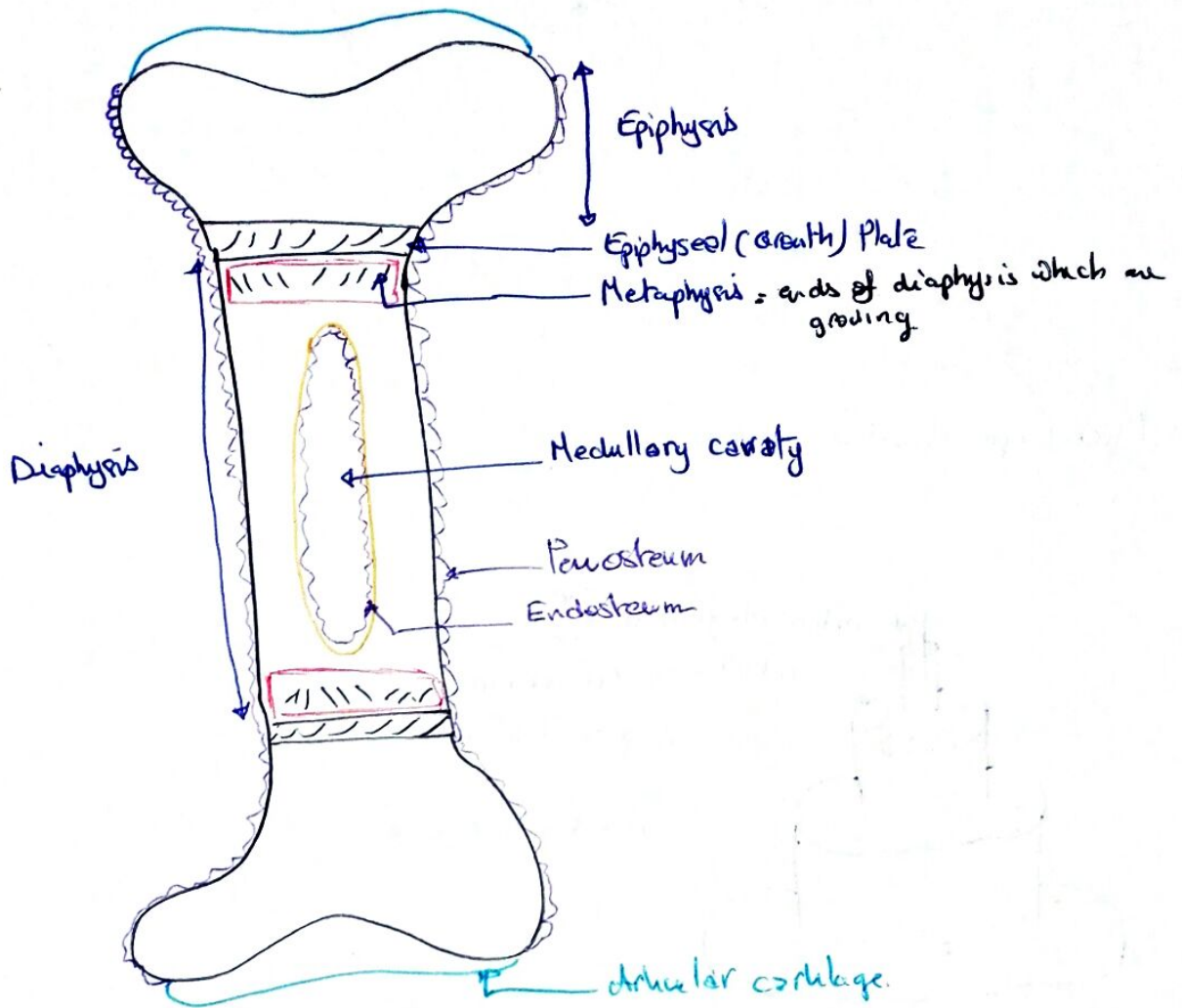
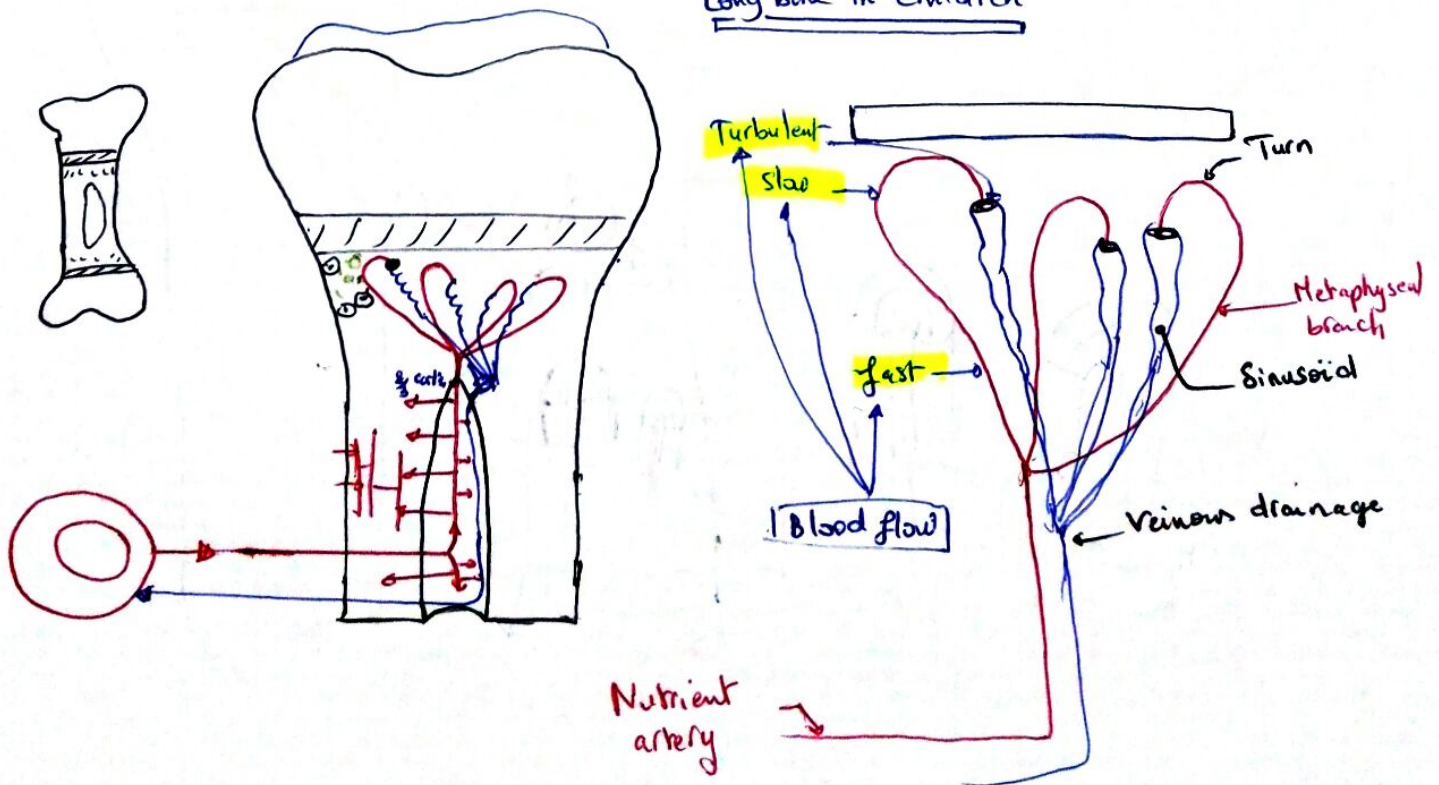
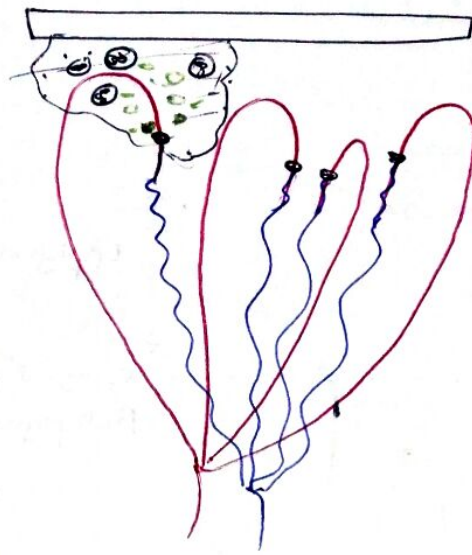


