

→ Ix Oc → MRI — "fibrous capsule"

shell of capsule: implant membrane floating in silicon i.e. "LINGUINE SIGN"

→ BREAST USG:-

→ Ix Oc in Breast abscess (lactating mother)

→ lactating female & painful lump. Don't do mammography - because

breast is already painful if you compress breast it will cause more

pain)

→ Differentiate b/w solid lump and cystic lump.

Tumor (Round & growth)

Benign (Round & O)

→ Poor investigation for DCIS (either mammography → > 40 yrs MRI → for high risk people)

⇒ CT Scan:-

FATHER:- SIR GOLDFREY HOUNSFIELD (BRITISH)

→ Invented in 1972

→ Nobel prize in 1979.

1st CT scan was made by →

a) GE

b) SIEMENS

c) EMI (electrical musical Instruments)

d) Toshiba

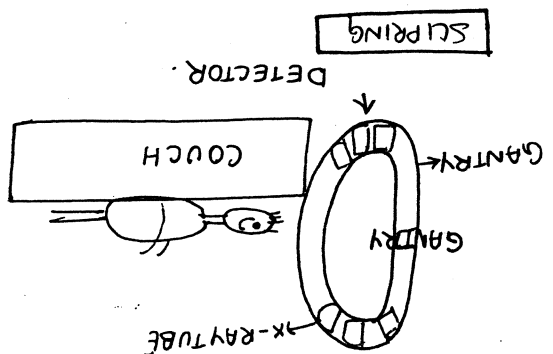
EMI :- Beatles company sell their instruments by EMI company.

→ Rich company

→ earn money & give to [Hounsfield for] invent CT

→ British company.

GE :- founder of GE is Thomas "Edison".



(i) Conventional CT :- 1st CT scanner by Hounsfield

→ capable only for doing "CT of brain"

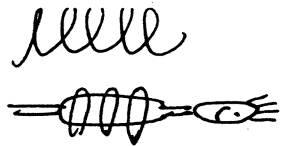
(due to problem in power supply)

→ can't hold breath.

so Invented Hardware - i.e. SLIPRING (share power b/w

couch & gantry)

a) SPIRAL CT :- Based on SLIPRING Technology.



→ couch & gantry move simultaneously which form spiral

→ In spiral CT, simultaneous X-ray tube & pt. movement.

→ "Breath Hold scan" (take entire trunk in single breath hold)
Spiral CT can image which part of body in breath hold
IS TRUNK (chest, abdomen)

→ How much length of body can be covered in 30 sec = 30cm

Basic principle of Routine spiral CT
 $= 1 \text{ Rotat}^\circ / 1 \text{ sect}^\circ \text{ done} / 1 \text{ sec}$
 $= 10 \text{ mm}$ For slice thickness (cuts)
 $= 1 \text{ cm}$

→ minimum size of a liver metastasis → easily detected

CT → 10 mm = 1cm < 10 mm we can't see in CT

→ 4 mm Pancreatic mass, Ixoc → endoscopic Ixoc USg

For Pancreatic Ixoc Ixoc → CECT

4mm (subcentimetric) → Ixoc - Endoscopic USg

Ixoc INSULINOMA (small Intrapancreatic cancers) → Endoscopic USg

3) MDCT (multidetector CT / multislice CT) :-

X-ray shaped

1) cone 2) pencil 3) Fan

→ X-ray beam shape is like cone
→ multiple rows of detector

Adv:- Cardiovascular imaging.

→ Cardiac CT done in mid diastole.

$I_x OC$ for Pulmonary Embolism → MDCT (large vessel from heart)

$I_x OC$ for Aortic Aneurysm → MDCT
↓ large vessel

$I_x OC$ for Aortic dissection → MDCT

⇒ MOST ACCURATE TEST FOR AORTIC DISSECTION MRI [MRI take more time but than MDCT]

CEREBRAL ANEURYSM $I_x OC$ → CONVENTIONAL ANGIOGRAPHY (a)
↓ small vessel
DIGITAL SUBTRACT ANGIOGRAPHY (DSA)

IN SAH (due to aneurysmal rupture) :- $I_x OC$:- ANGIOGRAPHY

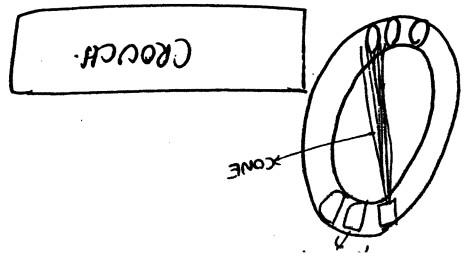
Rx:- ANEURYSMAL CLIPPING (not used now)

ENDOVASCULAR COILING ✓

(done because of risk of rebleed)
↓
which is fatal

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←
2015
JIMHANS



multidetector.
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→ Cardiac CT :- / Multislice CT :-

→ "SCREENING" FOR ASYMPTOMATIC CORONARY ARTERY DISEASE
↓
Pt. have no symptoms

→ Take only the heart part for CT.

→ It tells how much Ca²⁺ present

→ So it is CORONARY Calcium Scoring.

"AGATSON SCORE" Atherosclerosis

⇒ Conventional CT → Brain

Spiral CT → TRUNK

MDCCT → CVS

4 ⇒ DUAL Energy CT

DUAL SOURCE CT :- ⊕ in Allms Hospital

→ Characterize urinary stones (Fe²⁺ stones ⊕ or ⊖ & also what tell is the stone made up of)

5 ⇒ HRCT :-

→ It is just algorithm that we used for Lung

PARENCHYMAL evaluation

Ixoc for Diffuse lung disease

— ILD

— Bronchiectasis

— milary TB.

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α HRCI → Take 1-2 mm thick [slice - thin]

→ Reconstruct the image by Bone algorithm

1) HRCI IS SPECIAL CT TECHNIQUE FOR LUNG DISEASES. ITS

USES

a) lung filters

b) Bone algorithm

c) Thick slices sections

2) ON HRCI can we identify :: yes.

a) alveolitis

b) early pneumonitis

carni!

aparently lungs are hazy.

white

GROUND GLASS HAZINESS - on HRCI
1) lungs will not be black as well as

3) Bronchi appear dark so it is

Dark bronchus sign

c) Alveolar proteinosis → CRAZY PAVEMENT HRCI

Hounsfield Scale

Bone :: X-rays has max attenuation (stopping power of X-rays)

+1000 on Hounsfield Scale (based on attenuatⁿ power)

+ 60-70 → Hemorrhage

+ 20-40 → Brain

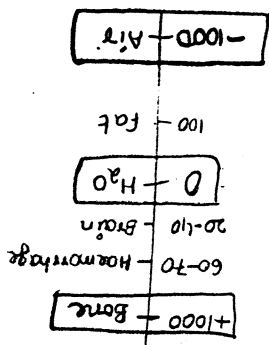
Water :: Intermittent attenuation

0 → on Hounsfield Scale

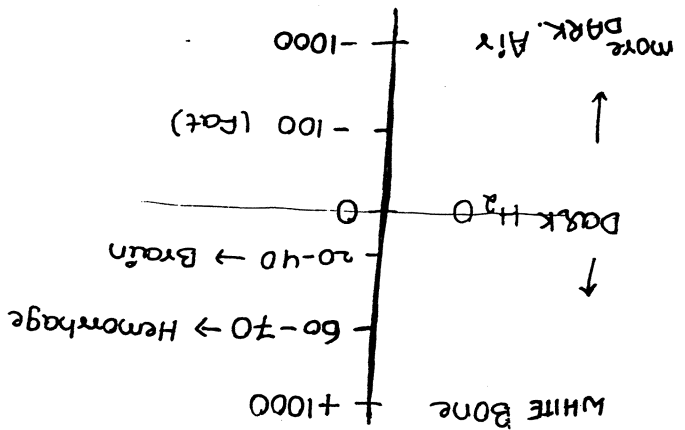
→ 100 (Fat)

AIR :: min. attenuatⁿ

-1000 on Hounsfield scale.



H₂O on CT scan appear H₂O black.



Brain
 Hemorrhage (more white) → Hyper Dense.
 CSF — Hypo Dense



Q. Pt has Fever, altered sensorium and CT scan show dark cold in Temporal bone (i.e. edema)

i.e. HSV-1 encephalitis

→ HSV- encephalitis involves

- a) Temporal lobes
- b) Subfrontal lobe (inf. part of frontal lobe)
- c) Cingulate gyrus

e)
d)

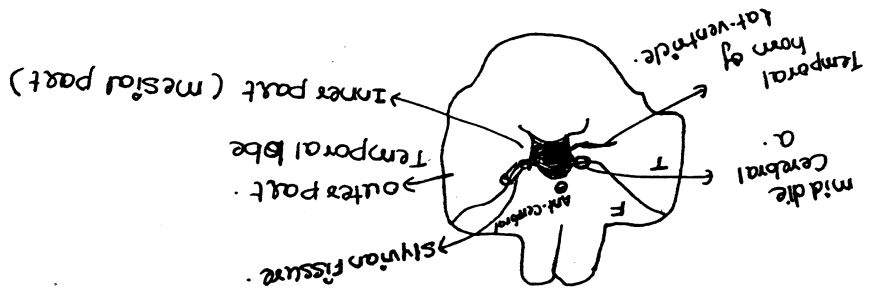
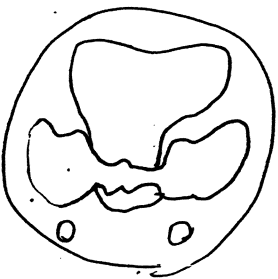
Parameningeal
 also affect (lung ca. etc.)
 Small cell lung ca

(HSV Herpes is a cause of
 Limbic encephalitis)

→ Atrophy of Temporal lobes - Alzheimer's dementia.
 as is parietal atrophy

Fronto Temporal atrophy → Pick's disease

→ Tx in vermis → medulloblastoma (in midline)



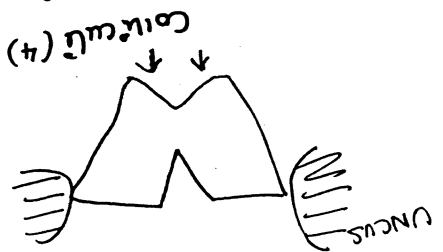
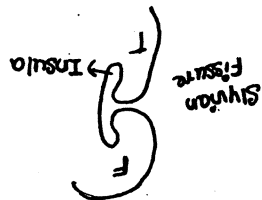
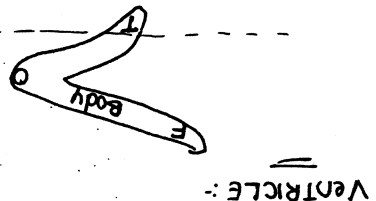
⇒ mesial part of Temporal lobe →

→ Epilepsy occur

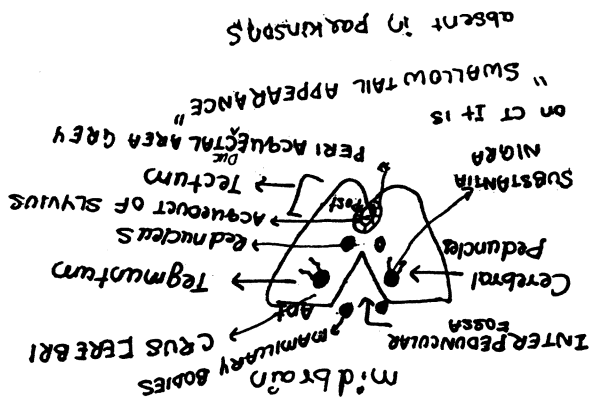
→ ICA Hippocampus

middle cerebral a → Sylvian Fissure.

Ant cerebral a. — Inter Hemisphere Fissure.



Quadrangular plate = Tectal plate



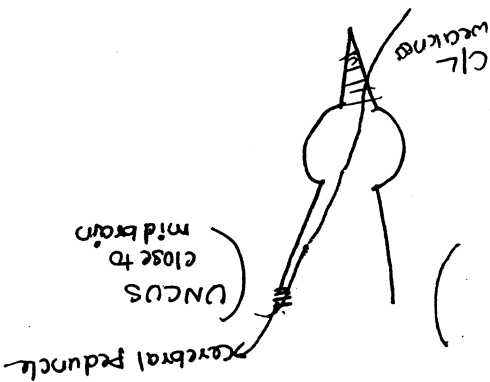
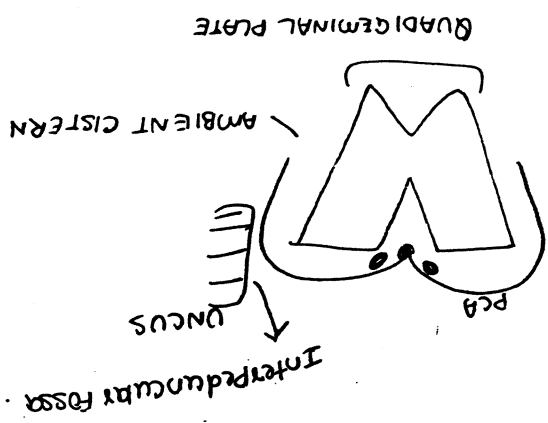
Name disease where mammillary body is involved → Wernicke's encephalopathy

Acute Thiamine deficiency

WERNICKE'S ENCEPHALOPATHY :-

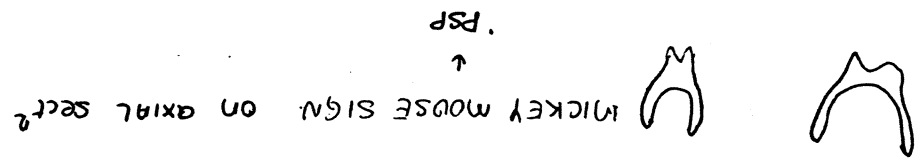
- 1) MEDIAL THALAMUS → memory loss due to this involvement
- 2) PERI ACQUEDUCTAL GREY MATTER
- 3) MAMMILLARY BODY → classical involvement

Thiamine dependent metabolism occur



UNCAL HERNIATION :-
 Contralat. weakness
 ↓ fib
 B/L weakness

→ MIDBRAIN ATROPHY OCCUR IN → PROGRESSIVE SUPRANUCLEAR PALS (PSP)



Interpeduncular space widens

Peduncles become less

BENIGN - CYSTIC LESION IN BRAIN IN

FORAMEN OF MONRO IS

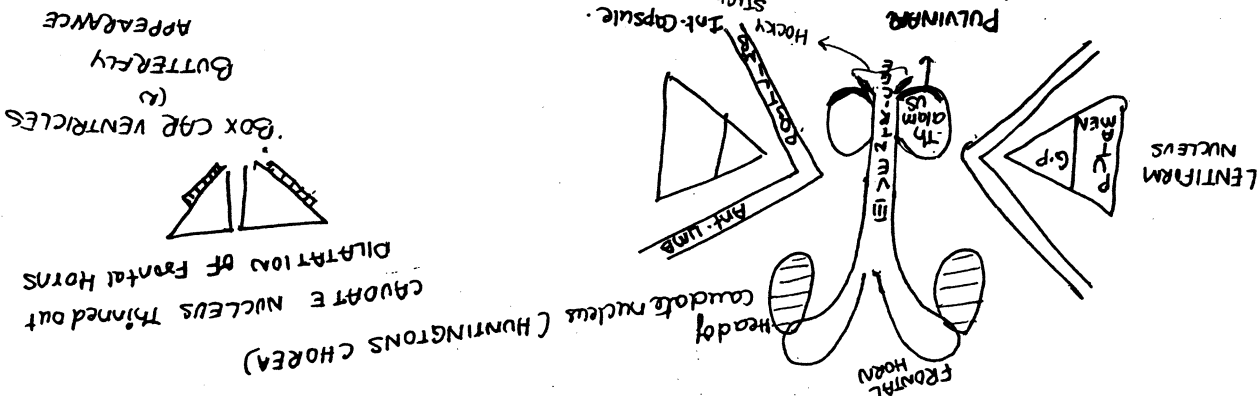
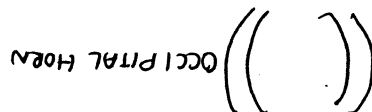
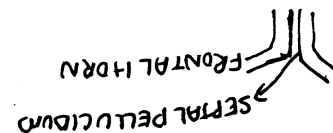
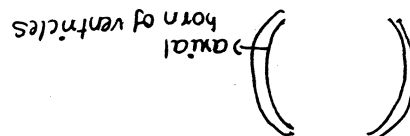
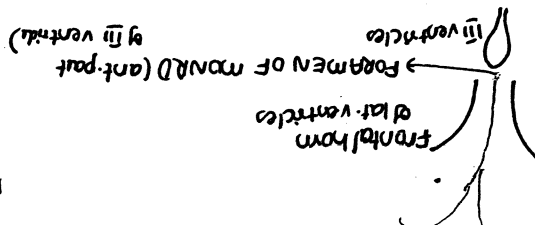
"COLLOID CYST"

"Paraphysis Remnant"

→ pt. asymptomatic
→ sudden severe headache

Present 2 sudden hydrocephalus

(lat. ventricle dilat)



Involved in

(REUTZ-FOLD JACOB DISEASE PRION DISEASE

FAMILIAL SPORADIC VARIANT

Involved

BASAL GANGLIA

BRAIN CORTEX

Involved "PULVINAR" part

MAD COW DISEASE

BSE (BOVINE SPONGIFORM ENCEPHALOPATHY)

MRI :- Cortex is bright

CORTICAL ribboning sign

→ Poisoning that involve Globus pallidus is CO poisoning

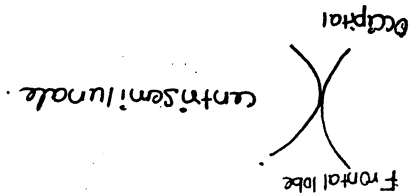
→ IRON DEPOSITION IN Globus pallidus is HALLERVORDEN-SPATZ
HALLE VORDEN SPATZ

MRI → Eye of TIGER appearance.

PKAN → Pantothenate kinase associated neurodegeneration



→ PUTAMEN → Hypertensive bleed.



