LOCAL ANTIBIOTIC INSTILLATION AND SUCTION DRAINAGE FOR BONE AND SOFT TISSUE INFECTION

Pakistan
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slides and text available at:
www.boneinfection.co.za

PRIORITIES IN MANAGEMENT OF CHRONIC BONE & JOINT INFECTION

- Adequate radical debridement of bone and soft tissue.
- Administer appropriate systemic antibiotics.
- Achieve effective levels of antibiotic locally and systemically
- Anatomical closure of wound in layers.
- Maintain wound cover.
- Closely monitor progress of treatment.
- Minimise wound exposure.

TISSUE LEVELS OF ANTIBIOTIC WITH SYSTEMIC ADMINISTRATION

500 mgm antibiotic dissolved in 5 litres blood should produce 100 ug per ml.

Joint fluid achieves 80-100% of blood level

Inflamed muscle obtains similar concentration

Subsequently, and at variable speed

1. Antibiotic may be bound to protein.
2. Dispersed into extra cellular fluid.
3. Metabolised e.g. in liver.
4. Bound to fat and slowly released later.
5. Excreted via kidney or liver.
6. Serum or tissue levels steadily diminish.

The rise and fall of antibiotic levels occurs more gradually after intramuscular administration

Even more so after oral administration

There may be barriers to bowel absorption

And inactivation in bowel and liver

AVERAGE TISSUE CONCENTRATIONS FOUND IN PRACTICE

Antibiotic	Dose mgm	Blood ug/ml	Muscle ug/gm	Bone ug/gm
Penicillin	600	3	0.3	0.3
Floxapen	600	6.5	1.25	1.04
Gentamicin	80	4.0	1.0	2.8
Cephazolin	500	27	1.28	2.1
Cotrimoxazole	480	10.0	14.0	3.0
Lincomycin	300	9.1	5.0	2.0
Oral Fucidin	500	20.0	23.0	10.0
Linezolid	600	100%	93%	46%

AVERAGE TISSUE CONCENTRATIONS FOUND IN PRACTICE

- Blood and Tissue levels of antibiotics
- administered systemically are most
- variable, unreliable and unpredictable.

With systemic administration antibiotic is distributed throughout entire body of which the infected lesion may constitute a very small proportion.

The antibiotic may have unpleasant or even dangerous side effects particularly on liver, kidney, VIII nerve

DEAD SPACE MANAGEMENT

1. Leave wounds open and
   pack with frequent dressings
   Wait for cavity to fill in with granulation
2. Fill space with local or free vascularised flap
3. Fill space with material loaded with antibiotic

EXAMPLES OF ANTIBIOTIC LOADED MATERIAL

Methyl Methacrylate

solid monolith, fragments, beads

Fibrin

Collagen

Calcium Sulphate granules (particle size)

Bank bone allograft (variable fragments)

ADVANTAGES/DISADVANTAGES

Methyl Methacrylate

Needs heat stable, antibiotic powder

Antibiotic leached from surface only

Produces adequate antibiotic tissue levels

MIC exceeded for only a few days

Thereafter becomes permanent inert foreign body

Perfect for biofilm with resistant bacteria

Chains of beads cannot be easily extracted after 2 weeks

ADVANTAGES/DISADVANTAGES

- Fibrin fully absorbed, rapid release of antibiotic in a few days – no residue
- Collagen fully absorbed but more gradually
- Calcium Sulphate larger surface, thus faster release than cement but incomplete Some may be incorporated into host bone.
- Allograft bone releases antibiotic over months as bone incorporates by creeping substitution depending on size and structure of graft

ADVANTAGES/DISADVANTAGES

In all the foregoing materials there is –

- Limited choice of antibiotic
- No chance to change antibiotic
- No direct monitoring of progress
- Risks inherent in foreign material or bone grafting
- Enormous cost compared to instillation

ADVANTAGES OF LOCAL ANTIBIOTIC INSTILLATIONS

- Reliable sustained concentration of antibiotic – 500 mgm in 50 ml saline or 10 000 ug per ml
- Intermittent suction collapses soft tissue spaces
- Streptokinase dissolves and removes inert blood clot - a good medium for bacteria
- Affords opportunity to monitor volume of cavity, appearance, and bacterial content of wound fluid