Osteomyelitis

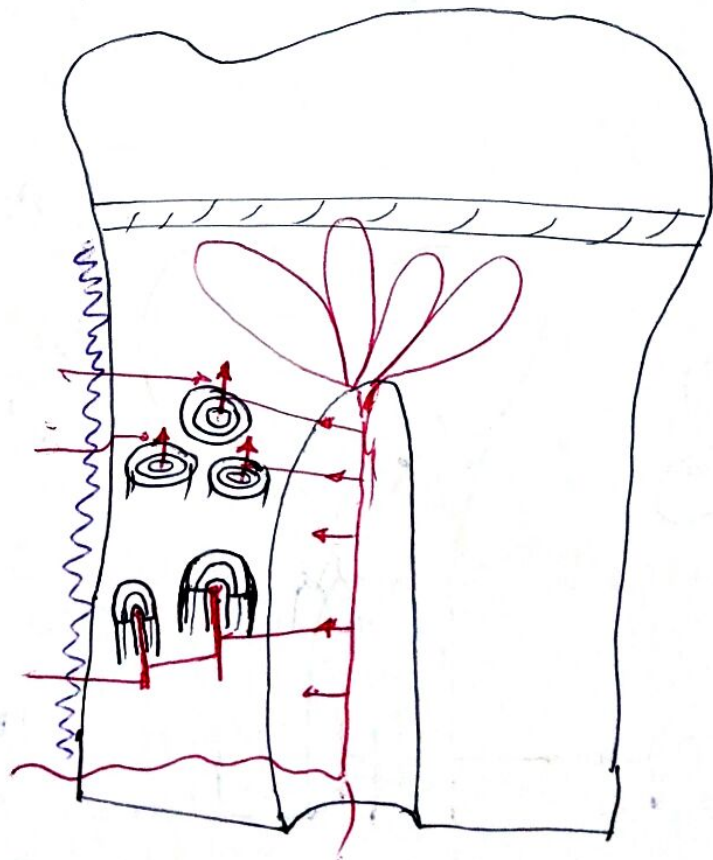
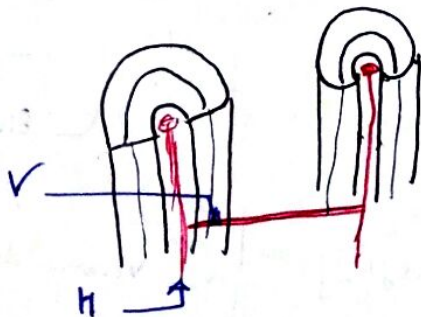
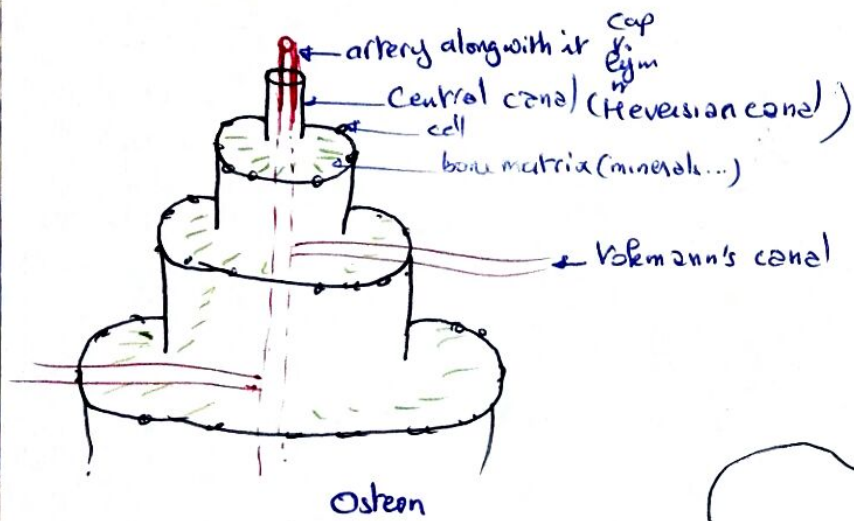