→ Acute Brain Hemorrhage Ix OC → NCCT

ON MRI it appears Isointense to Brain
(Illia to surrounding brain)

→ Acute Head Injury → NCCT

STROKE
→ Hemorrhagic
→ Ischemic
→ NCCT

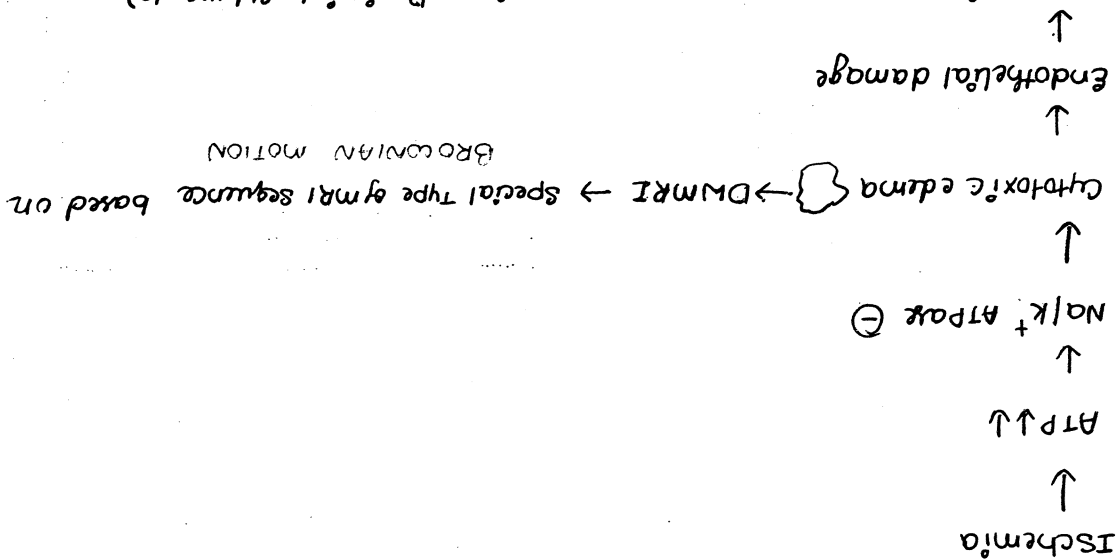
CT- Brain For RTA what we do

→ Take sections from upper cervical spine.

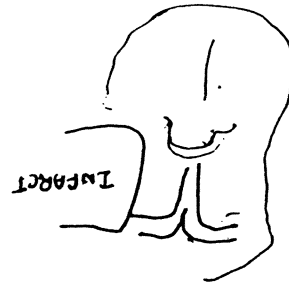
Brain infarct is earliest detected by → Diffusion weighted MRI

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→ Stroke:-



→ DWMRI can detect Brain Infarct as early as 3-30 min
↓
DWMRI
Rx:- Thrombolytic Therapy (TPA can be given)



Q A lady underwent c-sect 4 days back now ⊕ to you 2 13

Headache & Seizure 2 mild HTN. No proteinuria. CT-Scan show 2x3cm (a) Parasagittal hematoma.

a) HTN bleed b) Eclampsia.

(c) Sup. sagittal d) Pituitary apoplexy. Sinus thrombosis



Q IxOC To differentiate epidural cyst from arachnoid cyst → DW MRI

Arachnoid cyst

epidermoid cyst

→ meninx primitiva. (⇒) cyst

Routly develop. (blow molding cyst is formed)

→ usually developed in

CSF middle cranial fossa.

→ congenital

→ Incidentally.

→ on CT scan both appear illia.

CSF

keratin

→ Show Brownian movement/motion

DW MRI

MC locations

Colloid cyst → Foramen of Monro

Arachnoid cyst → Middle cranial fossa

Epidermoid cyst → CP angle

MRI

→ MRI principle given by

1) Paul Lauterbur

&

2) Sir Peter Mansfield (British)

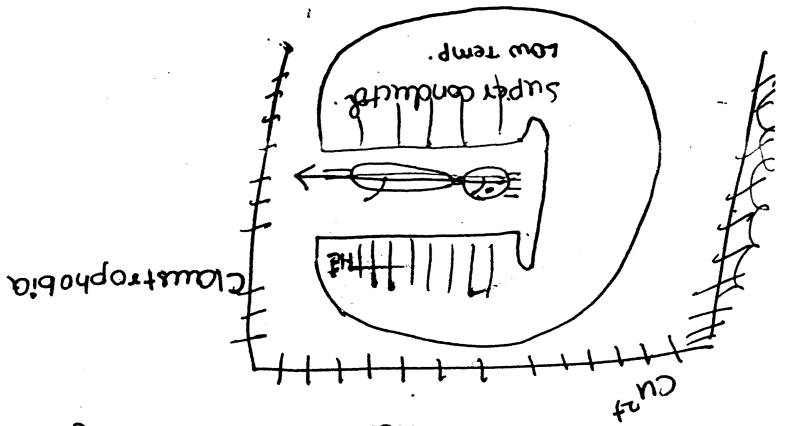
Nobel prize → 2003

→ 1st MRI machine was made by Dr. Raymond Damadian

→ For any discovery, 3 people can be awarded [for discovery]

Nobel prize

Doctor
"PATENT"
Physicist
Lauterbur



→ Absolute C/I to MRI

a) claustrophobic

b) Orthopedic Implants (relative C/I)

✓ c) Cardiac Pacemaker (Pacemaker can't work properly in EM field)

→ MRI magnetic field range $\rightarrow 0.2 - 7$ Tesla (MF)

→ For routine MRI MF strength $\rightarrow 1.5$ Tesla. (much stronger than Earth's MF)

→ Using superconductors produce this high MF

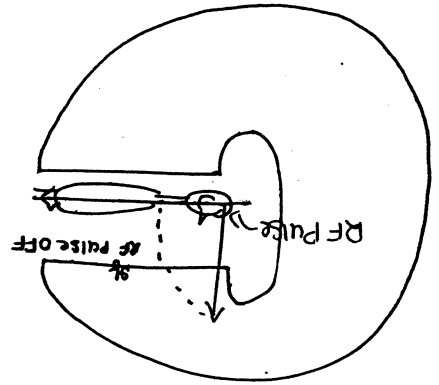
→ MRI require Helium liquid for lowering Temperature.

→ walls of MRI room coated in Copper so MRI MF can't be

disturbed by any external field \rightarrow FARADAY'S CAGE

→ Pt. have H^+ ions which are dipoles acts as tiny magnets

→ All H^+ ions are aligned in same line/directⁿ along MF of machine



→ Free Inductⁿ Decay

LARMOUR PRINCIPLE

Pt. put in steady state

Apply RF pulse

off RF pulse

↓

Relaxation time. for tissues to relax

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Spin Echo Images

T_1
 T_1 WI
 T_2
 T_2 WI

WHITE
 HYPERINTENSE

LESS WHITE

CSF
 H_2O
 BILE
 }
 APPEAR DARK
 HYPOINTENSE

FAT → WHITE

→ Substance → Equally hyperintense on T_1 & T_2 WI → FAT

⇒ Substance that appear white on T_1 WI :-

- Fat
- post-pituitary
- malignant melanoma
- subacute hematoma.

DARK ON BOTH T_1 T_2

CORTX
 Ca^{2+} / CALCIFICATION
 AIR
 HEMOSIDERIN
 FLOWING BLOOD
 TENDON / LIGAMENT

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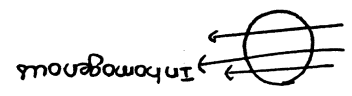
→ Calcification best detected by CT

Calcified neurocysticercosis → CT

Calcified brain lesion → CT

Calcified Pericarditis → CT

⇒ Air :-



In Air filled, MRI

→ can't make good quality magnetic field

For lungs → CT

→ lung metastasis → CT

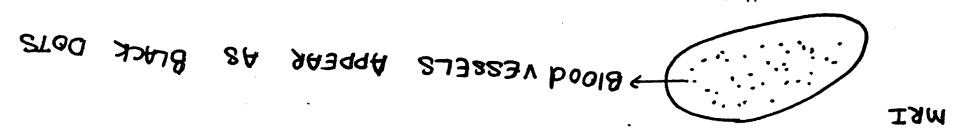
→ Bowel Abstract? → CT

→ Sinus → CT

⇒ Flowing blood = Doesn't produce any signal so it is k/a

Flow void (old vessels)

In Glomus Tx:-



"SALT & PEPPER APPEARANCE"

"SALT-PEPPER SKULL" → Hypoparathyroidism

"MR Angiography" → special type of MRI called as TIME OF WHITE
 For blood vessels
 appear as "white outs"
 SEQUENCE

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⇒ Brain Screening in AD-PCD →

→ Has cerebral aneurysms in Brain

→ MR angiography (for large vessels)

⇒ Acute Brain Hemorrhage → Hemorrhage in (BH)
 Deoxy Hb (doesn't have magnetic properties so appear isointensive appear in MRI)

→ methHb (Paramagnetic appearance)
 ↑
 T₁ → white
 T₂ → variable

→ can be seen on MRI

Chronic BH

→ Hemosiderin

Dark on T₁ & T₂
 → can be seen on MRI

1) Acute Hemorrhage

T₁ T₂

Appears

DD → < 48hrs

(Isointense)

(difficult to detect)

BD

→ 3-7 days

BB

→ ± 14 days

DD

→ > 14 days

3) Chronic

ON MRI :-

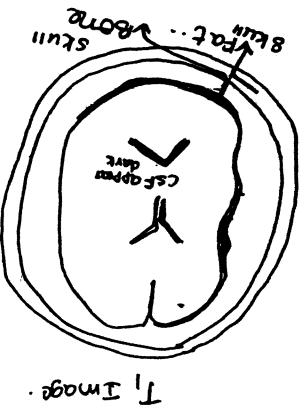
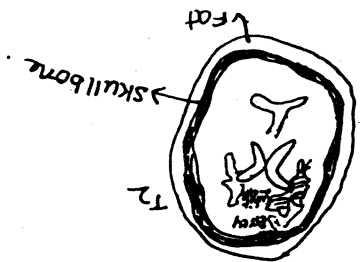
T₁ WI → Grey matter → Grey (U) Dark

white matter → white

T₂ WI → Grey matter → white

white matter → Dark

T₂ WI & dark CSF → FLAIR Image



FLAIR Image → Inversion Recovery Sequence

→ Fluid attenuated inversion Recovery

→ T₂WI - CSF DARK

→ Vaso-genic edema

STIR :- Image :-

→ Short TAU Inversion Recovery

→ To look for Bone marrow edema.

CT → only axial sectⁿ

⇒ MRI IS MULTIPLANAR SECTIONS (can take images in any plane)

CORPUS CALLOSUM

↑
AGENESIS

MC SITE FOR LIPOMA IN BRAIN

on MRI :-

BRACKET SHAPE CALCIFICATION ()

RACING CAR
APPEARANCE

ON MRI :-

NECROSIS
↑
IN CHRONIC ALCOHOLICS
↑
MARCHIAFAVA
BINGAMI SYNDROME
(ITALIAN PATHOLOGIST)

TUBER CINERUM :- Part of Hypothalamus just ant. to mammillary body.

→ This is the site of Hypothalamic Hamartoma.

↑

() ass. w. precocious puberty

2. Gelastic seizures

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→ PINEAL GLAND Tx :-

① compress Dorsal (post) tectal part of

MIDBRAIN & cause upward gaze palsy

② collicular compress

in PARANOID SYNDROME

→ 12 yr Boy → upward gaze palsy, MRI → mass in post. III ventricle

Pineal gland Tx

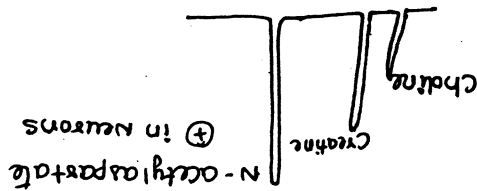
→ VOLUME OF HIPPOCAMPUS SEEN BEST IN CORONAL PLANE

EPILEPSY



→ FOR ASSESSING CHEMICAL ENVIRONMENT OF BRAIN BY SPECIAL TEST

→ MR SPECTROSCOPY



Choline ⊕ in cell membranes

Creatine → energy store house of cells

→ Glioma :- Tumor will have more all membranes

→ dupli energy levels

→ NAA less, Tx of glial cells

Elevated choline level in MR Spectroscopy.

⇒ CANAVAN'S DISEASE :-

Elevated NAA levels in brain

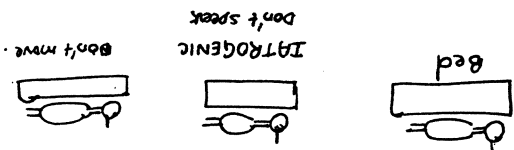
⇒ Functional MRI :-

→ Done to localize motor & speech area.

→ Based on "BOLD sequence" blood O₂ level dependent imaging.

→ This is done before operation. for brain Tx

Operative Planning:-



→ LIE DETECTOR

→ Special areas of brain like truth & lie detected by fMRI.

⇒ DIFFUSION TENSOR IMAGING:-

→ Detect white matter tracts in brain

→ Commissural fibres.

→ Subcortical 'U' fibres (just below cortex)

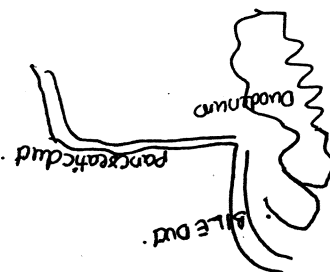
→ Projectⁿ fibres (tracts)

→ associatⁿ fibres



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MRCF



No Endoscope

noninvasive

Heavy T₂ WI

MRI BRAIN :-

T₁ AXIAL

T₂ AXIAL

FLAIR

DIFUSE

SAGITTAL

CORONAL

MCA's

I^x OC

PATHOLOGY

I^x OC

ANY NEUROLOGICAL PROBLEM

MRI > CT

MRI

BRAIN

MRI

SPINE

MRI

NERVE

EXCEPT IN 1) Acute Brain Hemorrhage. CT

2) Acute Head Injury

3) stroke

4) calcificatⁿ



MRCF

MRI → I^xOC

MULTIPLE SCLEROSIS

NEURO FIBROMA

ACOUSTIC NEUROMA

ASTROCYTOMA

SPINAL CORD TUMOR

OPTIC NEURITIS

OPTIC GLIOMA

TUBERCULAR MENINGITIS

TRANSVERSE MYELITIS

VIRAL ENCEPHALITIS

→

NCC

Neurocysticercosis

→ CI

Neurocysticercosis → 4 stages radiologically.

STAGES: 1. VIABLE → VESICULAR

SCOLEX

FLUID FILLED CYST

→ MINIMAL TO NIL EDEMA WILL BE THERE IN SURROUNDING BRAIN

→ ALIVE PARASITE

2. DYING → COLLOIDAL

TURBULENT FLUID

→ INFLAMMATION IN SURROUNDING BRAIN

→ VAS PERMEABILITY ↓

→ VASOGENIC EDEMA → MRI

→ PT. HAS SEIZURE (PT BECOMES SYMPTOMATIC)

3. DYING → GRANULAR

CYST WALL THICKENED

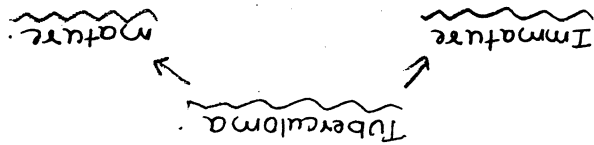
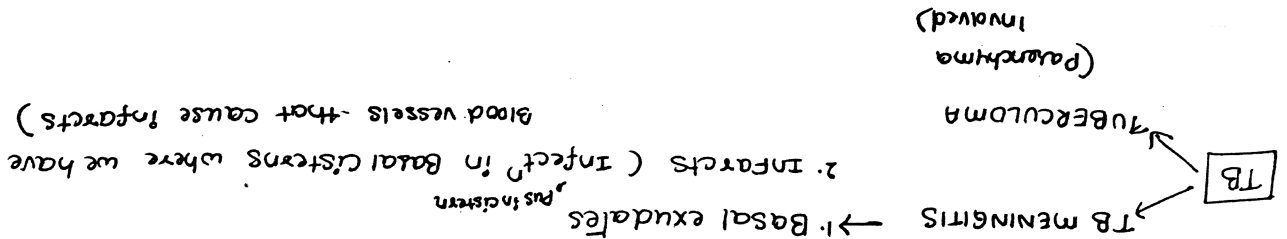
EDEMA

MRI → RING ENHANCEMENT SIGN



RING ENHANCEMENT SIGN :- also seen in TB

TB MENINGITIS



solid, discoid & extensive surrounding edema
 Ring lesion & surrounding edema
 Centre become necrotic



→ many Ring lesions conglomerate → "conglomerate" seen

In nec → single ring lesion conglomerate

⇒ Post Trauma Paraplegia. → T₁₀C MRI

spinal cord injury

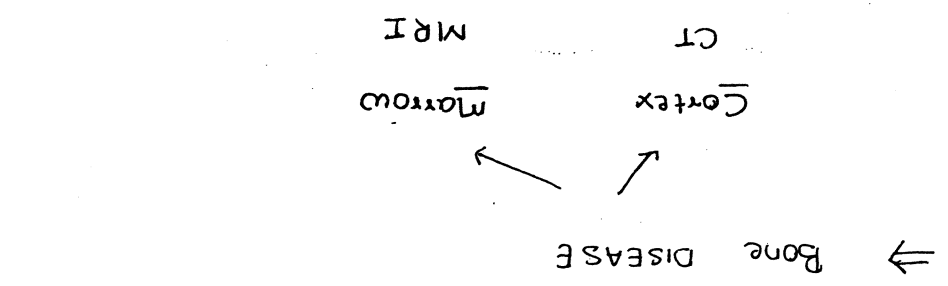
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SciWORA: - spinal cord injury cont radiological abnormality

→ MC in children

→ more in cervical spine



→ Acute osteomyelitis - hematogenous → MRI

marrowedema

→ MRI sequence can detect acute osteomyelitis → STIR

→ Avascular Necrosis of Bone → MRI
(marrow infarction)

- Ankle #
- Acetabular #
- Temporal bone #
- Craniofacial #

Break in Cortex → CT

- Occult #
- Bone Bruise # (Bone is not fx but bruise)
- Stress #
- Hair line #
- Trabecular #

MRI {
MRI {

of any Tendon/Ligament appear white on T_2 Image \rightarrow Torn.

Cartilage
 Tendon
 Ligament
 muscle
 MRI > CT

(N) on T_2 They appear dark.

Osteoarthritis \rightarrow MRI
 (Begins in articular cartilage)

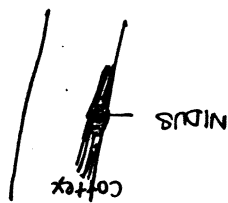
Tendon Ligament MRI except
 \rightarrow Rotator cuff Tear
 \rightarrow Tendoachilles Tear
 \rightarrow Patellar Tendon Tear
 USG (superficial tendons)

\rightarrow Osteochondroma (exocytosis) \rightarrow MRI

Bony spur going away from spur & have
 cartilage.

To know the cartilage change to Sarcoma.

\rightarrow Osteoid osteoma. \therefore CT



CT

CECT

NECT

MRI

Plas MRI

Contrast MRI

→ For IVP / Angiography / CT → Iodinated contrast

→ These are all done based on x-rays.

→ Iodine is a Radio opaque substance.

Non Ionic dye

Ionic dye

Iodinated contrast

Chemical name

→ UROGRAPHIN → Na/Meglumine

DIKAZOATE

→ GASTROGRAPHIN

→ CHONRAY → IOTHALMATE

→ IVERSOL

→ IOPAMIDOL

→ IOHexal → OMNIPaque (TRADE NAME)

IONIC

Osmolality High

→ 1400 mosm

NONIONIC

Low.