ADVANTAGES OF LOCAL ANTIBIOTIC INSTILLATIONS

- Allows change of antibiotic any time according to bacterial content and sensitivity
- All without disturbing dressing
- Entire system is closed thus

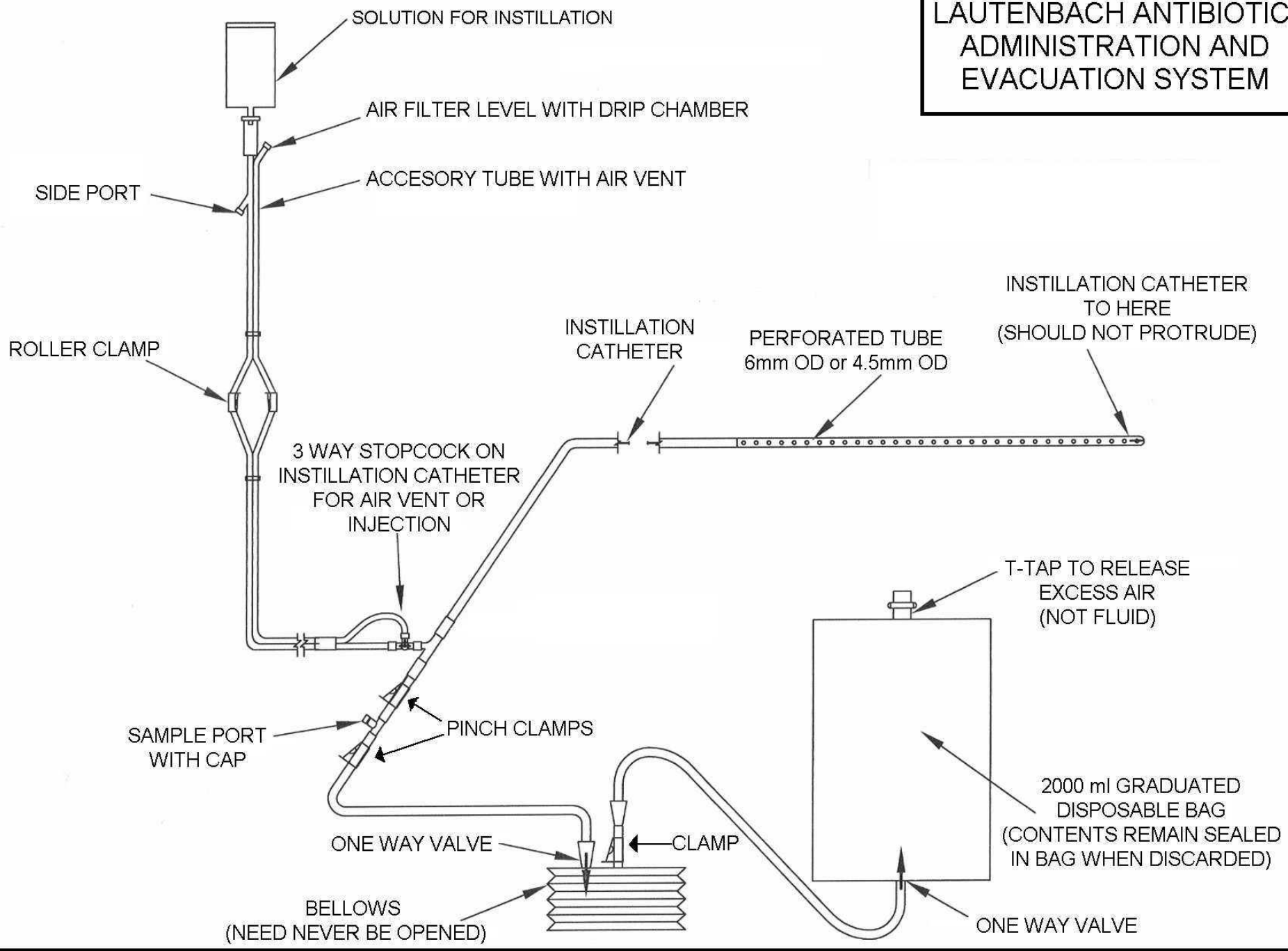
  reduced risk of cross infection
- Antibiotic concentrations far exceed MIC in bone but less than 0.02 ug/ml in systemic blood.
- A single 500 mgm vial of stable antibiotic can

  last up to 5 days…very small volumes needed

DISADVANTAGES OF LOCAL ANTIBIOTIC INSTILLATION

- Time consuming and labour intensive (alleged)
- Tube blockage can lead to
  wound leakage, distension and rupture
- Tubes provide direct access to wound interior
  in case of mismanagement
  thus promoting nosocomial infection