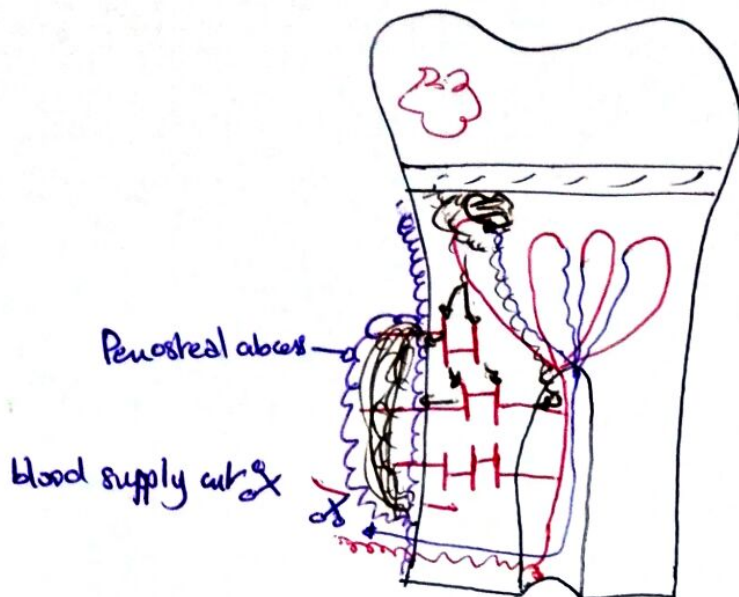
Long bone in children



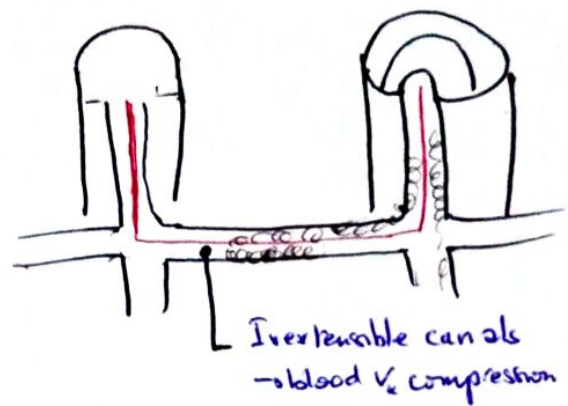


Microscopic structure of bones

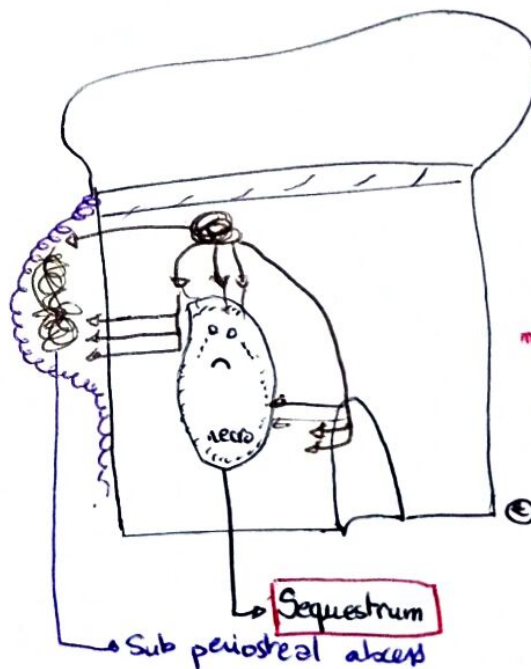
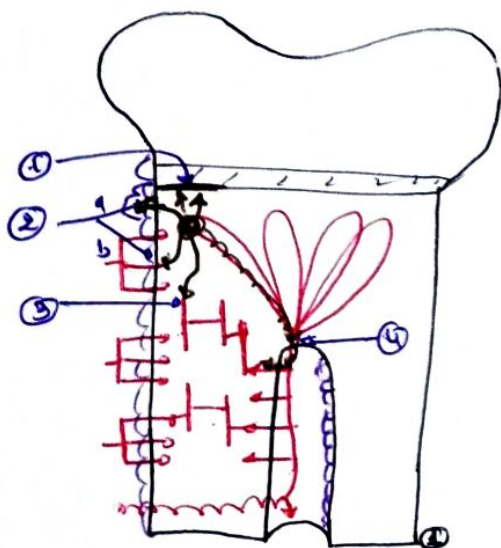