→ 800-600 mosm

"SAFER TO USE" (osmolality ill to plasma)

→ IODINE / PARTICLE RATIO
↑ Ionic
(no. of particles in solution)
Osmolality

= 3 : 2

3 : 1 (monomers)
if they are.

6 : 1 (oligomers) → used now

neg particles decreased.

Adv :- 1. It produce better image quality for IVP

2. Cost (cheaper to use)

Indications :-
where we can use only nonionic dye but not ionic dye

1. → ~~TR~~ TRACHEO ESOPHAGEAL fistula (TEF)

Dye used is → DIANOSIL [IOHexol → now used]

→ H₂O soluble

→ nonionised

Ionic dye → goes to lung → pulm. edema.

2. Dye used for Bronchography :- nonionic.

3. Dye used for myelography :- nonionic dye
(if use ionic cause nerve root damage)

Side effects of Ionic dye :-

Idiosyncratic

(occurs small amount also)

→ Anaphylactoid reaction

not true anaphylaxis

becoz on molecular level

they are not IgE mediated

→ mediated by direct

histamine release

complement activation

dose related

→ nephrotoxic

(TRANSIENT, NON OLIGURIC

NEPHROPATHY)

→ DM

→ multiple myeloma

→ Preexisting renal disease

→ Dehydration.

→ Δ is for contrast nephropathy:-

↓ Sr. Creatinine by 25% above baseline after 48 hrs.

→ Preventⁿ of Contrast Nephropathy:-

- AVOID - BIODENATED DYE

→ Hydration by normal saline

↓ f/b

Dye

→ For DM/IVP - non ionic dye is used.

⇒ MRI:-

Dye:- GADOLINIUM - LANTHANIDE

Rare earth

→ "Paramagnetic" property.

⇒ Commonly used dye is → "Gd-DTPA" chelate

Beac Free form of Gadolinium is Toxic.

→ Can Gd to pregnant female. → NO

MRI can be done in pregnancy i.e. Placenta but not Contrast

which crosses placenta.

→ Gd to CRF → NO

Gd is c/I CRF specially $e_{GFR} < 30 \text{ ml/min}$

Gd-DTPA → has renal excretion

so Gd C/I in CRF.

Gd accumulated in body and has fibrosis around

Gd³⁺ ions. so pt. have nephrogenic systemic fibrosis

[Painful, multisystemic cysts fibrosis] if Gd given to CRF.

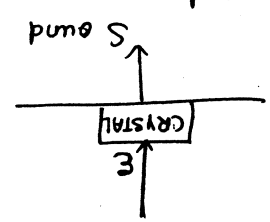
USG

Father of medical USG → John wild.

Father of obstetric USG → Sir Ian DONALD (British) (Scotland)

USG crystals are made up of
 PZT → Titanium
 ↓
 Pb Zirconium

PRINCIPLE → PIEZOELECTRIC EFFECT

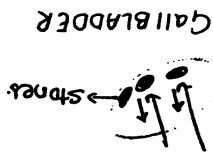


Frequency of sound used

- 1) In Routine
 - USG Abdomen } 3-5 MHz (Deep)
 - obstetric }

- 2) Superficial Organs :- Orbit } 7-12 MHz
- Breast }
- Thyroid }

- 3) TVS → 5-7 MHz



GALLBLADDER



LIVER



CYST

FLUID FILLED

Clear H₂O

H₂O not

reflect

sound

freely allow

sound to transmit

→ **ANECHOIC** appear

FLUID FILLED APPEAR

Black

DRAWBACK OF USG = OPERATOR DEPENDENCE (SKILL OF OPERATOR)

Acoustic shadow seen in

ACOUSTIC ENHANCEMENT

- STONES
- BONES
- AIR
- Fluid filled areas.
- (distal end we can see lightened)

COMET TAIL SIGN ON USG seen in → Adenomyomatosis of GB.

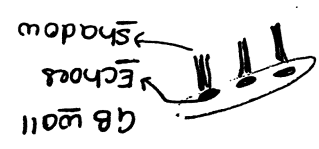
Rocky sinus



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Chronic cholecystitis

GB shrunken in chronic



LESS SIGN ON USG



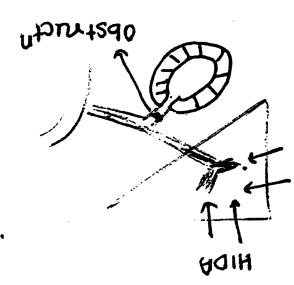
→ Acute cholecystitis IxOC → USG

Best Ix → Tc-HIDA SCAN (most accurate)

↓
taken up by hepatocytes → bile

NON VISUALIZATION OF GB in acute cholecystitis

IN HIDA SCAN



→ Acute cholecystitis

Calculus

USG

Acalculus

Tc-HIDA detect both calculus & acalculous

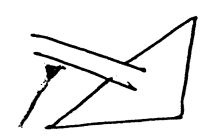
Best is Tc-HIDA SCAN → detect i. cystic obstruction

a. Biliary atresia

→ BILIARY ATRESIA:

ON USG = Δ^{lax} cord sign

IxOC → Tc HIDA SCAN



FOR GALL BLADDER IxOC → USG

→ SAFE IN PREGNANCY :-

- a) x-ray
- b) CT
- c) MRI
- d) USG

→ In 1st Trimester :-

MRI is done in caut

Incidents → abort in animal experiments.

→ SAFE AND ACCURATE FOR FOETAL VIABILITY at 6wks :-

CARDIAC ACTIVITY SENO
TVS

- a) ~~phcg~~
- b) ~~usg~~
- c) uterine size
- d) Doppler

* Doppler should be used in caution in 1st Trimester

Thermal effect (Tissue get heated up) → Theoretical apoptosis

→ PREGNANCY + SAFE → usg.

Q →

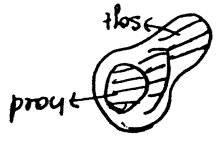
Tissue Harmonic Imaging new update :-
vt sound

- a) CT
- b) ~~usg~~
- c) MRI
- d) PET

→ USG ELASTOGRAPHY

Able to assess hardness of Tissue.

→ "Lump" Bx is always take from "HARD"



Tissue always take from Hard

1) TO Guide Breast Intervent

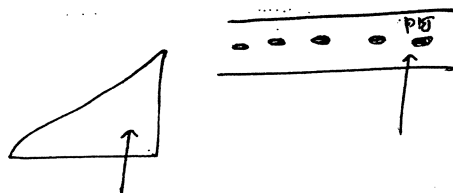
2) Chr. Liver disease

→ CHRONIC liver disease
→ detect early stages of liver disease

FIBROSCAN

which is k/a

⇒ Doppler USG :-



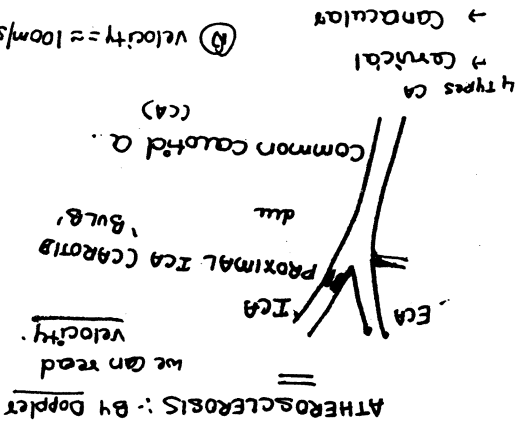
FREQUENCY SHIFT → discovered by Doppler

USG of moving objects → Doppler USG
↑
Frequency shift

Red → Flow Towards USG probe
Blue → Flow away from USG probe
Color in Doppler shows direction

Indications:-

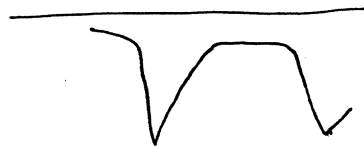
- 1) DVT
- 2) Portal HTN
- 3) Carotid stenosis Screening



In stenosis $\geq 110 \text{ cm/sec}$
↓
Diameter & velocity

→ Risk for stroke in atherosclerosis

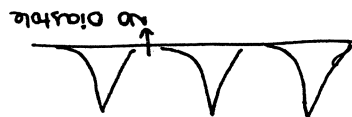
after 22 wks, uterine a's supply so no diastolic notch
 of persistence of diastolic arch is
 Preeclampsia.



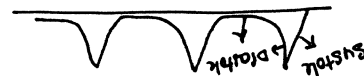
UTERINE A. DOPPLER.



→ risk of IUD.
 → placental resistance (so high)



IUGR



UMBILICAL ARTERY: $\frac{S}{D} \downarrow \rightarrow$ IUGR.

$\frac{S}{D} \uparrow \rightarrow$ IUGR

$\frac{S}{D}$ Ratio

Severe placental resistance = also
 more severe PR \rightarrow Reverse.

umbilical a \rightarrow IUGR.

✓ \rightarrow PACS \rightarrow Picture ARCHIVING & Communicatⁿ System

Radiology Depot. to Hospital linking

2000 yL : INTERNET ERA

→ standard digital format for medical images.

Nuclear Medicine

Nuclear Scan

(a)

Isotope scan

(a)

Scintigraphy

(a)

Radionuclide scan

Nuclear Scan:-

Commonly we do nuclear scan by using Isotope = Tc^{99m}

m = metastable isomer.

- In any nuclear scan, Tc^{99m} bind to a ligand.

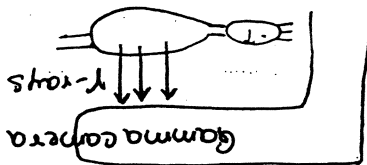
$T_{1/2}$ of $Tc^{99} = 6hrs$

γ-rays emitted by $Tc^{99} \rightarrow \gamma\text{-rays} = 140k.e.v$ (energy released by γ-rays)

- organ imaging in nuclear scan done by Gamma Camera
 Anger's camera.

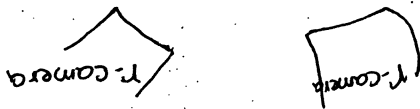
→ It has multiple scintillation detectors (which can detect γ -rays)

→ Those detectors are made up of Na-I.



SPECT :- single photon emission computed Tomography

It has 3 dimensional - nuclear scan (CT of nuclear scan)



PET SCAN :- Positron Emission Tomography.

- cyclotron generated Isotopes are used in PET

Cyclotron = proton accelerator.

- To proton, bombardment of Fluorine \rightarrow 18-Fluorine Radio active

which emits positron



positron - anti-matter

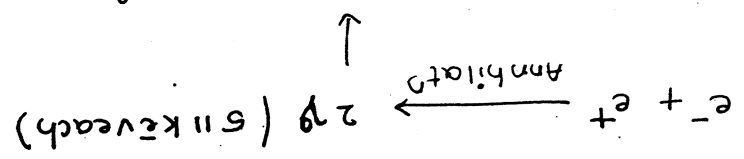
+ve electron

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Isotopes in PET $O_2 - 2 \text{ min}$
 $N_2 - 10 \text{ min}$
 $C - 20 \text{ min}$

(mc used) Fluorine = 110 min

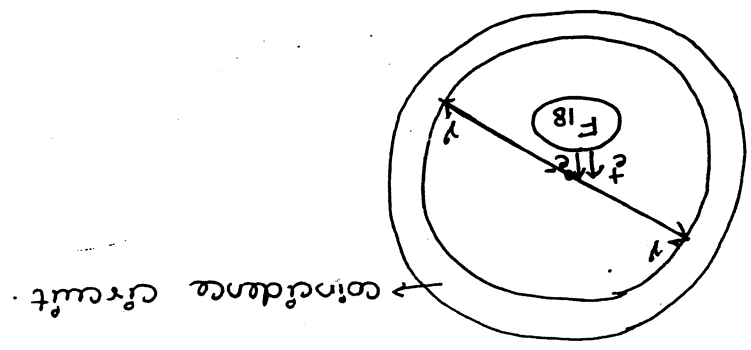
Physical principle of PET:



These rays strike machine 180° each other

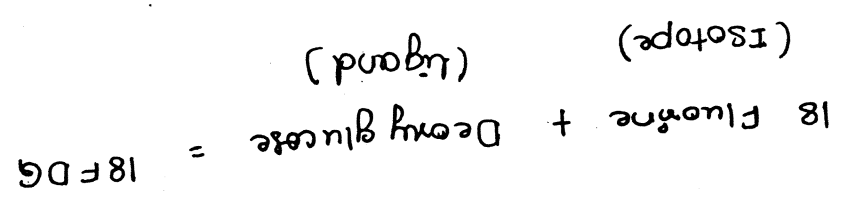
Positron Annihilates an e^- to produce 2 γ photons of

511 keV each to opposite direction.



→ coincidence circuit.

Biological principle in PET :-



$^{18}\text{F} \text{ DG}$ - mainly used in oncology.

(N) - Cancer cells require more glucose for their

development.

so they uptake glucose and undergo aerobic glycolysis (Warburg effect)

But, when we introduce FDG into cancer cells.



Cancer cells uptake it.



But doesn't (FDG) undergo aerobic glycolysis

(FDG accumulate in cancer cells)

Clinical Indication of PET Scan :-

- For staging of cancer particularly lymphomas, lung ca.
- For recurrent Tumors of brain (or GIST).
- To follow up Tumors after chemotherapy.
- used as Ixoc for solitary pulm. Nodule.

PET Scan
False +ve
False -ve

+ve FDG — → not cancer

eg:- Chr. Infections - TB

• Tumor

Ixoc for - Pyrexia of unknown origin

- Brown fat (metabolically active) - mostly ⊕ at supra fat

clavicular area.

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→ Even brain tumour may not show up, PET scan is

not used in Brain Tumor. (Because Brain uptake of FDG more & accumulate in it. So there is mis of

Brain Tumor behind the brain. But FDG PET is

useful for recurrent brain tumor because gliosis

is a scar, which is metabolically inactive (gliosis

produced after removal of Tumor). On FDG PET we

appreciate that, compare to surrounding Brain tissue.

→ For Infection & Inflammation :- Gallium Scan (also used in

sarcoidosis analogue of Transferrin lymphoma)

In @ person, after giving Gallium Injection, it will

accumulate in nasal mucosa, and nasal cavity of

face But in Sarcoidosis (glands are affected)

- So Gallium will accumulate in parotid gland, lacrimal

gland.

Panda sign on Gallium scan



Lambda sign seen in chest on Gallium scan

Face of giant Panda on MRI scan - Wilson's disease

(Hepato-lenticular

stratial degeneration)



Red nucleus get spared in Wilson's disease, but whole mid brain get involved.

Q1 pt. \pm AIDS undergoes Gallium scan for chest & lungs

appears hot (Gallium highly taken up by chest) all are

possible, except.

a) PCP b) m.TB c) Kaposi sarcoma d) lymphoma

Because Gallium scan usually identify infection, sarcoidosis, inflammation, lymphoma.

→ Another scan used to identify infection - Indium labelled WBCs (more specific)

In Kidneys: Isotopes used are

Tc DTPA Tc DMSA / static Renogram

dynamic renogram

Structure of kidney

Scanning of kidney (reason of scanning in kidney is

- reflux

- vesicular

- Renal scanning \pm clubbed calyces indicates - Reflux

- For Reflux nephropathy $IxOC \rightarrow$ DMSA

VUR $IxOC \rightarrow$ MCU

- Renal function: Best assessed by Isotope \rightarrow Tc - MAG3

Tc MAG-3 - excreted mainly by - Tubular secretion

also by glomerular filtration

But DTPA - excreted only by glomerular filtration.

GFR is better estimated by Tc DTPA.

Screening Test for Reno-vascular HTN - (captopril DTPA scan

Absolute C/I for ACE^o is - B/L Renal a. stenosis patient

most sensitive and specific Test for Renal a. stenosis

- MR - Angiography
(non invasive)

IxOC for Renal a. stenosis - Angiography (diagnostic + Rx)

Heart :-

we used Isotope study called as myocardial perfusion scintigraphy

(or) stress Thallium

This is done to detect - Reversible myocardial

Ischemia.

Reversible myocardial Ischemia:-

- On Exercise (on $\frac{TMT}{\text{Threadmill test}}$) - while injecting Thallium - finds a

Cold area. (i.e. no blood perfusion to that area of myocardium)

- at same pt, in rest - Cold area is absent (Scan on Gamma camera)

Tc pyrophosphate :- binds to myocardium Infarct.

Infarct^o appear as hot - in this scan.

Tc Rbc - MUGA Scan :- (multly uptake gated Acquisition)

done to estimate - ventricular Function.

a) ventricular Function best assessed by which radiological

Test - - MRI

Indications of MRI in heart:-

- It is most accurate test for - ventricular function.
- To assess pericardial thickness (② pericardial thickness on MRI - < 3mm)
- It is useful for identify - myocardial scar tissue.
- (On MRI, scar tissue shows - delayed post Gd enhancement)
- most accurate test for - Aortic dissection. (but $Ixoc$ - MOC)
- $Ixoc$ for myocardial viability - PET scan

Cardiac PET scan:-

- | Isotope used | FDG | NH_3 , (w) H_2O (w) Rubidium |
|----------------|-----|----------------------------------|
| For metabolism | | Cardiac perfusion |
- Rubidium is the non-cyclotron produced isotope.
- Ischemic but viable myocardium shows on PET scan - NH_3 -ve FDG ++
- ② myocardium - F.A metabolism

- During Ischemic - it will switch to glucose metabolism.
- Hibernating myocardium - Chronically Ischemic myocardium which is still viable & dysfunctional on ECHO
- on PET - FDG ++ (For myocardial scar - FDG -ve)
- For viability of myocardium better - Cardiac PET
- For myocardial scar tissue better - MRI

In lungs:-
 ventilation / perfusion scan (To identify - pulm. embolism)

$I^{125}C$ For pulm. emboli - HCT

For lung ventilation
 For lung blood flow

Isotopes - Xenon

Krypton

Technique gas

a) on V/Q scan, pulm. embolism shows

- ventilation
 - perfusion
 } V/Q mismatch

But on any other lung pathology like pneumonia

on V/Q scan = AB (v) & AB (p)

Because on Response to Hyperventilation

Hypoxia

↑
 vasoconstrict of pulm. vessel

↓
 AB (p) perfusion

In Bones :-

Bone scan - $Tc^{99} MDP$ (methylene Diphosphate) (pays attention to bone)

Indication of Bone scan:- skeletal metastasis

multiple myeloma
 skeletal metastasis

"Cold"

(MDP will not accumulate on bone)

X-ray - lytic lesion

(N)

(MDP accumulate in bone)

"Hot"

hot (+ve)

on Bone scan may be (N)

39
Dexa (dual energy x-ray absorptiometry) done for - Osteoporosis evaluation
- Bone mineral density value

on Dexa (Report)

Z score = obtained by comparing pt. c. Same Age/sex of other (N) Person.