LAUTENBACH ANTIBIOTIC ADMINISTRATION AND EVACUATION SYSTEM



DEPLOYMENT AND EMPLOYMENT

OF SYSTEM

Thorough surgery ABSOLUTELY paramount

Ream full length of long bone through windows at either end

Debride all necrotic and fibrotic and unhealthy bone and soft tissue

Thoroughly flush debris from surgical field

Fig. 256.—Right Femur seen from in Front.

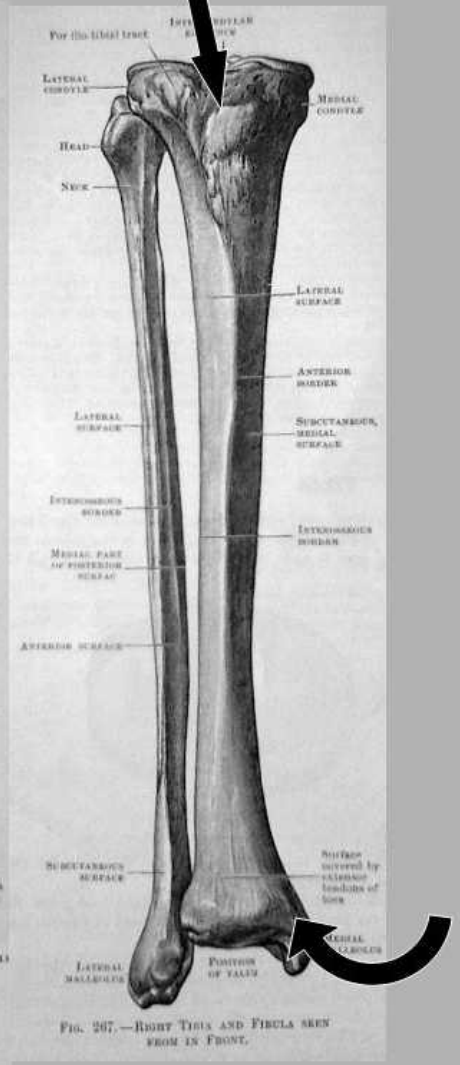


Fig. 267.—Right Tibia and Fibula seen from in Front.

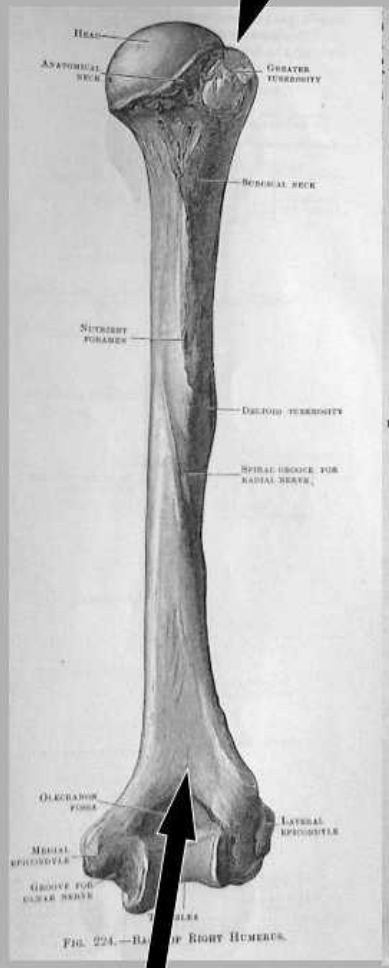


Fig. 224.—Back of Right Humerus.