Pus spread through
-haversian
-volkmann's system



Irreversible canals
→ blood & compression



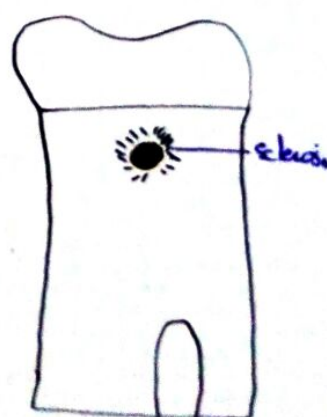
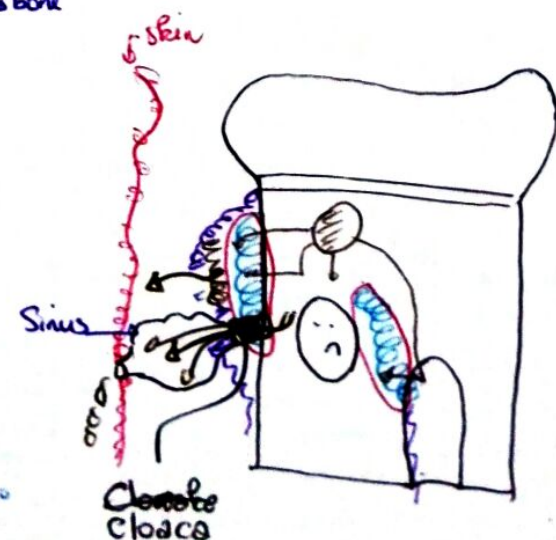
no blood supply
-no Ab
-no ATB

- ① Pus can't pass through growth plate
- ② Under the periosteum ~~and~~ directly
 - a. directly by bone destruction
 - b. indirect by through Volkmann's

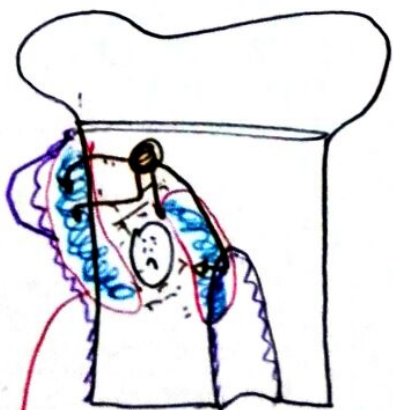
Sequestrum

Sub periosteal abscess

- ③ Haversian canals
- ④ Medullary canal → Volkmann's → bone



Subacute osteomyelitis
Brodie's abscess



Reactive bone formatⁿ

Involucrum

Diabetes : uncontrolled!

Peripheral neuropathy

nerve endings damage

↓
loss of pain sensations

↓
repetitive foot injuries
(the diabetic won't realize that he is being hurt)

↓
untreated foot injury

↓
Infection easily settle.

Vascular damage

blood vessels injury

↓
narrow blood vessels

↓
Ischemia

↓
↓ local defenses

White blood cells

drunk with sugar



↓
ineffective
-phagocytosis
-wound healing

↓
↓ defenses

↓
Repeated injury + Infection

↓
ulceration

↓ deep
microbes can reach the bones now!

↓
Osteomyelitis

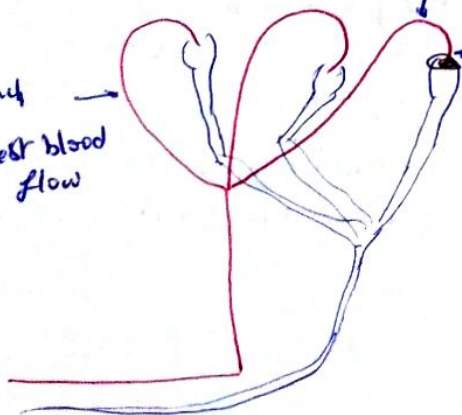
Direct inoculation

Penetrating injury
Surgery, implants
Open fractures

} direct

Metaph. blood

fast blood flow



Turn = slow blood flow → bacteria accumulate

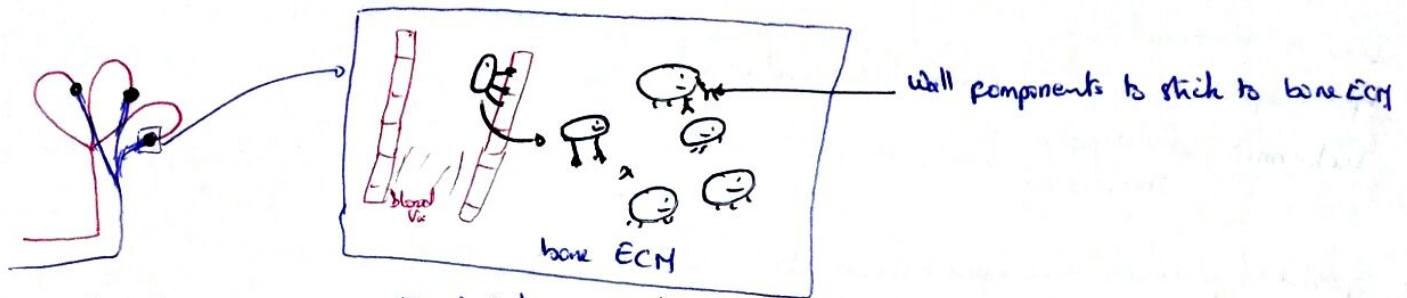
arterial blood drains into sinusoid
↑ P narrower ↓ P larger