T score = obtained by comparing pt. c. young adult/sex of

(N) person

T score = < 2.5 - Osteoporosis Rx = Bisphosphonate & follow up after 1 yr

-1 to -2.5 = Osteopenia Rx = +/- Bisphosphonate & follow up after 2 yr.

-1 to +1 = (N) Rx = Follow up after 3 years

In Thyroid :-

Isotopes of Iodine = I_{123} I_{124} I_{125} I_{127} I_{131}

For Rx of Thyroid cancer (or) to detect metastasis after sx

= I_{131} ($T_{1/2}$ - 8 days)

To know Functⁿ of Thyroid = I_{123} [not easily available in India, produced by cyclotron

$T_{1/2}$ - 13 hrs]

I_{131} Produce $\begin{cases} \beta \text{ rays} - \text{only destruct neoplastic cells - unsealed} \\ \gamma \text{ rays} \end{cases}$ Radiotherapy

- used for Brachytherapy & Radio Immuno assay - I_{125}

- In PET scan - I_{124}

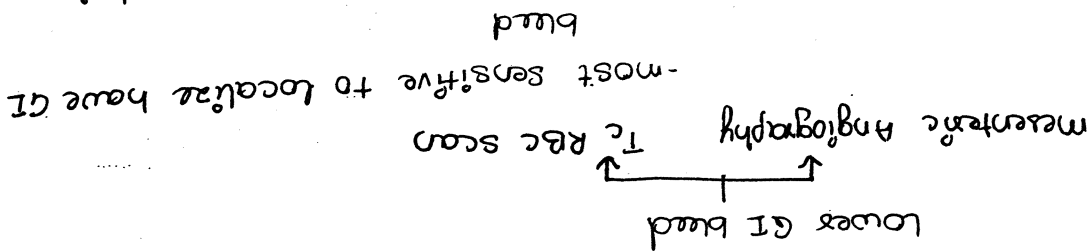
- Stable Iodine isotope - I_{127}

In GIT :-

- lower GI bleeding - localization (that is site where bleeding occurs)
- For upper GI bleeding - Endoscopy

- On Barium Swallow, Oesophagus shows - String on bead appearance of oesophageal varices

- Barium study is avoided during Active lower GI bleed



- even the G.I bleed 0.1 ml/min

we can detect.

- ^{99m}Tc for d meckel's diverticulum - Tc pertechnetate Scan (Tc pertechnetate is taken up by gastric mucosa, but not

Intestine) - if that isotope uptake occur in intestine, it indicates -

ectopic gastric mucosa.

⇒ Tc - sulphur colloid scan :- colloid - taken up by macrophages (res)

(2) - colloid uptake more in liver (beacoz of large organ)

colloid uptake compare to liver, spleen less uptake.

colloid shift - liver uptake less } Indicates Cirrhosis (or Portal HTN spleen uptake more

→ Hepatic Tumor, that is diagnosed by Tc - colloid scan

FNH (focal nodular Hyperplasia) - Benign T_x

- Rich in Kupfer cells

- "Hot" in colloid scan

Ix Oc for Hepatic angiomatoma - CCT

most accurate Ix for Hepatic angiomatoma - Tc RBC scintigraphy (Gold standard)

Q) 22 yr ♂, otherwise healthy on USA - incidental 2cm mixed

echogenic lesion what is the next step.

correct b) Bx c) scintigraphy

→ Ix Oc for clinically suspected phochromocytoma → MRI abdomen

(because mostly Ix localized)

On MRI abd. Pheochromocytoma shows -

light bulb appearance

[MRI - light bulb appearance - Hepatic Hemangioma
meningioma]

X-ray - light bulb appearance - post. dislocation of shoulder

If MRI abd. came @ look for other site where Ix localized.

for that we use Isotope - MIBG

DOPA pet. (Best)

Neuroendocrine Tx - Somatostatin Receptor Scintigraphy (Ix Oc)

more sensitive → DOTATOC - PET

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Units of Radiation :-

Common unit

S.I unit.

Röntgen

C/kg

exposure

RAD

Gray [1 Gy = 100 rad]

2. Unit of Absorbed Radiation

3. Biological Equivalent

REM

SI UNIT

Effectiveness

- Equivalent dose = Absorbed dose x Radiation Factor

- Effectiveness dose = Absorbed dose x RF x Tissue factor

- most imp. unit for medical sector - Sievert

- SI unit of radioactivity = Becquerel = 1 disintegration/sec.

- 1 Curie = 3.7×10^{10} disintegration/sec.

Chest X-ray

In PA view - pt. facing film, Inspiratⁿ, shoulder forward

- done always in erect.

CXR - (N) done in full inspiration

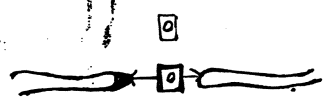
CXR - done in Expiratory - Pneumothorax.

AP view → done in erect & supine position (usually done)

How to identify, rotation on CXR

1) medial end of clavicles, should be equidistance from

the spinous process B/L



→ most imp. factor to differentiate A-P & P-A views - scapula

In PA view → scapula rotating away from lung field.

In AP view → scapula rotating towards lung field.

Lateral view according to position of film.

a) lat. decubitus view:- film in front of patient (L/DV)

- pt. lying on lat. side

- done to 2° pleural effusion.

L/DV on X-ray → Detect → 25 ml of pleural fluid.

a) How to identify (Rt) middle lobe pathology on PA view

Silhouette sign - described by Felson

↑
mediastinal border, can only be obscured by pathology which is in direct anatomical contact

a) of (Rt) cardiac border is not seen → pathology located in (Rt) middle lobe.

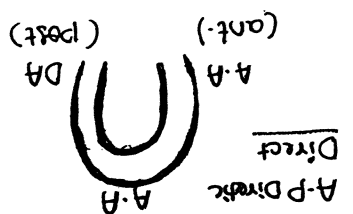
a) of (Lt) cardiac border is obscured → pathology located in Lingula.

a) of Aortic knuckle obscured on CXR, pathology located in - (Lt) upper lobe post.

Aortic knuckle - It is part of

descending aorta comes.

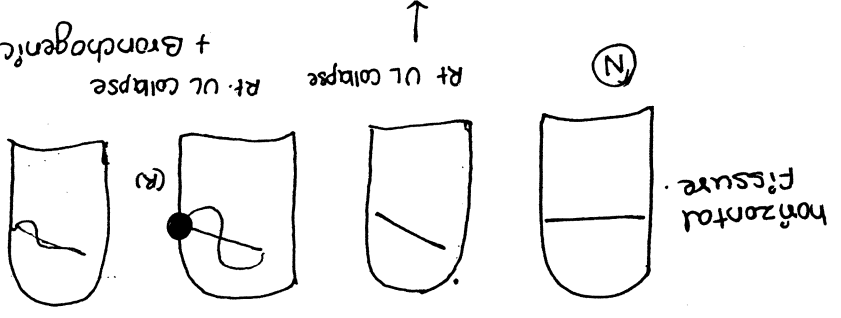
- It is posteriorly located.



a) (L) upper lobe collapse is difficult to find on CXR.

Luft Schiel phenomenon :- that collapsed (L) upper lobe, interposed b/w Chest wall & over inflated (L) lower lobe

→ Rt. upper lobe collapse + Bronchogenic Tx = Golden's sign on CXR.



earliest CXR finding in RHD - straightening of (L) cardiac border. (because (L) atrial enlargement → (L) aortic bulging)

on CXR - Rt. ventricle anteriorly placed.

→ Rt. heart border - Rt. atrium - IVC - SVC

→ lifted apex - RV enlargement.

eg:- boot shaped heart = TOF (boot is formed by RV enlargement)

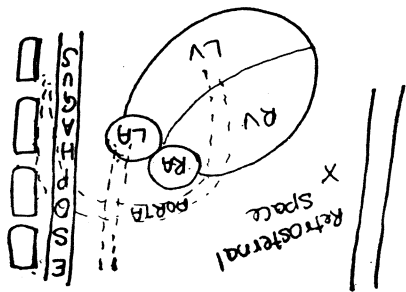
→ Left heart border on CXR = LV

= L. Auricle.

= main pulm. A.

= Aortic knuckle.

⇒ (Rt) sided chambers are anteriorly placed
(Lt) sided chambers are posteriorly placed
on lat. view



- Retrosternal space obliterated seen in - RA enlargement > RV enlargement

- enlargement of LA leads to post. displacement of Oesophagus

a) enlargement LA leads to displacement of aorta (ascending)

"Bedford sign"

a) Hoffman Rigler sign - LV enlargement on lat. view CXR.

Hollman miller sign - Angiobroma.

Identification of valve calcification:-

Draw a line from carina to ant. Cardio phrenic angle

- mitral valve calcification - lies below the line.

- Aortic valve calcification - lies above the line.

Hilum on CXR - shadows of pulm. arteries (mainly)

also contributed by - upper lobe veins

- small part of bronchus.

Air bronchogram = described by Fleischner.

It is sign of alveolar pathology

Alveolar disease spread, one alveoli to

another cont affecting bronchus by

Foras of Kohn.

- Visualization of black Bronchus (air filled) on white alveoli

(no air in alveoli) - Air bronchogram.

- main cause of Air bronchogram on CXR:-

- Pneumonia (Alveoli filled w/ exudate & pus) -

specially bacterial pneumonia.

- Pulmonary edema - due to LVF

- HMD - due to deficiency of surfactant - collapse of

alveoli.

In advance HMD, CXR shows - white out lung & Air

bronchogram

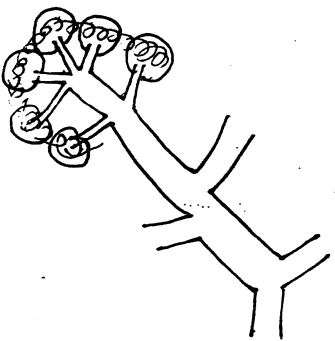
Q) Air bronchogram is seen in all, except

a) pneumonia

b) lung Ca.

c) HMD

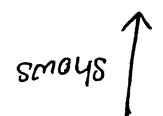
d) pulm edema



→ Viral pneumonia - causes Interstitial disease (but not alveolar disease).

→ Cancer that shows Air Bronchogram -

- Broncho-Alveolar Carcinoma / Adeno Carcinoma in situ.



lipidic spread (it spreads along intact Airways but

don't obstruct & destruct it.)

PET scan -ve.

Identification of pneumococcal pneumonia in CXR:-

Pneumococcal pneumonia :- lower lobe predominant &

lobar consolidation.

- Klebsiella pneumonia :- upper lobe predominant (exudative

pneumonia)

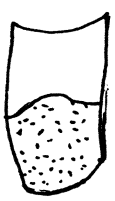
- Bulging fissure sign seen - Klebsiella pneumonia.

- Pneumatocele on CXR - Staphylococcal pneumonia.

- Klebsiella pneumonia

- Kerosene poisoning

- Pneumocystis carinii



Pneumocystis carinii:-

- Earliest on H&T - Ground Glass appearance

- Gallium scan

- pneumatocele - CXR

- Bat wing appearance / perihilar infiltration

- Lymphadenopathy / pleural effusion - uncommon

TB



on CXR - LN enlargement
[Hilar & (RT) paratracheal LN]

- Any segment of lung is involved but (L) lobe > Rt. lobe
Result of haematogenous spread

- miliary TB

→ miliary appearance on CXR

- TB

- histoplasmosis

- sarcoidosis

- metastasis

- varicella

- mitral stenosis

[becog it leads to pulm-venous HTN
↑ leads to
Hemosiderosis

on CXR - Sand storm appearance = Alveolar microlithiasis

"Tree in bud" sign = Endobronchial TB (TB spread by endobronchial)



miliary TB I x OC
= HRCT

- characterised by presence of
cavitation
even squamous all ca of lung
also shows "cavitation"

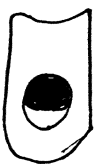
- It involves [apical] segment of upper
lobe & apical segment of lower
lobe.

34 - Sometimes a branch of Pulm. Artery in TB cavity.

Rass mussen Aneurysm - as 2 TB

Fungal :-

Aspergilloma - Air crescent sign / moon's sign



Air P Allergic Bronchopulmonary Aspergillosis -

on CXR - "Central Bronchectasis"
"Gloved finger of Simon"

Cystic Fibrosis on CXR - Upper lobe Bronchectasis

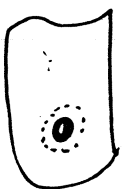
- Floating opacities on CXR seen in - ABPA
- Wegner's granulomatosis

- Invasive Aspergillosis :- seen only in Immunocompromised pt.

Aspergillus invade surrounding blood vessel & causes

Infection in lung Red Infarct

on CT - CT Halo sign.

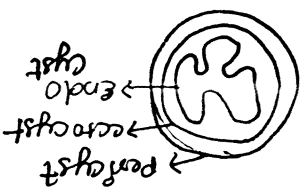


Reverse Halo sign - (m)

Ateoli sign

Hydrad Cyst :-

On USG - Coat wheel appearance

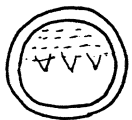


Liver
Spleen
Lung
↑
it doesn't calcify
Calcified

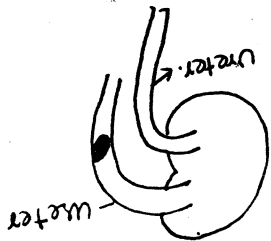
- of pericyst ...

- of air enter in b/w different layer of hydatid cyst -
pearl & ectocyst - Air crescent.

- of only endocyst get ruptured, daughters are float in
Cumbo sign on CXR.



→ Drooping Lilly sign on IVP - duplication & nonfunctional



→ Pleural Effusion:
on CXR :- Blunting of CP angle.

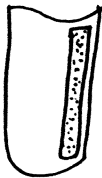


Ellis's Curve.
effusion

Min. amount of fluid identified
on Lat. decubitus - 25 ml
PA view - 100 - 200 ml

⇒ Empyema :- Pus in pleural cavity
(pleural membrane became thick & separated by pus)

- split pleural sign

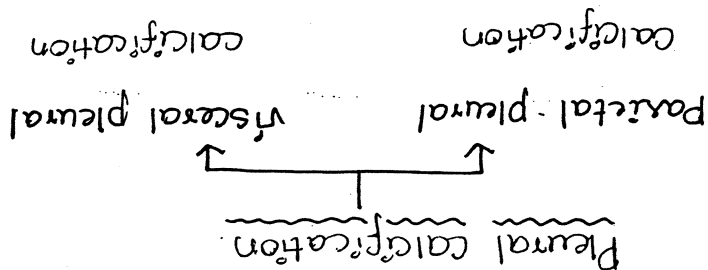


⇒ Pneumomediastinum :-
(i) Continuous diaphragm sign on CXR
(air in mediastinum also)



- wave sign of muirfy
(N) Thymus gland

- Spinnaker sail sign on CXR



Eg: Abs.
Asbestosis
(involves diaphragmatic (base) pleura)
CXR - Holly leaf sign
Asbestosis
old empyema
old haemothorax

CT chest - comet tail appearance (seen in Pseudotumor)

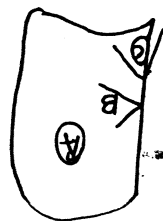


1° tumor
Pleural Tumors
2° tumor

mesothelioma

Breast
Bronchus
Thymoma

Tumor A - lung sig



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- pleural tumors are always form
 - Lung tumor always form Acute angle \angle chest wall

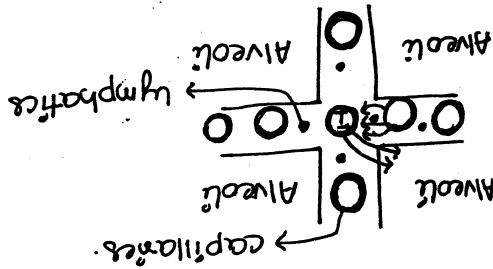
Pulmonary Edema.

→ It is due to Heart failure

→ stages
 ①
 ②
 ③

1st x-ray sign of Heart failure

① Cephalisation (more blood flow to upper lobe
 $> 3mm$)



2) Fluid into Interstitium space - lymphatic engorgement.
 (1)

3) Alveolar edema

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PCWP

Pathology

CXR.

1. 8-12mmHg

(N)

(N)

2. 13-19mmHg

early HF (az)

upper lobe vessels

early cardiac

get dilated

tamponade

- cephalisation

3. 20-24mmHg

interstitial edema

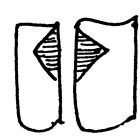
Kerley lines



4. > 25mmHg

alveolar edema

Bat wing appearance



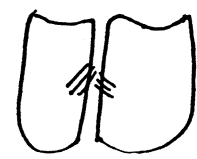
⇒ CXR :- is best for cardiac Pacemaker integrity

→ Cardio - thoracic ratio - 0.6 (N) in infant - 0.5 (N) in adult.

- New born has respiratory compliance, on CXR - sun ray appearance (fluid filled central lymphatics)

- Transient tachypnea of new born (TTN) or wet lung disease.

- Fluid in horizontal fissure - another 'identical' marker on CXR.



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- Pulmonary edema

- wet lung

- Lymphatic engorgement = Kerley lines

- Fluid in fissure

= vanishing Tx

Kerley B lines can be seen in lymphangitis carcinomatosa.
Cx, colon, breast, bronchus, pancreas, thyroid, larynx,
stomach, Tx's are causes - lymphangitis carcinomatosa

(cancer in lung lymphatics)

Bronchectasis

mild bronchectasis on CXR → Tram track appearance



Varicose bronchectasis → string of beads appearance

Cystic bronchectasis → bunch of grapes appearance

On CT - Bronchectasis appear as. Signet Ring sign



CXR findings

PE

Pulmonary embolism (PE)

CXR - (N)

V/Q - mismatch

$I^{xOC} = HDCT$

Westermark sign - focal oligemia
Hampton's hump - wedge shaped
Capacity to convexity towards hilum
Pulm. artery
Pulm. a. dilatation

Pallas sign - dilated (at) descending

Sequestration :- A segment of lung, which is embryologically (37)

Cut off from (N) lung [it not goes to receive blood supply from pulmonary & not receiving any bronchus].

It receives blood supply from Aorta.

=> Gold standard test to Δ^e sequestration = Aortography.

I_{xoc} for sequestration = CECT

- Sequestration mostly seen in (site)

= left lower lobe.

- pt \in sequestration got recurrent chest infectⁿ due to

(i) Pores of Kohn.

(ii) microscopic communication of foregut.

Venous drainage of sequestration:-

Extra lobar sequestration

drains into systemic



veins

drains into

Intra lobar sequestration



pulmonary veins

Solitary Pulmonary Nodule (SPN)

slice thickness to be done for scanning test for SPN - 3mm



done by CT

SPN

Benign nodules

malignant nodules.

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Benign nodules

→ Coarse central calcification

→ Calcification - in centre,

periphery or

anywhere calcification

- Hamartoma
- popcorn calcification
- on exr.
- on CT = presence of fat.

→ I^xOC of SPN - CT-PET

→ Best investigation (Gold standard) to SPN - CT guided biopsy.