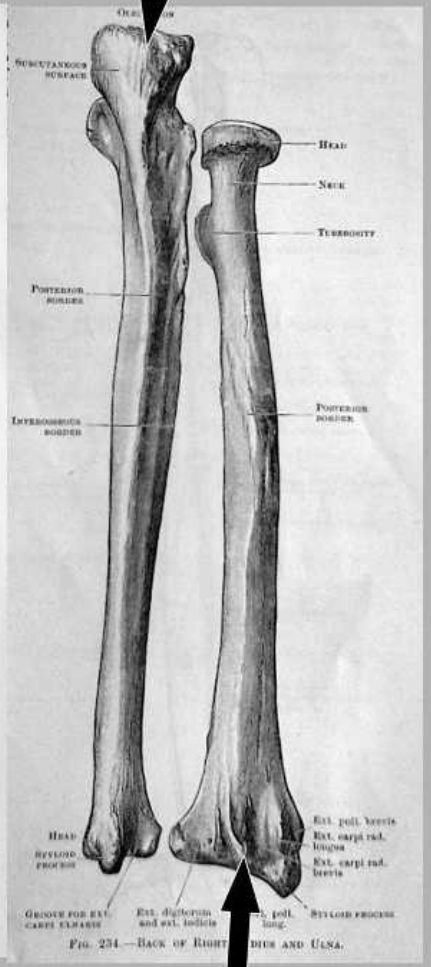


Fig. 234.—Back of Right [illegible] dius and Ulna.

SELECTION OF LOCAL ANTIBIOTIC

- Mandatory to identify bacteria and their antibiotic sensitivity
- Know minimal inhibitory concentrations
- Antibiotic should be soluble
- Stable in solution at room temperature
- Not irritant to local tissues
- Toxicity to internal organs not important (very little in circulation)

SELECTION OF LOCAL ANTIBIOTIC

When no single antibiotic effective against all bacteria in mixed infection mix additional antibiotics in separate bag and administer through separate portal

SELECTION OF LOCAL ANTIBIOTIC

Don’t mix antibiotic in single chamber

May be unpredictable, undesirable reactions

Or deal with mixed infections sequentially

1st Anaerobes then gm+ves then gm-ves

SELECTION OF LOCAL ANTIBIOTICS

If antibiotic is unstable in solutions (e.g. Penicillins)