Turbulence

↓
bacteria has higher chances to reach touch endoth. wall and attach to it

Hematogenous acute osteomyelitis: children, long bone metaphysis

metaphysis predilection: - Vascular arrangement (previous schema)
- phagocytic capacity



Site predilection
Bacterial settlement

Bacterial survival and
Multiplication

→ local tissue damage

inflammation: PMN

HP

lymphocytes

release of damaging molecules

further tissue damage



Pus formation

Pus: alive, dying and dead
exudate (protein rich inflammatory)
bacteria
PMN
local cells



Inflammatory focus

Inflammatory focus spread:

Through the least resistant pathways.

~~Epiphyseal~~ Epiphyseal - metaphyseal blood vessels connections $\begin{cases} \checkmark \rightarrow < 1 \text{ year} \\ \times \rightarrow > 1 \text{ year} \end{cases}$ of age

Spread to the epiphysis $\begin{cases} < 1y \rightarrow \text{possible} \rightarrow \text{joint destruction} \\ > 1y \rightarrow \text{no} \end{cases}$

~~Pus can't go through~~

As time passes by → more inflammation, more pus formation

1. Pus can't go through growth plate ($> 1y$) but it goes ..

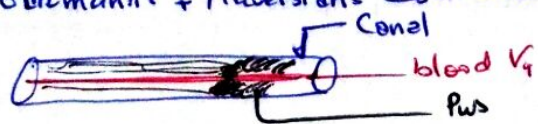
2. Under the periosteum - directly by bone destruction

→ through Volkmann's system

3. Through Haversian canals

4. Medullary canal → Volkmann's → cortical bone

* Volkmann's + Haversian $\rightarrow$ inextensible canals



* Spreading pus $\rightarrow$ compresses blood vessels within the inextensible canals

Inextensible canals

~~Spreading~~ Spreading pus compresses blood vessels
destroyed } $\rightarrow$ ischemia
thrombosed }

* Spread to periosteum $\rightarrow$ periosteum stripped away $\rightarrow$ blood vessels cut off
 $\rightarrow$ another blood flow source is cut off

Blood fails to enter from both $\left\{ \begin{array}{l} \text{Periosteal} \\ \text{Medullary} \end{array} \right.$ sides

* Ischemia $\rightarrow$ ischemic necrosis

Necrotic bone $\rightarrow$ no functional blood supply $\left\{ \begin{array}{l} \rightarrow \text{neither antibodies} \\ \rightarrow \text{nor antibiotics} \end{array} \right.$ can reach it

o bacterial heaven

o antibiotics are not enough $\rightarrow$ surgery is needed

to remove the necrotic bone called: sequestrum

Sequestra $\rightarrow$ chronic osteomyelitis

* Periosteal reaction:

Chronic inflammation $\rightarrow$ prolonged cytokines release $\rightarrow$ (+) Periosteum which contains
mesenchymal osteoprogenitor cells $\rightarrow$ osteoblasts $\rightarrow$ new bone formation around
the pus sequestrum - Reactive bone formation

Chronic inflammation $\rightarrow$ cytokines $\rightarrow$ periosteal reaction $\rightarrow$ reactive bone formation
it's an attempt of our biological system to contain the pus and sustain the bone
 $\left\{ \begin{array}{l} \rightarrow \text{abnormal structure} \\ \rightarrow \text{weak} \end{array} \right.$
 $\downarrow$
Pathological

newly formed bone is called $\rightarrow$ Involucrum
no lamellar structure $\rightarrow$ weak

* As time passes by:

Periosteal abscess $\rightarrow$ rupture into the soft tissue

Sinus formation: Pus digests the involucrum and digs an opening in this $\rightarrow$ involucrum

* The opening is called Cloaca

Pus goes out through cloaca (the opening), damages the tissues and makes a pathway out.