Lung Cancer

Squamous
 { Small cell (large mediastinal LN) central tumors

Large cell
 { Adeno carcinoma. peripheral tumors

carcinoma = Squamous Ca

= Large cell Ca.

CXR = Air Bronchogram - seen in Broncho-alveolar carcinoma.

malignant nodules

- Any nodule with spiculated margins
- Any nodule with lobulations
- Any nodule with umbilication
- cavitation
- on periphery of Nodule
- ↳ fine amorphous calcification



IxOC for Pancoast Tx = MRI (becoz involvement of brachial plexus invasion)

Cannon Ball appearance on CXR = Lung metastasis (hematogenous)

Cardiac findings in CXR :-

Tetralogy of Fallot on CXR shows

oligemia (black shadow of lungs)
 ↳ Ebstein's anomaly
 ↳ TOF

Boot shaped heart (coarctation-sabot)

Pentology of Cantrell :-

- Sternal cleft

- Ectopia cordis

- Diaphragmatic defect

- Omphalocele

- ASD/VSD

TAPVC :- All 4 pulmonary veins form a anomalous vein

& opens into R. atrium.

CXR :- Snow man heart

Figure of 8 heart

Cottage loaf heart

PAPVC :- (Partial Anomalous pulm. venous connectn)

In it, only Rt. lower lobe, pulm. vein open into IVC

CXR - Scimitar sign

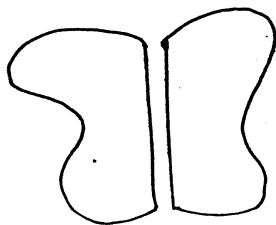
Fig of '8' brain - Lissencephaly

(smooth brain)

due to neuronal migratn defect.



Sulcus & gyr not formed properly



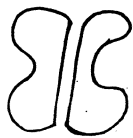
- Neural 'migrant' defect - pachy gyrus

- polymicrogyria

- Lissencephaly

- Schizencephaly (split brain) ventricle

Connect to brain surface



Holoprosencephaly :- single forebrain

single ventricle

fused thalamus

Prosencephalon - not further divides

MRI - Pan cake brain

Boomerang shape ventricle

Horse-shoe shape ventricle

This condition seen in - Trisomy 13 (Patau syndrome)

seen in

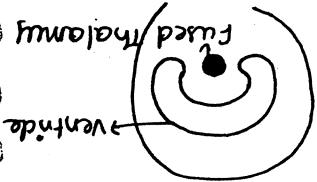
Appearance

→

Egg on string heart → uncorrected TGA

Egg on side heart → uncorrected TGA

Egg in cup heart → Constrictive pericarditis



Appearance

Seen in

(39)

→ Money bag heart - Pericardial effusion

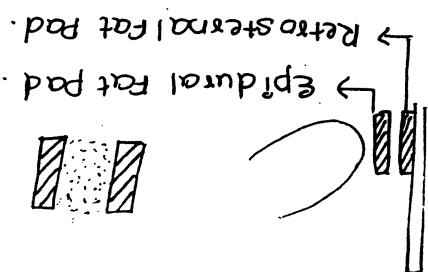
→ Box shaped heart - Ebstein's Anomaly

→ Sitting duck heart - Persistent Truncus Arteriosus

→ Tug handle heart - Pulm. artery HTN

→ Oreo cookie sign - pericardial effusion on lat. CXR

→ Polomint sign on CT - Portal vein thrombosis



Coarctation of Aorta

mc site of CoA - Just distal to origin of (L) subclavian a.

CXR - 3 sign - CoA

(Reverse 3 sign on barium study - Paraspillary Carcinoma)

→ Inf. rib notching - classically involves 3rd - 7th rib

- also seen in CoA

- Seen in older child, not in New born

→ mc site of Thoracic Aorta injury on RTA - At site of

Insertion of

on CXR - widening of superior mediastinum (>8cm)

(L) pleural cap.

- Trachea push to (R) side.

X-rays of bones

Achondroplasia

- Rhizomelic (shortening of proximal bones) dwarfism,
- Autosomal Dominant



- Champagne glass pelvis

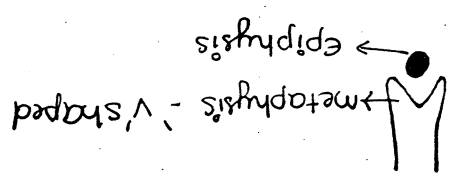


- Bullet shaped vertebra

- Tombstone iliac blades

- lumbar canal stenosis

- chevron sign



Rickets

- Earliest x-ray finding - loss of provisional zone of ossification
- Defective mineralization
- Provisional zone of ossification - area where transition from cartilage to bone occurs.



2) X-ray - Growth plate widening

Because osteoid is formed

it not get mineralized.

[of epiphyseal enlargement - Juvenile RA

epiphyseal dysplasia hemimelic.

[epiphyseal dysgenesis - hypothyroidism]

X-ray findings of hypothyroidism - delayed bone age

- Bone age calculated - from epiphyseal closure

- Tanner white house - method (mc) used in India

- Greulich - Pyle method.

4) Recovery of provisional zone of ossification - white line (healing)

of bone in Rickets



3) displaying
cupping
fraying

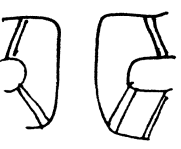
Osteomalacia

- unmineralisation of bone due to vit D deficiency

- On X-ray ① Looser's zone :- unmineralised area of bone

Pseudo #

Melmon's #



mc sites of Looser's zone = Pubic ramus

= Neck of Femur

= Outer border of Scapula

= Ribs

Acetabulae # - Judet's view

2) Triradiate Pelvis / Protrusio acetabuli

3) Biconcave / Cod fish / Fish vertebrae

Scorbuty

- James-Lind

- defective Osteoid formation

- [Osteoid Fat formed is less so less osteoid get mineralised]

↓

thin cortex

X-ray :- Pencil Thin cortex

- prominent margins in epiphysis - Wimberger's Ring

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- Osteosclerosis.

- Osteomalacia (due to no format
of vit d)

- 2° hyperparathyroidism

In CRF :-

as. 2 CRF

1° hyperparathyroidism

as 2 parathyroid adenoma

1° hyperparathyroidism

3. Brown Tumors (osteoclastic destruction of bone)

2. Intra cortical resorption of skull - Salt & Pepper skull



1. Sub periosteal resorption of bone
Earliest ← on radial side of
2nd & 3rd digit.

X-ray :-

Hyperparathyroidism

-- Lead poisoning.

- healing rickets.

- Scurvy.

8) Metaphyseal dense lines, seen in -

- Pelican spurs

- Sub periosteal haemorrhages



- white line of Frenkel - dense provisional zone of ossification

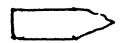
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3. Car shaped ribs.



2. Central - beaking vertebrae - Morquio disease

1. Antero - Inferior beaking vertebrae - Hurler disease



On x-ray - J shaped sella.

Mucopolysaccharidosis

on x-ray.

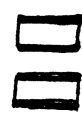
→ In 2° Hyper parathyroidism - Rotten fence Post appearance

Spine x-ray = Rugged Jersey spine.

X-ray = ↓ bone density, Bone c/s Bone appearance

white, thick.

⇒ Osteopetrosis marble Bone - By Birth bones are very



also seen in Osteopetrosis-II
(↓ bone density in vertebrae)

Renal Osteodystrophy on x-ray - Rugged Jersey Spine

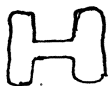
Haematological

Haemolytic Anemia

Sickle cell Anemia (SCA)

X-ray :-

1. H-shaped vertebrae



due to vertebrae end plate infarction

- also seen in

a) Thalassemic dwarfism



Telephone Hand along bones

2. Bone τ in Bone appearance

(also seen in Osteopetrosis)

\Rightarrow Bone infarct causes 1. Idiopathic

2. SCA

3. Coatsen's disease

4. Gaucher's disease

5. Trauma

6. Pancreatitis

Haemophilia

X-ray :-

1. Deep Intercondylar notch.
 2. Squaring of patella
- because of haemarthrosis.

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red marrow expansion

1) Erlenmeyer Flask Femur (due to



2) Hair on end Skull/Crew cut appearance

3) Expansion of hand bones

earliest x-ray finding :-

X-ray :-

Thalassemia



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⇒ Pneumoperitoneum best seen on CXR.

③ Scaddings criteria for CXR Finding.

② egg shell calcificatⁿ - Sarcoidosis < silicosis.

① 1 2 3 sign

- X-ray :-

- Paratracheal lymph nodes.

- B/L hilar lymphadenopathy

Sarcoidosis

- ↓ heel pad thickness (> 21mm)

- Pseudogout

soft tissue enlarges.

cartilage enlarges

Bone enlarges

- Premature Osteoarthritis.

- widening of joint spaces (because of GH excess)

- X-ray - Spade like phalanges

Acromegaly

- X-ray :- metaphyseal lucency.

Leukemia

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Rad-2
20/5/14

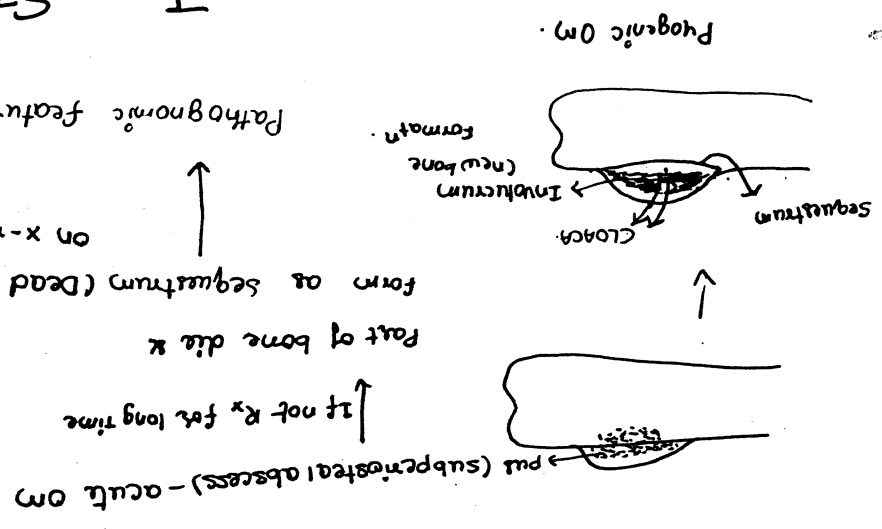
Infections

⇒ ACUTE OSTOMYELITIS :-

1. Earliest x-ray finding is "Soft tissue swelling" & "Blurring of Tissue planes"
2. Bony changes appear on x-ray - 7-10 days
3. Specific finding :- "Periosteal react"
4. Child has fever, pain in leg, x-ray shows - blurring of tissue planes.

D/D → Acute OM
→ callus
MRI differentiate these.

4. Radiological Ixoc - MRI



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⇒ Tubercular OM



on x-ray → NO periosteal reactⁿ almost

→ almost NO new bone formatⁿ

→ ↓ blood supply



Bone become demineralisatⁿ



Osteoporosis

Tubercular

almost NO new bone formatⁿ

new bone formatⁿ

Periosteal reactⁿ

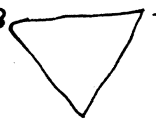
NO Periosteal reaction

osteoporosis

⇒ Tubercular Arthritis

& PHEMISTER TRIAD

osteoporosis



Joint space narrowing

Erosions in

surrounding surface

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⇒ POTT'S SPINE :-

• Nucleus pulposus - Remnant of notochord.

CHORDOMA :- Tx of Bone
clivus

Sacrocoelangeal area.

→ MC locatⁿ of TB is PARADISCAL

↑
PARADISCAL Abscess
→ DISC SPACE NARROWING

→ Earliest X-ray finding :- Rarefactⁿ of end plates (or)

Disc space narrowing.

→ Radiological Ix OC → But is

a) X-ray.

b) CT

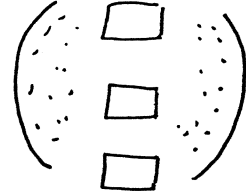
✓ CT GUIDED BIOPSY.

mri

✓ mri

d) mantoux

X-ray :-



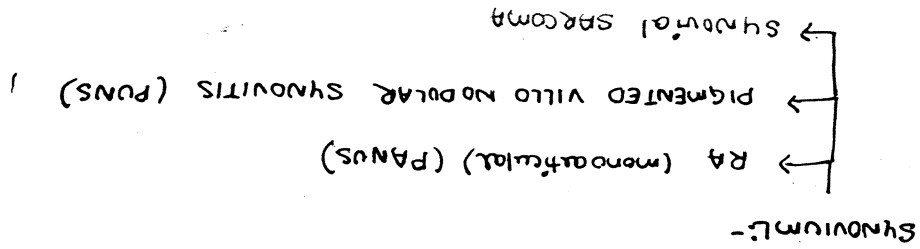
PARADISCAL Abscess → calcificatⁿ → Tubercular
on

→ 40 yr old alcoholic man - has Backache - X-ray co shows collapse

of D₃ & loss of D₃-D₄ disc space.

a) Trauma
b) Pott's spine
c) Multiple myeloma
d) metastasis.

→ D/B is RA



Synovial Thinning (Hypertrophy)

Involve synovium (lining of joints) NO bone involvement.

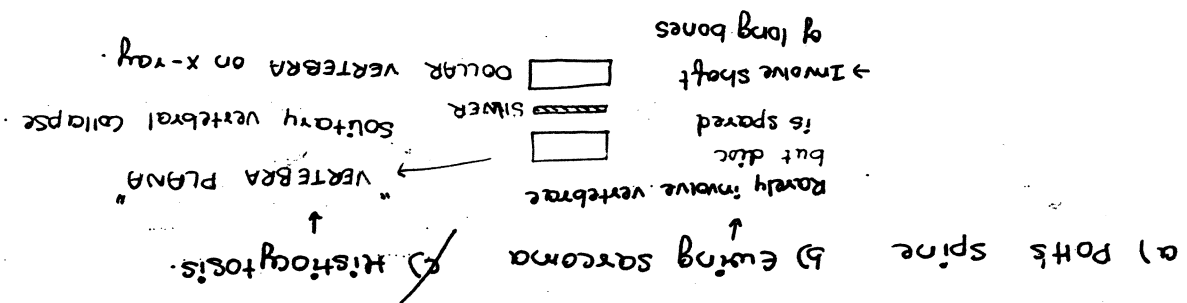
⇒ TB OF KNEE :-

Bone & joint involved → Destruct

WANDERING ACETABULUM - seen in x-ray in advanced stages.

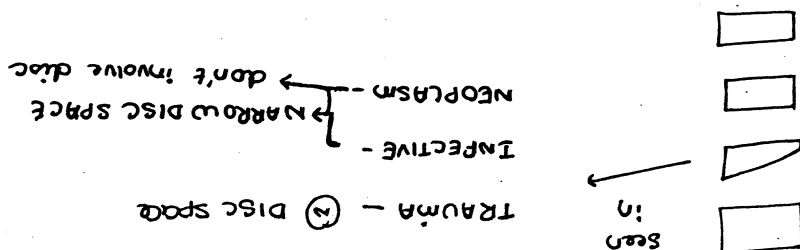
Earliest Feature :- on x-ray finding :- OSTEOPOROSIS

⇒ TB OF HIP :-



Disc space normal

→ A child 8 year old - Backache x-ray show collapse of D₁₀ vertebrae



Q- 25 yr old man show erosions on knee on x-ray. MRI show

synovial hypertrophy - low signal on T₁ & T₂ WI

In PUNIS - Haemosiderin is pigment deposited in synovial thickening.

PUNIS - Haemosiderin Th laden thickened synovium & erosions

⇒ TB shoulder :-

CARIES SICCA -
TB
Dry (no abscess)

D/D Gout all Tx

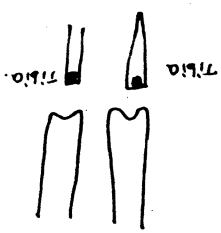
⇒ TB PHALANGES :-

SPINA VENTOSA

Intrauterine Infections
(Involve bone)
Congenital syphilis
Cong. Rubella.

⇒ Cong. syphilis :- Involve metaphysis of bone.

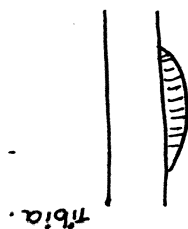
Knee Joint :-



erosion of Tibial metaphysis - WIMBEEGER SIGN

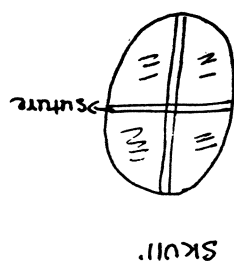
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X-ray:- Tibial shaft is thickened due to
(cortex)



Periosteal involvement

SABER TIBIA

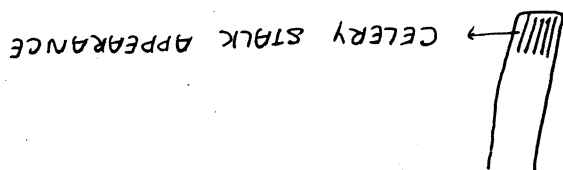


HOT CROSS BUN SKULL

Don't involve sutures

Cong. Rubella:

Involve metaphysis of Bone



CELERY STALK APPEARANCE

Intracranial calcifications caused by

CMV
Toxoplasmosis

Periventricular
Scattered

(Calcificatⁿ around
ventricles in brain)

Disorganised Joint

debris - bony fragment in joint

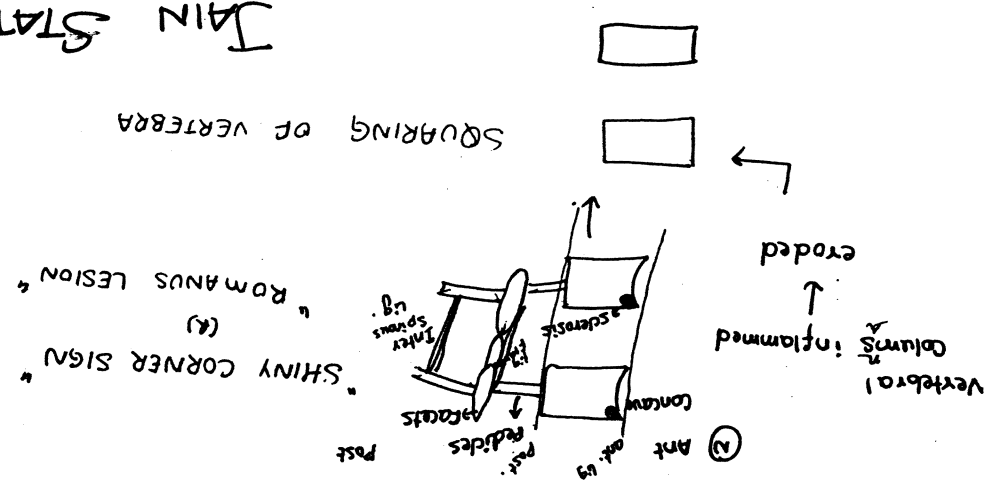
↓ density

⇒ NEUROPATHIC JOINTS:- Look like 'infect' but it's not 'infect' it is neuropathic

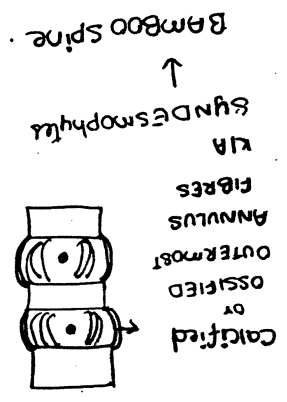
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ENTESIS :- ENTESIS :- Part of bone where tendon & lig. attached

ENTHESOPATHY

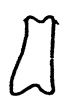


Disse
Outermost annulus fibres ossify in Ankylosing spondylitis
AS involve → Sacroiliac Joints.