It should be discarded and renewed daily

OBSTRUCTION OF TUBES

Fibrin clot essential for haemostasis

DO NOT try to prevent it

Urokinase most efficient but expensive fibrinolytic

Streptokinase most cost effective fibronolytic

Streptokinase will dissolve
250 ml clot in 3 to 7 days

Unstable in solution at room temp

Thus refrigerate and renew daily

Discontinue when effluent clear of clot

VEHICLE OR SOLVENT

Use simple Isotonic electrolyte

Sugars feed bacteria

Amino acids interfere with antibiotic

Some antibiotics need specific pH buffer

VEHICLE OR SOLVENT

Make 0.1 to 1% solution of antibiotic

in 50 ml Isotonic electrolyte without sugar or amino-acid

Initially add 20 000 units Streptokinase

Renew daily until no clots forming

Note dead space in administration set

ADMINISTRATION

20 drops (1 to 2 ml) 4 hourly of solution

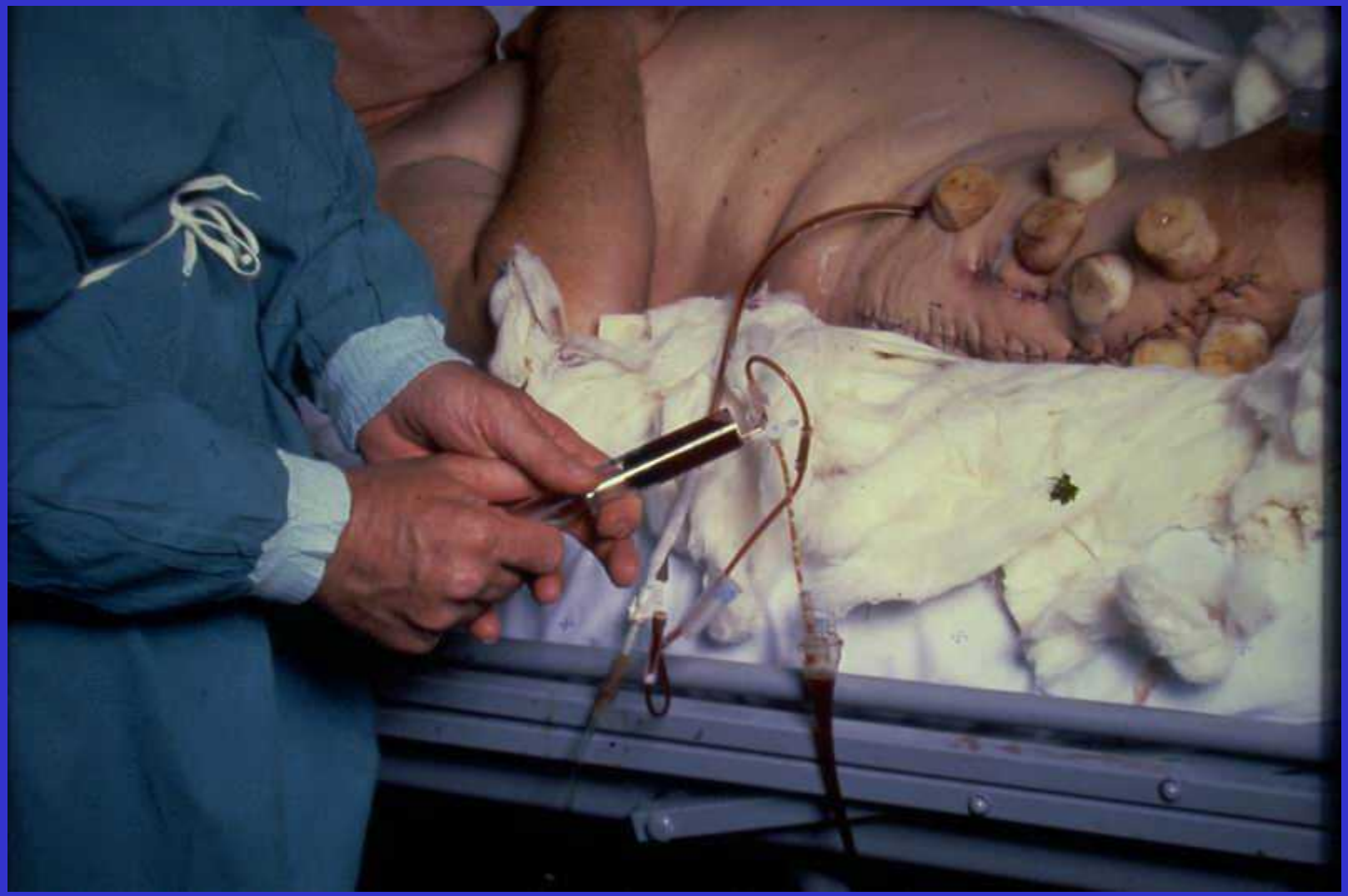
Preceded by half an hour of suction

Accept clot obstruction during first 2 days

1-2 ml 4 hourly amounts to 6-12 ml daily

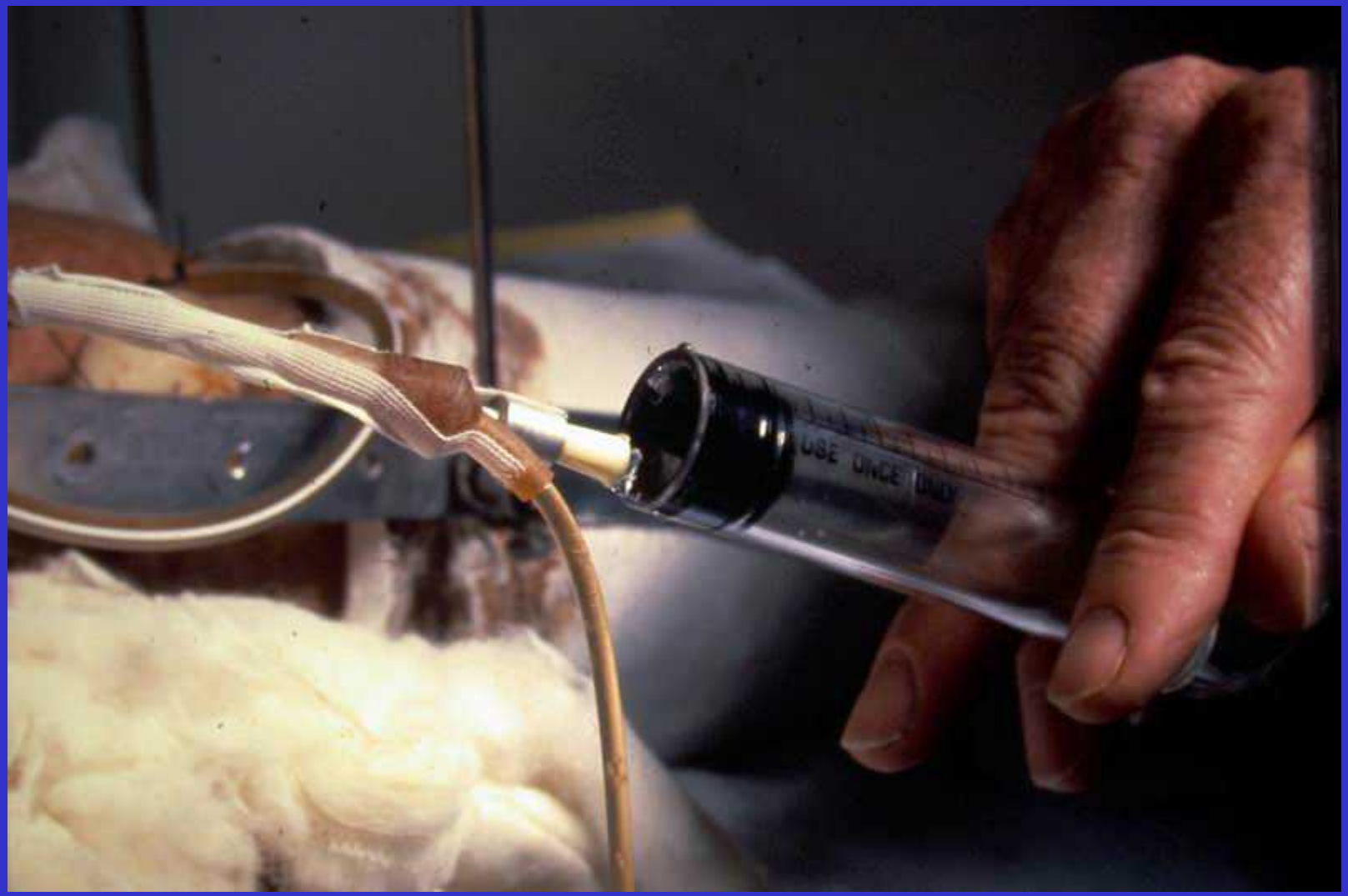
This will not over distend a wound

Measure volume of cavity



Evacuate wound cavity totally

Only complete when air let in



Fill to overflow while limb level

Take fluid sample for culture from each tube twice a week for microscopic examination, culture and sensitivity