The pathway from cloaca to the surface is called Sinus

Sinus epithelialization (squamous epith growing inward) $\rightarrow$ Permanent channel

Brookes' abscess:

Sub acute form of osteomyelitis

↑ defenses

↓ virulent organisms

} → pus contained with fibrosis and sclerosis around it

Complications

- 1) Septic arthritis
✓ children < 1y; adults
✗ growing children > 1y
- 2) Pathologic fractures
- 3) Tumors
↳ bone sarcoma: chronic inflammation
↳ squamous cell carcinoma (permanent draining sinus)
- 4) Septicemia
- 5) Infective endocarditis
- 6) Systemic amyloidosis

Clinical Course

Systemic

Malaise
Fever, chills, night sweats
Anorexia
Weight loss

Features

Local

Inflammation:

pain
swelling
warmth
tenderness
loss of function

Clinical presentations

- A → Systemic + local
- B → Systemic only: children ++ : Fever of unknown origin
- C → Local only

+/- complications

Spine: Back pain and tenderness

Epidural abscess → sensory/motor loss

Osteomyelitis

- Acute → Antibiotics
- Chronic → Surgery

~~Sinus~~ Sequestra, sinus → chronic

Some authorities

- ↳ < 10 d acute
- ↳ > 10 d chronic

Sometimes orthopedic surgeon is contacted in the acute phase.

After 36h of adequate ATB → no improvement of systemic features
keep deteriorating

Investigations

→ Imaging

Plain x Ray → normal until 10th day
not helpful with early Dx
helpful with the differentials → rule out [Tumor
fracture

CT scan → sensitive but not specific

MRI → sensitive and specific: • soft tissue changes • Penetrol lift →

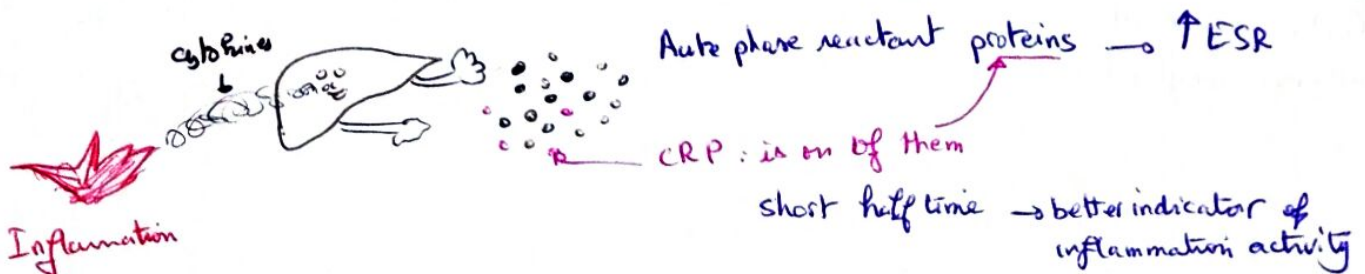
Ultra sound → fluid collections within soft tissue

→ Blood Tests → inflammatory condition

CBC: Complete Blood Count: Leucocytosis (PMN ↑)

ESR and CRP ⊕

if normal it doesn't exclude osteomyelitis



→ Culture and Sensitivity

Blood cultures

Acute → ⊕ 50%

Chronic → almost always (-)

Bone biopsy

Most accurate

Do not culture sinus or ulcer

Treatment

Acute

Antibiotics

Bactericidal

Bone penetration

Covering Staph. aureus

Adequate dose and duration

Chronic

Orthopedic surgery

Which microbes we are supposed to suspect.

S. aureus
② S. aureus
Pseudomonas
Candida

Extra
eye
lth.

① S. aureus
?

③
- S. aureus
- Myco. TB
chr

④ Sickle cell disease (lost spleen)
• S. aureus
• Salmonella

⑤ Replaced joint
S. aureus
S. epidermidis

⑥ UTI
↳ E. coli
↳ Pseudomonas
↳ Klebsiella

⑦ Sexually active
N. g (septic arthritis ++ om)

⑧ ear lorn
• group B streptococci
= Strep agalactiae
• H. influenzae

⑨ Cat and dog bites
Pasteurella multocida

⑩ Perforated foot
injury
Pseudomonas

⑪ Diabetic foot
P.m
polymicrobial
including anaerobes

ulcer area > 2 cm²

Sterile probe
easily pushed to the
bone

Think of osteomyelitis