- Charcot joint
- Clutton joint
- Tumbling Block spine
- SIG SAW VERTERAE
- BAG OF BONES SIGN

Leprosy.
Neuropathic Bone Resorption called as
LICKED CANDY BONE



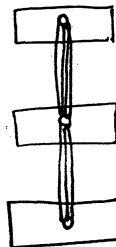
are sclerosed and then shiny corner sign

↑
vertebral columns inflamed

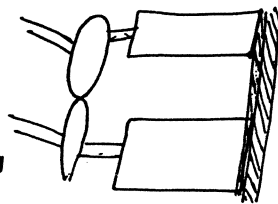
↑
eroded

↑
squaring of vertebrae.

(concavity of vertebral columns becomes straight)



DAGGER SIGN :: Interspinous lig. ossify.



FLOWING WAX OSSIFICATION SPINAL LIGAMENTS seen in

DISH

→

Diffuse idiopathic skeletal hyperostosis

(R)

FORESTEIR'S DISEASE

→ Flowing wax - spinal lig.

ligaments

→ ossific more on (R) side (asymmetrical)

→ SI Joint (N)

→ ALKAPTONURIA ::

- Intervertebral disc calcified in this.

- spinal calcificat.

⇒ Inter vertebral disc calcificat:-

- ALKAPTONURIA

- Ankylosing spondylitis

- Post Traumatic.

⇒ MOLTEN CANDLE WAX BONE

- seen in "MELODOSTEOSIS"

FLOWING WAX OF LIGAMENTS - seen in DISH.

PAGET'S DISEASE

Involve skull, spine, long bones

Skull :- well defined lytic area in skull k/a Osteoporosis

Circumscribe area of reduced density k/a



CIRCUMSCRIPTA



COTTON WOOL SKULL



PICTURE FRAME VERTEBRA.



ENTIRE VERTEBRAE IS DENSE k/a IVORY VERTEBRAE - on X-ray

↓

Hodgkin's lymphoma also

Long Bone:-



"BLADE OF GRASS"

Broader in subcuticular area & Tapered.

Disease

1. Psoriatic arthropathy

DIP involved.



PENCIL IN CUP DEFORMITY

in distal phalanx

→ Bone density - (N)

→ Periostitis - Sausage digit (swollen finger)

Earliest X-ray

- soft tissue swelling.

- PERIARTICULAR OSTEOPOROSIS (↓ bone

density)

- PIP & MCP involved.

3. Bone Tumors

MATRIX

PERIOSTEAL REACTION

MATRIX



OSTEOID Tx



CLOUD LIKE

SUNRAY Appearance

ARC/RING

STIPPLED

POPCORN



CHONDROID Tx



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divide into 5 types.



Periosteum lifted up & New bone below it deposited



LAMINATED / ONIONPEEL → EVINGS

Periosteal reactⁿ starts

Tr stops grow

Then grow like spurt

Then stop

grow

MALIGNANCY

Periosteum lifted up

but entire continuity is seen (Benign) so it is continuous

Lamellar Periosteal Reactⁿ

SPICULATED

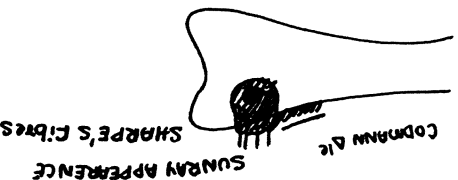
Ossificatⁿ around

Sharpe's fibres k/a (Periosteum to bone linkage)

Spiculated periosteal

reactⁿ look like

SUN RAY APPEARANCE



CODMAN'S ARC adjacent to it Sharpe's fibre ossificatⁿ i.e

Sunray appearance.

OSTEOSARCOMA

Periosteum lifted up little Interrupted Periosteal Reactⁿ

CODMAN'S ARC

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→ X-ray shows → stippled calcification

→ Pediatric age group

→ Involve epiphysis

→ microscopy → giant cell

→ Histologic → chicken wire like calcification

⇒ In chondroblastoma / Codman's Tx :-

- PVNS
- Giant cell - osteosarcoma type
- Brown Tx
- Nonossifying fibroma / aneurysmal bone cyst
- Chondroblastoma
- Osteoclastoma
- Giant cell containing Tx

stippled calcification & biopsy shows giant cells :- any chondroblastoma

→ 12 yr child shows lytic lesion in upper humeral epiphysis :-

As:- EWING'S SARCOMA

Round cells - MIC-2 +ve

malignant perosteal reaction

& A child on X-ray shows

Benign Tx

X-ray

4. → Enchondroma (true Tx)
Benign cartilage Tx)



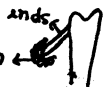
'O' RING SIGN

Ring like lesion in phalanx is

→ multiple Enchondromas → OLIER SYNDROME

→ multiple enchondromas to subcutaneous Haemangiomas → MAFUCCI SYNDROME

5 → Exostosis (a)
Osteochondroma
(Benign)



→ cartilaginous cap. @ - 1cm.

> 1.5 cm - Biopsy - advise MRI

multiple exostosis called as "DIAPHYSEAL ACLASIS"

X-ray of fetus bone:-

6 → Fibrous Dysplasia (proliferation of woven bone)
Adult bones → lamellar bone
Fetal bones → woven bone



+
Abn woven bone

→ on Bone scan, FD appear as HOT
"Tc-MDP"
HOT

SHEPHERD CROOK

→ commonly involve femoral neck.

GROUND GLASS APPEARANCE OF BONE

FD + Precocious Puberty + Cafe au spots
McCune Albright syndrome.

3) Vertebral Hemangioma (benign)



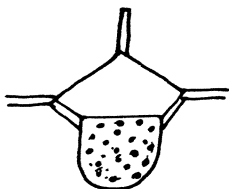
Vertical striations in

vertebrae.

X-ray

Codrey CLOTH appearance

on CT:- Polka DOT SIGN.



8) SIMPLE bone cyst



Central unilocular cystic

appearance

Fx of wall of simple bone cyst

Fall into cystic cavity seen in

Simple bone cyst 2 pathological

Fx.

Malignant

multiple
myeloma

cold

lytic.

Skull :- Punched out lesion.

outer & inner table are

equally involved.



metastasis

Hot.

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Bevelled edges - lytic lesions.

Inner Table less involved

Outer Table more involved.

1. Vertebra plana. (a) Silver Dollar vertebra.

2. Bevelled edges.

3. Floating Teeth (mandible fx).

also seen in Hyperparathyroidism

4. on CXR → Honey comb appearance.

5. E/microscopy → Birbeck granules

Rocket appearance.

Bone metastasis

Lytic

blastic

mcc in male → Prostate

mcc → ♀ → Breast

other stomach

Bladder

Carcinoid.

Lytic & Expansile
RCC & Thyroid



→ Isotopes which are systemically used for Bone Tx :-

- a) Radioactive Phosphorus — Bone Tx
- b) Strontium
- c) Yttrium
- d) Samarium, Rhenium → β & γ rays.
- e) Radium 223 → α -rays

Emits pure β rays

→ Use of ... Bone metastasis 84y in one Fractⁿ (early 30 64 in 10 Fractⁿ)

GIT

→ Barium study:-

Single contrast

only Barium

Double contrast

Barium + Air [By giving end to Barium] Effervescent agent

⇒ Barium:-

→ Ba swallow → esophagus

→ Ba meal → Stomach & Duodenum

→ Ba meal Follow S I through

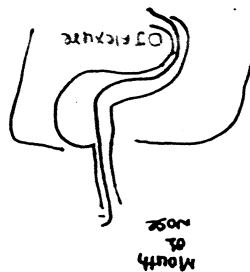
→ Ba Enema L I

I^xOC for small bowel pathology → Enteroclysis ^{small Enema} > Ba meal follow through

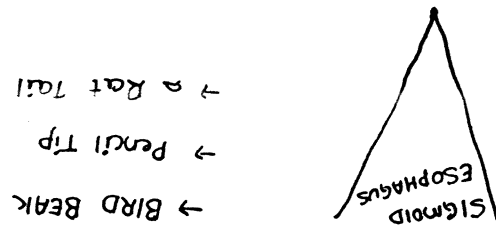
BILBAD DOTTER TUBE (Active process)

Put tube upto DJ flexure

Barium given directly into SI



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Achalasia Cardia:

1. Tracheoesophageal fistula → use Dianasil (non ionic) dye.
2. Perforation → Gastrografin study.

⇒ In some conditions, where Barium is not used is.

- Small Bowel Pathology → Enteroclysis.
- Small Bowel Tumor → CT scan
- GIST → CECT
- Recurrent GIST → PET

I^xOC

I^xOC For Small Bowel I^xOC (Stomach Tx) = CT Scan
↓
Gross exophytic
outside lumen

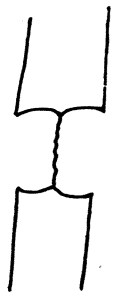
Then take X-ray.



Ba meal follow through
(passive) process

Enteroclysis (active process)

Ca esophagus



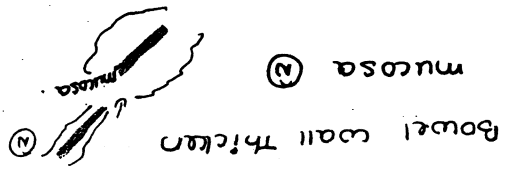
SHOULDER RING MARGIN

RAT TAIL (classically Ca esophagus)

APPLE CORE (classically Ca colon)

USG appearance

1) For Bowel thickening → PSEUDO KIDNEY SIGN



STOMACH

Long. Hypertrophic pyloric stenosis

Ixoc :- USG

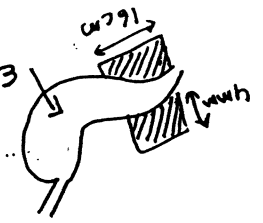
USG findings:-

pyloric length > 16mm

wall thickness > 4mm

pylorus thickened

Empty stomach > 95%



on Barium :- STRING SIGN

DOUBLE TRACK SIGN

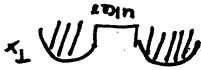
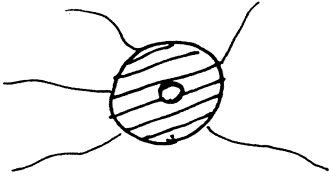


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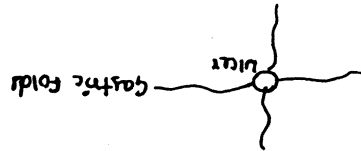
→ Gastric folds don't reach the ulcer margin.



→ IT IS A Tumor.

→ margins are everted, heaped up

greater
malignant.



margin like spoke wheel

Gastric folds radiating from ulcer

lesser

Benign

b) Gastric ulcer



In ulcer :-

cap becomes scarred.



(Chr. duodenal ulcer)
Benign - acid pep

a) Duodenal ulcer → duodenum becomes Trifoliate duodenum.

large bowel → Incomplete folds → Haustra

Ileum → characteristics.

complete folds

Ileum → valvulae conniventes → Feathery

Duodenum → 'C'

cap

1st part of duodenum → looks like.

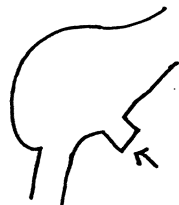


On Barium :-

ULCER

Benign ulcer appear as

Outpouching



Filling defect seen in this

Malignant

Carmann's meniscus sign seen in

1) Gastric ulcer

2) Ca stomach

→ which of following doesn't indicate malignancy in gastric ulcer.

a) located on greater curvature.

b) Folds - Don't reach ulcer margin.

c) Carmann's sign

c) Lesser curvature ulcer \leq nodular ring \uparrow Tx

→ CARMAN'S MENISCUS SIGN K/A → CARMAN KIRKLIN COMPLEX malignant gastric ulcer.

→ ulcer lead to perforation

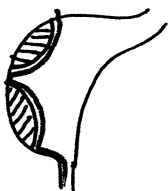
After Perforation → Gas under diaphragm (only 70% people show this)

→ Best X-ray for Pneumoperitoneum:-

→ CXR - PA view

→ CXR - erect

CARMAN'S
MENISCUS SIGN



For Pneumoperitoneum, if we can't do CXR (pt. can't stand) we do X-ray left lateral decubitus (because gas will rise up)

⇒ For Pneumoperitoneum:-

CXR PA view > ⑦ lat. Decubitus.

→ IxOC for Pneumoperitoneum:- $\boxed{CT} > CXR > \textcircled{1} \text{ lat. decubitus}$

Pneumothorax
Pneumo mediastinum
Pneumo peritoneum

CT

→ In Supine X-ray Pneumoperitoneum:- ① FOOT BALL SIGN on abd. X-ray.

→ don't see gas under diaphragm

→ see gas below umbilicus. (centre of abdomen)



2. RIGLER'S SIGN:-



In Perforatⁿ:

visualisatⁿ of both inner & outer

aspect of bowel wall. seen

in Pneumoperitoneum in supine

position.

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⇒ Tell Tale Δ^c sign :-

seen in Pneumoperitoneum

Δ^c pocket of air on x-ray of

abdomen.



⇒ Falciform lig. sign :- air around falciform lig.

⇒ Cupola sign.

⇒ Kidney veil sign :- air surrounding kidney.

perforation in Retroperitoneal area

⇒ Double bubble sign :- Duodenal atresia

annular Pancreas.



Pancreas

Acute Pancreatitis

CECT (To see extent of necrosis)

edematous

necrotizing (worst prognosis)

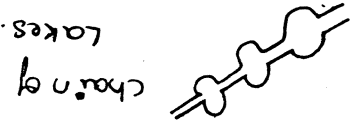
Prognosis → Degree of necrosis

"BALTHAZAR" GRADING system

Chr. Pancreatitis
I_{sc} = MRCP - non invasive.

(shows Bile duct &

Pancreatic duct)



multiple alternate structures

& dilatation

Acute

Chronic

Plain X-ray Abdomen:-

→ Colon cut off sign.

Colonic gas can't see

behind hepatic flexure

→ Sentinel loop sign - "ileus obstruct"

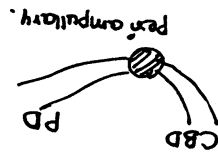
→ Gasless abdomen - due to vomiting.

Periampullary Carcinoma.



FROSTBERG SIGN or REVERSE S SIGN.

CT scan



Double duct sign

→ Jaundice, wt. loss, CT scan - CBD, PD fill lower end

Ca head of Pancreas.

on barium

widening of C-loop of duodenum.

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X - - X - -
Sunburst calcification

Stellate like.

CT/MRI Bunch of Grapes. multicystic.

Pancreatic Head of pancreas :- Intraductal Pancreatic mucinous neoplasm
Bunch of grapes → dilated PD. (IPMN)

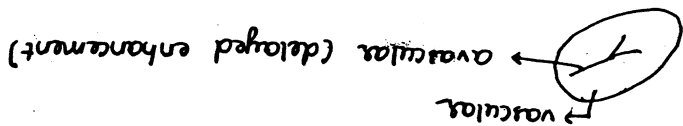
Liver

Hepatic Hemangioma Ixoc → CECT

CT of Liver → TRIPPLE PHASE CT OF LIVER
→ Arterial phase
→ venous phase
→ capillary phase

1. Hepatic adenoma
 2. FNH
 3. HCC
- enhance in arterial phase.

FNH - has central scar → avascular - delayed enhancement
late
- Vascular Tumor → enhances in arterial phase.



→ Liver has Kupfer cells so it take more T_2

→ Focal hepatic lesion → Triple phase CT

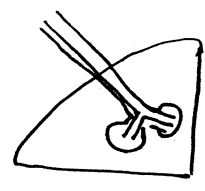
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→ Best, Hepatic Hemangioma - Tc RBC scintigraphy.

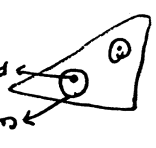
CAROLI'S DISEASE:-

Intra hepatic bile duct dilated

I_{xOC} - mrcp.



CT.



CENTRAL DOT SIGN

Intestine.

Intestinal Obstructⁿ - $I_{xOC} \rightarrow$ CECT

X-ray \rightarrow of abdomen.

upto 3 air fluid levels it is (N)

In Intestinal obstructⁿ

> 3 Air fluid levels, > 2.5 cm.

small Bowel obstructⁿ large Bowel obstructⁿ

AFL centrally placed peripherally placed

small

large

Valvulae

Haustra

Jejunum obstructed:-



STRING OF BEAD APPEARANCE - X-ray abdomen
 ↑
 Small Bowel (Jejunal) obstructions

⇒ Confused:-

STRING of BEADS in angiography - Fibromuscular dysplasia

↓ seen in
 Renal a. stenosis



In CT scan →

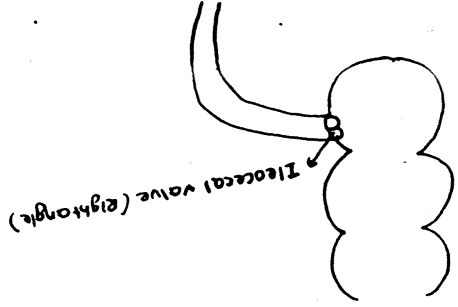
1. Bowel loops measuring
 - 3 cm → small bowel obstructed
 - 6 cm → large bowel
 - 9 cm → caecum

2. Transition → Tells the site of obstruct

3. Cause of obstruct

Bowel TB

Terminal ileum appear narrow
 ↓
 due to stricture
 Shows STRING SIGN

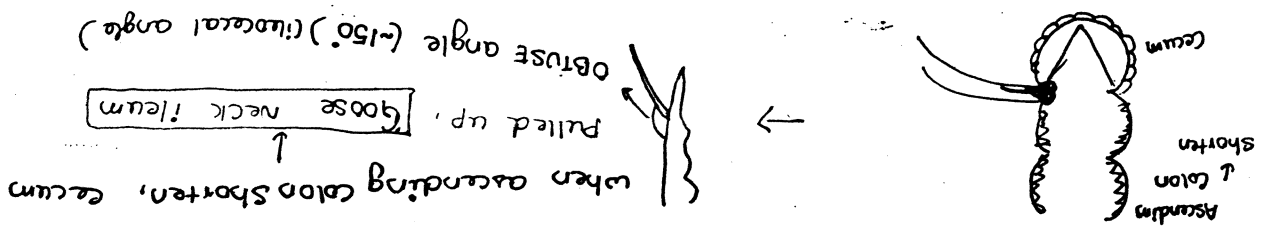


Ileocecal valve becomes thickened
Terminal ileum becomes narrow.