Once established

patients may lie at home

operating the system themselves

under nursing supervision

Volume of cavity

halved every week

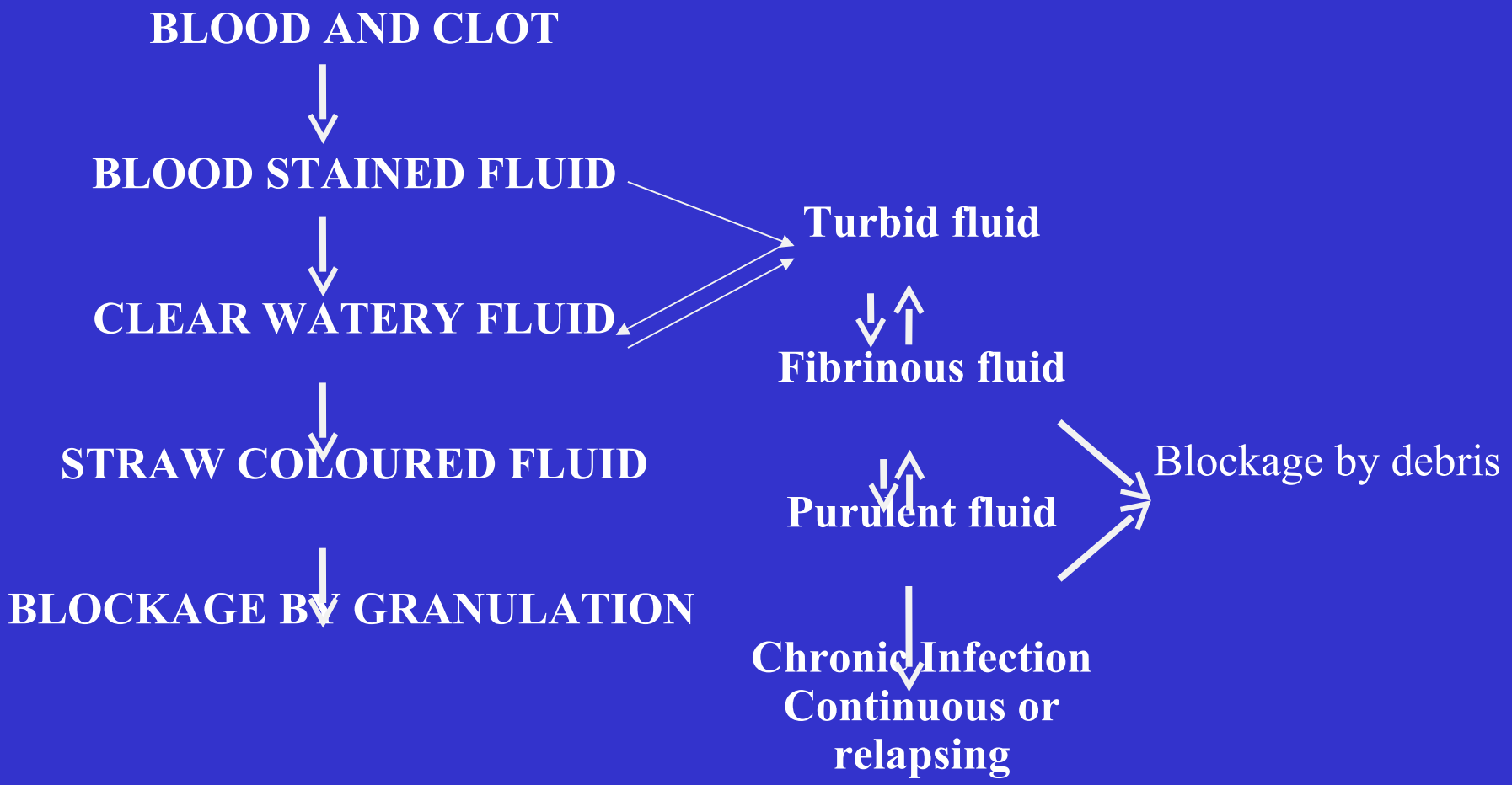
Granulation enters and fills tubes

Flush wound and

remove tube while

filling with antibiotic

CHANGES IN FLUID DISCHARGED FROM SUCTION TUBE



CAUSES OF TURBID FLUID

- Necrotic tissue incompletely excised
- Tissue Necrosis devitalised by surgery
- Irritant irrigation fluid
- Hypertonic solution
- Fucidin, Vancomycin, Teicoplanin
- Low soluble Tetracycline and Chloramphenicol
- Secondary infection, re-infection, super-infection