FLEISCHNER SIGN & INVERTED UMBELICA SIGN.



Cecum fibrosed → contracted & become conical in shape.



Conical Cecum → Bowel TB

→ Crohn's disease

→ Amoebiasis.

Ulcerative Colitis

Crohn's Disease

1. Earliest Finding on Barium
Mucosal granularity (irregular mucosa)

Tiny APTHOID ULCERATION.

2. ULCERS on Barium study

Narrow neck
Broad base
Collar Neck
Button ulcers



Pseudo polypus.

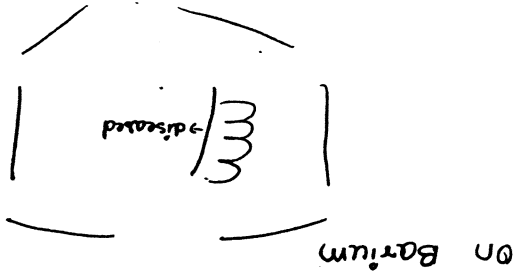
→ Patches of Mucosa on background of ulcerated mucosa.

→ Colon is fibrosed

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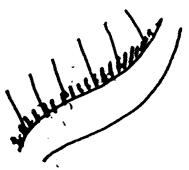
Hose Pipe Intestine

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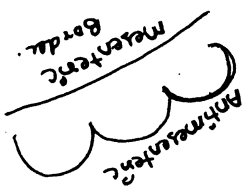
CT-scan Finding:-

↓ vascularity
in mesenteric
border
(⑤ less vascular)
Comb sign.



due to mesenteric border
shortened.

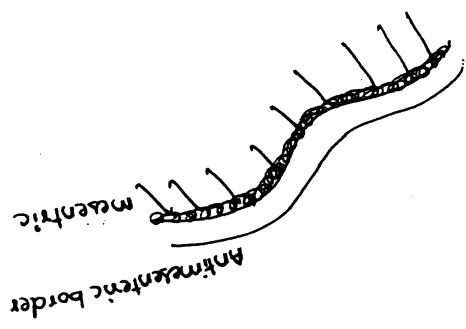
look like Pseudo sacculations



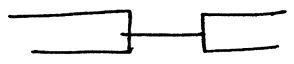
→ Antimmesenteric border folded &

shortened.
fibrosed &

→ Mesenteric border of border
Involved. ↑

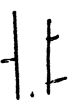


STRING SIGN OF CANTOR.



Tiny mucosal ulcers of small
bowel

ROSE THORN



HOSE PIPE INTESINE.

Intesine is fibrosed

Lead Pipe colone
Pipe stem colon
Hose Pipe colon
→ Back wash ilitis
→ Terminal ilium is
involved



Gastric Chorns:-

on → Barium study → Ram's Horn
pylorus becomes very narrow.



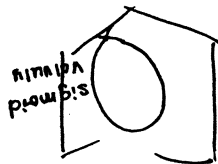
→ Pseudo Biliroth-I (look like as Biliroth
operation is done)

⇒ Thumb print sign → on Barium Enema. → Ischemic colitis

on X-ray neck → Acute epiglottitis

Ischemic Colitis : Ixoc → cect

→ Old, Feeble persons.

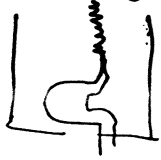


coffee bean appearance. on X-ray.



on Barium enema → Bird of Prey sign

→ midgut volvulus:-



Cork screw appearance.

on Barium meal.

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→ Acute diverticulitis → CECT



Diverticulum is inflamed
↓
abscess (pericolonic)
↓
CECT

→ Acute appendicitis → CECT (adult)
→ Arrowhead sign

→ IxOC for acute appendicitis in child → Graded compression USA
(because abd. small)

appendiceal diameter > 6mm

in child, don't give
extradiatn

For appendicitis

Blunt abdominal trauma

IxOC → CECT
1st step

FAST

(Focused assessment)

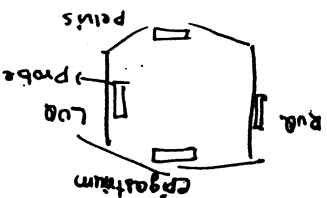
Sonography in Trauma)

→ procedure done by physician (Emergency room)

→ look for Hemoperitoneum (200mm)

→ Detect 200mm blood

→ done for 1-2 min



look in

RUL → Morrison's pouch

Epigastrium → Cardiac Tamponade

Pelvis → Bld in pelvis

LUL → Perisplenic area

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Acute pancreatitis
Intestinal obstructⁿ
Pneumoperitoneum
Appendicitis
Devericulis
Ischemic colitis
Blunt abd. Trauma.

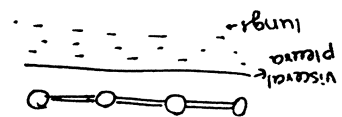
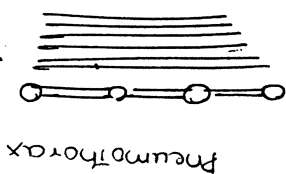
CT

In acute abdomen \rightarrow I^xoc \rightarrow CT

except.
Gall bladder \rightarrow usg.
Gynecology emergencies

SEA SHORE SIGN.
USG (N)
can't see visceral pleural space.

STRATOSPHERE SIGN.



(N) Chest appearance.

Pneumothorax.

Haemothorax



Look For Thorax & abdomen

e Fast \rightarrow extended FAST.

INDICATION
 I_{xOC} → CECT (any renal pathology) (after early - IVP)

→ STONE :- (pelvic/renal stone)

I_{xOC} for urinary stone :- NECT

Why CT > Xray because some stones are radiolucent (uric acid)

which are not detected by X-ray.

USG → Poor Ix for ureteric stones.

→ show bladder & kidney.

→ ON IVP

Acute ureteric obstruct

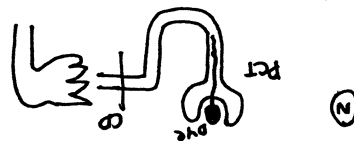
Chronic ureteric obstruct

1) ON IVP

Persistent Dense

Severe hydronephrosis

Nephrogram
 ↓ also in dehydratⁿ
 renal a. stenosis
 dye stays at
 per only
 can't go down



"RIM NEPHROGRAM"

kidney become thin.

1 min → nephrogram (outline of PCT)

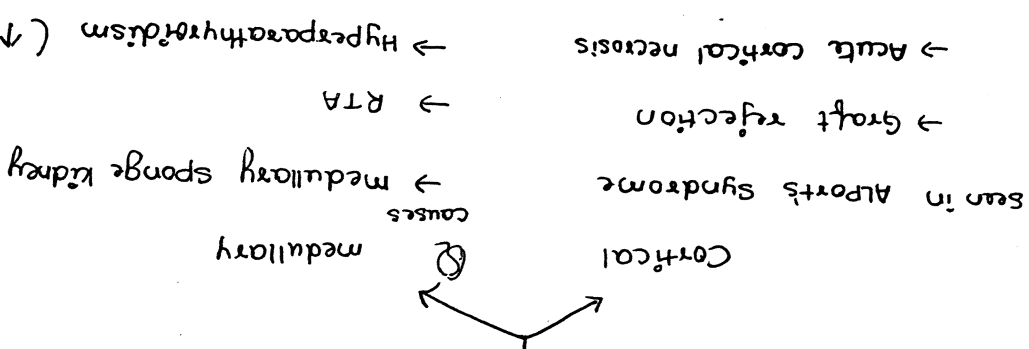
5 min → calyces

10 min → ureter

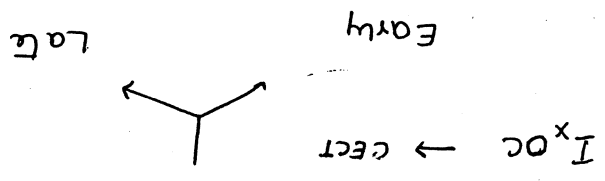
15

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Nephrocalcinosis

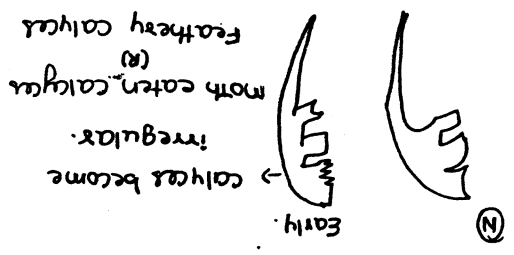


Renal TB



most sensitive imaging
 For early Renal TB is

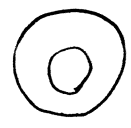
IVP



- PUTTY KIDNEY (amorphous powder like)
- CEMENT KIDNEY
- AUTO NEPHRECTOMY

⇒ Bladder in TB :- Thick walled Bladder

Rarely calcify.



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Schistosomiasis.

pgt bladder calcificatⁿ can be seen -

✓ a) schistosomiasis

✓ b) TB

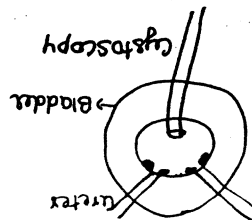
✓ c) Bladder TCC

on cystoscopy:-

GOLF - HOLE URETERS

mucosa thickened at UB junctⁿ

ureteric opening is very thickened.



Papillary Necrosis:-

Renal papillary necrosed & sloughed off.

Seen in - phenacetin abuse

- TB

- sickle cell appse anemia.

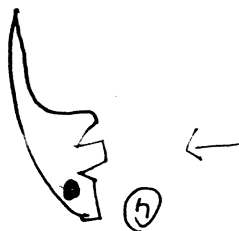
- DM.

In IVP → Egg in cup
Dead papilla.
calyx

GOLF BALL ON TEE SIGN

RING SIGN

LOBSTER
GLOUS
Claw sign



Polycystic Kidney Disease

I^xOC → CECT

AR AD
Infants adult

→ B/L

Small cysts linearly arranged
Randomly
Large cyst irregularly arranged
Randomly



ON IVP



STRIATED NEPHROGRAM
SWISS CHEESE NEPHROGRAM

Cysts don't take dye.

Q. 40 yr old ♀ - Burning micturition, Fever, (R) Renal cyst (+)

IVP - striated nephrogram

Ans :- Acute Pyelonephritis

Blood vessels obstructed & ischemic due to infection



Ischemic areas (↓ blood flow)

Q. Acute PN on USG show an except.

- a) enlarged kidney
- b) Thickened perinephric tissue.
- c) Altered echogenicity
- d) ↓ vascularity on Doppler.

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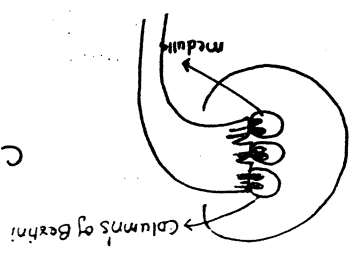
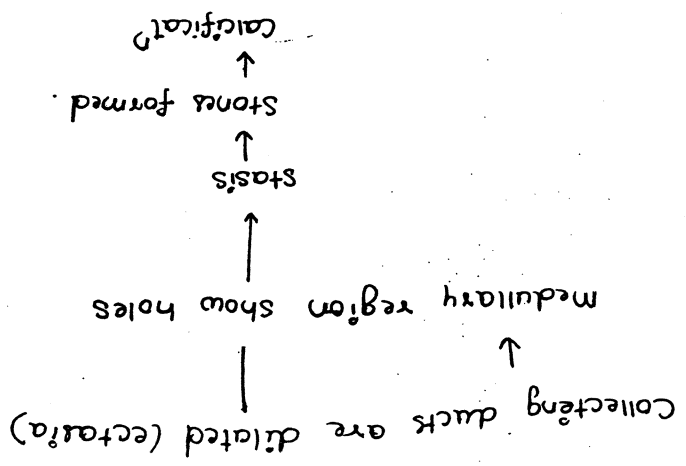
HORSE SHOE KIDNEY FLOWER VASE APPEARANCE

upper calyces faces opp. to each other

lower face / calyces face each other. → Hand shake sign.

Bouquet of flower appearance on IVP → medullary sponge kidney

Medullary sponge kidney.



URETEROCOELE
adder head appearance on IVP



I_xOC

VUR → MCU

(Post-urethral PUV → MCU
valve)

Post-urethra → MCU

I_xOC for Urethral Injury → RGV (Retrograde)

A child has



Tx in upper pole of kidney

WILMS

Neuroblastoma

Displace vessels

Calcification

Lung metastasis

Bony metastasis

Vascular encasement (Tx all around vessels)

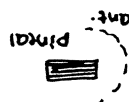
CNS

→ sites of physiological calcification in skull X-ray

a) PINEAL - cigar like calcification

(epithalamus)

b) Habenula -



c shaped calcification

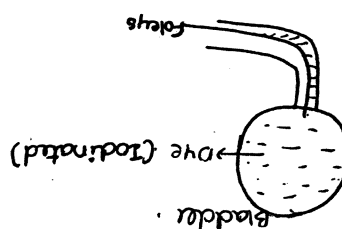
c) choroid plexus

d) Arachnoid granulations

e) Dura, pituitary, Basal ganglia

MICUTRATING CYSTO
URETHROGRAPHY

RETROGRADE urethrogram
(RGU)



catheter insert at tip of urethra

✓ Basal ganglia calcificatⁿ on skull x-ray.

causes:-

- senile (normal)
- young one (It is abⁿ) - seen in Hypoparathyroidism
- Hypothyroidism

- CO/Pb poisoning

- Anoxia (prolonged)

- FAHR, Cockayne syndrome.

→ Brain Tx showing calcification:-

CA²⁺ come

C - Craniopharyngioma

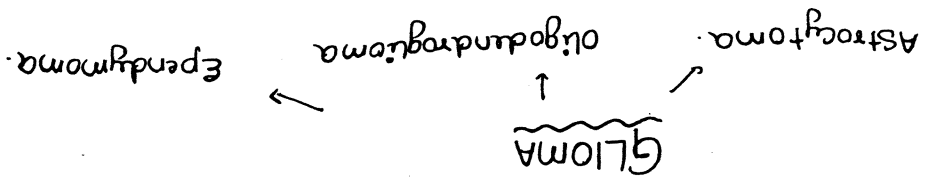
A - Astrocytoma.

C - Choroid plexus Papilloma

O - Oligodendroglioma.

m - meningioma

E - Ependymoma



CRANIOPHARYNGIOMA: arises from Rathke's pouch.

→ we see calcificatⁿ in suprasellar region.

- seen in Bimodal
- appears like solid-cystic areas
- cysts are filled w fluid (machine oil like content)

Cranio-pharyngioma pathologically divided into

- Adamantinous
- Papillary

Child Adult

calcificatⁿ is common calcificatⁿ uncommon

PCP calcificatⁿ is uncommon in adult craniopharyngioma issue

⇒ Brain Tx which show csf spread :-

1) medulloblastoma

2) CNS lymphoma

3) Germinoma

4) Ependymoma

5) Glioblastoma multiforme

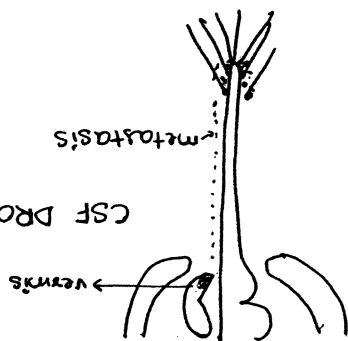
medulloblastoma

1. It is Primitive Neuroectodermal Tx (PNET)
- Small Round cell Tx (Ewing's also)

2. locatⁿ :- Post. Fossa midline

3. Typical medulloblastoma can't calcify but atypical medulloblastoma can calcify

TURCOT'S syndrome = Glioma + medulloblastoma + polyposis



CSF DROP n on MRI called as SUGAR COATING appearance

CNS LYMPHOMA

1° CNS lymphoma ass. 2 AIDS

→ AIDS pt. showing → RING enhancing lesion on MRI

- TOXOPLASMOSIS

also - Tuberculoma

- Neurocysticercosis

- metastasis

- Brain abscess

→ AIDS pt. shows a homogenous enhancing lesion → Lymphoma.

→ AIDS, Brain shows subcortical atrophy → HIV encephalopathy

AIDS - Focal lesion

Non enhancing

(Virus)

- CMV encephalitis

- PML (progressive multifocal leukoencephalopathy)

caused by JC Virus

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GERMINOMA

→ Germ cell Tx of Brain. spread by CSF (act)

→ These are extragonadal GCT (mc site is mediastinum) (yuvraj. seminomatous variety)

→ mc site → Pineal gland

→ mc pineal Tx :-

- Pilocytopoma.
- Pinealoblastoma
- Germioma
- Astrocytopoma.

TERATOMA

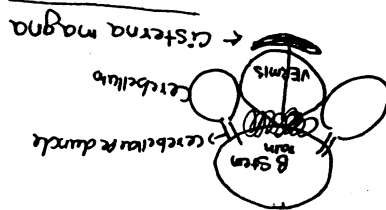
Seen in Newborns

Ependymoma

→ Glial Tx, spread by CSF.

→ In child, we classically seen in IV ventricle - site

→ In adult, site - Conus medullaris (A) Filum Terminale.



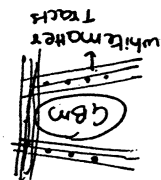
Property of Ependymoma is contiguous spread.

Young pt. headache, Tumor in IVth ventricle extending into surrounding
for a Cisterna magna. → Ependymoma.

Glioblastoma multiforme

Sizarre forms.

→ Highly malignant Brain Tx



GBM spreads via 1. CSF

2. Surrounding white matter Tracts

Rx:- Sx + Radiotherapy + chemotherapy.

Meningioma

arises from Arachnoid cap cells

→ more in ♀ (Have female Hormonal receptors) - Hormone dependent.

→ Tx enlarge in Preg. → pit. adenoma

meningioma.

↳ Syndrome assoc. 2 meningioma → NF-2

→ It is a Radiation Induced Tx

→ shows calcification on X-ray / Hyperostosis (thickening of skull bone)

→ on MRI:-

Dural Based.



Dural Tail Sign

40 yr old female, present w/ headache, MRI - dural based Tx

→ meningioma.

→ Dural Tail sign seen in.

a) acoustic neuroma.

b) pit. adenoma

c) meningioma

d) astrocytoma.

→ In meningioma, if you give contrast, it shows intense

homogenous enhancement. Comes early & stay till late
 [MOTHER IN LAW Phenomenon, IN Brain MRI]

Vestibular Schwannoma



nerve sheath Tx

→ k/A Acoustic neuroma.



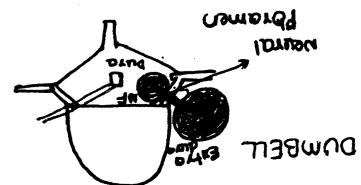
ICE CREAM CONE Appearance on MRI
 In canal it is narrow

In CP angle, it is broad.

→ B/L -

→ as 2 NF-2 (chr. 22)

→ located :- Intradural extramedullary. (IDEM)



→ T₂ which show intra & extra dural is spinal neurofibroma. (NF)

Spinal cord tumors

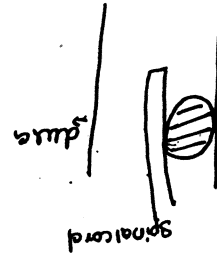
→ spinal hemangioblastoma (rarely) - seen in VHL

→ Ependymoma

→ Astrocytoma

→ For spinal cord we do MRI (now)

→ Expansion of the filled space on myelography → IDEM

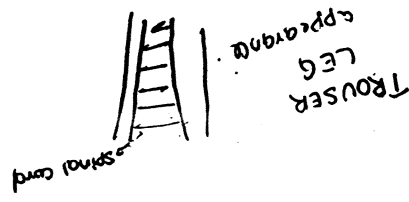


CSF space - expands

→ Expansion of spinal cord → Intramedullary T_x

↓
In this CSF space ↓

spinal cord expand



Intradural

IM

Astrocytoma

Ependymoma

expansion of spinal cord

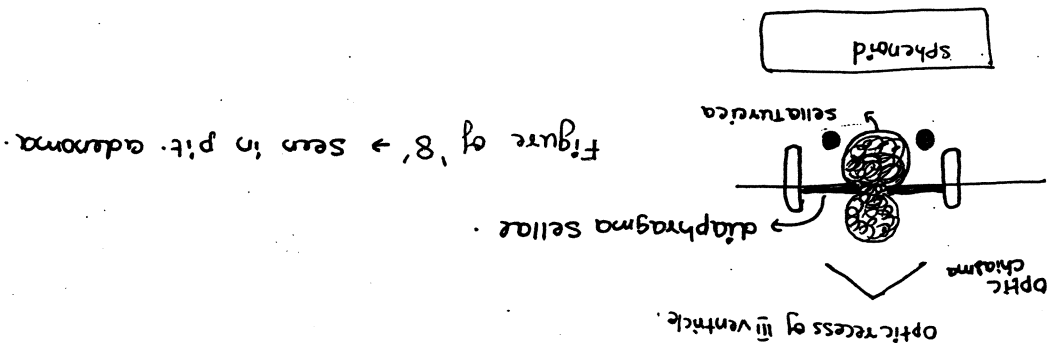
TRouser LEG Appearance

EM

Neurofibroma

Meningioma

expansion of CSF space



Pituitary Tx → adenoma (slow growing)

micro
micro
> 10 mm

Neurocutaneous disorders / Phakomatosis

(Skin lesions ± neurological problem)

1. NF

2. Sturge weber

3. Tubercous sclerosis

4. VHL

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AD

chr. 22.

B/L

ass & acoustic neuroma. (B/L)

- meningioma

→ Brain T₁ ass & NF-1

is optic glioma.

It is a pilocytic Astrocytoma (PA)

mc site - cerebellum

→ Juvenile cerebellar PA

→ low grade

→ Histologic finding:- Rosenthal fibres

→ ass & bony defects. i.e.

sphenoid dysplasia

(sphenoid not formed properly)

on skull X-ray → Bare Orbit sign

→ Pseudarthrosis of long bones

mostly T1gial Pseudarthrosis

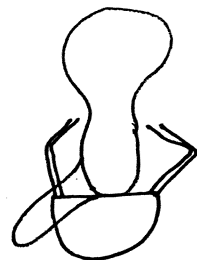
→ scoliosis

→ ribbon like ribs (flat ribs)

→ lateral meninges → mesodermal defect

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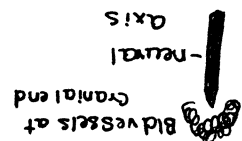
mesodermal defect.



Sturge Weber Syndrome.

Osler Weber Rendu Syndrome:- Hereditary Hemorrhagic Telangiectasia.

- k/A - Encephalo Trigeminal Angiomatosis
Brain Face bid vessel

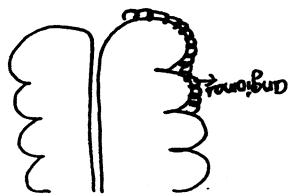


abnormal persistence of embryonic vessels

Port wine stain Naevus.

Portuguese

In Brain :-



SUPPIL Angiomas

In
calciated Brain surface vessels k/A TRAM TRACK appearance
in older age.

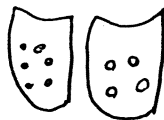


→ Tram Track appearance is seen in newborn Sturge
Weber syndrome → False - seen in older age.

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→ Retina: Retinal Astrocytomas.

→ Lung: Lymphangioleiomyomatosis → exclusively seen in young ♀
 ↑
 Honey comb on CXR
 Recurrent chylothorax
 (cyst rupture into pleural)



→ TS may lead to Polycystic kidney like disease

→ Kidney: Angiomyolipoma

→ Heart: Cardiac Rhabdomyoma

→ White matter Ab (B) due to ab (B) in myelinat?

→ At Foramen of Monro - Subependymal Giant cell Astrocytoma (Tumors)

→ Subependymal nodules → Hamartomas

→ Cortical Tubers - Glioneuronal Hamartomas

Tuberous sclerosis (TS)

Seizures occur opposite to stain



Hemiatrophy of Brain



→ Vascular steal phenomenon

VHL Syndrome



- Hemangioblastoma
- mc site - cerebellum.
- ans = clear cell RCC, pancreatic cyst / tumor, polycythemia.

→ Endolymphatic sac Tx

- Epididymis + Fallopian Tube
- Adjuvant Tx

→ ans = Pheochromocytoma.

white matter Disorder



Demyelinationⁿ destroy myelin
 Dysmyelinationⁿ (myelin not formed)

→ multiple sclerosis - Relapsing, Remitting, no factor

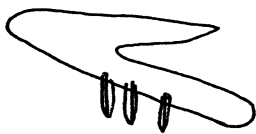
→ Osmotic demyelination (rapid correctⁿ of Central pontine osmotic hyponatremia)

demyelination.

→ ADEM (acute disseminated

- childhood

- Initiating factor viral infectⁿ monophasic. neural problem



Dawson finger

Finger like demyelination
T1ar to ventricle

→ Demyelination → Periventricular.

→ Identification in MRI

→ Mc Donald's criteria - used for MRI diagnosis.

→ How to identify demyelination on MRI

demyelination only on 3 sides &/a - ring sign (

Dysmyelination

→ child - developmental delay - white matter (N) - MRI

Large head.

Alexander disease:- Involvement of frontal lobe.

On HPE :- Rosenthal fibers.

Canavan disease:-

→ involve diffusely.

→ on MRS → NAA ↓

→ Developmental delay

Subcortical U fibres are spared

all white matter involved

as Krabbe's disease

↳ metachromatic Leukodystrophy - (MLD)

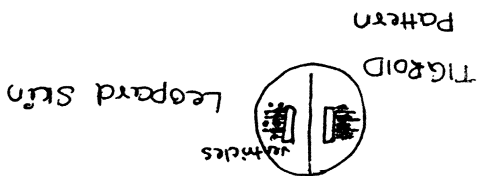
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1. → KRAEBT'S disease k/a - GLOBOID leukodystrophy.

involvement of Thalamus & basal ganglia & destroyed.

2. → MLD :-



3. → Adrenoleukodystrophy :- posterior part involved.

Occipital } Parietal
parts involved

Q. Infant → Infarct in MRI of Brain, Lactic acid levels ↑

Asis is mitochondrial encephalopathy.

MELAS

Parkinson's Disease

MRI finding:- Absence of swallow Tail.

mid brain atrophy Look like Parkinson's disease → Progressive supranuclear atrophy Palsy.

Humming Bird sign on MRI



Transverse sectⁿ → Mickey mouse sign

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MSA (multisystem atrophy)

Types:-

MSA_c - Olive Ponto cerebellar atrophy

MSA_P - Putaminal atrophy → PUTAMEN RING SIGN

MSA_a autonomic → k/A - SHYDRAGER



cruciform fibers
seen in
HOT CROSS BUN PONS → MSA_c

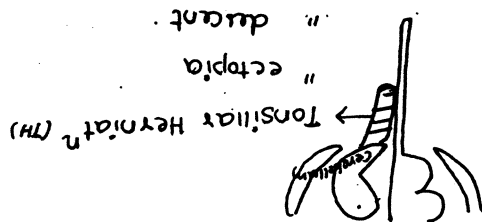
HIND BRAIN PROBLEMS (post. part of brain)

Chiari malformation

Dandy walker malformation

Post. part of skull - small

Small post. fossa



Chiari Type I → only TH

Chiari Type II → TH + Spina bifida

meningomyceloid

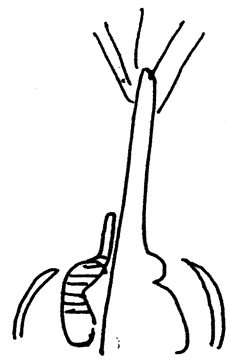
ARNOLD CHAIRI malformation

CHAIRI Type III & IV - rare.

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Chiari-I



At Birth -> no problem.

pt. develop long syringomyelia. (at age of 30-40)
Younger adult

Tonsillar H compress spinal cord
at Foramen.

Chiari-II

- spina bifida.

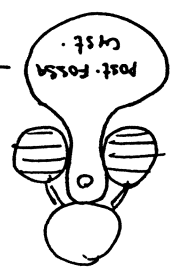
-> cerebellum pulled & wrapped around
spinal cord



BANANA SIGN. Cerebellum

LEMON shape skull
on MRI / USG

Dandy walker :-



-> Post. fossa cyst -> vermian agenesis

-> absence of vermis

IV ventricle easily communicate w cisterna magna

leading to

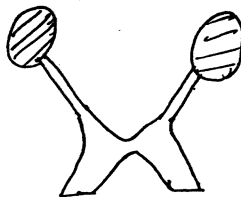
expand post. fossa.

Vermian agenesis → in Tuberous sclerosis

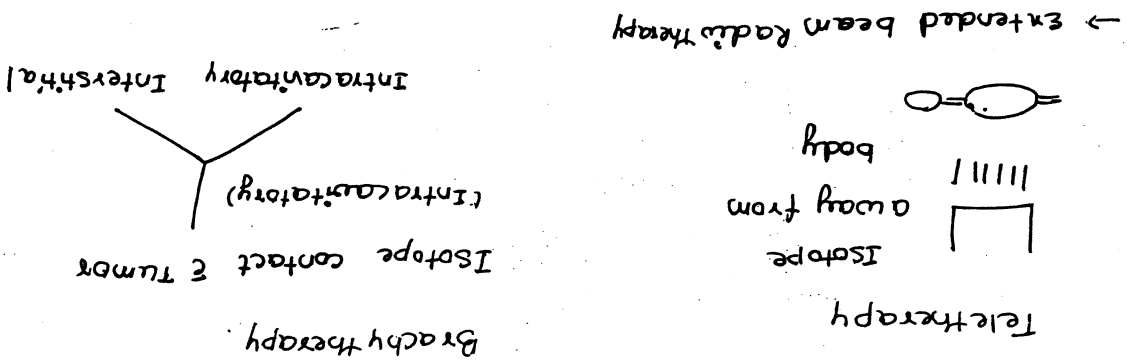
sup. peduncles mid Brain stretched
attached

Vermis absent

MOLAR TOOTH SIGN.



Radiotherapy



Unsealed RT → systemic administration of isotope.

Iodine — Thyroid

phosphorus — Bone Tx

⇒ Teletherapy :

- 1) X-rays
 - 2) γ-rays
- If tumor is deep.

3) e-Beams → superficial Tx → skin Ca.
electron.
→ Intraoperative RT

2 types of machines

cobalt machine
LINAC linear accelerator.

X-ray generator (produce x-rays)

1) Orthovoltage variety

2) megavoltage

3) supervoltage.

- artificial isotope
- $t_{1/2} - 5.2$ years
Co⁶⁰ decays
↑
β rays
Ni⁶⁰ + γ rays
(most penetrate)

→ Co kept away from body

so β-ray γ-rays reach

body

→ Co⁶⁰ emits - γ-rays

β-rays.

Q → max. skin burns are at 2

a) Co

b) Orthovoltage

c) megavoltage

d) supervoltage.

Cobalt

LINAC

→ orthovoltage

pt. rejected initially.

→ Now we are using this.

because No isotope required for this

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FRACTIONATION

→ Once daily / weekend off

→ Hyperfractionation (> once daily) in lung Ca.

→ CHART REGIME of Radiotherapy for lung Ca. (non small cell variety)
Continuous hyperfractionated accelerated radiotherapy

→ For small cell Ca → Prophylactic cranial Radiation.
(all also)
→ as soon as D_{50}^{mod} cut metastasis, Radiation is given prophylactically.

IMRT

→ Intensity modulated Radiotherapy
→ Radiation given according to shape of tumor

for thick → more intensity.
Thin → less intensity

→ Give conform → 3D shape of T_x.

→ given for Prostate, Head & Neck Ca.

→ GMV - dose given for Prostate Ca.
Radiatⁿ

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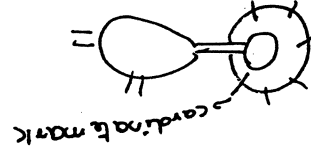
IGRT Image Guided Radiotherapy Based on CT, MRI Images on Stereotactic Radio Surgery

→ Classic SRS is Gamma knife - Radiatⁿ sx in Brain

Indications for Gamma knife:

- - 1) Acoustic schwannoma
 - 2) pit. adenoma
 - 3) meningioma
 - 4) Arteriovenous malformatⁿ
 - 5) Trigeminal neuralgia
- } Slow growing Tx (To arrest growth of Tx - gamma knife given but no sk)

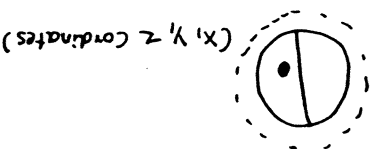
Gamma knife



Frame around head of pt

LEKSELL'S FRAME

do MRI of Brain

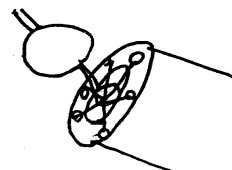


calculate locatⁿ of Tx



Put pt. in Gamma knife machine

Cobalt source
↑
Isotope



⇒ Cyber knife :- for whole body (any Tx in body)

→ It is LINAC Based

→ Frameless

→ Non Invasive Therapy

2 Aims

→ Stereotactic radiosx of body is most useful for (1.)

✓ stage 1 lung ca. (localised)

2) lymphangitis carcinomatous (ca. spread to lymphatics)

3) miliary metastasis (small metastasis)

4) Ca Tongue ± LN +ve

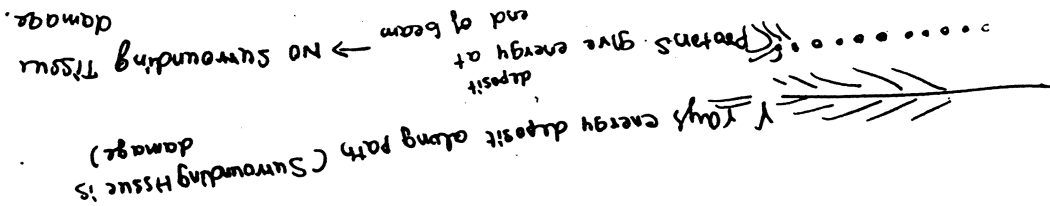
Ca spread to
↓
lymphatics
LN

Gamma knife is not used in GBM

→ For GBM Rx :- surgery + 16 whole Brain Radiotherapy + chemo therapy.

Proton Beam Radiotherapy

Bragg's Peak - Based on physics principle.



→ Brachytherapy:-

Adv:- giving radiation only to the Tx

Disadv:- Radiation exposure to medical personnel

② "REMOTE AFTER LOADER" - machine (used now) (new)
 ↓
 load isotope in container

Brachytherapy

HDR

High dose rate

> 12 Gy/hr

→ Iridium

→ Cesium

→ also called as

Temporary Implant

→ also called as

→ Gold.

→ I-125

→ Palladium

0.4 - 2 Gy/hr

Low dose rate

LDR

Radium - 226

→ 1st isotope used for Ca Therapy

→ NO longer used in medical field now.

→ Ra 226 → $t_{1/2} = 1600 \text{ yrs.}$

↓ emits all (α, β, γ)

→ classically emits α - emitter

Major isotope used in Brachytherapy now is Iridium

Cancer seen in Radium dial painters → Osteosarcoma of mandible.

Intrauterine radiation is a risk factor for → Leukemia

→ maximum permissible dose in pregnancy → 0.5 RAD
(in occupational females)
(to safeguard embryo)

→ Even at upto 5 RAD radiation → NO Teratogenicity is seen.
min. Teratogenic dose.

> 5 RAD → Teratogenicity is seen.

Cellular Tissue \times

MOA → Radiation → Injury to cell by

Free radical formation



DNA damage

Ionising Radiation → α, β, γ, X -ray.

radio
Cell cycle most sensitive → G_2M phase.
least radio sensitive → late-S phase

Radio sensitive DNA >>> RNA

Radio sensitizer :- It is O_2

give Hyperbaric O_2 1st

↓ then

Radiation

↑

more Free radical damage around Tumor area.

Radio protective SH group → scavenger of free radicals

Amifostine - Radioprotective drug.

most Radio sensitive Tissue - Bone marrow

least Radio sensitive Tissue - Nervous tissue.

more Radio sensitive Blood cell - Lymphocyte

least Radio sensitive. Bld cell - PLT / Rbc

T_x
Highly

Radio sensitive

→ Radio resistant.

(pm office)

Wilms T_x

Ewings Sarcoma

Seminoma

M } myeloma.

L - lymphoma

E

Pancreatic Ca
Malignant melanoma
Osteosarcoma.

Stag horn calculus in kidney

→ Pine tree / Christmas Tree bladder → Neurogenic Bladder

Detrusor & Sphincter m's are not simultaneously contract

→ Broadie abscess:

Small lytic lesion = Intense surrounding abscess

→ Terry Thomas sign / David Letterman sign

Scapho lunata diolocat (gap @ b/w scaphoid & lunate bone)

resemble front tooth of those patients

→ Hirschsprung's Disease:

Abrupt change from Return to sigmoid

→ Adult myelination complete - 2 yrs

Fibres last to myelinate - subcortical U fibres

→ Subarachnoid → Sulci look white
Hemorrhage

Inter hemisphere fissures white

NCT

↓ doubt

look

Lumbar → xanthochromia in CSF

Punctures

→ Holoprosencephaly - Chr 13, Patau Syndrome

1 ventricle

→ Giant panda sign → Wilson's disease

→ Δ's of cavernous thrombosis on MRI

Dilatation of superior ophthalmic vein

→ eye of Tiger → Hallovedan's

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