AVOIDANCE OF COMPLICATIONS

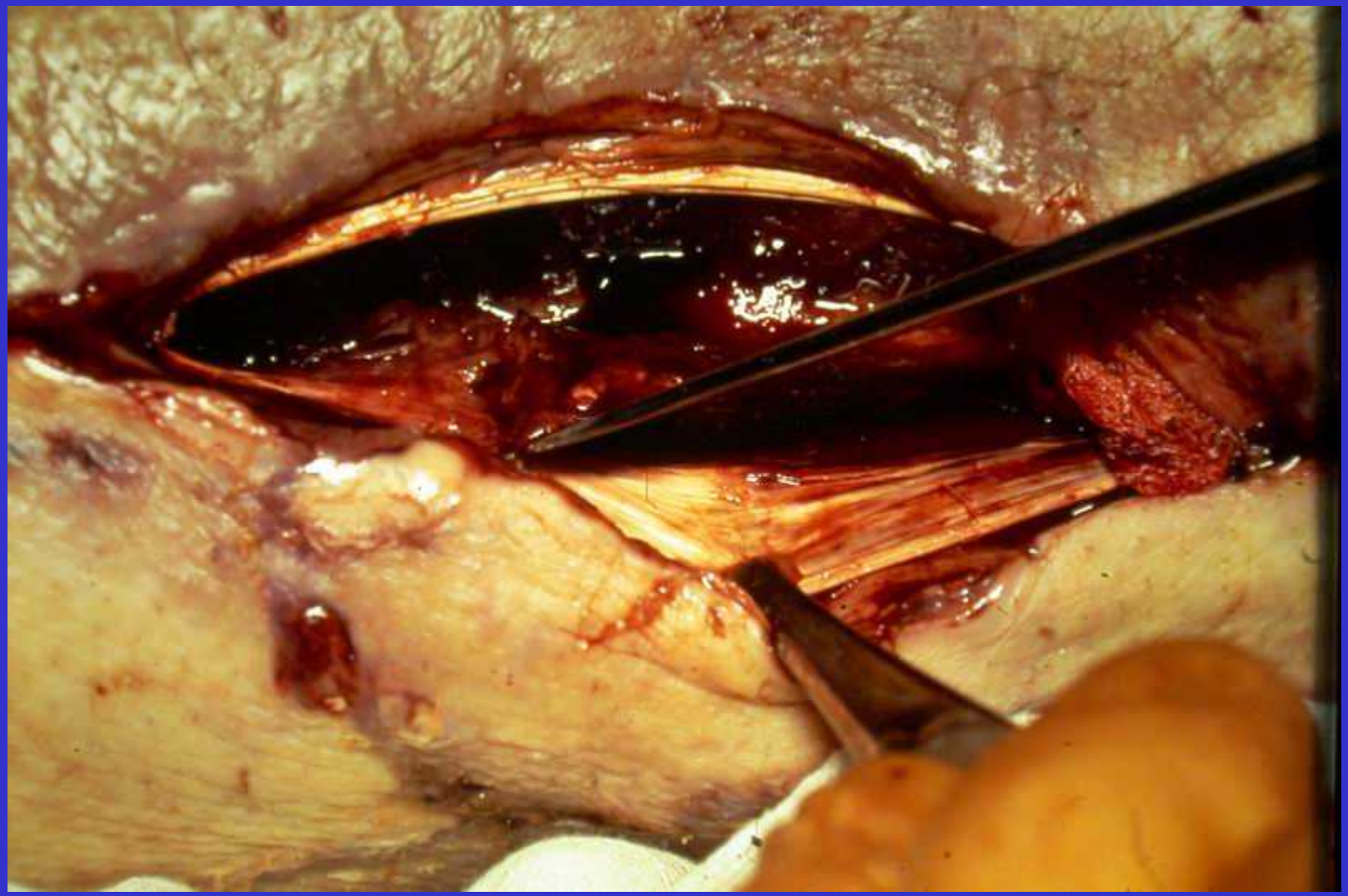
Don’t give up too soon

Accept transient blockage in first 48 hrs

Achieve and maintain free flow in tubes

If new bacteria supervene

change to appropriate antibiotic



Factors Determining Successful Eradication

In order of priority:

- General Health and nutrition
- Tissue immunity
- Humoral immunity
- Tissue perfusion
  (arterial, venous, lymphatic)_
-
-

  (overlooked foci of infection)
- Retained foreign bodies
- Haematoma
- Immobilisation_

Irrigation only comes after

all these in order of importance

CONCLUSION

Local irrigation – valuable adjunct to adequate surgery

Time consuming, demanding, Needs attention to detail

Obviates frequent dressings

Shortens hospital stay

Accelerates healing

Allows close monitoring of progress and bacteria

Reduces cross infection

Open drainage after 2 months

Same patient 2 weeks after debridement, reconstruction and closure over irrigation